

# **316, 318 and 420 Lawn and Garden Tractors**

**For complete service information also see:**

**Onan Engines (16,18,20,24 HP) . . . . . CTM2**

**John Deere Horicon Works  
TM1590 (17MAY95)**

LITHO IN U.S.A.  
ENGLISH

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*All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.*

TM1590-19-17MAY95

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A John Deere ILLUSTRATION™ Manual

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INDX

# Introduction

## FOREWORD

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

**N** This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Technical manuals are divided in two parts: repair and diagnostics. Repair sections tell how to repair the components. Diagnostic sections help you identify the majority of routine failures quickly.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, other materials needed to do the job and service parts kits.

Section 10, Group 15—Repair Specifications, consist of all applicable specifications, near tolerances and specific torque values for various components on each individual machine.

Section 10, Group 20—Test and Adjustment Specifications, consist of all applicable test and adjustment specifications for various systems for each individual machine.

Binders, binder labels, and tab sets can be ordered by John Deere dealers direct from the John Deere Distribution Service Center.

This manual is part of a total product support program.

FOS MANUALS—REFERENCE

TECHNICAL MANUALS—MACHINE SERVICE

COMPONENT MANUALS—COMPONENT SERVICE

Fundamentals of Service (FOS) Manuals cover basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes. FOS Manuals are for training new personnel and for reference by experienced technicians.

Technical Manuals are concise guides for specific machines. Technical manuals are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

Component Technical Manuals are concise service guides for specific components. Component technical manuals are written as stand-alone manuals covering multiple machine applications.

# Dealer Presentation Sheet

## JOHN DEERE DEALERS

**IMPORTANT: Please remove this page and route through your service department.**

This is a complete revision for models 316, 318 and 420 found in TM1277 and TM1345. The complete revision of remaining machines (322, 330, 332 and 430) can be found in TM1591. AFTER receiving both TM1590 and TM1591, please discard old TM1277 dated December 1987, TM1345 dated June 1986 and TM1309 dated July 1985.

*NOTE: There are several "versions" of each model tractor. All versions were not available at time of latest printing. Some versions may not be covered.*

*Dealer Presentation Sheet*

# Section 10 GENERAL INFORMATION

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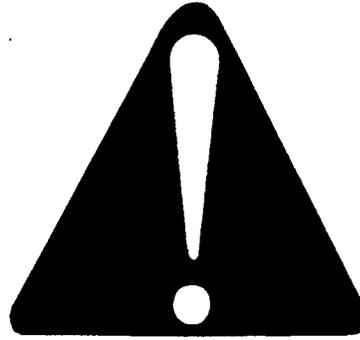
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## RECOGNIZE SAFETY INFORMATION

This is the safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.



DX,ALERT -19-03MAR93

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T81389

## UNDERSTAND SIGNAL WORDS

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.



DX,SIGNAL -19-03MAR93

-19-30SEP88  
TS187

## FOLLOW SAFETY INSTRUCTIONS

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.



DX,READ -19-03MAR93

-UN-23AUG88  
TS201

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### HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.



DX,FLAME -19-04JUN90

-UN-23AUG88  
TS227

### PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



DX,SPARKS -19-03MAR93

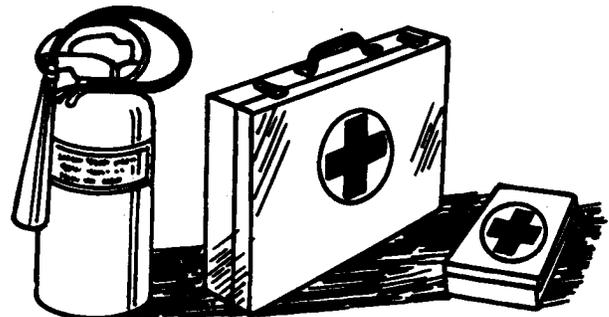
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TS204

### PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



DX,FIRE2 -19-03MAR93

-UN-23AUG88  
TS291

## PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

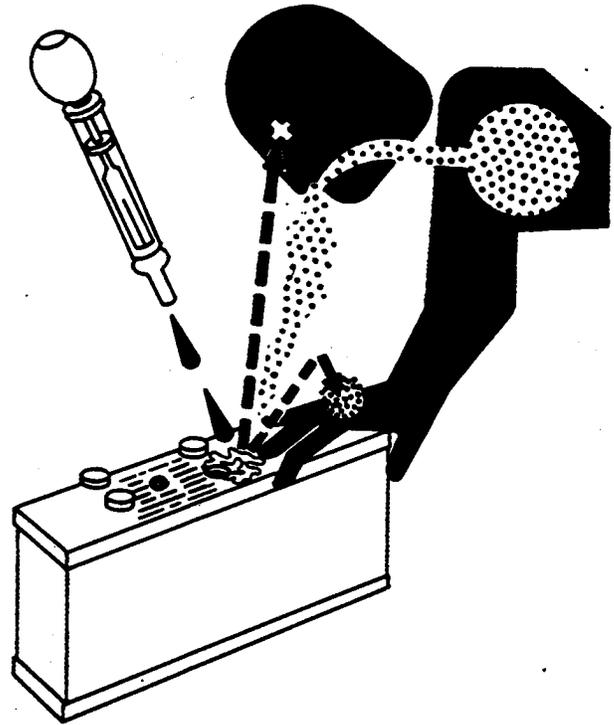
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



DX,POISON -19-21APR93

TS203 -UN-23AUG88

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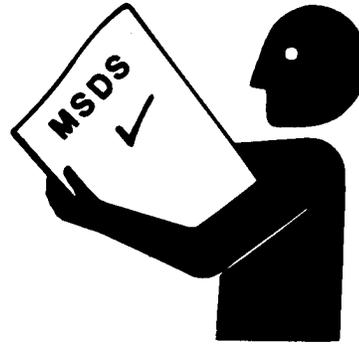
## HANDLE CHEMICAL PRODUCTS SAFELY

Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques.

Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

(See your John Deere dealer for MSDS's on chemical products used with John Deere equipment.)



DX,MSDS,NA -19-03MAR93

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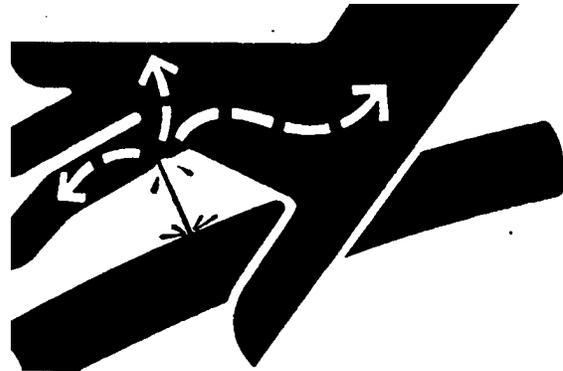
## AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



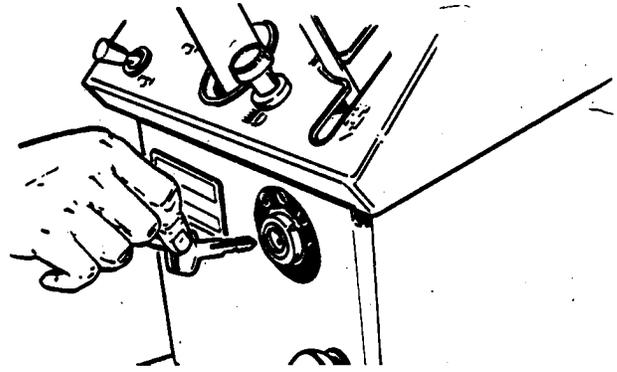
DX,FLUID -19-03MAR93

X9811 -UN-23AUG88

## PREPARE MACHINE FOR REPAIR

1. Move hydrostatic control lever to STOP position.
2. Disengage PTO's
3. Lower all equipment to the ground.
4. Engage park brake.
5. Stop the engine and remove the key.
6. Operate all hydraulic control levers to release hydraulic pressure in the system.

Before you leave the operator's seat, wait for engine and attachment parts to stop moving.



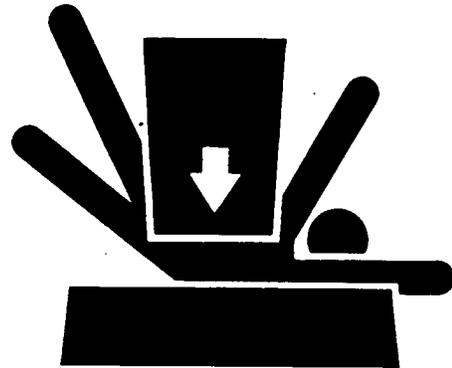
MX,1005R,8 -19-01APR86

M34228 -UN-24APR89

## SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



DX,LOWER -19-04JUN90

TS229 -UN-23AUG88

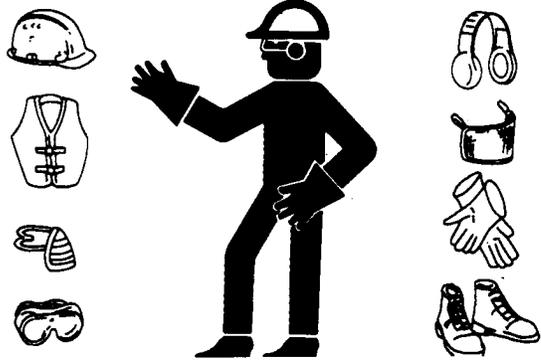
### WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



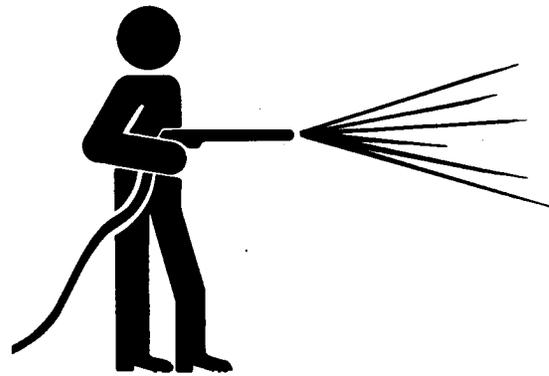
DX,WEAR -19-10SEP90

TS206 -UN-23AUG88

### WORK IN CLEAN AREA

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



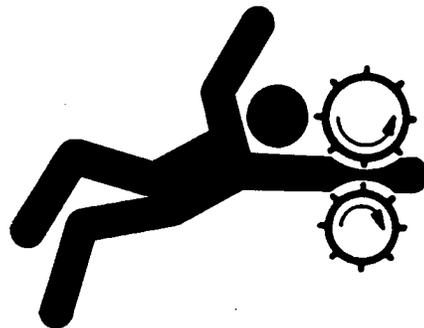
DX,CLEAN -19-04JUN90

T6642EJ -UN-18OCT88

### SERVICE MACHINES SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



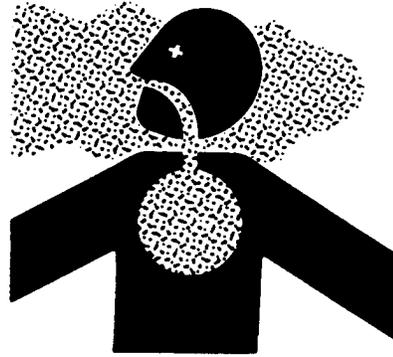
DX,LOOSE -19-04JUN90

TS228 -UN-23AUG88

### WORK IN VENTILATED AREA

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

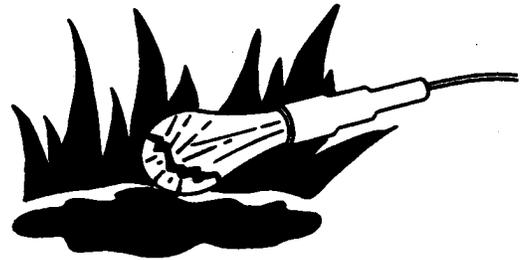


DX,AIR -19-04JUN90

TS220 -UN-23AUG88

### ILLUMINATE WORK AREA SAFELY

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



DX,LIGHT -19-04JUN90

TS223 -UN-23AUG88

### REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



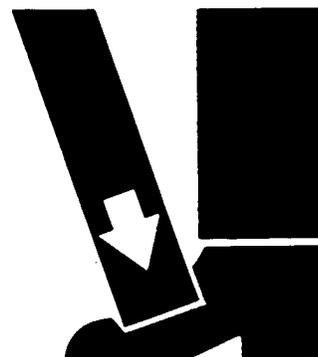
DX,SIGNS1 -19-04JUN90

TS201 -UN-23AUG88

### USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



DX,LIFT -19-04JUN90

TS226 -UN-23AUG88

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## REMOVE PAINT BEFORE WELDING OR HEATING

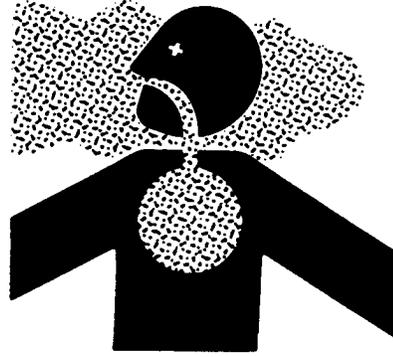
Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



TS220 -UN-23AUG88

DX,PAINT -19-03MAR93

## AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.



TS953 -UN-15MAY90

DX,TORCH -19-03MAR93

## SERVICE TIRES SAFELY

Explosive separation of a tire and rim parts can cause serious injury or death.

Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.

Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.



DX,TIRECP -19-24AUG90

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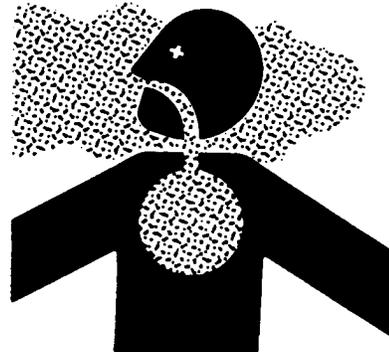
## AVOID HARMFUL ASBESTOS DUST

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.

Keep bystanders away from the area.



DX,DUST -19-15MAR91

-UN-23AUG88  
TS220

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## PRACTICE SAFE MAINTENANCE

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet, and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

Disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.



DX,SERV -19-03MAR93

TS218 -UN-23AUG88

## USE PROPER TOOLS

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



DX,REPAIR -19-04JUN90

TS779 -UN-08NOV89

## DISPOSE OF WASTE PROPERLY

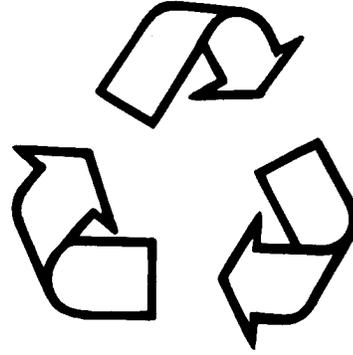
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



DX,DRAIN -19-03MAR93

TS1133 -JUN-26NOV90

10-05-11

## LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.



DX,LIVE -19-25SEP92

TS231 -19-07OCT88



**MACHINE SPECIFICATIONS**

	316	318	420
<b>ENGINE</b>			
Manufacturer	Onan	Onan	Onan
Type	Gasoline	Gasoline	Gasoline
Model Number			
Early	B43E	B43G	B48G
Later	P218G	P218G	P220G
Horsepower (SAEJ607)			
Early	11.9 kW (16 hp)	13.4 kW (18 hp)	14.9 kW (20 hp)
Later	13.4 kW (18 hp)	13.4 kW (18 hp)	14.9 kW (20 hp)
Torque	4.4 kg m (31.5 ft lbs)	4.4 kg m (31.5 ft lbs)	4.4 kg m (31.8 ft lbs)
Engine Rated Speeds			
Fast Idle (No Load)	3450 rpm	3450 rpm	3450 rpm
Low Idle (No Load)	1350 rpm	1350 rpm	1350 rpm
Number of Cylinders	2	2	2
Crankshaft Alignment	Horizontal	Horizontal	Horizontal
Stroke/Cycle	4 Cycle	4 Cycle	4 Cycle
Bore	82.55 mm (3.25 in.)	82.55 mm (3.25 in.)	82.55 mm (3.25 in.)
Stroke			
Early	66 mm (2.620 in.)	66 mm (2.620 in.)	73 mm (2.875 in.)
Later	73 mm (2.875 in.)	73 mm (2.875 in.)	73 mm (2.875 in.)
Displacement			
Early	710 cm <sup>3</sup> (43.3 cu in.)	710 cm <sup>3</sup> (43.3 cu in.)	782 cm <sup>3</sup> (47.7 cu in.)
Later	782 cm <sup>3</sup> (47.7 cu in.)	782 cm <sup>3</sup> (47.7 cu in.)	782 cm <sup>3</sup> (47.7 cu in.)
Compression Ratio			
Early	6.2:1	6.5:1	7.0:1
Later	7.0:1	7.0:1	7.0:1
Cylinder Material	Aluminum	Aluminum	Aluminum
Cooling	Air	Air	Air
Air Filter Type	Dry with Pre-Cleaner	Dry with Pre-Cleaner	Dry with Pre-Cleaner
Lubrication System	Full Pressure w/Filter	Full Pressure w/Filter	Full Pressure w/Filter
Crankcase Capacity (w/o Filter)	1.4 L (1.5 U.S. qt)	1.4 L (1.5 U.S. qt)	1.4 L (1.5 U.S. qt)
Oil Filter	Replaceable	Replaceable	Replaceable
Spark Plugs	NGK BPR5EFS Champion RS14YC	NGK BPR5EFS Champion RS14YC	NGK BPR5EFS Champion RS14YC
<b>FUEL SYSTEM</b>			
Fuel Tank Location	Rear	Rear	Rear
Fuel Gauge	Standard	Standard	Standard
Fuel Reserve System	N/A	Standard	Standard
Fuel Tank Capacity	17 L (4.5 U.S. gal)	17 L (4.5 U.S. gal)	25 L (6.5 U.S. gal)
Fuel (min. octane)	85 Octane Unleaded	85 Octane Unleaded	85 Octane Unleaded
Fuel Pump Location	Engine	Engine	Engine
Fuel Pump Type	Pulse	Pulse	Pulse
Fuel Delivery	Fixed Jet Carburetor	Fixed Jet Carburetor	Fixed Jet Carburetor
<b>ELECTRICAL SYSTEM</b>			
Ignition	Electronic	Electronic	Electronic
Type of Starter	12 Volts, Solenoid	12 Volts, Solenoid	12 Volts, Solenoid
Charging System	Early, 15 amp Stator Later, 20 amp Stator	20 amp Stator	20 amp Stator

Continued on next page.

MX,15901010,1 -19-25APR95

General Specifications/Machine Specifications

10-10-2

	316	318	420
<b>ELECTRICAL SYSTEM, continued</b>			
Battery Type	BCI Group 22F	BCI Group 22F	BCI Group 22F
Battery Voltage	12V	12V	12V
Battery Reserve Capacity @			
25 amp	102 minutes	102 minutes	102 minutes
Battery Cold Cranking amp @ 0°F	491 amp	491 amp	491 amp
Headlights	Standard	Standard	Standard
Rear Reflector/Tail Lights	Standard	Standard	Standard
Dash Indicator Lights	Standard	Standard	Standard
Operator Presence System	Standard	Standard	Standard
<b>Dash Instrumentation</b>			
Hourmeter	Standard	Standard	Standard
<b>POWER TRAIN</b>			
Transmission Type	Hydrostatic	Hydrostatic	Hydrostatic, 2 Ranges
Number of Speeds	Infinite	Infinite	Infinite
<b>Travel Speeds</b>			
Forward	0—12.38 km/h (0—7.69 mph)	0—12.38 km/h (0—7.69 mph)	N/A
Reverse	0—6.19 km/h (0—3.85 mph)	0—6.19 km/h (0—3.85 mph)	N/A
Forward, High	N/A	N/A	0—15.04 km/h (0—9.35 mph)
Forward, Low	N/A	N/A	0—9.35 km/h (0—5.80 mph)
Reverse, High	N/A	N/A	0—7.52 km/h (0—4.67 mph)
Reverse, Low	N/A	N/A	0—4.66 km/h (0—2.90 mph)
Transmission Capacity w/Filter	6.1 L (13 U.S. pt)	7.1 L (15 U.S. pt)	7.1 L (15 U.S. pt)
Transmission Oil Cooler	N/A	Standard	Standard
Transmission Oil Filter	Standard	Standard	Standard
Differential Lock	N/A	N/A	Standard
<b>STEERING</b>			
Type	Manual	Power, Hydrostatic	Power, Hydrostatic
<b>BRAKES</b>			
Location	Rear Wheels	Rear Wheels	Rear Wheels
Individually Controlled	N/A	Standard	Standard
Type	Shoe and Drum	Shoe and Drum	Shoe and Drum
Return-to-Neutral Braking	Standard	Standard	Standard
Parking	Yes	Yes	Yes
<b>HYDRAULIC SYSTEM</b>			
Type	Single-Function	Two-Function (One w/Float)	Three-Function (One w/Float)
Hydraulic Couplers	One Set	Two Sets	Two Sets

Continued on next page.

MX,15901010,2 -19-25APR95

*General Specifications/Machine Specifications*

	316	318	420
<b>PTO</b>			
Front	Standard	Standard	Standard
Rear	Optional	Optional	Optional
Type	Electric Clutch	Electric Clutch	Electric Clutch
Control	Elec. Switch on Dash	Elec. Switch on Dash	Elec. Switch on Dash
<b>PTO rpm (No Load)</b>			
Front	3450	3450	3450
Rear	2000	2000	2000
<b>MOWER ATTACHMENT</b>			
Compatibility	38, 46 and 50 Inch	38, 46 and 50 Inch	50 and 60 Inch 260 Rotary
Lift System	Hydraulic	Hydraulic	Hydraulic
<b>WHEEL TREAD</b>			
Front	813 mm (32 in.)	813 mm (32 in.)	914 mm (36 in.)
Rear			
Narrow	775 mm (30.5 in.)	775 mm (30.5 in.)	818 mm (32 in.)
Wide	834 mm (32.8 in.)	834 mm (32.8 in.)	980 mm (38.6 in.)
<b>TIRES</b>			
<b>Standard Tires</b>			
Front Turf	16 x 6.50-8, 2 PR	16 x 6.50-8, 2 PR	18 x 8.50-8, 4 PR
Rear Turf or Bar	23 x 10.50-12, 2 PR	23 x 10.50-12, 2 PR	26 x 12.00-12, 2 PR
<b>Optional Tires</b>			
Front (Turf)	16 x 6.50-8, 4 PR	16 x 6.50-8, 4 PR	N/A
Rear (Turf or Bar)	23 x 8.50-12, 2 PR	23 x 8.50-12, 2 PR	N/A
<b>Inflation Pressure</b>			
Front	41—110 kPa (6—16 psi)	41—110 kPa (6—16 psi)	41—152 kPa (6—22 psi)
Rear	34—69 kPa (5—10 psi)	34—69 kPa (5—10 psi)	34—69 kPa (5—10 psi)
<b>SEAT</b>			
Style	High-Back	High-Back	High-Back
Suspension	2 Spring	2 Spring	2 Spring
Adjustment	Slide Rail	Slide Rail	Slide Rail
<b>DIMENSIONS</b>			
Wheel Base	1.2 m (46 in.)	1.2 m (46 in.)	1.3 m (52 in.)
Overall Length	1.8 m (69.5 in.)	1.8 m (69.5 in.)	2.0 m (77 in.)
Overall Height	1.1 m (44.5 in.)	1.1 m (44.5 in.)	1.21 m (47.5 in.)
Overall Width (max.)	1.1 m (43.3 in.)	1.1 m (43.3 in.)	1.31 m (51.5 in.)
Overall Width (min.)	1.04 m (41 in.)	1.04 m (41 in.)	1.14 m (45 in.)
<b>Turning Radius</b>			
Inside Rear Wheel	660 mm (26 in.)	660 mm (26 in.)	660 mm (26 in.)
Outside Front Wheel	2.0 m (80 in.)	2.0 m (80 in.)	2.2 m (86 in.)
NET WEIGHT (No Fuel)	354 kg (780 lbs)	354 kg (780 lbs)	408 kg (913 lbs)
SHIPPING WEIGHT	386 kg (852 lbs)	386 kg (852 lbs)	450 kg (993 lbs)

*(Specifications and design subject to change without notice.)*

MX,15901010,3 -19-25APR95

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**REPAIR SPECIFICATIONS**

Item	Specifications
<b>ENGINE</b>	
For all repair specifications—Use CTM2	
Engine Mounting Cap Screw/Nut Torque	
316 . . . . .	39 N·m (29 lb-ft)
318 and 420 . . . . .	47 N·m (34 lb-ft)
Drive Shaft-to-Engine Cap Screw Torque . . . . .	27 N·m (20 lb-ft)
PTO Belt Tension Spring Length (420)	
Horizontal Adjuster (Early) . . . . .	41 mm (1.600 in.)
Vertical Adjuster (Later) . . . . .	35 mm (1.380 in.)
<b>ELECTRICAL</b>	
Front PTO Clutch-to-Crankshaft Cap Screw Torque . . . . .	47 N·m (35 lb-ft)
PTO Clutch Armature-to-Rotor Clearance . . . . .	0.46 mm (0.018 in.)
PTO Belt Tension Spring Length (420)	
Horizontal Adjuster (Early) . . . . .	41 mm (1.600 in.)
Vertical Adjuster (Later) . . . . .	35 mm (1.380 in.)
<b>POWER TRAIN</b>	
<b>Transmission</b>	
Charge Pump-to-Transmission Cap Screw Torque . . . . .	70 N·m (52 lb-ft)
Transmission Cover Bearing Installation Height . . . . .	3 mm (0.118 in.) above housing surface
Center Section-to-Housing Cap Screw Torque . . . . .	35 N·m (26 lb-ft)
Transmission-to-Differential Cap Screw Torque . . . . .	45 N·m (33 lb-ft)
Axle Housing-to-Frame Cap Screw Torque . . . . .	100 N·m (75 lb-ft)
Brake Rod Spring Length . . . . .	42 mm (1.650 in.)
Differential-to-Frame Support Cap Screw Torque . . . . .	61 N·m (45 lb-ft)
Swashplate Control Arm-to-Control Shaft Nut Torque . . . . .	60 N·m (44 lb-ft)
Drive Shaft Clamping Yoke-to-Transmission Pump Shaft Cap Screw Torque . . . . .	60 N·m (44 lb-ft)
<b>Differential</b>	
Case and Cover Oil Groove Depth (Minimum) . . . . .	0.25 mm (0.010 in.)
Carrier Cap Screw Torque . . . . .	53 N·m (39 lb-ft)
Cover-to-Case Cap Screw Torque . . . . .	23 N·m (20 lb-in.)
<b>Axle Housing</b>	
Differential Seal Depth . . . . .	3 mm (0.118 in.)
Axle Housing-to-Differential Cap Screw Torque . . . . .	81 N·m (60 lb-ft)
Brake Plate-to-Axle Housing Cap Screw Torque . . . . .	68 N·m (50 lb-ft)
Axle Housing-to-Frame Cap Screw Torque . . . . .	100 N·m (75 lb-ft)
Brake Rod Spring Length . . . . .	42 mm (1.650 in.)
Brake Drum-to-Axle Nut Torque . . . . .	88 N·m (65 lb-ft)
Rear Wheel Cap Screw Torque . . . . .	70 N·m (52 lb-ft)
<b>Drive Shaft</b>	
Drive Shaft-to-Engine Cap Screw Torque . . . . .	27 N·m (20 lb-ft)
Clamping Yoke-to-Transmission Pump Shaft Cap Screw Torque . . . . .	60 N·m (44 lb-ft)

Continued on next page.

MX,15901015,1 -19-08MAY95

Item	Specifications
<b>STEERING AND BRAKES</b>	
Steering—316	
Gearbox Mounting Cap Screw Torque . . . . .	95 N·m (70 lb-ft)
Steering Wheel-to-Shaft Nut Torque . . . . .	15 N·m (133 lb-in.)
Pitman Arm Nut Torque . . . . .	224 N·m (165 lb-ft)
Preload Adjuster Maximum End Clearance . . . . .	0.05 mm (0.002 in.)
Side Cover-to-Gearbox Housing Cap Screw Torque . . . . .	40 N·m (30 lb-ft)
Worm Bearing Preload Rolling Torque . . . . .	0.60—1.0 N·m (5—8 lb-in.)
Over-Center Preload Rolling Torque . . . . .	0.50—1.20 N·m (4—10 lb-in.)
Preload Adjuster Lock Nut Torque . . . . .	34 N·m (25 lb-ft)
Steering Shaft Universal Joint-to-Worm Shaft Cap Screw Torque . . . . .	24 N·m (212 lb-in.)
Steering—318 and 420	
Steering Wheel-to-Shaft Nut Torque . . . . .	15 N·m (133 lb-in.)
Rotor-to-Stator Maximum Allowable Clearance . . . . .	0.08 mm (0.003 in.)
Steering Tube Bushing Depth . . . . .	2.5 mm (0.100 in.) below top of tube
Commutator Cover-to-Commutator Screw Torque . . . . .	1.4 N·m (12 lb-in.)
Port Cover Nut Torque . . . . .	30 N·m (22 lb-ft)
Check Ball Plug Torque (Early Version) . . . . .	14 N·m (124 lb-in.)
Steering Cylinder Mounting Nut Torque . . . . .	163 N·m (120 lb-ft)
Brakes	
Brake Plate-to-Axle Housing Cap Screw Torque . . . . .	68 N·m (50 lb-ft)
Axle Housing-to-Frame Cap Screw Torque . . . . .	100 N·m (75 lb-ft)
Brake Rod Spring Length . . . . .	42 mm (1.650 in.)
Brake Drum-to-Axle Nut Torque . . . . .	88 N·m (65 lb-ft)
Rear Wheel Cap Screw Torque . . . . .	70 N·m (52 lb-ft)
<b>HYDRAULICS</b>	
Single-Spool Valve	
Spool Screw Torque . . . . .	4 N·m (35 lb-in.)
Spool Cap-to-Body Screw Torque . . . . .	4 N·m (35 lb-in.)
Check Valve Plug Torque . . . . .	31 N·m (23 lb-ft)
Two-Spool Valve	
Versions One, Two and Three	
Spool Cap-to-Body Screw Torque . . . . .	31 N·m (23 lb-ft)
Versions Four and Five	
Spool Screw and Detent Torque . . . . .	4 N·m (35 lb-in.)
Spool Cap-to-Body Screw Torque . . . . .	4 N·m (35 lb-in.)
Check Valve Plug Torque . . . . .	31 N·m (23 lb-ft)
Three-Spool Valve	
Versions One, Two and Three	
Spool Cap-to-Body Screw Torque . . . . .	31 N·m (23 lb-ft)
Lock Nut Torque (Version Three) . . . . .	31 N·m (23 lb-ft)
Version Four	
Spool Screws and Detent Torque . . . . .	4 N·m (35 lb-in.)
Spool Cap-to-Body Screw Torque . . . . .	4 N·m (35 lb-in.)
Check Valve Plug Torque . . . . .	31 N·m (23 lb-ft)

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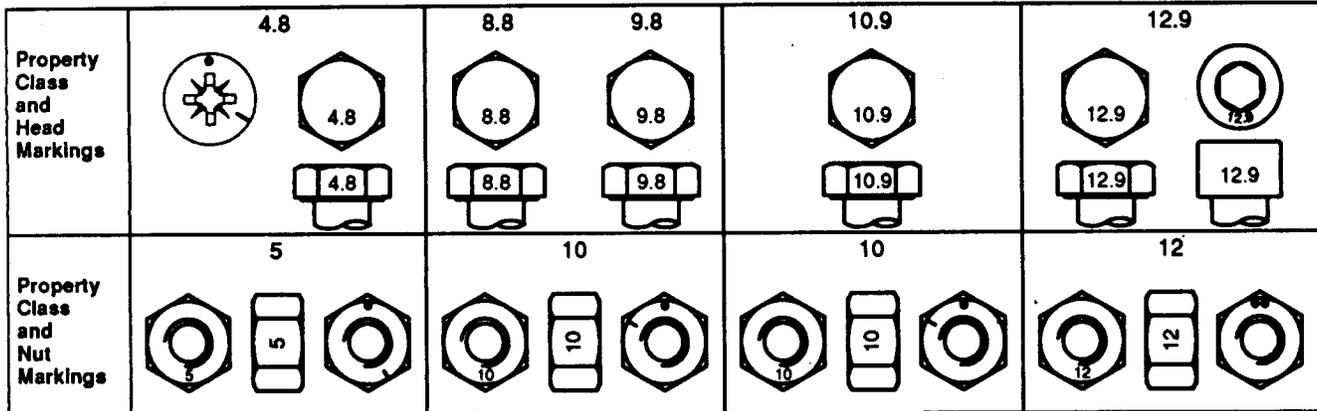
MX,15901015,2 -19-08MAY95

Item	Specifications
<b>MISCELLANEOUS</b>	
<b>Front Axle</b>	
PTO Belt Tension Spring Length (420)	
Horizontal Adjuster (Early) . . . . .	41 mm (1.600 in.)
Vertical Adjuster (Later) . . . . .	35 mm (1.380 in.)
Toe-In . . . . .	4.8 mm (3/16 in.)
<b>Mower Blade Spindles</b>	
Driven Sheave-to-Spindle Lock Nut Torque . . . . .	140 N·m (103 lb-ft)
Blade-to-Spindle Cap Screw Torque . . . . .	73 N·m (54 lb-ft)
<b>Mower Blade Jack Sheave</b>	
Jack Sheave-to-Spindle Lock Nut Torque . . . . .	140 N·m (103 lb-ft)
Blade-to-Spindle Cap Screw Torque . . . . .	73 N·m (54 lb-ft)
<b>50-Inch Mower Gear Case</b>	
Plug Installation Depth . . . . .	1.59 mm (0.062 in.) below gear case surface
Retainer Seal Installation Depth . . . . .	2.54 mm (0.100 in.) below retainer surface
Retainer-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
Pillow Block Seal Installation Depth . . . . .	2.54 mm (0.100 in.) below block surface
Pillow Block-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
<b>Early 60-Inch Mower Gear Case</b>	
Cap-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
Output Shaft Endplay . . . . .	0.025—0.076 mm (0.001—0.003 in.)
Input Shaft Backlash . . . . .	0.076—0.130 mm (0.003—0.005 in.)
<b>Later 60-Inch Mower Gear Case</b>	
Gear Case Seal Installation Depth . . . . .	2.54 mm (0.100 in.) below gear case surface
Retainer-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
Pillow Block Seal Installation Depth . . . . .	2.54 mm (0.100 in.) below block surface
Pillow Block-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
<b>260 Rotary Mower Gear Case</b>	
End Cap-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)
Input Shaft Endplay . . . . .	0.025—0.076 mm (0.001—0.003 in.)
Output Shaft Backlash . . . . .	0.076—0.130 mm (0.003—0.005 in.)
Housing-to-Gear Case Cap Screw Torque . . . . .	30 N·m (22 lb-ft)

MX,15901015,6 -19-20MAR95

**METRIC BOLT AND CAP SCREW TORQUE VALUES**

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TS1163 -19-04/MAR91

Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated <sup>a</sup>		Dry <sup>a</sup>		Lubricated <sup>a</sup>		Dry <sup>a</sup>		Lubricated <sup>a</sup>		Dry <sup>a</sup>		Lubricated <sup>a</sup>		Dry <sup>a</sup>	
	N-m	lb-ft	N-m	lb-ft												
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

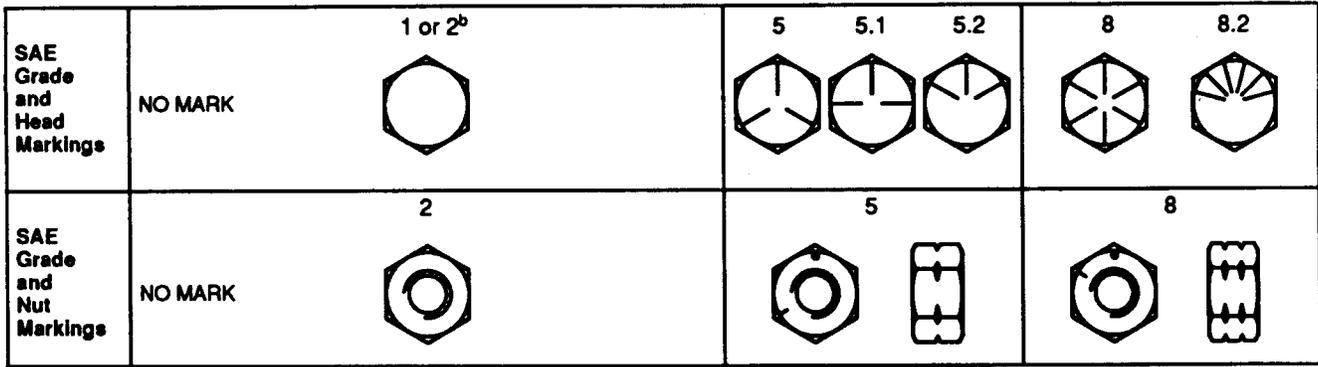
Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

<sup>a</sup> "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

**UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES**



Size	Grade 1				Grade 2 <sup>b</sup>				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated <sup>a</sup>		Dry <sup>a</sup>													
	N-m	lb-ft	N-m	lb-ft												
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

<sup>a</sup> "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

<sup>b</sup> Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

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**METRIC CAP SCREW TORQUE VALUES—GRADE 7**

*NOTE: When bolting aluminum parts, tighten to 80% of torque specified in table.*

Size	N-m	(lb-ft)
M6	9.5 - 12.2	(7-9)
M8	20.3 - 27.1	(15-20)
M10	47.5 - 54.2	(35-40)
M12	81.4 - 94.9	(60-70)
M14	128.8 - 146.4	(95-108)
M16	210.2 - 240	(155-177)

MX,15901015,3 -19-01MAR95

**SET SCREW SEATING TORQUE CHART**

Screw Size	Cup Point	Square Head
Torque in Inch Pounds		
#5	(1.02 N-m) 9	—
#6	(1.02 N-m) 9	—
#8	(2.26 N-m) 20	—
#10	(3.73 N-m) 33	—
1/4	(9.83 N-m) 87	(23.96 N-m) 212
5/16	(18.65 N-m) 165	(47.46 N-m) 420
3/8	(32.77 N-m) 290	(93.79 N-m) 830
7/16	(48.59 N-m) 430	—
1/2	(70.06 N-m) 620	(237.30 N-m) 2100
9/16	(70.06 N-m) 620	—
5/8	(138.43 N-m) 1225	(480.25 N-m) 4250
3/4	(240.13 N-m) 2125	(870.10 N-m) 7700

*NOTE: Allow a tolerance of plus or minus 10 per cent on all torques given in this chart.*

*Divide readings by 12 for foot-pound values.*

MX,TORQ,SET -19-09DEC94

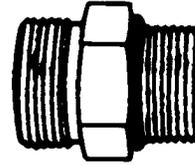
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M77900 -19-15DEC94

## SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS

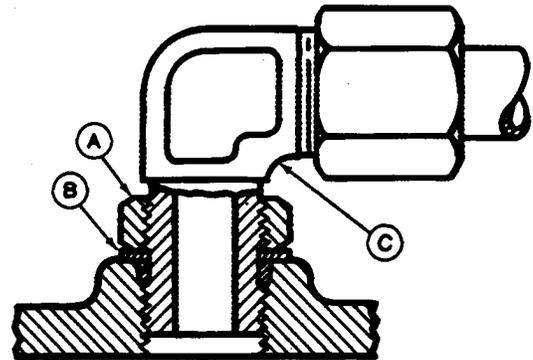
### STRAIGHT FITTING

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



### ANGLE FITTING

1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.
2. Turn fitting into threaded boss until back-up washer contacts face of boss.
3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).
4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.



*NOTE: Do not allow hoses to twist when tightening fittings.*

### TORQUE VALUE

Thread Size	N-m	lb-ft
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

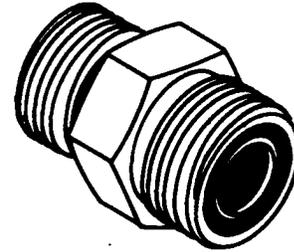
*NOTE: Torque tolerance is  $\pm 10\%$ .*

04T.90,K66 -19-01AUG94

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-UN-18OCT88  
T6249AE  
-UN-18OCT88  
T6520AB

## SERVICE RECOMMENDATIONS FOR FLAT FACE O-RING SEAL FITTINGS

1. Inspect the fitting sealing surfaces. They must be free of dirt or defects.
2. Inspect the O-ring. It must be free of damage or defects.
3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
6. Tighten fitting or nut to torque valve shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.



T6249AD -JUN-18OCT88

FLAT FACE O-RING SEAL FITTING TORQUE

Nominal Tube mm	O.D. (in.)	Dash Size	Thread Size In.	Swivel Nut Torque		Bulkhead Nut Torque	
				N-m	(lb-ft)	N-m	(lb-ft)
6.35	0.250	-4	9/16-18	16	12	5.0	3.5
9.52	0.375	-6	11/16-16	24	18	9.0	6.5
12.70	0.500	-8	13/16-16	50	37	17.0	12.5
15.88	0.625	-10	1-14	69	51	17.0	12.5
19.05	0.750	-12	1 3/16-12	102	75	17.0	12.5
22.22	0.875	-14	1 3/16-12	102	75	17.0	12.5
25.40	1.000	-16	1 7/16-12	142	105	17.0	12.5
31.75	1.250	-20	1 11/16-12	190	140	17.0	12.5
38.10	1.500	-24	2-12	217	160	17.0	12.5

NOTE: Torque tolerance is +15 -20%.

OR,SEAL,FIT -19-03MAR89

## **TUBE AND HOSE FITTING, 37° FLARE AND 30° CONE SEAT CONNECTOR SERVICE RECOMMENDATIONS**

1. Inspect the flare and the flare seat. They must be free of dirt and defects. If repeated leaks occur, inspect for defects with a magnifying glass. If burrs and raised nicks on the connector body cannot be removed with a slip stone, replace the connector.
2. Defects in the tube flare cannot be repaired. Replace the tube. Overtightening a defective flared fitting will not stop leaks.
3. As a field repair, a ductile truncated cone shaped washer can be used between the tube flare and connector body. These washers are soft enough to fill defects in the seat and flare. They will also seal the connection. Ductile washers are available from industrial supply houses.
4. Align the tube with the fitting before attempting to start the nut. Failure to do so can cause a deformed flare and subsequent leaks. Install hoses without twists. A twisted hose attempts to straighten out when pressure is applied. This exerts a torque on the connection, eventually causing failure.
5. Lubricate the connection with hydraulic fluid, petroleum jelly or soap. Tighten the swivel nut by hand until it is snug.
6. Mark a line across the nut and connector body. This line will serve as a visual indicator as to whether the nut has been tightened and by how much.
7. Using two wrenches, one on the connector body and a torque wrench on the nut, tighten the nut to the torque value as shown in the chart. In the case of a hose, it may be necessary to use three wrenches to prevent twisting.

MX,15901015,4 -19-17JAN95

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15  
9

TUBE AND HOSE FITTING, 37° FLARE AND 30° CONE SEAT CONNECTOR TORQUE

Thread Size	N·m	Torque <sup>1</sup> (lb-ft)	New <sup>2</sup> Number of Flats	Used <sup>3</sup> Number of Flats
3/8-24 UNF	8	(6)	2-1/2	1
7/16-20 UNF	12	(9)	2-1/2	1
1/2-20 UNF	16	(12)	2-1/2	1
9/16-18 UNF	24	(18)	2	1
3/4-16 UNF	46	(34)	2	1
7/8-14 UNF	62	(46)	1-1/2	1
1-1/16-12 UN	102	(75)	1	3/4
1-3/16-12 UN	122	(90)	1	3/4
1-5/16-12 UN	142	(105)	3/4	3/4
1-5/8-12 UN	190	(140)	3/4	3/4
1-7/8-12 UN	217	(160)	1/2	1/2

1. Tolerance of ± 10 percent.

2. To be used if a torque wrench cannot be used. After tightening fitting by hand, put a mark across the fittings, then tighten fitting the number of flats shown.

3. Flare connection seal by deforming or squeezing the tube between the nut and the connector. More deformation is possible with new parts than with old. Therefore, if a torque wrench is not used for re-assembly, the values in this column must be used to prevent damage.

MX,15901015,5 -19-17JAN95

## TEST AND ADJUSTMENT SPECIFICATIONS

Item	Specifications
<b>ENGINE</b>	
Spark Plug Gap .....	0.64 mm (0.025 in.)
Slow Idle Speed .....	1350 rpm
Fast Idle Speed .....	3450 rpm
Dashpot-to-Governor Arm Bracket Clearance (B43E, B43G and B48G) .....	1.3 ± 0.2 mm (0.050 ± 0.010 in.)
<b>Fuel Pump</b>	
Minimum Fuel Flow .....	120 mL (4 oz)/30 seconds
Minimum Vacuum .....	9 kPa (2.6 in. mercury)
Minimum Fuel Pressure .....	12 kPa (1.7 psi)
<b>Minimum Crankcase Vacuum</b>	
B43E, B43G and B48G .....	25 cm (10 in.) Water
P218G and P220G .....	33 cm (13 in.) Water
<b>Ignition Point Gap (B43E, B43G and B48G)</b>	
B43E and B43G .....	0.41 mm (0.016 in.)
<b>B48G</b>	
Spec A and B .....	0.51 mm (0.020 in.)
Spec C .....	0.41 mm (0.016 in.)
<b>Minimum Compression</b>	
B43E, B43G and B48G .....	690 kPa (100 psi)
P218G, P220G .....	517 kPa (75 psi)
Maximum Difference Between Cylinders .....	69 kPa (10 psi)
<b>Oil Pressure</b>	
Slow Idle .....	69—103 kPa (10—15 psi)
Fast Idle .....	124—152 kPa (18—22 psi)
<b>Oil Pressure Regulating Valve</b>	
Cap Screw Thread Length .....	22 mm (0.875 in.)
Spring Free Length .....	25 mm (1 in.)
Spring Test Length .....	13 mm (0.500 in.) at 12 N (2.6 lbs force)
<b>ELECTRICAL SYSTEM</b>	
<b>Ignition Point Gap (S.N. —420000)</b>	
B43E and B43G .....	0.41 mm (0.016 in.)
<b>B48G</b>	
Spec A and B .....	0.51 mm (0.020 in.)
Spec C .....	0.41 mm (0.016 in.)
<b>Ignition Coil Resistance with Coil Temperature at 20°C (68°F)</b>	
<b>(S.N. —420000)</b>	
Primary Windings .....	3.9—4.7 ohms
Secondary Windings .....	12.6—15.4 K-ohms
<b>(S.N. 420001— )</b>	
Primary Windings .....	3.7—4.6 ohms
Secondary Windings .....	34.02—41.6 K-ohms
<b>Starter (Bendix Type)</b>	
<b>316 (S.N. —362983), 318 (S.N. —364137), 420 (S.N. —360009)</b>	
Current Draw (Maximum) .....	250 amps at 300 rpm cranking speed
No-Load rpm (Minimum) .....	5900 rpm
No-Load Amp Draw (Maximum) .....	30 amps

Continued on next page.

MX,15901020,1 -19-16MAY95

Test and Adjustment Specifications

10  
20  
2

Item	Specifications
<b>ELECTRICAL SYSTEM, continued</b>	
<b>Starter (Solenoid Shift)</b>	
316 (S.N. 362984— ), 318 (S.N. 364138— ), 420 (S.N. 360010— )	
Current Draw (Maximum)	250 amps at 300 rpm cranking speed
No-Load rpm (Minimum)	7000 rpm
No-Load Amp Draw (Maximum)	53 amps
<b>Alternator</b>	
<b>Regulated Current Output</b>	
316 (P218G), 318 and 420	20 amps
316 (B43E)	15 amps
<b>Unregulated Output</b>	
<b>P218G and P220G</b>	
Spec A	28—41 VAC
Spec B and C	28—57 VAC
B43E	28—40 VAC
B43G and B48G	28—31 VAC
<b>Stator Resistance</b>	
<b>P218G and P220G</b>	
Spec A	0.06—0.10 ohms
Spec B and C	0.10—0.19 ohms
B43E	0.10—0.20 ohms
B43G and B48G	0.30—0.50 ohms
PTO Clutch Armature-to-Rotor Clearance	0.46 mm (0.018 in.)
<b>POWER TRAIN</b>	
Oil Temperature for Hydraulic Tests	43°C (110°F)
Charge Pump Pressure	620—1240 kPa (90—180 psi)
Implement Relief Valve Pressure	5861—6722 kPa (850—975 psi)
Charge Pump Flow at 3450 kPa (500 psi)	11 L/min (3 gpm)
318 and 420; Steering Valve Pressure in Neutral Position	620—1240 kPa (90—180 psi)
Hydrostatic Lever Tension	31—44.5 N (7—10 lb force)
<b>Turnbuckle Lock Nut Torque</b>	
(Transmission Control Lever Linkage, Version One—All Models and Version Two—318)	
	33 N·m (24 lb-ft)
<b>Detent Spring Length</b>	
(Transmission Control Lever Linkage, Later Versions—All Models)	
	50 mm (1.970 in.)
<b>STEERING AND BRAKES</b>	
Oil Temperature for Hydraulic Tests	43°C (110°F)
<b>Steering System Leakage Test at Slow Idle</b>	
Torque Applied to Steering Wheel Nut	6.8 N·m (60 lb-in.)
Maximum Left and Right Turn rpm	6 rpm
<b>HYDRAULIC SYSTEM</b>	
Oil Temperature for Hydraulic Tests	43°C (110°F)
<b>Control Valve Leakage Test</b>	
Control Valve Pressure	5860—6550 kPa (850—950 psi)
Control Valve Leakage	15 mL/min (1/2 fl oz/min)

MX,15901020,2 -19-17MAY95

## FUEL

**N** **CAUTION:** Handle fuel carefully. If the engine is hot or running, do not fill the fuel tank. Do not smoke while you fill the fuel tank or service the fuel system. Fill fuel tank only to bottom of filler neck.

**IMPORTANT: DO NOT** mix oil with gasoline.

1. Unleaded fuel is recommended. Regular leaded gasoline with an anti-knock index of 87 or higher may be used. Avoid switching from unleaded to regular gasoline to prevent engine damage.

Use of gasohol is acceptable as long as the ethyl alcohol blend does not exceed 10 percent. Unleaded gasohol is preferred over leaded gasohol.

2. Fill fuel tank at end of each day's operation. Fill fuel tank only to bottom of filler neck.



MX,15901025,1 -19-09DEC94

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25  
1

M33122  
-JUN-25AUG88

## STORING FUEL

If there is a very slow turnover of fuel in the fuel tank or supply tank, it may be necessary to add a fuel conditioner to prevent water condensation. Contact your John Deere dealer for proper service or maintenance recommendations.

DX,FUEL -19-03MAR93

## ENGINE OIL

Use oil viscosity based on the expected air temperature range during the period between oil changes.

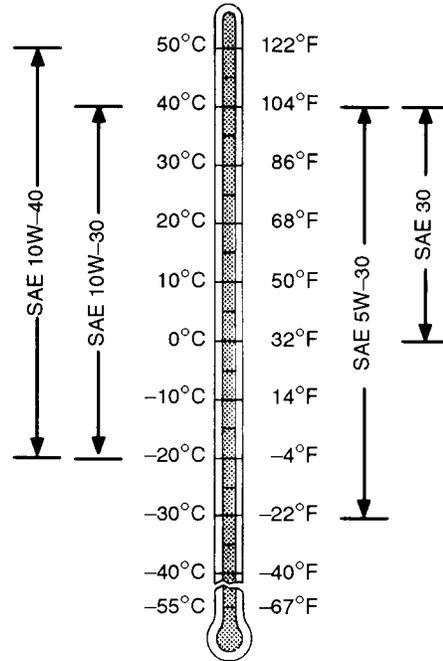
The following oils are preferred:

- John Deere TURF-GARD™
- John Deere PLUS-4®

Other oils may be used if they meet one or more of the following:

- API Service Classification SH
- API Service Classification SG
- CCMC Specification G5

Arctic oils (such as Military Specification MIL-L-46167B) may be used at temperature below -30°C (-22°F).



TS1624 -JUN-07NOV/94

MX,15901025,2 -19-09DEC94

## TRANSMISSION AND HYDRAULIC OIL

Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following oils are preferred:

- John Deere HY-GARD®
- John Deere Low Viscosity HY-GARD®

The following oils are also recommended:

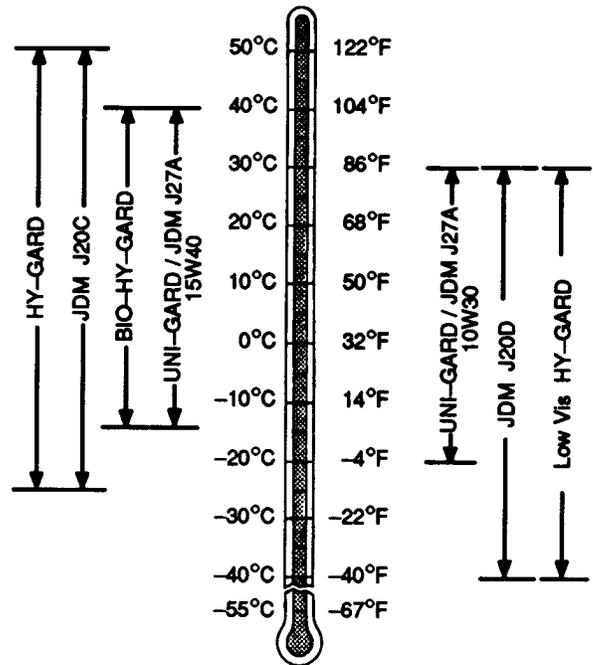
- John Deere UNI-GARD™
- John Deere BIO-HY-GARD™<sup>1</sup>

Other oils may be used if they meet one of the following:

- John Deere Standard JDM J20C
- John Deere Standard JDM J20D
- John Deere Standard JDM J27A

**IMPORTANT: Do not use engine oil for this application.**

Arctic oils (such as Military Specification MIL-L-46167B) may be used at temperatures below -30°C (-22°F).



<sup>1</sup>BIO-HY-GARD meets or exceeds the minimum biodegradability of 80% within 21 days according to CEC-L-33-T-82 test method. BIO-HY-GARD should not be mixed with mineral oils because this reduces the biodegradability and makes proper oil recycling impossible.

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4

## GREASE

Use grease based on the expected air temperature range during the service interval.

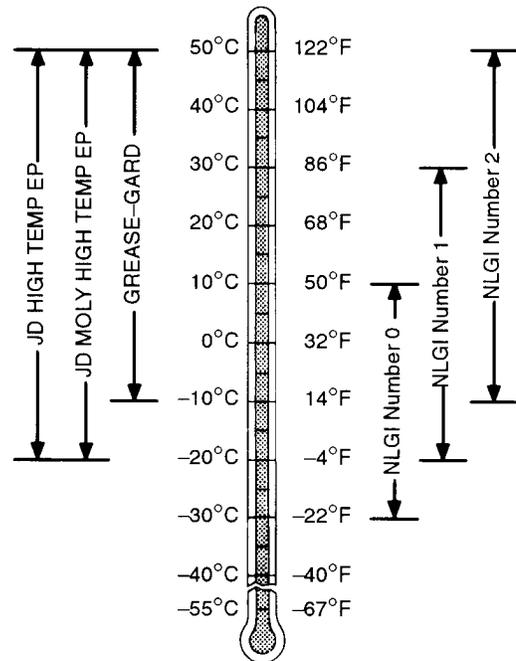
The following greases are preferred:

- John Deere MOLY HIGH TEMPERATURE EP GREASE
- John Deere HIGH TEMPERATURE EP GREASE
- John Deere GREASE-GARD™

Other greases may be used if they meet one of the following:

- SAE Multipurpose EP Grease with a maximum of 5% molybdenum disulfide
- SAE Multipurpose EP Grease

Greases meeting Military Specification MIL-G-10924F may be used as arctic grease.



DX.GREA1 -19-02NOV94

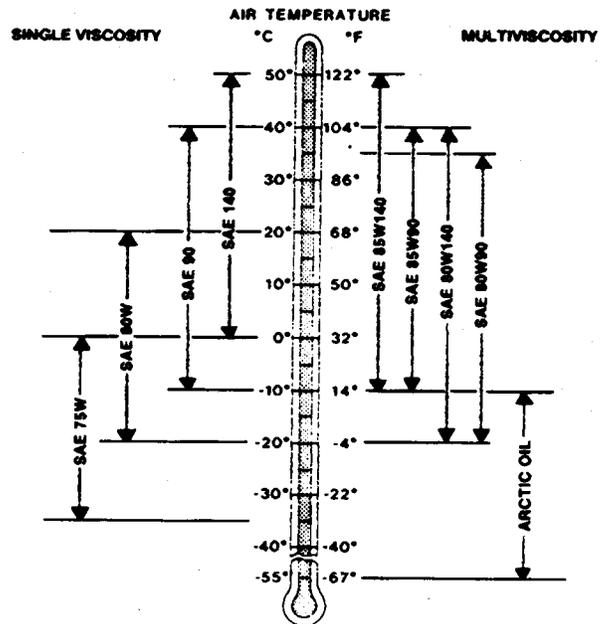
TS1622 -UN-02NOV94

## MOWER DECK GEAR CASE OIL

Depending upon the expected air temperature range during the drain interval, use oil viscosity shown on the adjoining temperature chart.

John Deere API GL-5 Gear Oil is recommended. If other oils are used, they must meet performance requirements of:

- API Service Classification GL-5
- Military Specification MIL-L-2105C



MX,15901025,3 -19-14FEB95

X9322 -19-30SEP88

## ALTERNATIVE AND SYNTHETIC LUBRICANTS

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual. Some John Deere lubricants may not be available in your location. Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements listed in this manual.

DX,ALTER -19-01FEB94

## LUBRICANT STORAGE

Your equipment can operate at top efficiency only if clean lubricants are used.

Use clean containers to handle all lubricants.

Whenever possible, store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

DX,LUBST -19-01FEB94

## MIXING OF LUBRICANTS

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements. Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

DX,LUBMIX -19-01FEB94



## SERIAL NUMBERS

When working on machines or components that are covered by warranty, it is **IMPORTANT** that you include the tractor Product Identification Number and the component serial number on the warranty claim form.

The location of component serial number plates are shown below.

MX,M21,1030R,1 -19-22APR85

## PRODUCT IDENTIFICATION NUMBER

*NOTE: All identification number plates are located on the pedestal. On some models, the plate is on the right-hand side. On others, front top left corner.*



M34494  
-UN-08NOV89

MX,15901030,1 -19-12MAY95

## ENGINE SERIAL NUMBER

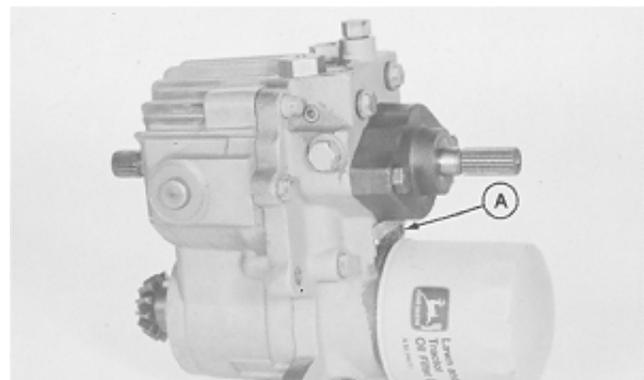


M77302  
-UN-15DEC94

MX,15901030,2 -19-12MAY95

## TRANSMISSION SERIAL NUMBER

Serial number plate (A) location.

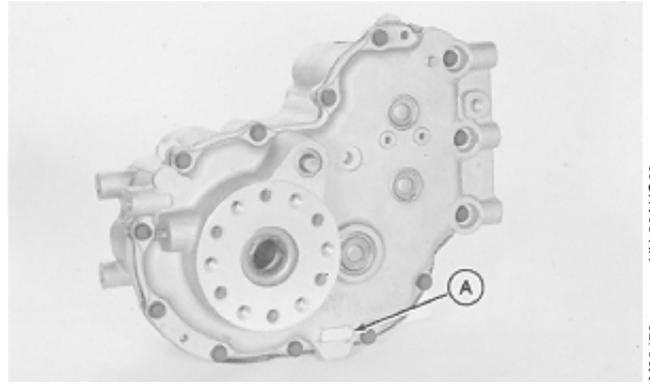


M38478  
-UN-29AUG88

MX,15901030,3 -19-12MAY95

### DIFFERENTIAL SERIAL NUMBER

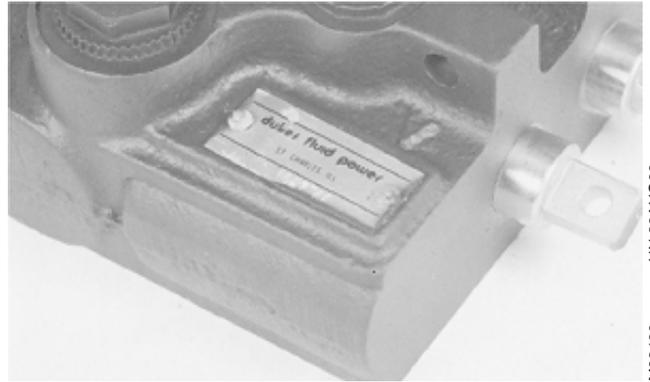
Serial number plate (A) location.



M38479 -UN-29AUG88

MX,15901030,4 -19-12MAY95

### CONTROL VALVE SERIAL NUMBER



M38480 -UN-29AUG88

MX,15901030,5 -19-12MAY95

# Section 20 ENGINE REPAIR

## Contents

Page

### Group 05—Engine

Repair—Use CTM2 .....	20-05-1
Remove and Install .....	20-05-1

20



## ONAN ENGINE REPAIR—USE CTM2

For complete repair information, the component technical manual (CTM) is also required. Use the component technical manual in conjunction with this machine manual.



MX,15902005,1 -19-09DEC94

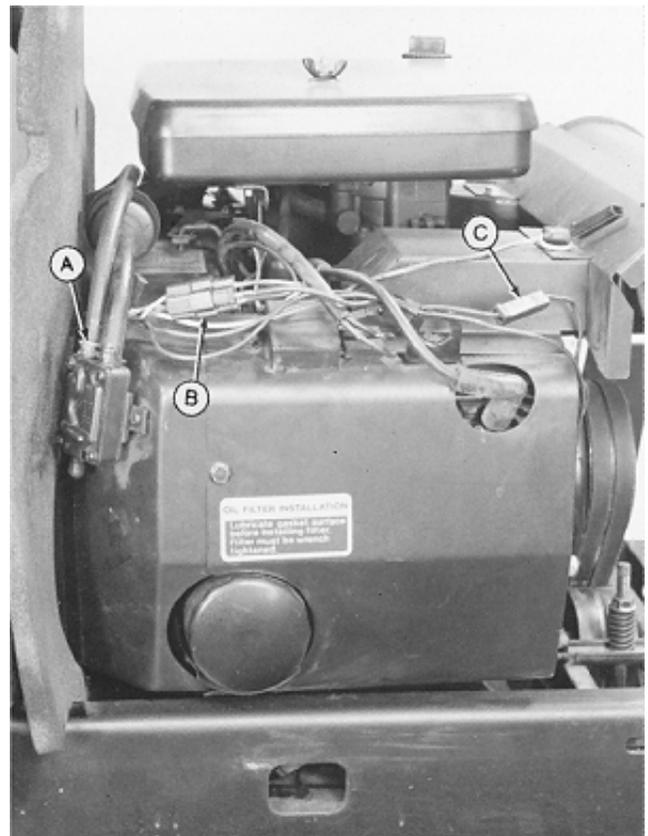
TS225  
-UN-17JAN89

20-05-1

## REMOVE AND INSTALL ENGINE

1. Disconnect battery negative (—) cable.
2. Disconnect headlight lead and headlight ground.
3. Remove grille, side panels, hood, hood support and air cleaner.
4. Disconnect items (A—C).

**A—Fuel Pump Inlet Line**  
**B—Regulator/Coil Lead**  
**C—PTO Lead**



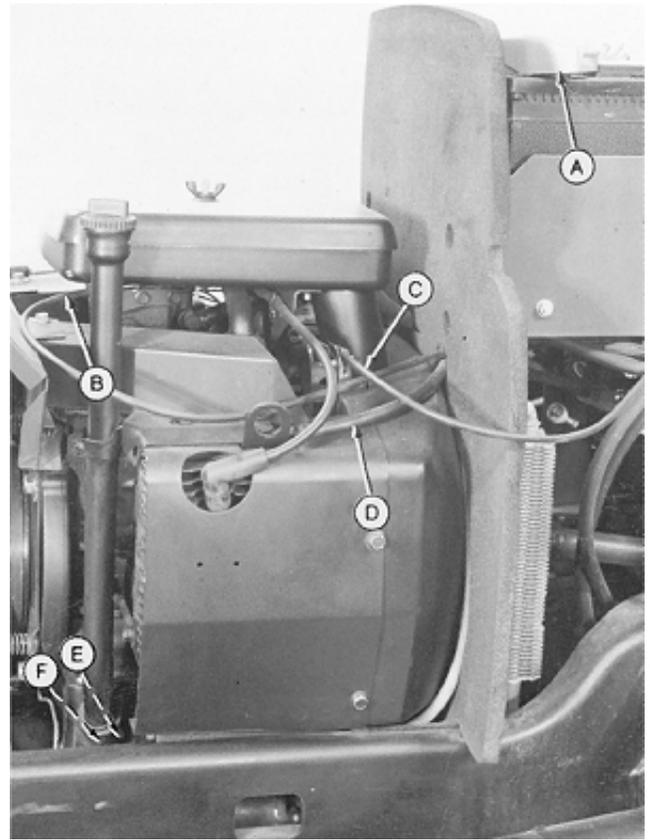
MX,15902005,2 -19-09DEC94

M49500  
-UN-20DEC89

20  
05  
2

5. Disconnect items (A—F).
6. Disconnect drive shaft at engine.
7. Loosen PTO belt tension and remove belts from engine.
8. Remove engine mounting cap screws.
9. Attach load positioning sling to lift eyes and remove engine.
10. Make repairs as necessary. (See CTM2.)

- A—Positive Battery Cable
- B—Choke Cable
- C—Throttle Cable
- D—Battery Ground Cable at Engine
- E—Positive Battery Cable from Starter
- F—Starter Solenoid Lead



M49501 -JUN-20DEC89

MX,15902005,3 -19-24FEB95

11. Installation is done in the reverse order of removal.

- Tighten engine mounting cap screws to specifications.
- When connecting drive shaft, tighten cap screws to specifications.

*NOTE: Determine which adjuster you have. (420 only)*

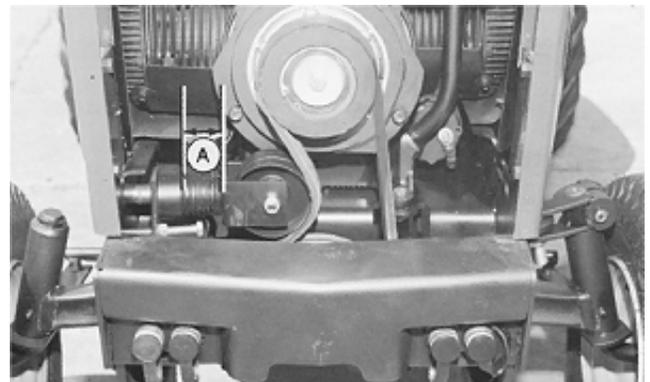
- When adjusting PTO belt tension on horizontal adjuster, tighten bolt until spring measures 41 mm (1.600 in.).

When adjusting PTO belt tension on vertical adjuster, tighten nut until spring measures 35 mm (1.380 in.).

- Adjust slow and fast idle. (See Section 220, Group 10.)

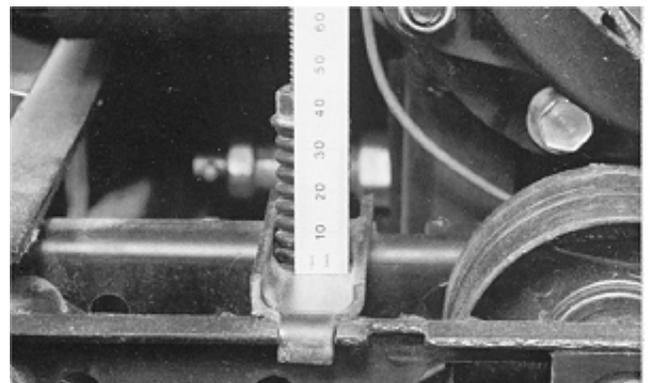
**TORQUE SPECIFICATIONS**

Engine Mounting Cap Screws	
316	39 N·m (29 lb-ft)
318 and 420	47 N·m (34.5 lb-ft)
Drive Shaft Mounting Cap Screws	27 N·m (20 lb-ft)



Horizontal Adjuster (Early 420)

M49503 -JUN-20DEC89



Vertical Adjuster (Later 420)

M49502 -JUN-20DEC89

MX,15902005,4 -19-24FEB95

# Section 40 ELECTRICAL REPAIR

## Contents

### Page

#### Group 05—Front PTO Clutch

Remove . . . . .	40-05-1
Disassemble, Inspect and Assemble . . . . .	40-05-2
Install . . . . .	40-05-4



## REMOVE FRONT PTO CLUTCH

1. Remove grille and right-hand side panel.
2. Loosen PTO belt tension and remove belts from PTO clutch sheaves.
3. Disconnect PTO clutch wire lead.

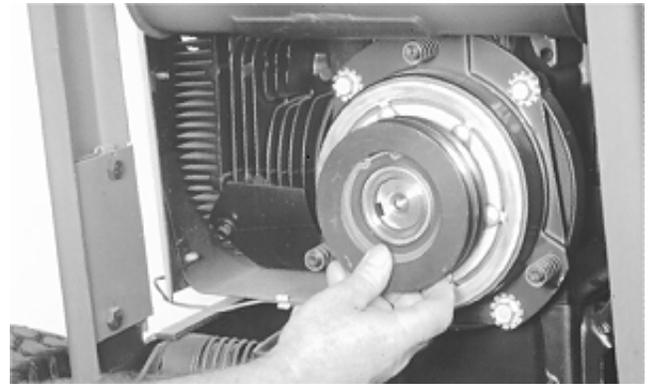
*NOTE: On some models, the brake plate may be assembled to the armature assembly.*

4. On 316 and 318:

- Remove armature assembly from field coil.
- Remove three springs.

- On 420:

- Push idler back and remove brake plate.
- Remove three springs.
- Remove armature assembly from field coil.



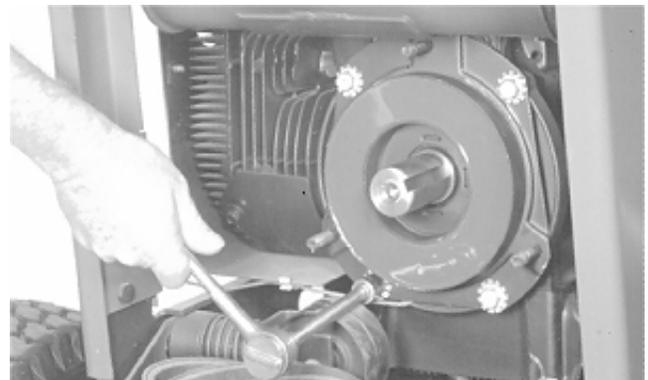
Early 420 Shown

M32108 -UN-03AUG89

MX,15904005,1 -19-16JAN95

*NOTE: Note position of clutch wire lead to aid in installation.*

5. Remove rotor from field coil.
6. Remove key from shaft.
7. Remove field coil.



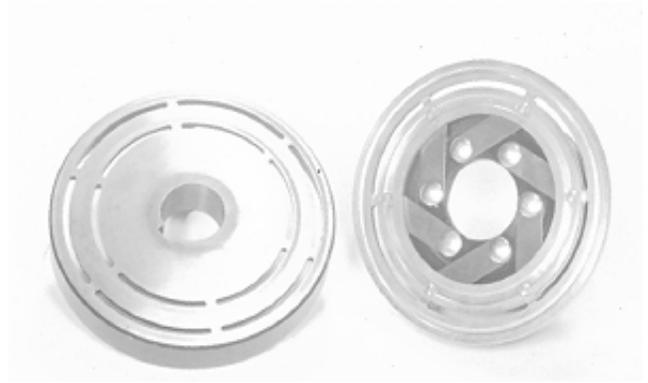
Early 420 Shown

M32112 -UN-03AUG89

MX,15904005,2 -19-16JAN95

## DISASSEMBLE, INSPECT AND ASSEMBLE FRONT PTO CLUTCH

1. Inspect armature for bent, weak or broken contact springs. Replace armature if damaged.
2. Inspect rotor and armature face contacts for wear. Replace if worn or grooved. Clean face contacts of dirt or foreign material.



MX,15904005.3 -19-12MAY95

M32117 -UN-03AUG89

*NOTE: Bearing is press-fit in armature. Remove only if replacement is necessary.*

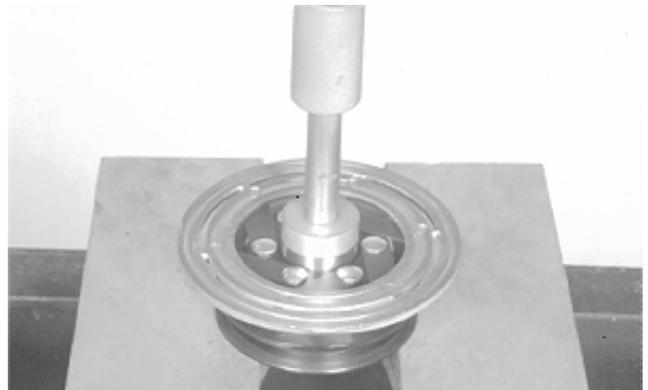
3. Inspect armature bearing for wear or damage. Replace if necessary.
4. To replace armature bearing; remove snap ring.



MX,15904005.4 -19-14DEC94

M32113 -UN-03AUG89

5. Remove hub and bearing from armature using a press and a 1-11/16 in. driver disk. Make sure assembly is supported on pulley, NOT on armature plate.
6. Remove shim washer from inside pulley hub.
7. Remove hub from bearing using a press and a 1-3/4 in. driver disk.
8. Install hub into new bearing using a press and driver disk.
9. Install shim washer in bottom of pulley hub.



MX,15904005.5 -19-14DEC94

M32114 -UN-03AUG89

**IMPORTANT:** Support the armature assembly on the spring rivets when installing bearing/hub assembly into armature assembly, or damage to armature and springs will occur.

10. Support armature on spring rivets and install bearing/hub assembly into pulley hub with a press and a 2-15/16 in. driver disk.

11. Install snap ring.



UN-03AUG89  
M32120

MX,15904005,6 -19-14DEC94

12. Inspect field coil for wear or damage. Replace if necessary.

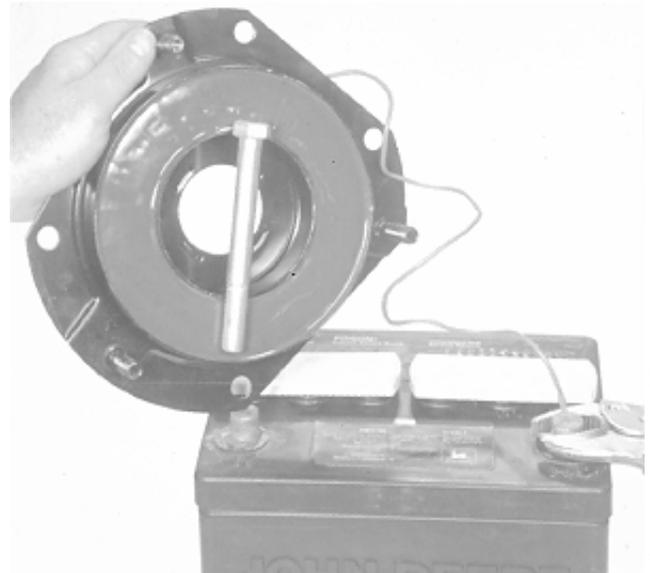
13. Test field coil for electrical continuity.

Early version:

- Attach field coil lead to positive (+) terminal of a charged storage battery.
- Set coil base on negative (—) battery terminal.
- Put a steel bolt across coil. Electromagnetic action will hold bolt to coil if coil is good. If bolt does not stick to coil, replace the coil.

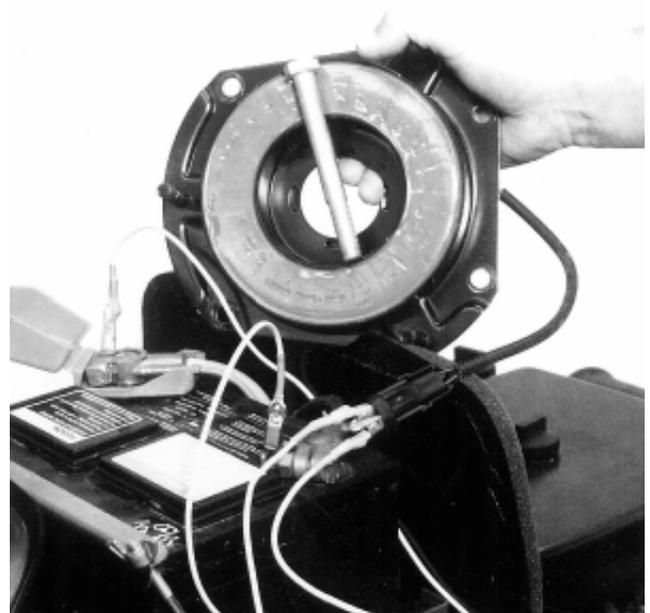
Later version:

- Attach a jumper wire from one terminal of two-pin connector to negative (—) battery terminal.
- Attach another jumper wire from the remaining terminal of two-pin connector to positive (+) battery terminal.
- Put a steel bolt across coil. Electromagnetic action will hold bolt to coil if coil is good. If bolt does not stick to coil, replace the coil.



UN-03AUG89  
M32118

Early Version



UN-25JAN95  
M77321

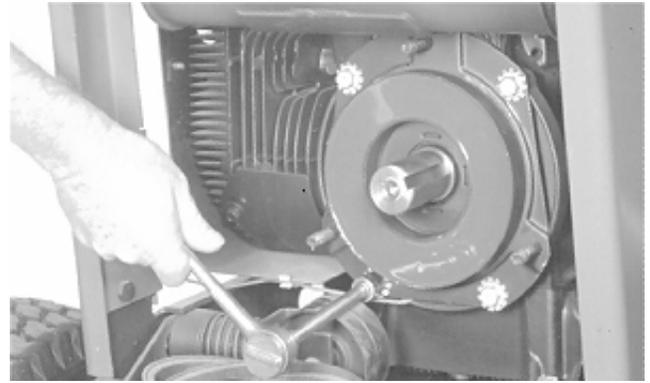
Later Version

MX,15904005,7 -19-19JAN95

## INSTALL FRONT PTO CLUTCH

**IMPORTANT:** Make sure clutch wire lead is in same position as when removed, to prevent shorting of wires.

1. Install field coil and fasten with four cap screws and lock washers. Be sure coil assembly pilots, on backside of coil, are seated in engine face. Tighten cap screws.
2. Install rotor and key.



Early 420 Shown

M32112 -JUN-03AUG89

MX,15904005,8 -19-01MAR95

*NOTE: Some models have a notch in the hub of the armature assembly. This notch MUST slip over the extended key in the crankshaft.*

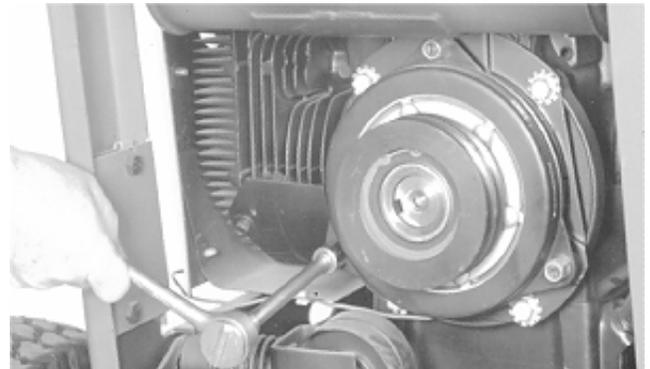
3. On 316 and 318:

- Install three springs on mounting studs.
- Install armature assembly.

On 420:

- Install armature assembly.
- Install three springs on mounting studs.
- Push idler back and install brake plate.

4. Install lock nuts. DO NOT tighten nuts.
5. Install washer and cap screw on end of crankshaft. Tighten cap screw to 47 N·m (35 lb-ft).
6. Connect PTO clutch wire lead.



Early 420 Shown

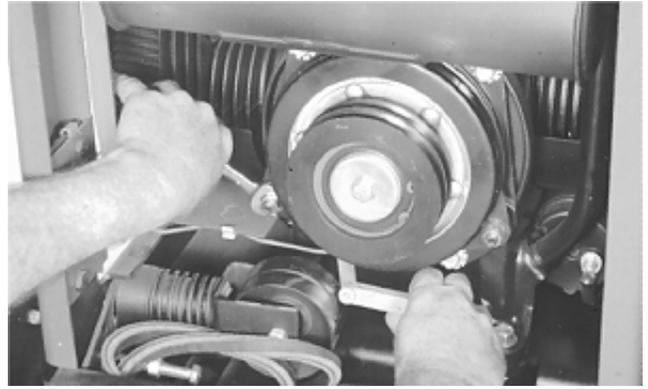
M32107 -JUN-03AUG89

MX,15904005,9 -19-08MAY95

## Front PTO Clutch/Install

7. Put a 0.46 mm (0.018 in.) flat feeler gauge through slots in brake plate between rotor and armature. Turn lock nuts until space between rotor and armature is 0.46 mm (0.018 in.). Be sure all three nuts are adjusted so space between armature and rotor is adjusted to specification at each of three slots in brake plate.

8. After adjusting, turn ignition switch ON. Move PTO switch ON and OFF several times to seat parts. Turn ignition switch OFF. Recheck clearance and adjust as necessary.



Early 420 Shown

MX,15904005,10 -19-20MAR95

9. Install PTO clutch belts.

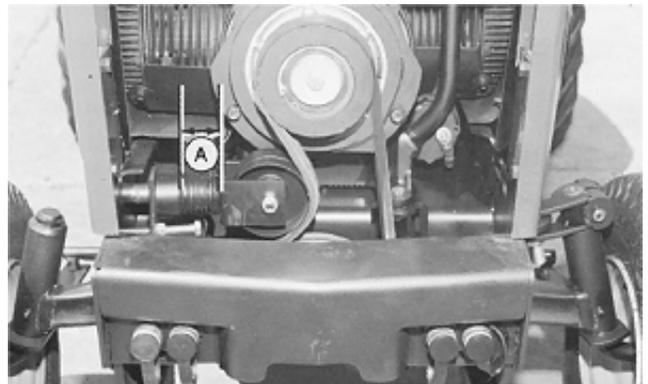
10. On 420, lubricate idler shaft with multipurpose grease.

*NOTE: Determine which adjuster you have. (420 only)*

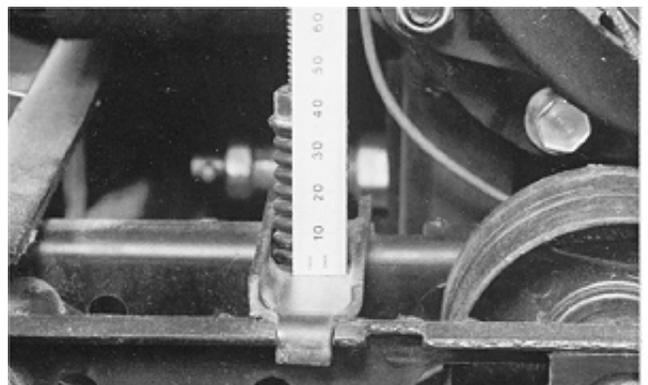
11. When adjusting PTO belt tension on horizontal adjuster, tighten bolt until spring measures 41 mm (1.600 in.).

When adjusting PTO belt tension on vertical adjuster, tighten nut until spring measures 35 mm (1.380 in.).

12. Install right-hand side panel and grille.



Horizontal Adjuster (Early 420)



Vertical Adjuster (Later 420)

MX,15904005,11 -19-16JAN95

40  
05  
6

# Section 50

# POWER TRAIN REPAIR

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**OTHER MATERIAL**

<b>Number</b>	<b>Name</b>	<b>Use</b>
M79292	MPG-2® Multi-Purpose Polymer Grease	Prevents parts from seizing. Apply to splines of transmission input shaft.

*®MPG-2 is a registered trademark of DuBois USA.*

MX,15905005,OTH-19-07MAR95

**SERVICE PARTS KITS**

The following kits are available through your parts catalog:

Charge Relief Valve Shim Pack Kit

Implement Relief Valve Shim Pack Kit

Differential Frame Support Bracket Replacement Kit for Early Models

Motor Valve Plate Replacement Part for Early Models

MX,15905005,KIT-19-23FEB95

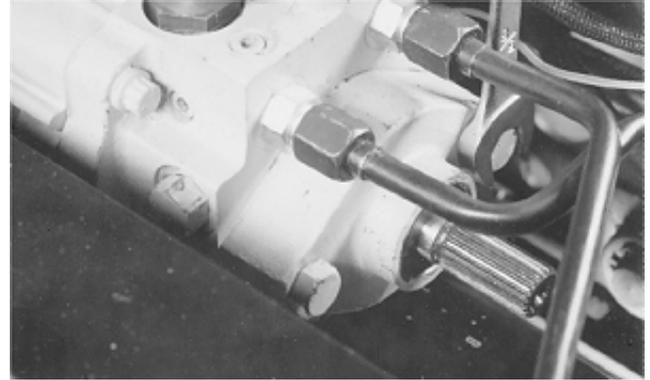
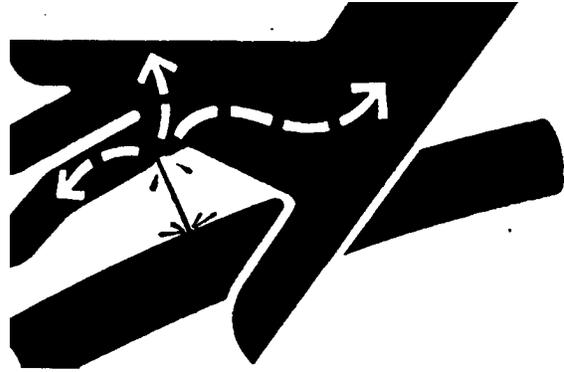
50  
05  
1

## REMOVE AND INSTALL CHARGE PUMP

1. Remove fender deck and fuel tank.
2. Remove drive shaft. (See procedure in Group 25.)

**N** **CAUTION:** To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

3. Remove two cap screws and charge pump.



420 Shown

MX,15905005,2 -19-23FEB95

-UN-23AUG88

X9811

-UN-25JAN90

M36534

*NOTE: Transmission is removed for photographic purpose only.*

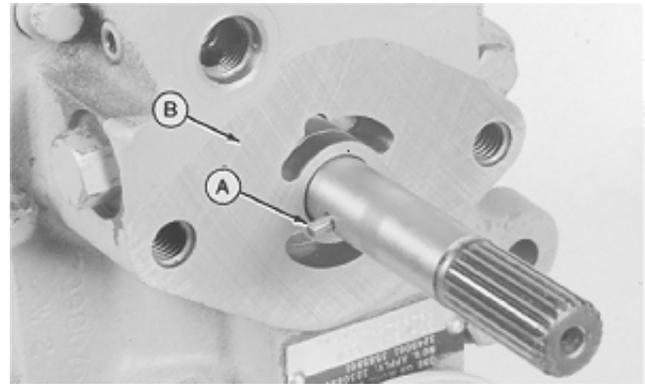
4. Remove pin (A). Inspect pin for straightness and rounded ends. Replace if necessary.
5. Inspect machined surface (B) of transmission for severe scoring. If scoring is noted replace transmission.
6. Make repairs as necessary. (See Disassemble, Inspect and Assemble Charge Pump.)
7. Installation is done in the reverse order of removal.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal components.

- Apply petroleum jelly to pin (A) (to hold in place) and lip of oil seal.

**IMPORTANT: Tape end of transmission input shaft to prevent seal damage during charge pump installation.**

- Apply tape around end of transmission input shaft.
- Install charge pump onto shaft. Turn pump until flat side of casting is on relief valve side.
- Install mounting cap screws and tighten to 70 N-m (52 lb-ft).
- Remove tape from shaft and apply MPG-2® Multi-Purpose Polymer Grease on splines.

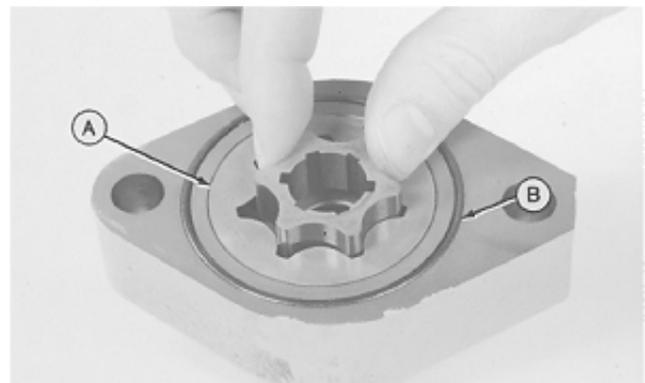


M36084 -UN-29AUG88

MX,15905005,3 -19-07MAR95

## DISASSEMBLE AND INSPECT CHARGE PUMP

1. Remove inner ring and rotor ring (A).
2. Remove O-ring (B).

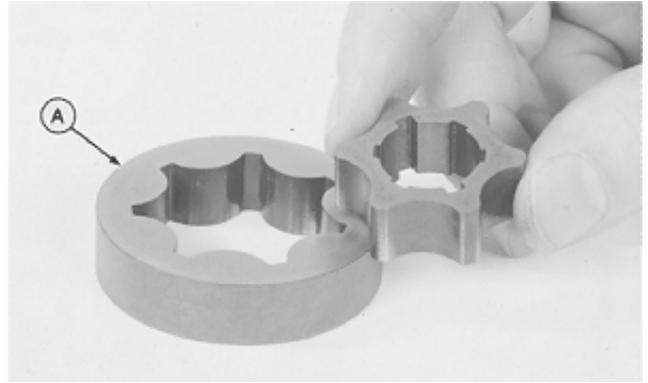


M36085 -UN-29AUG88

MX,15905005,4 -19-23FEB95

## Transmission/Charge Pump

3. Inspect inner ring key way for damage or shear pin debris.
4. Inspect rotor ring (A) for cracks or signs of scoring on the outer edge.
5. Inspect gerotor set for wear or damage. If any component is worn or damaged, replace gerotor set as an assembly.



M36086  
-UN-29JAN90

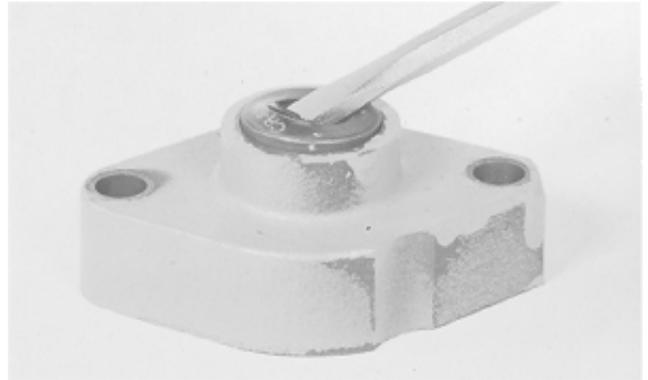
MX,15905005,5 -19-23FEB95

6. Pry out seal using a screwdriver.

*NOTE: Bearing is press-fit in housing. Remove bearing only if replacement is necessary.*

7. Inspect bearing for wear or damage. Remove bearing using a driver set.

8. Inspect housing for wear or damage. Replace entire charge pump if necessary.



M36087  
-UN-29AUG88

MX,15905005,6 -19-23FEB95

## ASSEMBLE CHARGE PUMP

**IMPORTANT: Always use new seals and O-rings.  
Damaged or used parts will leak.**

*NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.*

1. Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts.
2. If removed, press bearing into housing using a 1-1/8 in. driver disk. Install bearing until flush with housing surface.
3. Install new seal using a 1-5/8 in. driver disk. Install seal with lip (spring side) toward inside of housing.

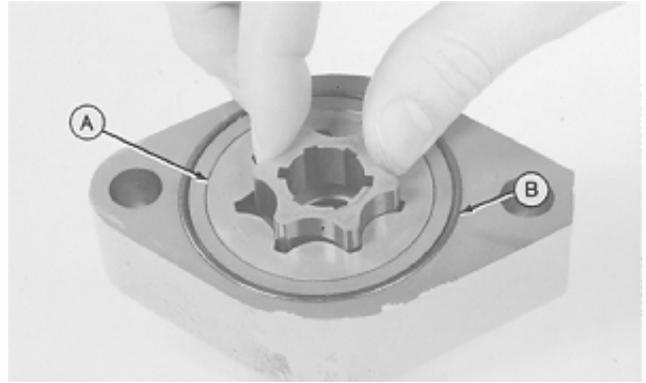


M36089  
-UN-29AUG88

MX,15905005,7 -19-23FEB95

4. Install new O-ring (B). Apply petroleum jelly to seal and housing to hold O-ring in its groove.

5. Install rotor ring (A) and inner ring. The gerotor set must spin freely in housing.



MX,15905005,8 -19-23FEB95

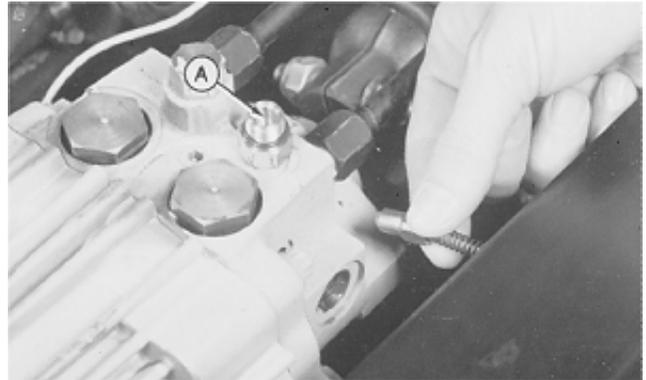
M36085 -UN-29AUG88

## REMOVE AND INSTALL CHARGE RELIEF VALVE

1. Remove fender deck and fuel tank.
2. Remove charge relief valve plug from right side of transmission housing.

**IMPORTANT:** If relief valve is being disassembled to be cleaned, the same number and thicknesses of shims must be installed when assembled.

3. Remove shims (A) if equipped, spring and valve.
  4. Inspect valve and housing for wear or damage. Valve must slide freely in bore. Replace parts if required.
  5. Installation is done in the reverse order of removal.
- Apply clean John Deere Low Viscosity HY-GARD® oil on valve and spring.



420 Shown

MX,15905005,9 -19-24FEB95

M36637 -UN-25JAN90

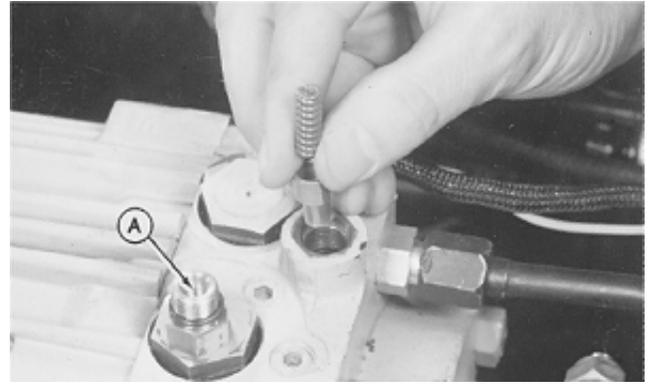
51950

## REMOVE AND INSTALL IMPLEMENT RELIEF VALVE

1. Remove fender deck and fuel tank.
2. Remove implement relief valve plug from top of transmission housing.

**IMPORTANT: If relief valve is being disassembled to be cleaned, the same number and thicknesses of shims must be installed when assembled.**

3. Remove shims (A) if equipped, spring and valve.
4. Inspect valve and housing for wear or damage. Valve must slide freely in bore. Replace parts as necessary.
5. Installation is done in the reverse order of removal.
  - Apply clean John Deere Low Viscosity HY-GARD® oil on valve and spring.



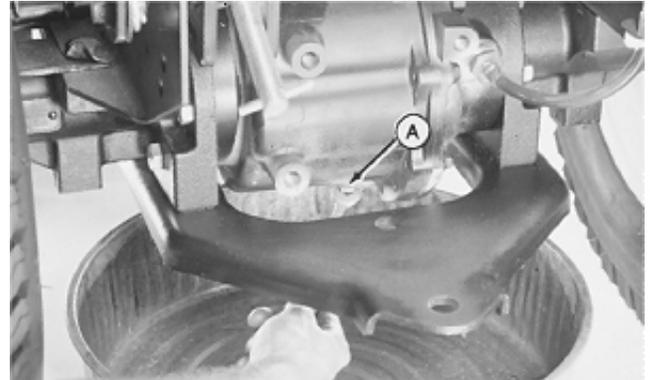
420 Shown

M36639  
-UN-25JAN90

MX,15905005,10 -19-24FEB95

## REMOVE TRANSMISSION

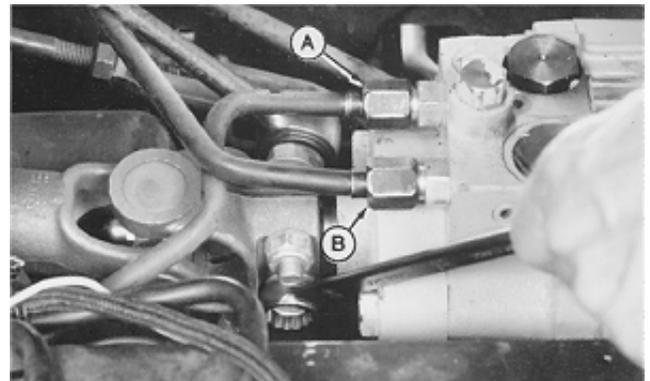
1. Remove drain plug (A) to drain transmission oil. Approximate capacity is 4.7 L (5 U.S. qt).
2. Remove fender deck and fuel tank.
3. Remove belly screen/pan.



MX,15905005,11 -19-23FEB95

M33430  
-UN-25AUG88

4. Loosen two lock nuts and cap screws, if equipped, on drive shaft.
5. Remove hydraulic pressure line (A) and return line (B). Close all openings with caps and plugs.



420 Shown

MX,15905005,12 -19-23FEB95

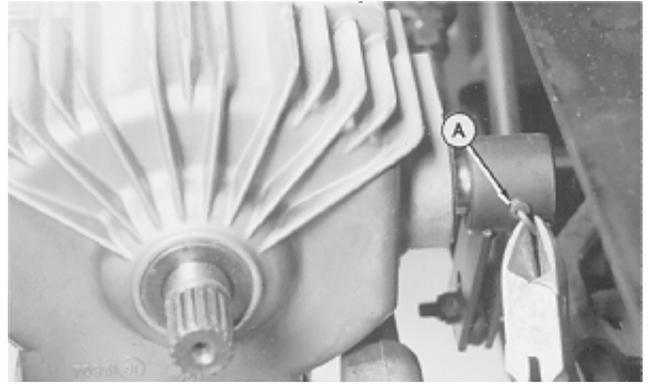
M36540  
-UN-25JAN90

## Transmission/Remove Transmission

**NOTE:** There are different versions of the swashplate control arm. Also, attaching swashplate control arm to the control shaft on transmission is different. Some machines use a safety wire and roll pin, others use a nut and cap screw.

6. Remove safety wire and roll pin (A) or nut and cap screw to disconnect transmission control linkage.

Early Model Shown

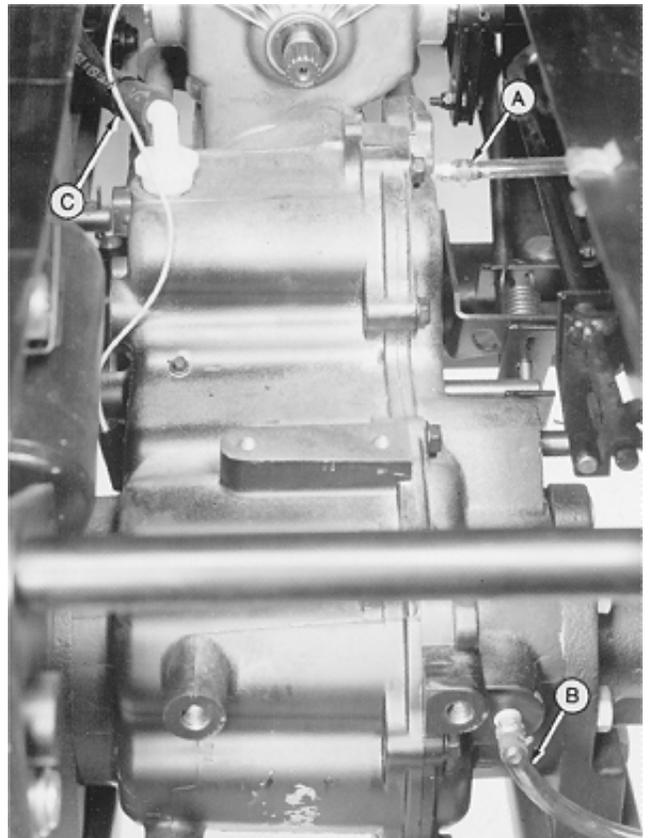


M36541  
-UN-25JAN90

MX,15905005,13 -19-23FEB95

7. Disconnect two hoses (A and B).

8. Disconnect oil fill tube hose (C).



M36542  
-UN-25JAN90

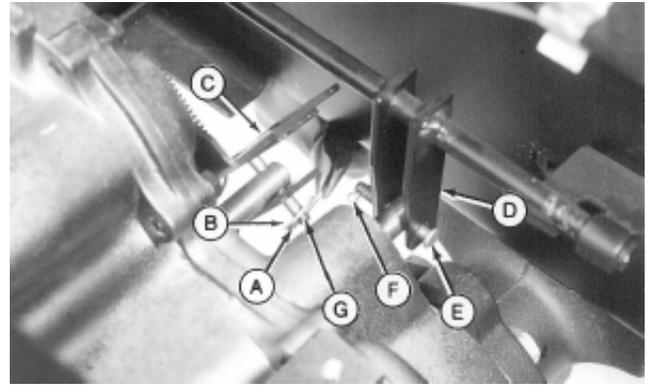
MX,15905005,14 -19-23FEB95

*NOTE: Steps 9 through 11 are for 420 only. Go to Step 12 to continue removal procedures for all machines.*

9. Move 2-speed axle shift lever to fast (rabbit) position to aid in removal of linkage.

10. Remove cotter pin (A), washer (B) and pin (G) to disconnect two-speed differential linkage (C).

11. Remove cotter pin (F) and pin (E) to disconnect differential lock linkage (D).



M36543 -UN-19JAN95

- A—Cotter Pin
- B—Washer
- C—Two-Speed Differential Linkage
- D—Differential Lock Linkage
- E—Pin
- F—Cotter Pin
- G—Pin

MX,15905005,15 -19-23FEB95

12. Use a floor jack to support transmission and place jack stands under tractor frame.

*NOTE: Early models have two bolts (A) attaching differential to frame support bracket (C). Later models have one shoulder bolt (A) or one bolt with a washer and spacer.*

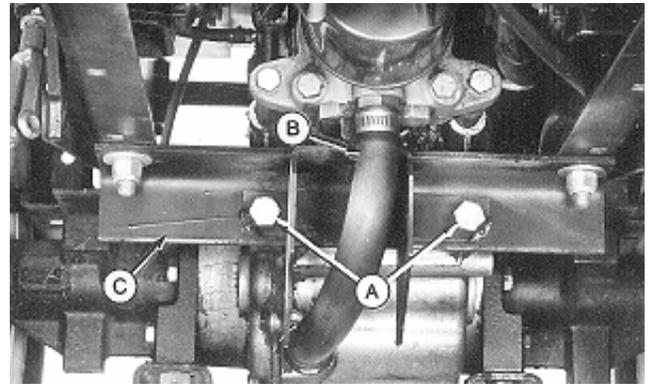
13. Remove two bolts or shoulder bolt (A) or bolt, washer and spacer.

14. Disconnect suction hose (B) from transmission. Close all openings using caps and plugs.

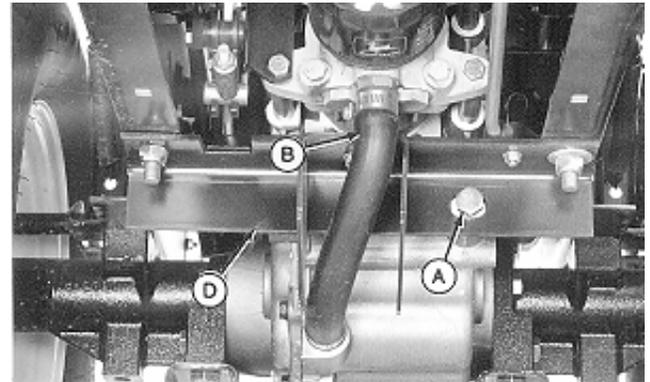
15. Disconnect all other mounting bolts, hoses and clamps needed to remove the transmission and differential.

**IMPORTANT:** It is recommended to replace the early model differential frame support bracket (C) with the later configuration (D). The early models attached the differential to the frame support bracket with two bolts (A). One in the differential case and the other in the differential cover. When the machine went over rough terrain, the flexing of the cover and case caused the differential gasket to leak. With the later model frame support bracket installed, the slotted hole and single shoulder bolt (A) (attached to the case only) will allow for flexing, eliminating any possible leaks.

16. Early models; Remove differential frame support bracket (C).



Early Models



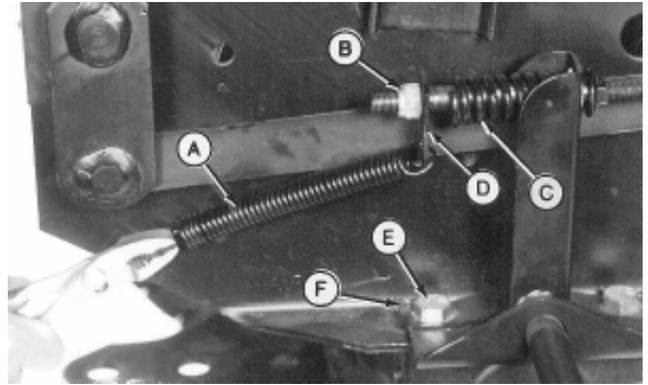
Later Models

- A—Bolt(s)
- B—Suction Hose
- C—Frame Support Bracket (Early Models)
- D—Frame Support Bracket (Later Models)

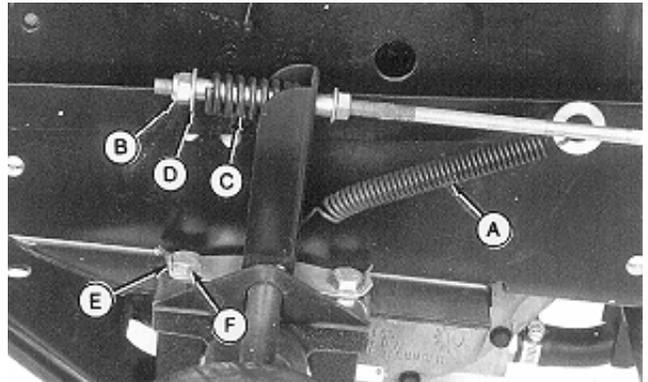
*NOTE: Disconnect brakes on both sides of machine.*

17. Disconnect spring (A).
18. Remove nut (B), plate or washer (D) and spring (C).
19. Bend tabs (F) flat. Remove two cap screws (E) from each side of machine.
20. Lower differential and transmission assembly and roll away from frame.

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)  
—Washer (Later Models)
- E—Mounting Cap Screw (2 used)
- F—Lock Plate Tab



Early Models



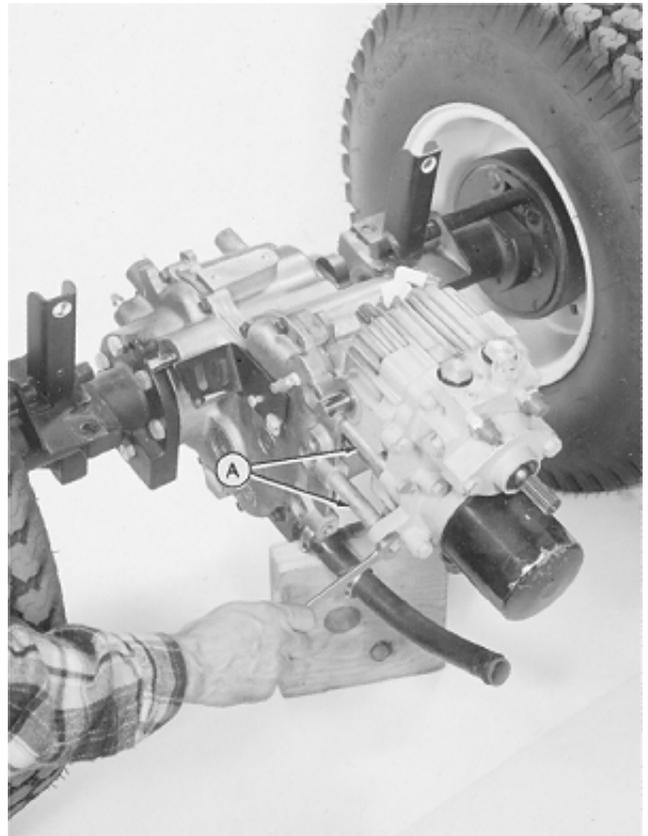
Later Models

MX,15905005,17 -19-23FEB95

21. Thoroughly clean outside surface of differential assembly with steam cleaner or cleaning solvent.

**IMPORTANT: Mark spacers and cap screws before disassembly. Each spacer must be installed in its original location.**

22. Remove four cap screws and spacers (A) to remove transmission.
23. Make repairs as necessary. (See procedures in this group.)

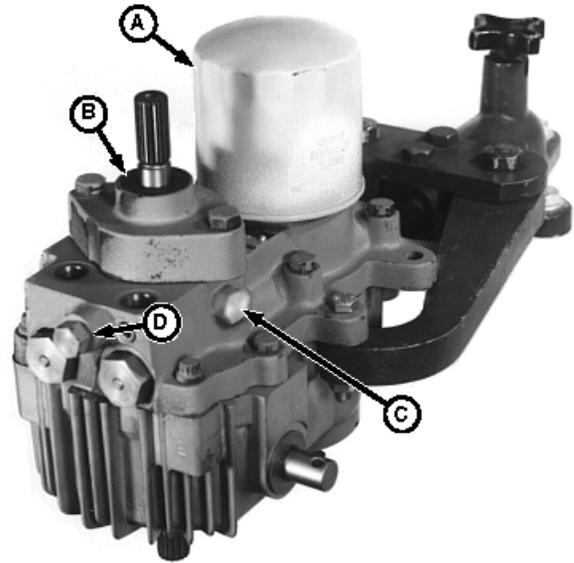


MX,15905005,18 -19-23FEB95

## DISASSEMBLE TRANSMISSION COVER

1. Thoroughly clean outside surface of transmission using a steam cleaner or cleaning solvent.
2. Install transmission on a bench fixture.
3. Remove charge pump (B). (See procedure in this group.)
4. Remove implement relief valve (D). (See procedure in this group.)
5. Remove charge relief valve (C). (See procedure in this group.)
6. Remove filter (A).

A—Oil Filter  
 B—Charge Pump  
 C—Charge Relief Valve  
 D—Implement Relief Valve



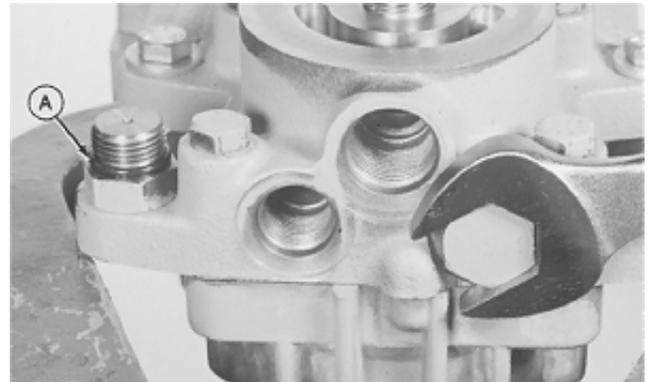
-JUN-21FEB95

M77333

50-05-11

MX,15905005,19 -19-14MAR95

7. Remove hose connector.
8. Remove two plugs and O-rings (A).

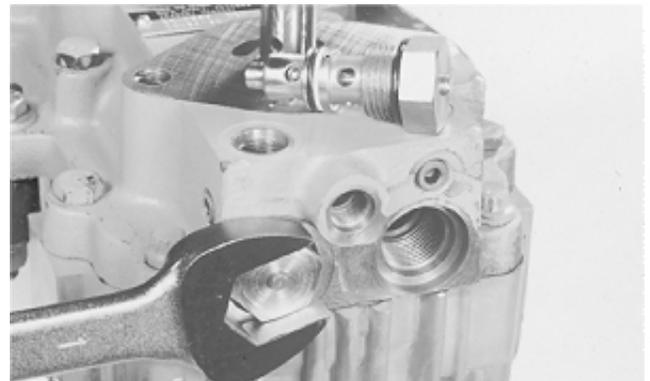


-JUN-29AUG88

M36100

5M3,5005K,O -19-18DEC87

9. Remove two check valves.



-JUN-29AUG88

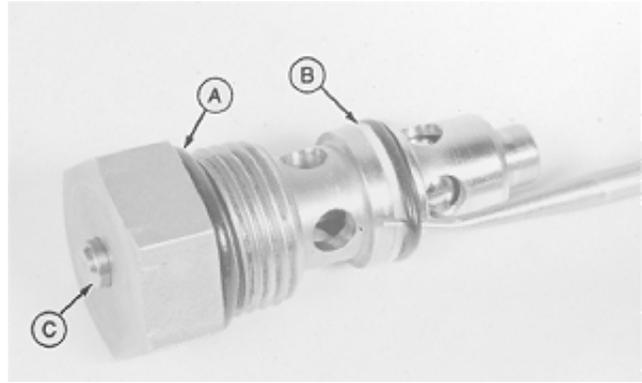
M36101

5M3,5005K,P -19-18DEC87

10. Remove O-ring, backup ring (B), and O-ring (A).

*NOTE: Originally equipped 420 Lawn and Garden Tractor transmissions do not have manually operated check valves. If check valves have been replaced; service replacements will have manually operated check valves.*

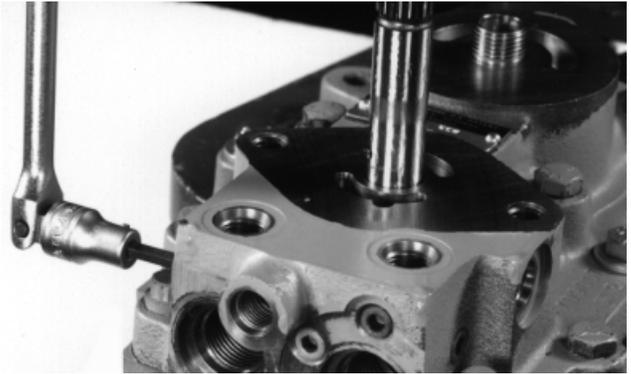
11. Internal valve (C) must move freely inside check valve.



M36102  
-UN-29AUG88

5M3,5005K,Q -19-18DEC87

12. Remove four pipe plugs.



M77534  
-UN-21FEB95

MX,15905005,41 -19-14MAR95

13. Remove snap ring to remove output shaft drive gear.

14. Remove O-ring.

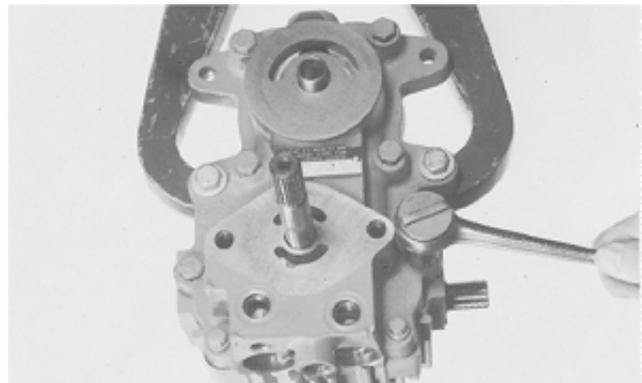


M36104  
-UN-29AUG88

5M3,5005K,S -19-18DEC87

**IMPORTANT: Do not disassemble the transmission any further while in the bench fixture.**

15. LOOSEN eight cap screws (do not remove). Remove transmission from bench fixture.

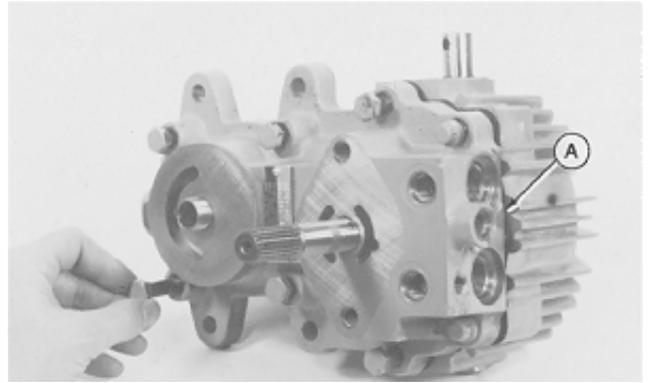


M36522  
-UN-25JAN90

5M3,5005K,T -19-18DEC87

**IMPORTANT: Do not allow internal parts to fall when removing center section.**

16. Put transmission on work bench and remove cap screws, center section and gasket (A).



M36523 -UN-25JAN90

5M3,5005K,U -19-18DEC87

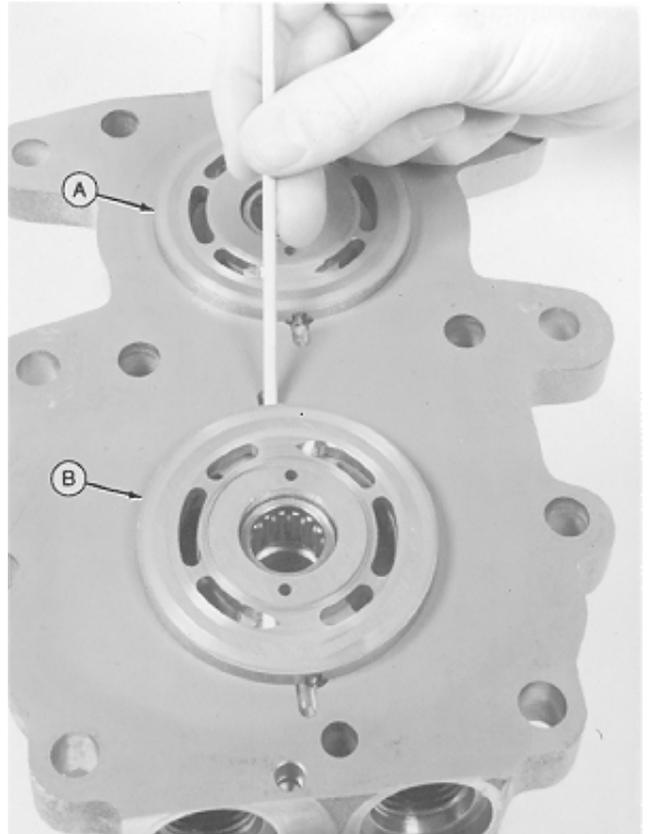
**IMPORTANT: Do not nick or scratch lapped or machined surfaces of the center section, valve plates or cylinder blocks.**

**Keep pump and motor components separate, they are not interchangeable.**

17. Remove valve plates (A and B). If it is necessary to pry valve plates loose from center section, use a wooden dowel and pry only at dowel pin grooves.

If valve plates do not come off with center section, remove valve plates from cylinder block assemblies.

It may be necessary to apply diesel fuel between valve plate and cylinder block to cut oil film.



M36107 -UN-31JAN90

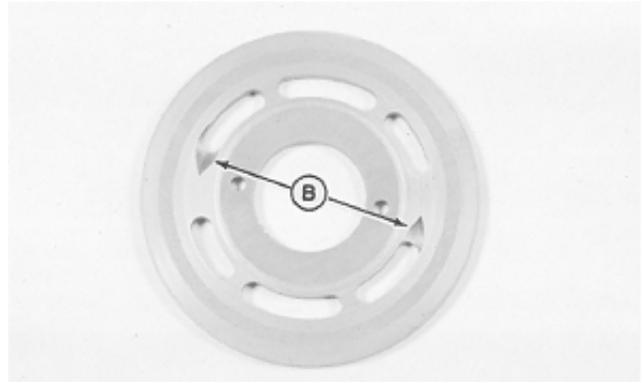
5M3,5005K,V -19-19DEC87

18. Inspect bearing plates. Bearing plates should be flat, free of all nicks, burrs, scratches and erosion around the ports. The bronze metal should show no scoring, smearing or be discolored.

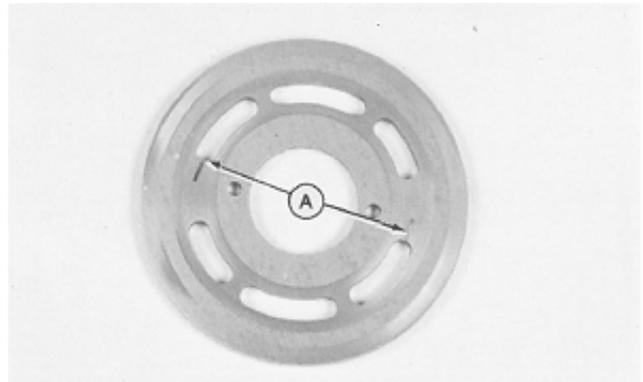
*NOTE: Scoring is indicated by fine scratches or grooves cut into the plate.*

*When these scratches can be detected by feel, finger nail or lead pencil, the plate should be replaced.*

*Some models may have a narrow slot (A) rather than a wide slot (B). While others may NOT have slots at all.*



M49510 -UN-20DEC89

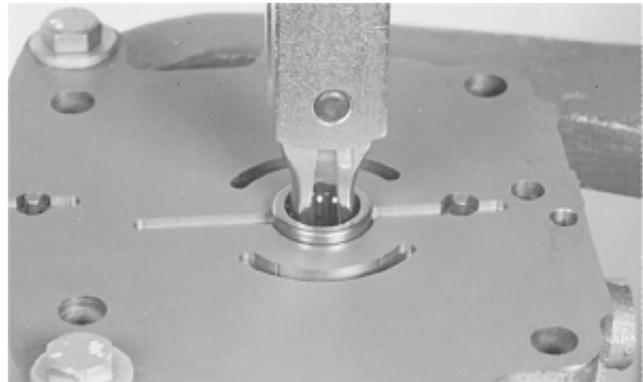


M49511 -UN-20DEC89

MX,15905005,20 -19-23FEB95

19. Inspect both bearings in center section, replace if necessary.

20. Install center section in bench fixture and remove bearing using a 2-jaw puller and a slide hammer.



M36109 -UN-29AUG88

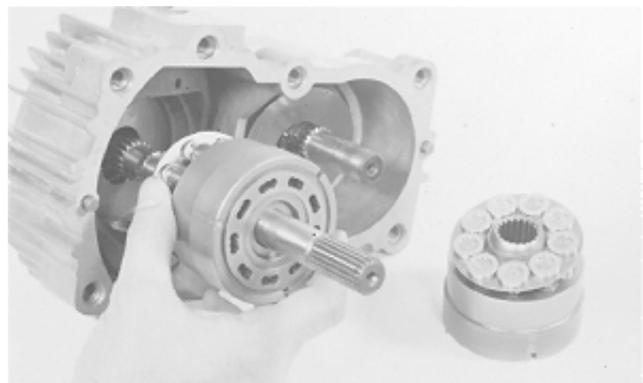
5M3,5005K,X -19-18DEC87

## DISASSEMBLE PUMP AND MOTOR

**IMPORTANT:** Do not nick or scratch lapped surface of cylinder blocks.

**Piston-to-Bore relationship need not be maintained; keep pump and motor components separate, they are not interchangeable.**

1. Remove motor and pump cylinder blocks.



M36110 -UN-29AUG88

MX,15905005,21 -19-23FEB95

2. Inspect cylinder block assemblies.

**IMPORTANT: Do not interchange pistons between motor and pump cylinder blocks. Pistons and cylinder blocks are matched.**

Lift piston retainer and pistons from cylinder block.  
Check for free movement of pistons in cylinder bores.



M45,5005A,51 -19-11JAN85

M36111 -UN-29AUG88

3. Remove and inspect all pistons.

Check barrel (B) for scoring, discoloration, or any signs of separation of slippers.

Check slipper (A) for scoring, smearing, rolled edges and a full 360° free rotation on barrel.

Check lubrication hole (C) for blockage. Clean with compressed air.

If any component of the piston is damaged, the cylinder block assembly must be replaced.



M45,5005A,52 -19-11JAN85

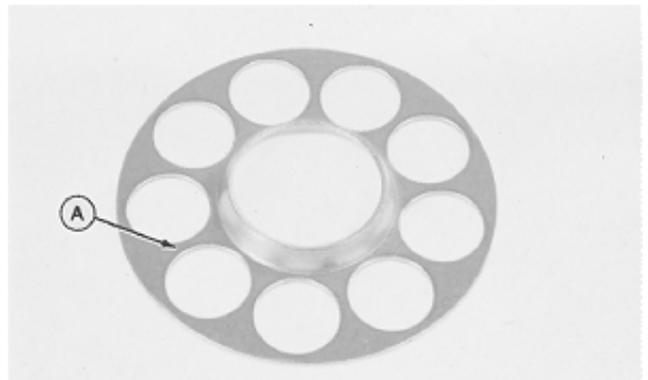
M36112 -UN-29AUG88

4. Remove and inspect both piston retainers.

Check retainer for flatness, nicks, burrs and discoloration.

Check area around piston slippers (A) for scoring.

If any part of the piston retainer is damaged, the cylinder block assembly must be replaced.



M45,5005A,53 -19-11JAN85

M36113 -UN-29AUG88

5. Inspect both cylinder blocks.

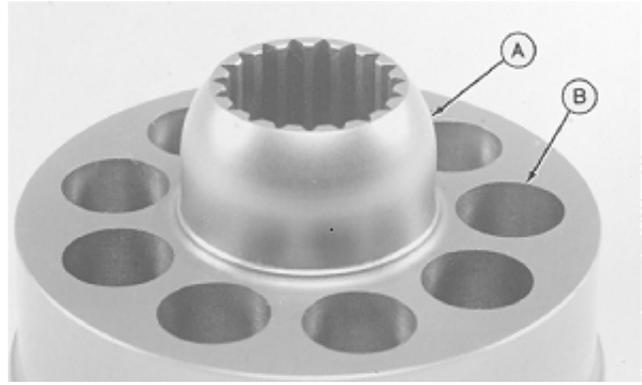
Check ball guide area (A) for scoring, wear and damage.

Check nine cylinder bores (B) for burrs and scoring.

Check lapped surface (C) for wear and damage.

Check spring assembly (D) for damage and free movement.

If any part of the cylinder block is damaged, the cylinder block assembly must be replaced.



M36114 -UN-29AUG88



M36115 -UN-29AUG88

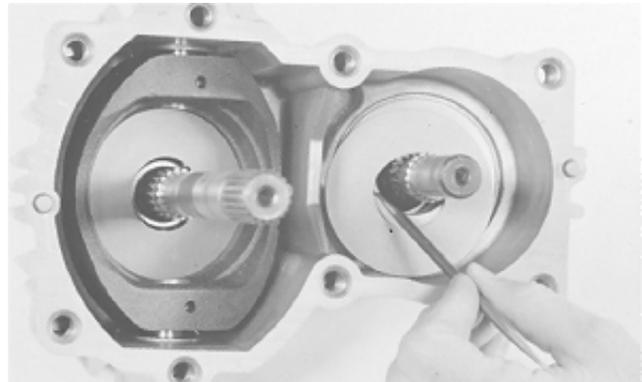
M45,5005A,54 -19-11JAN85

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**IMPORTANT: Do not scratch machined surfaces of thrust plates or swashplates.**

6. Remove pump and motor thrust plates using a brass O-ring pick.

7. Inspect thrust plates. Check plates for scoring and smeared bronze material.

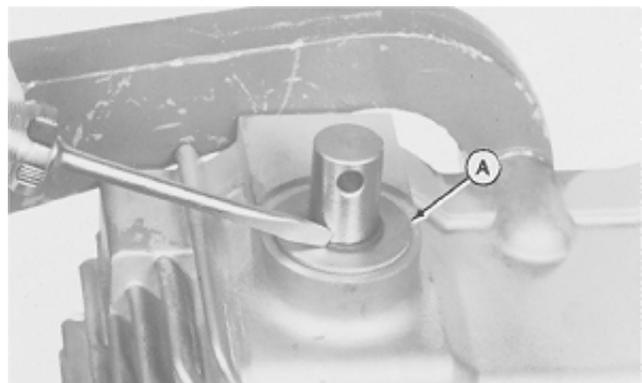


M36116 -UN-29AUG88

M45,5005A,55 -19-11JAN85

**DISASSEMBLE PUMP AND MOTOR HOUSING**

1. Remove snap ring and washer (A) from both trunnion and control shafts.



M36524 -UN-25JAN90

MX,15905005,22 -19-23FEB95

**IMPORTANT:** Pump shaft and bearing assembly could restrict movement of swashplate. Full swashplate movement is approximately 25 mm (1 in.) in each direction. If necessary tap shaft with a soft faced hammer.

2. Push top of swashplate (C) down until it contacts the stops in the housing.

**IMPORTANT: DO NOT** drive pins after they bottom. Housing damage will result.

3. Drive pin (B) until it bottoms in housing.

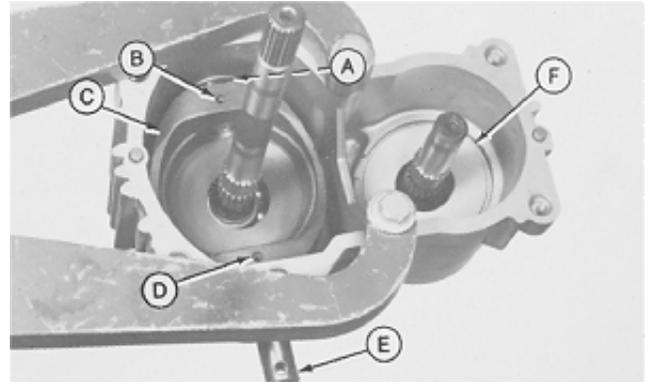
4. Drive two pins (D) until the lower one bottoms in housing.

5. Turn swashplate to the neutral position. Pins should fall into housing.

6. Repeat the above steps to remove second pin (D).

7. Remove control shaft (E) and trunnion shaft (A) to remove swashplate.

8. Inspect swashplate and motor housing (F).



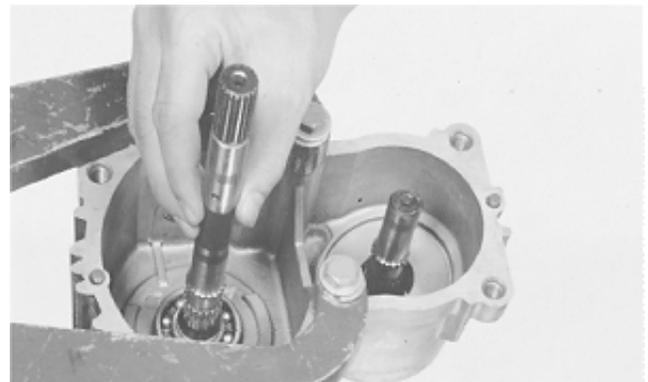
A—Trunnion Shaft  
 B—Spring Pin  
 C—Pump Swashplate  
 D—Spring Pin (2 used)  
 E—Control Shaft  
 F—Motor Housing

M36525 -UN-25JAN90

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5M3,5005K,Z -19-18DEC87

9. Remove pump shaft.



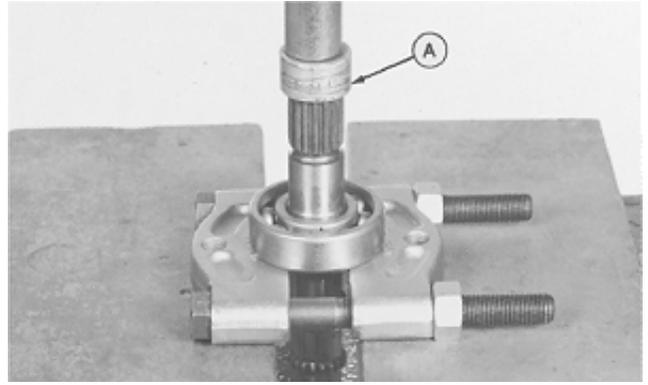
M36119 -UN-29AUG88

M45,5005A,58 -19-11JAN85

10. Inspect bearing, replace if necessary.

**IMPORTANT: Be sure to hold shaft while removing bearing.**

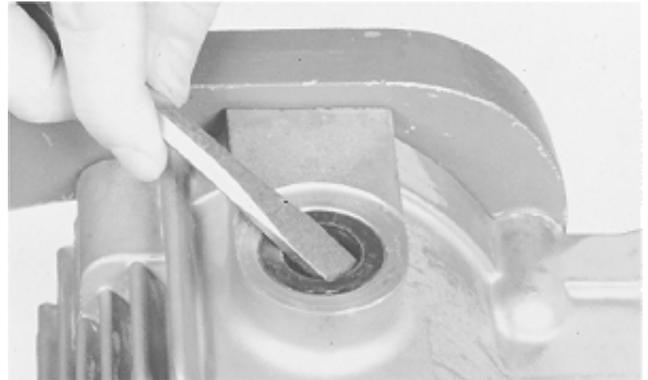
11. Remove bearing using a 1 in. driver disk (A), bearing puller attachment and a press.



M45,5005A,59 -19-13MAR85

M36120 -UN-29AUG88

12. Remove three seals from housing.



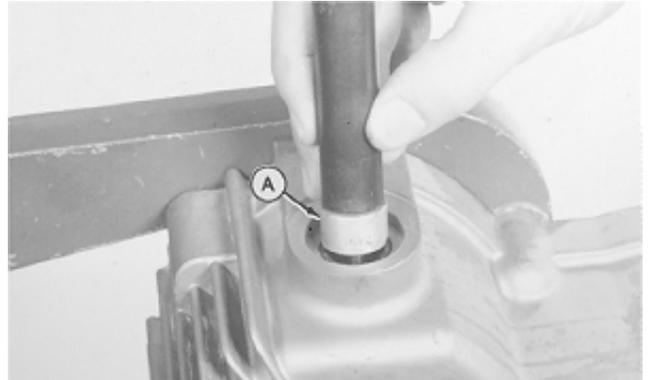
M45,5005A,60 -19-11JAN85

M36121 -UN-29AUG88

*NOTE: Some transmissions will have bearings, while others will have bushings.*

13. Inspect trunnion bearing and control shaft bearing. Replace if necessary.

14. Drive bearings or bushings through housing using a 13/16 in. driver disk (A) for bearings and a 7/8 in. driver disk for bushings.

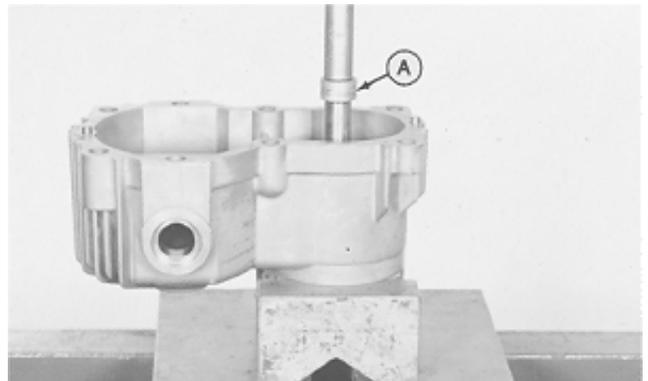


5M3,5005K,AA -19-18DEC87

M36122 -UN-29AUG88

**IMPORTANT: Be sure to hold shaft and bearing when removing from housing.**

15. Remove motor shaft and bearing. Using a 1-in. driver disk (A), and a press.



M45,5005A,62 -19-13MAR85

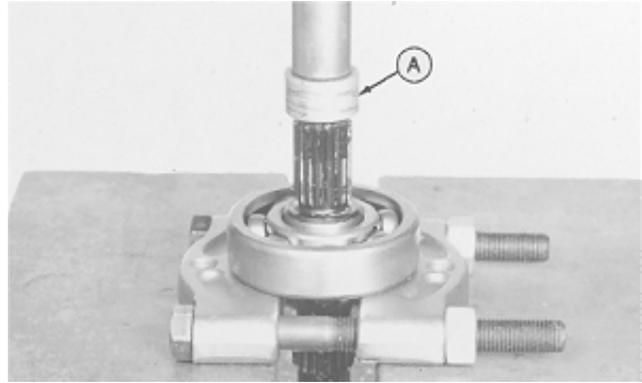
M36123 -UN-29AUG88

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16. Inspect bearing, replace if necessary.

**IMPORTANT: Be sure to hold shaft while removing bearing.**

17. Remove bearing using a 1 in. driver disk (A), bearing puller attachment and a press.



M45,5005A,63 -19-26APR85

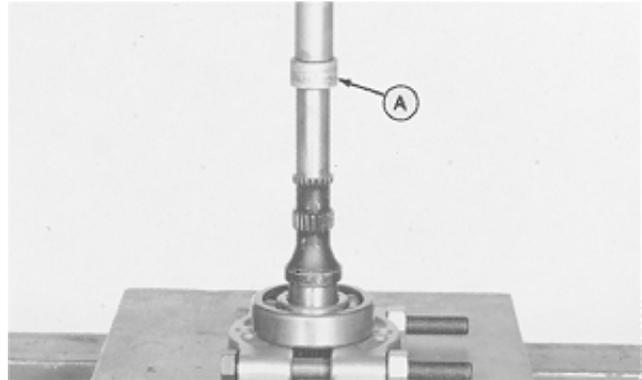
M36124 -UN-29AUG88

### ASSEMBLE PUMP AND MOTOR HOUSING

**IMPORTANT: Always use new seals and O-rings. Damaged or used parts will leak.**

*NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.*

1. Push motor shaft into bearing until it is on the shaft shoulder using 1 in. driver disk (A), bearing puller attachment, and a press.



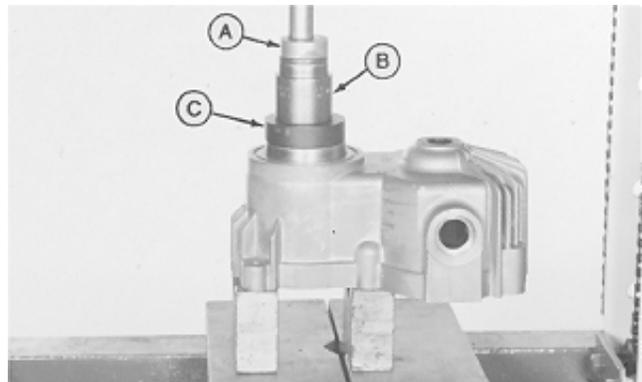
MX,15905005,24 -19-23FEB95

M36126 -UN-29AUG88

**IMPORTANT: To prevent bearing damage, press only on outer race of bearing when installing motor shaft assembly.**

2. Push motor shaft assembly into housing until bearing is at the bottom of bore using a 1-7/16 in. driver disk (A), socket (B) and a donut type disk (C) and a press.

*NOTE: There will be approximately 5 mm (3/16 in.) of the bearing race above the mounting surface.*



M45,5005A,66 -19-13MAR85

M36127 -UN-29AUG88

3. Install housing on bench fixture.

4. Drive bearings or bushings into housing until they are flush with surface using a 1-1/8 in. driver disk (A).

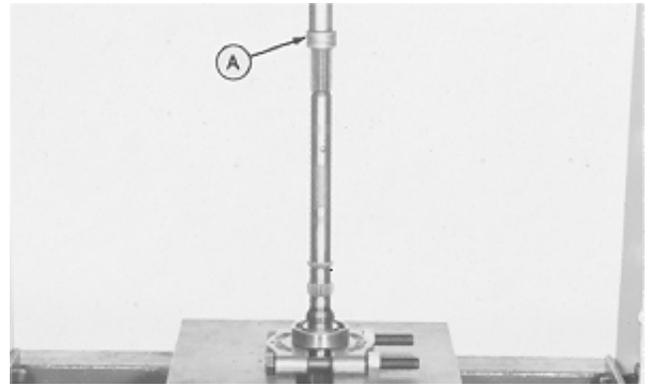
5. Install three oil seals. Install seal with lip of seal (spring side) toward inside of housing using a 1-7/16 in. driver disk.



MX,15905005,25 -19-23FEB95

M36128 -UN-29AUG88

6. Push pump shaft into bearing until it is on the shaft shoulder using a 1-in. driver disk (A) bearing puller attachment and a press.



M45,5005A,69 -19-13MAR85

M36130 -UN-29AUG88

*NOTE: Tape over splines to protect seals from possible damage when installing shafts, remove tape after installation.*

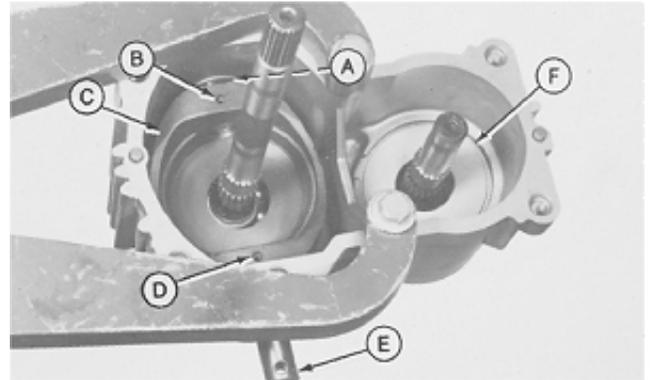
7. Install pump shaft.

8. Install swashplate (C), control shaft (E), and shaft (A).

**IMPORTANT: Pump shaft and bearing assembly could restrict movement of swashplate. Full swashplate movement is approximately 25 mm (1 in.) each direction. If necessary tap shaft with a soft faced hammer to seat bearing.**

9. Drive pin (B) into swashplate and shaft until pin is about 6 mm (1/4 in.) below swashplate surface.

10. Drive two pins (D) into swashplate and control shaft until top pin is about 6 mm (1/4 in.) below swashplate surface.



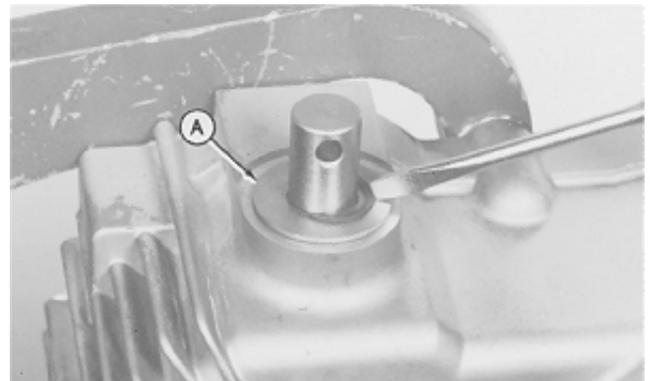
A—Trunnion Shaft  
B—Spring Pin  
C—Pump Swashplate  
D—Spring Pin (2 used)  
E—Control Shaft  
F—Motor Housing

M36525 -UN-25JAN90

MX,15905005,26 -19-23FEB95

11. Install washer (A) and snap ring on trunnion and control shaft.

12. Remove housing from bench fixture.



5M3,5005K,AF -19-18DEC87

M36526 -UN-25JAN90

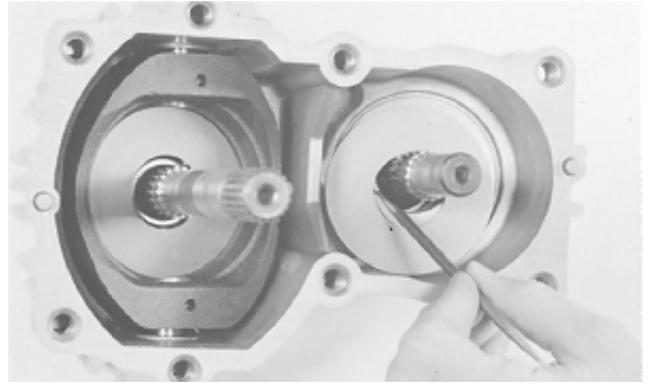
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## ASSEMBLE PUMP AND MOTOR

**IMPORTANT:** Do not nick or scratch lapped surface of cylinder blocks.

**Piston-to-Bore relationship need not be maintained; keep pump and motor components separate, they are not interchangeable.**

1. Put clean John Deere Low Viscosity HY-GARD® oil or an equivalent on all internal parts.
2. Install pump and motor thrust plates.



M36116 -UN-29AUG88

MX,15905005,27 -19-23FEB95

3. Install pistons and piston retainer.

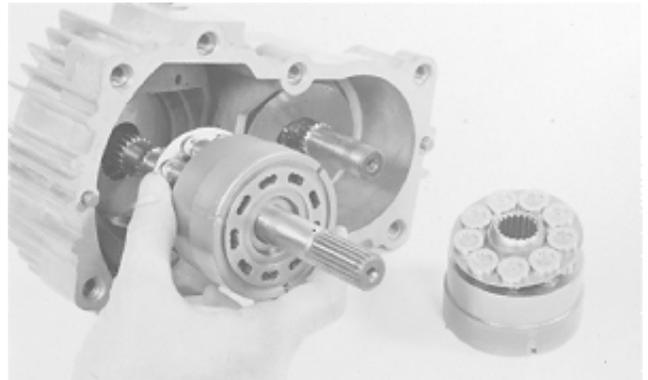
Lift piston retainer and piston from cylinder block. Check for free movement of pistons in cylinder block before installing in housing.



M36111 -UN-29AUG88

M45,5005A,74 -19-14JAN85

4. Install pump and motor cylinder blocks.



M36110 -UN-29AUG88

M45,5005A,75 -19-14JAN85

**ASSEMBLE TRANSMISSION COVER**

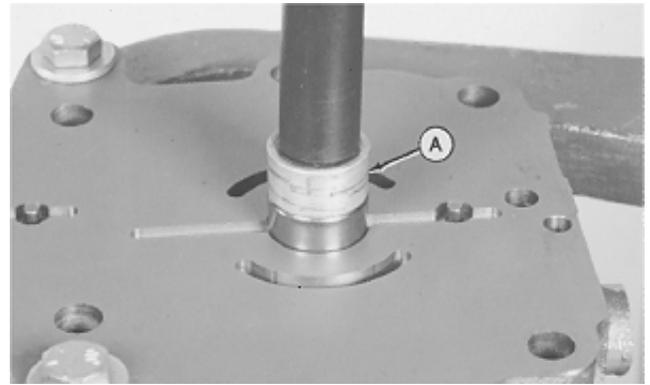
**IMPORTANT:** Do not nick or scratch lapped or machined surfaces of the center section, valve plates or cylinder block.

Keep pump and motor components separate. They are not interchangeable.

Always use new seals and O-rings. Damaged or used parts will leak.

*NOTE:* Lubricate all seals and O-rings with petroleum jelly during assembly.

1. Install two needle bearings. Drive bearings into housing until they are approximately 3 mm (0.118 in.) above the surface of the housing using a 5/8 in. driver disk (A).



M36132 -UN-29AUG88

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22

MX,15905005,28 -19-23FEB95

2. Put clean John Deere Low Viscosity HY-GARD® oil on valve plates and housing surface.

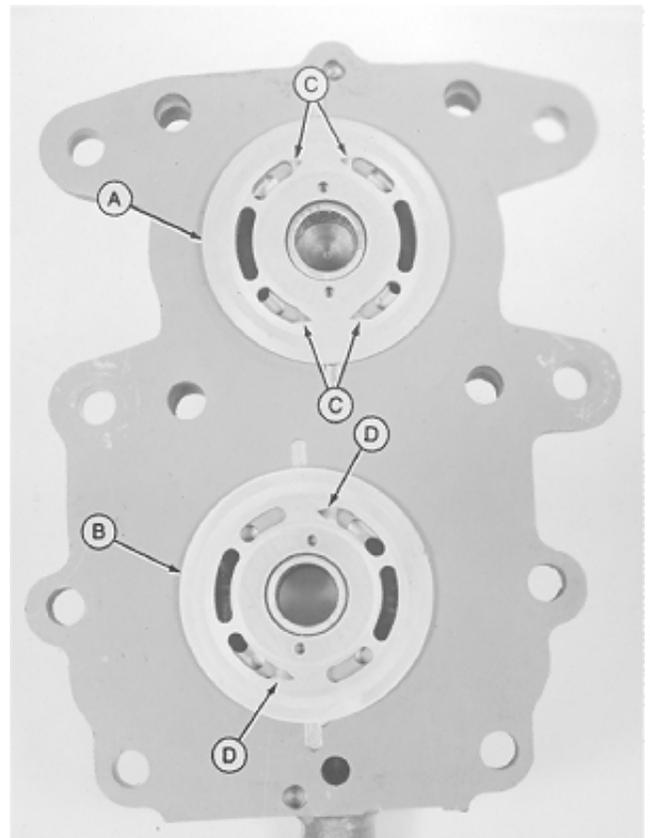
**IMPORTANT:** Pump valve plate (B) has TWO slotted ports (D).

Motor valve plate (A) may, or may not have slotted ports. Early models have FOUR slotted ports (C). Quiet hydro's (later models) have no slotted ports. All service or replacement plates will not have slotted ports.

*NOTE:* The motor valve plates are interchangeable between quiet hydros and early models.

3. Install pump valve plate (B) and motor valve plate (A) over the protruding bearings and align slots in plates with pins in housing.

- A—Motor Valve Plate
- B—Pump Valve Plate
- C—Slotted Ports (4) (Early Models)
- D—Slotted Ports (2)



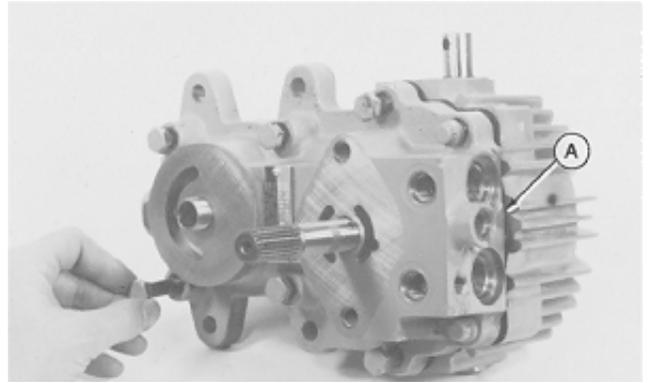
M36133 -UN-22NOV89

MX,15905005,29 -19-23FEB95

**IMPORTANT:** Use extreme care when assembling the center section, valve plates and cylinder block to avoid dropping, nicking or scratching lapped surfaces.

4. Install center section and gasket (A) on housing and install eight cap screws. Tighten cap screws evenly.

*NOTE: Center section will seem springy, this is because the springs inside the cylinder blocks are being compressed.*



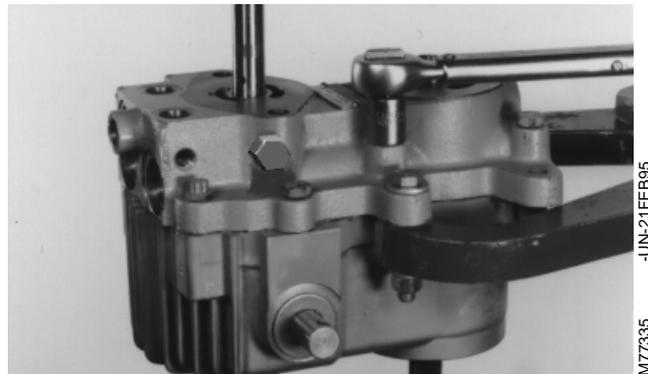
M36523 -UN-25JAN90

5M3,5005K,AG -19-18DEC87

5. Install transmission in bench fixture.

**IMPORTANT:** Check for proper internal assembly by slowly rotating pump, motor and control shaft while tightening cap screws.

6. Tighten cap screws to 35 N·m (26 lb-ft).



M77335 -UN-21FEB95

MX,15905005,30 -19-14MAR95

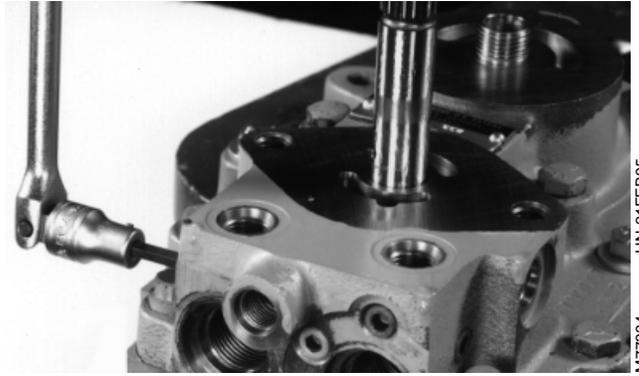
7. Install gear on motor shaft (output shaft). Install snap ring.



M36104 -UN-29AUG88

M45,5005A,80 -19-14JAN85

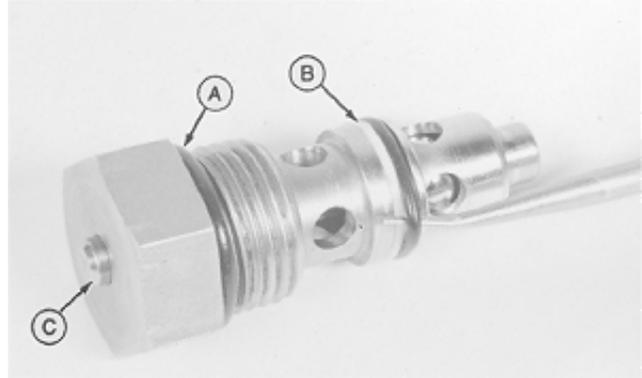
8. Install and tighten four pipe plugs.



-UN-21FEB95  
M77334

MX,15905005,42 -19-14MAR95

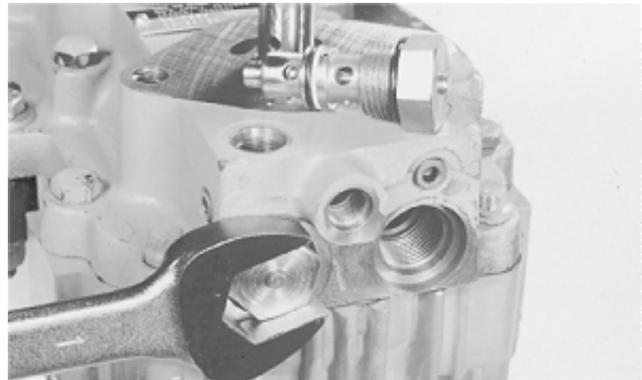
9. Install O-ring (A), backup ring (B) and O-ring. Internal valve (C) must move freely.



-UN-29AUG88  
M36102

M45,5005A,82 -19-13MAR85

10. Install and tighten two check valves.

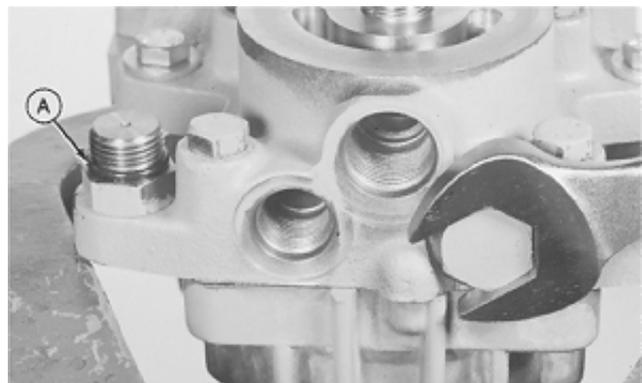


-UN-29AUG88  
M36101

M45,5005A,83 -19-14JAN85

11. Install plugs and O-rings (A).

12. Install suction line fitting.



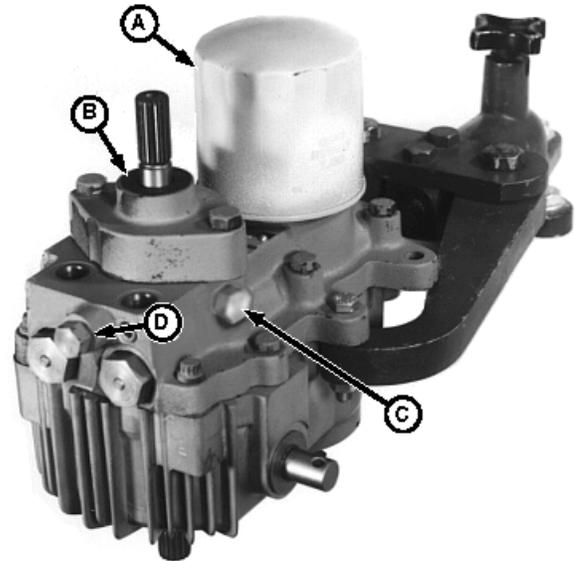
-UN-29AUG88  
M36100

5M3,5005K,AI -19-18DEC87

13. Install new filter (A).

14. Install charge relief valve (C), implement relief valve (D) and charge pump (B). (See procedures in this group.)

- A—Oil Filter
- B—Charge Pump
- C—Charge Relief Valve
- D—Implement Relief Valve



MX,15905005.31 -19-14MAR95

-JUN-21FEB95

M77333

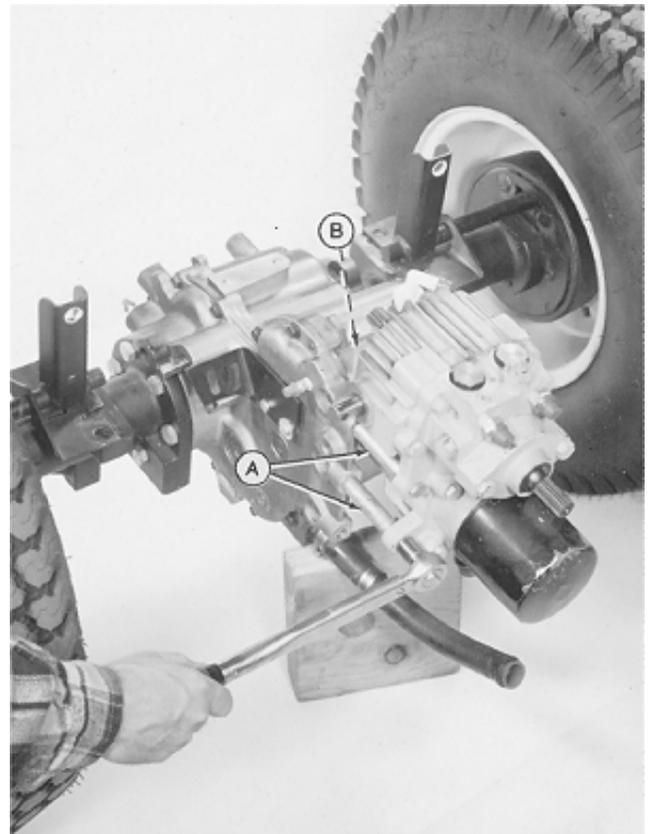
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## INSTALL TRANSMISSION

**IMPORTANT:** Always use new seals and O-rings.  
Damaged or used parts will leak.

*NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.*

1. Install new O-ring (B).
2. Install transmission; engage transmission output gear with differential gear.
3. Install four spacers and cap screws (A) in their original locations as marked during removal. Tighten cap screws to 45 N-m (33 lb-ft).



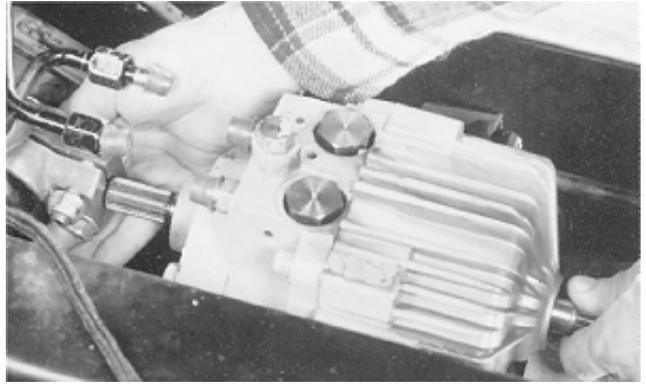
MX,15905005.32 -19-23FEB95

-JUN-25JAN90

M36651

4. Position differential assembly under tractor.
5. On 420; Hold differential lock linkage away from differential using wire, tape, etc.
6. Lift and position differential assembly. Put drive shaft on transmission input shaft. Turn pump shaft to align splines.

420 Shown



M36578 -UN-25JAN90

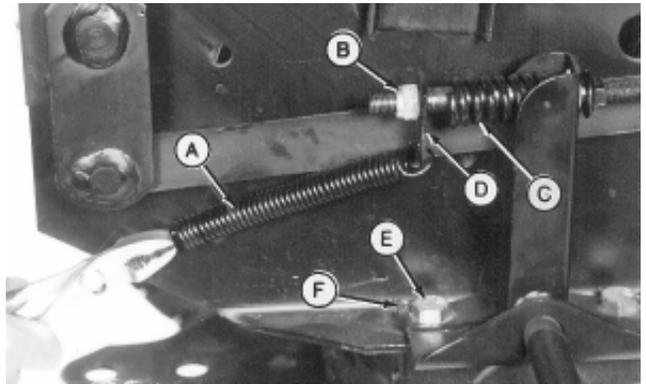
MX,15905005,33 -19-07MAR95

7. Position brake linkage and install install cap screws (E) on each side of machine. Tighten cap screws to 100 N-m (75 lb-ft). Bend tabs (F) over flat of cap screws.

*NOTE: Connect brakes on both sides of machine.*

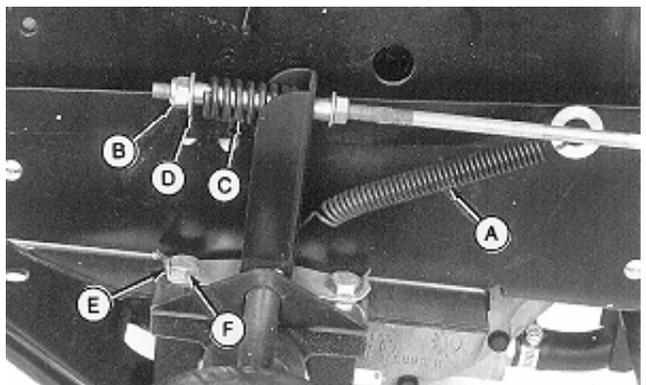
8. Install spring (C), plate or washer (D) and nut (B).
9. Connect spring (A).

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)
- Washer (Later Models)
- E—Mounting Cap Screw (2 used)
- F—Lock Plate Tab



Early Models

M77903 -UN-19JAN95

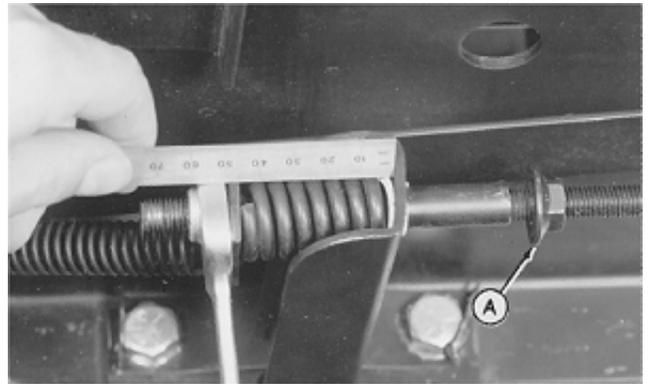


Later Models

M77332 -UN-13FEB95

MX,15905005,34 -19-23FEB95

10. Lock brake pedals together (318 and 420) and apply park brake.
11. Loosen lock nut (A).
12. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.

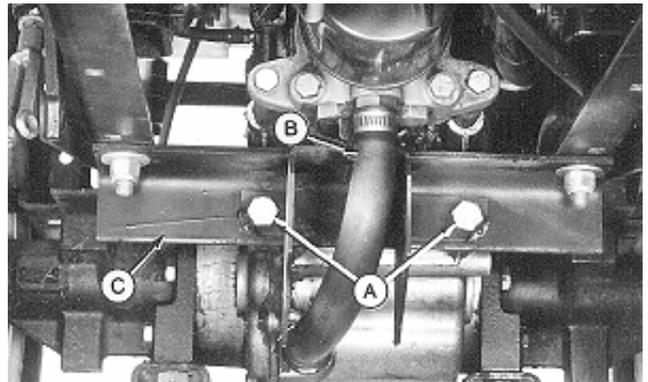


MX,15905005.35 -19-23FEB95

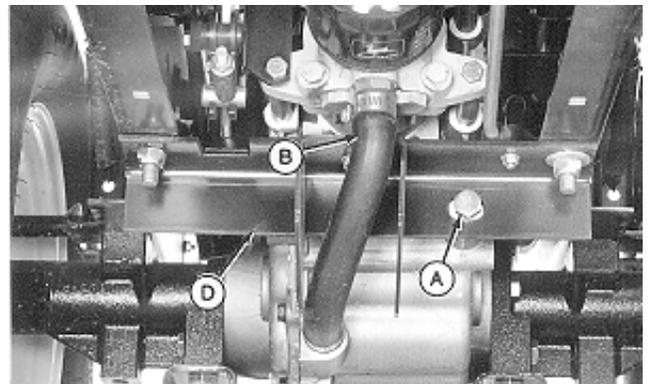
M36654 -UN-25JAN90

**NOTE:** Early models have two bolts (A) attaching differential to frame support bracket (C). Later models have one shoulder bolt (A) or one bolt with a washer and spacer.

**IMPORTANT:** It is recommended to replace the early model differential frame support bracket (C) with the later configuration (D). The early models attached the differential to the frame support bracket with two bolts (A). One in the differential case and the other in the differential cover. When the machine went over rough terrain, the flexing of the cover and case caused the differential gasket to leak. With the later model frame support bracket installed, the slotted hole and single shoulder bolt (A) (attached to the case only) will allow for flexing, eliminating any possible leaks.



Early Models



Later Models

13. Early models; Install new differential frame support bracket (D).
14. Install shoulder bolt (A) or bolt, washer and spacer. Tighten to 61 N·m (45 lb-ft).
15. Attach all mounting bolts, hoses and clamps.
16. Connect suction hose (B).
17. Remove jack stands and lower tractor.

- A—Bolt(s)
- B—Suction Hose
- C—Differential Frame Support Bracket (Early Models)
- D—Differential Frame Support Bracket (Later Models)

MX,15905005.36 -19-23FEB95

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M77300 -UN-24FEB95

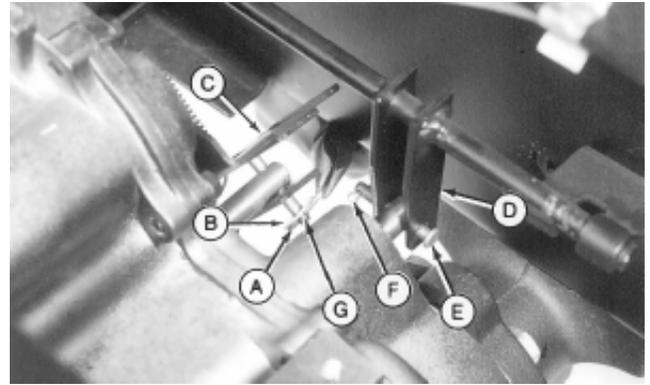
M77301 -UN-24FEB95

*NOTE: Steps 18 and 19 are for 420 only. Go to Step 20 to continue installation procedures for all machines.*

18. Connect differential lock linkage (D). Install pin (E) and cotter pin (F).

19. Connect two-speed differential linkage (C). Install pin (G), washer (B) and cotter pin (A).

- A—Cotter Pin
- B—Washer
- C—Two-Speed Differential Linkage
- D—Differential Lock Linkage
- E—Pin
- F—Cotter Pin
- G—Pin



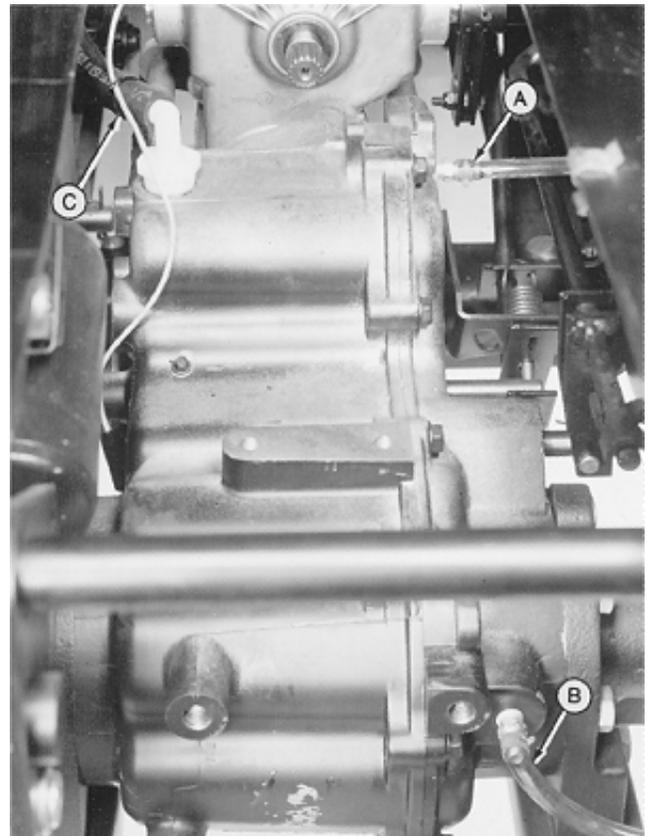
M36543 -UN-19JAN95

MX,15905005,37 -19-23FEB95

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20. Connect oil fill tube hose (C).

21. Connect two hoses (A and B).

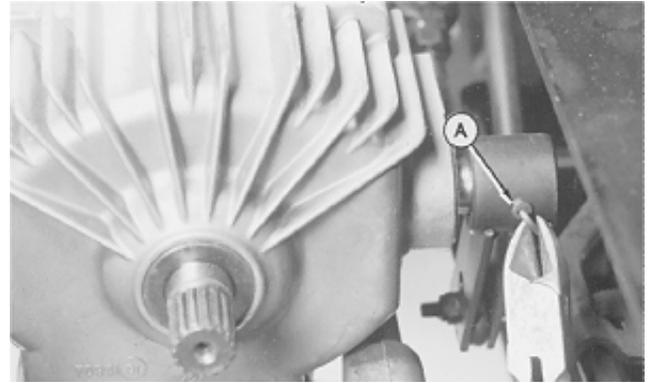


M36542 -UN-25JAN90

MX,15905005,38 -19-23FEB95

*NOTE: There are different versions of the swashplate control arm. Also, attaching swashplate control arm to the control shaft on transmission is different. Some machines use a safety wire and roll pin, others use a nut and cap screw.*

22. Attach swashplate control arm to control shaft with roll pin and safety wire or cap screw and nut. Tighten nut to 60 N·m (44 lb-ft).



Early Models Shown

MX,15905005,39 -19-23FEB95

23. Connect hydraulic pressure line (A) and return line (B).

24. Tighten two nuts and cap screws, if equipped, on drive shaft to 60 N·m (44 lb-ft) or install drive shaft, if necessary. (See procedure in Group 25.)

25. Install drain plug.

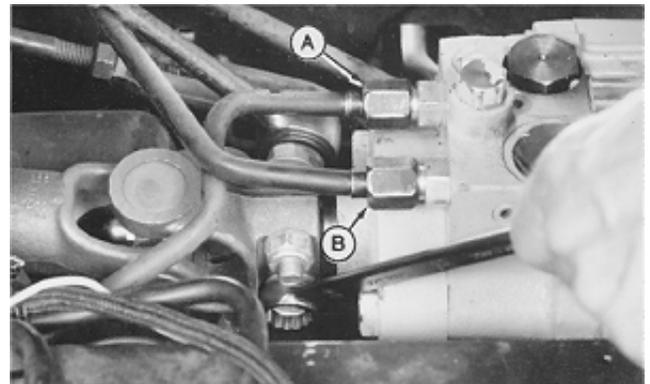
26. Install belly screen/pan.

27. Install fuel tank and fender deck.

28. Fill transmission with the recommended amount of John Deere Low Viscosity HY-GARD® oil.

29. Bleed the hydraulic system. (See procedure in Section 270, Group 20.)

30. If tractor creeps forward or reverse while in neutral, adjust neutral and neutral return linkage. (See procedures in Section 250, Group 15.)

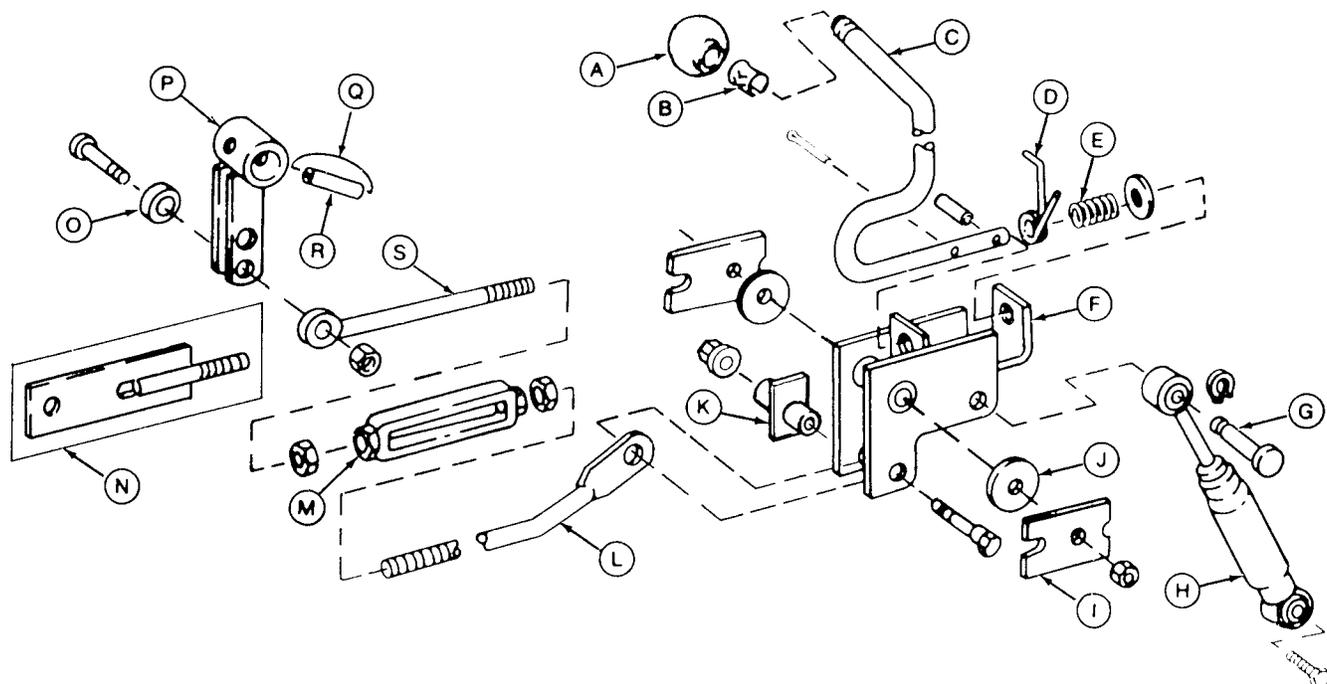


420 Shown

MX,15905005,40 -19-23FEB95

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**INSPECT AND REPAIR TRANSMISSION CONTROL LINKAGE—VERSION ONE (ALL MODELS)**



- |                       |                          |                       |                          |
|-----------------------|--------------------------|-----------------------|--------------------------|
| A—Knob                | F—Bracket                | K—Guide               | P—Swashplate Arm         |
| B—Clip                | G—Pin                    | L—Speed Control Rod   | Q—Wire                   |
| C—Speed Control Lever | H—Shock Absorber         | M—Turnbuckle          | R—Spring Pin             |
| D—Torsion Spring      | I—Brake Plate (2 used)   | N—Stud (Early Models) | S—Eyebolt (Later Models) |
| E—Compression Spring  | J—Friction Disc (2 used) | O—Spacer              |                          |

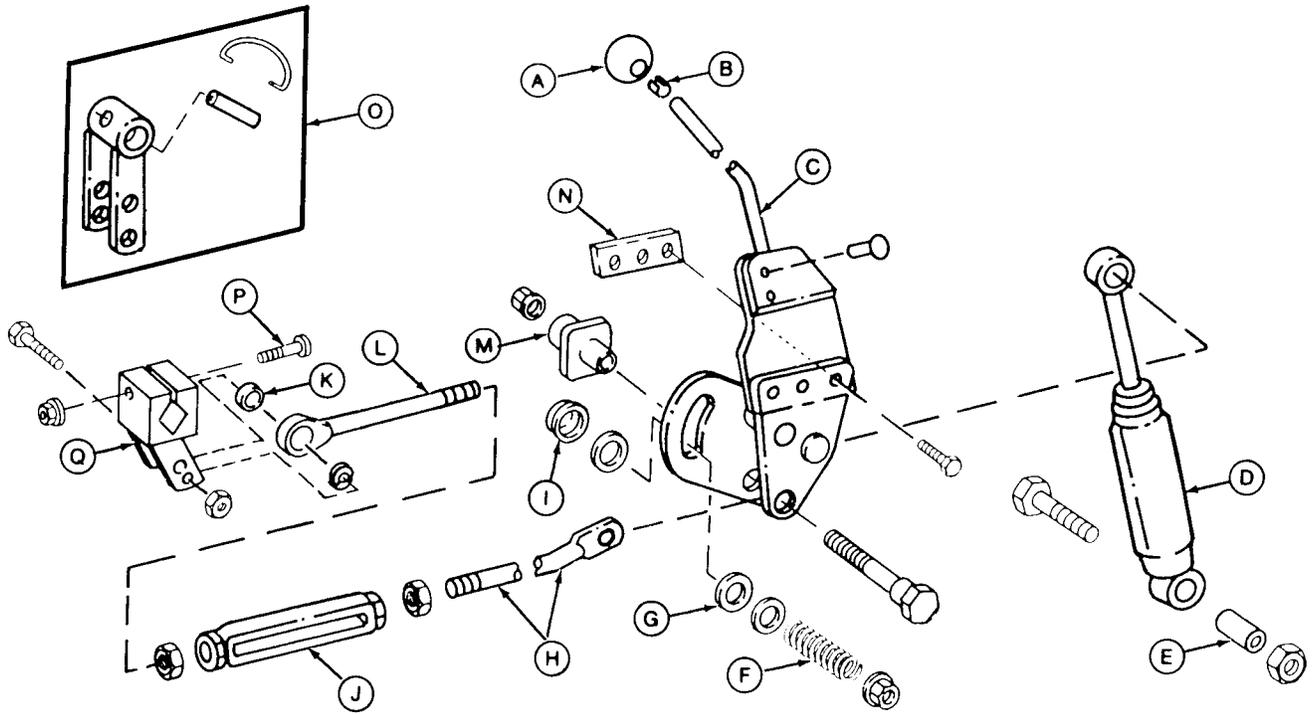
1. Remove belly screen/pan, fender deck and fuel tank.
2. Remove engine side panels, battery and battery base.
3. Remove right-hand pedestal side panel.
4. Inspect linkage for wear or damage. Replace parts as necessary.
5. Adjust hydrostatic lever friction and neutral return linkage. (See procedures in Section 250, Group 15.)

MX,15905010,1 -19-20MAR95

M77907 -JUN-13FEB95

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## INSPECT AND REPAIR TRANSMISSION CONTROL LINKAGE—VERSION TWO (316 AND 318)

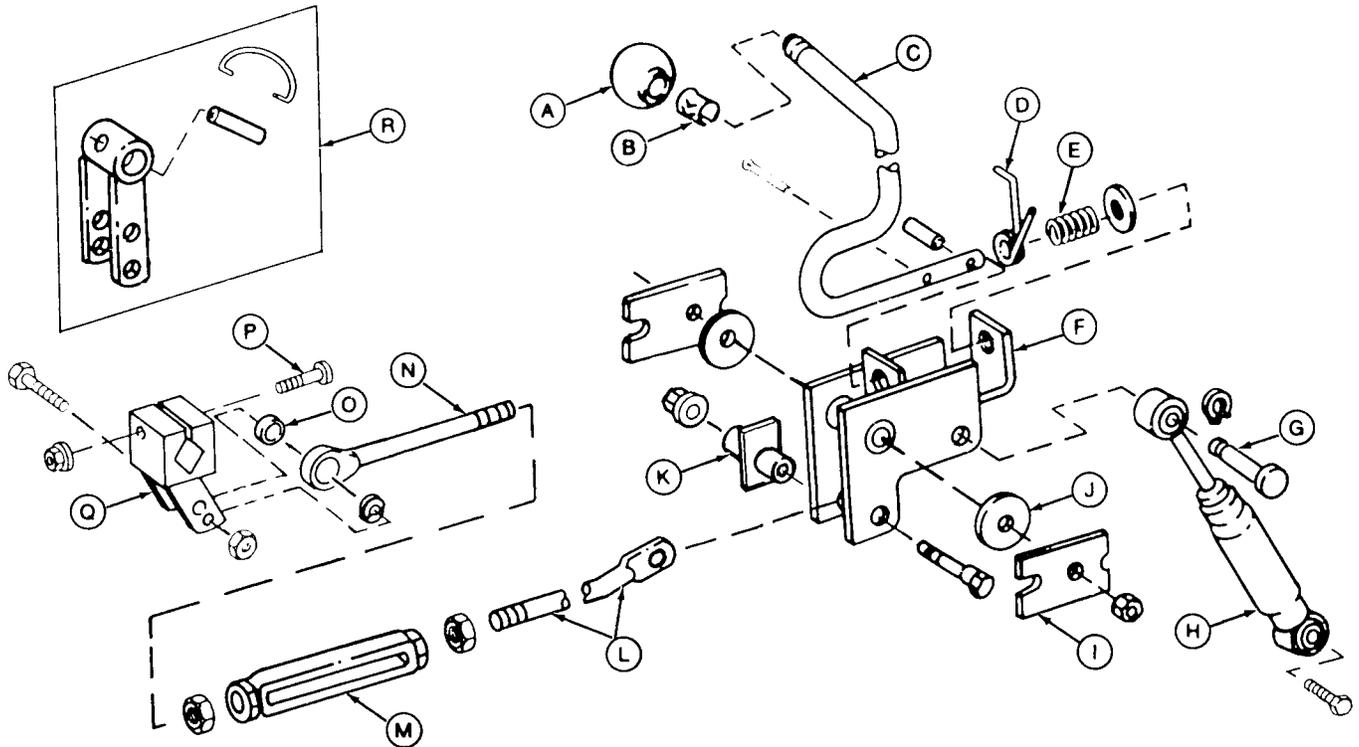


- |                       |                          |  |                                 |
|-----------------------|--------------------------|--|---------------------------------|
| A—Knob                | F—Compression Spring     | K—Spacer                                 | P—Cap Screw (Later Models)      |
| B—Clip                | G—Friction Disc (2 used) | L—Eyebolt                                | Q—Swashplate Arm (Later Models) |
| C—Speed Control Lever | H—Speed Control Rod      | M—Guide                                  |                                 |
| D—Shock Absorber      | I—Spacer                 | N—Weld Nut                               |                                 |
| E—Spacer              | J—Turnbuckle             | O—Swashplate Arm Assembly (Early Models) |                                 |

1. Remove belly screen, fender deck and fuel tank.
2. Remove engine side panels, battery and battery base.
3. Remove right-hand pedestal side panel.
4. Inspect linkage for wear or damage. Replace parts as necessary.
5. Adjust hydrostatic lever friction. (See procedure in Section 250, Group 15.)
6. Later Models; After connecting swashplate arm (Q) to transmission control shaft, tighten cap screw (P) to 60 N·m (44 lb-ft).
7. Adjust neutral return linkage. (See procedure in Section 250, Group 15.)

MX,15905010,2 -19-08MAY95

## INSPECT AND REPAIR TRANSMISSION CONTROL LINKAGE—VERSION TWO (420)



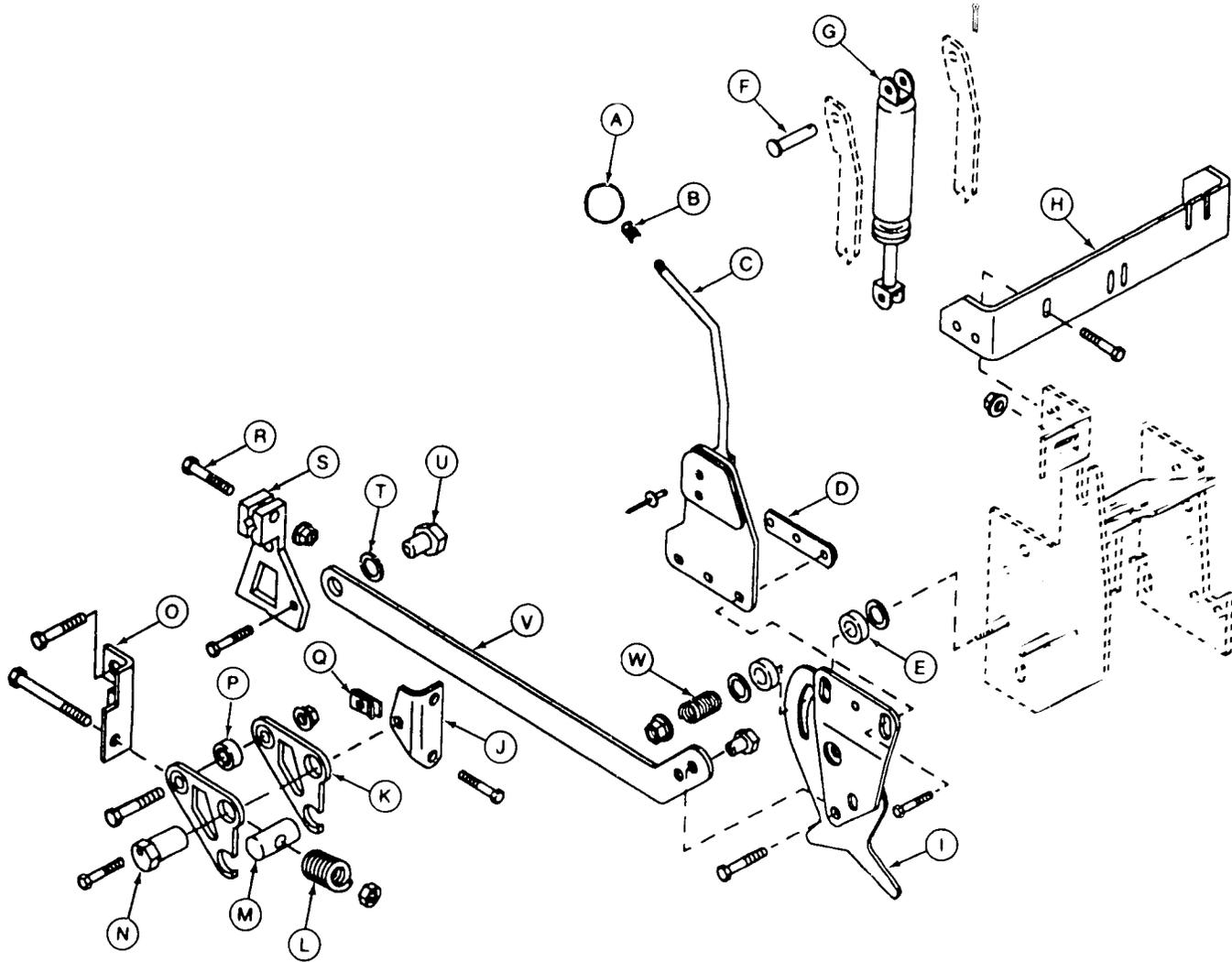
- |                       |                          |                     |  |
|-----------------------|--------------------------|---------------------|--|
| A—Knob                | F—Bracket                | K—Guide             | P—Cap Screw (Later Models)               |
| B—Clip                | G—Pin                    | L—Speed Control Rod | Q—Swashplate Arm (Later Models)          |
| C—Speed Control Lever | H—Shock Absorber         | M—Turnbuckle        | R—Swashplate Arm Assembly (Early Models) |
| D—Torsion Spring      | I—Brake Plate (2 used)   | N—Eyebolt           |  |
| E—Compression Spring  | J—Friction Disc (2 used) | O—Spacer            |  |

1. Remove belly pan, fender deck and fuel tank.
2. Remove engine side panels, battery and battery base.
3. Remove right-hand pedestal side panel.
4. Inspect linkage for wear or damage. Replace parts as necessary.
5. Adjust hydrostatic lever friction. (See procedure in Section 250, Group 15.)
6. Later Models; After connecting swashplate arm (Q) to transmission control shaft, tighten cap screw (P) to 60 N·m (44 lb-ft).
7. Adjust neutral return linkage. (See procedure in Section 250, Group 15.)

MX,15905010,3 -19-08MAY95

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-JUN-13FEB95  
M77909

**INSPECT AND REPAIR TRANSMISSION CONTROL LINKAGE—VERSION THREE (ALL MODELS)**



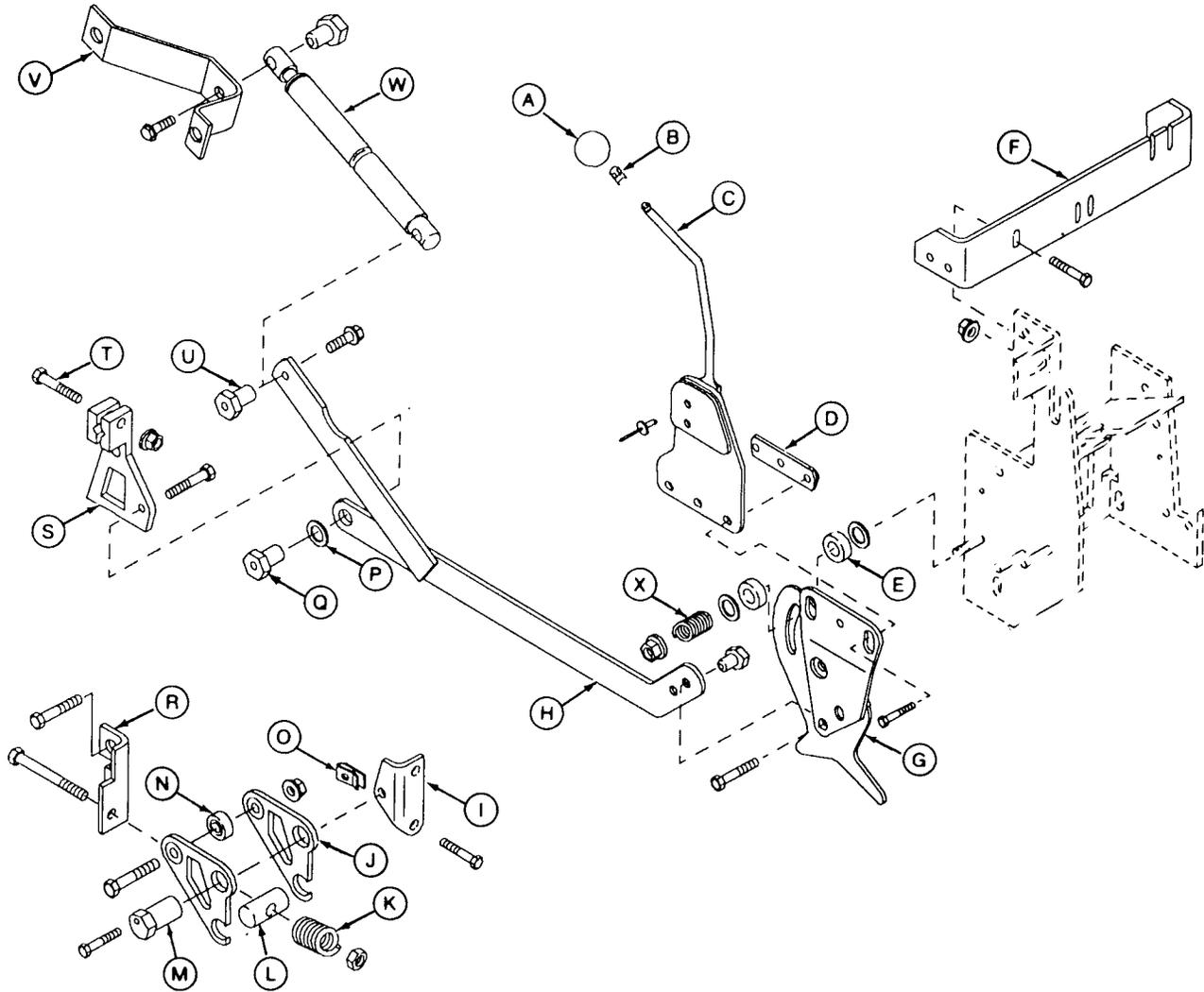
- |                          |                       |                                |                      |
|--------------------------|-----------------------|--------------------------------|----------------------|
| A—Knob                   | G—Torsional Dampener  | M—Pivot Pin                    | R—Cap Screw          |
| B—Clip                   | H—Bracket             | N—Adjustable Eccentric Bearing | S—Swashplate Arm     |
| C—Speed Control Lever    | I—Control Plate       | O—Bracket                      | T—Spring Washer      |
| D—Weld Nut               | J—Angle Bracket       | P—Ball Bearing                 | U—Nut (2 used)       |
| E—Friction Disc (2 used) | K—Detent Arm (2 used) | Q—Clamp-On Nut                 | V—Speed Control Link |
| F—Pin                    | L—Compression Spring  |                                | W—Compression Spring |

1. Remove belly screen/pan, fender deck and fuel tank.
2. Remove engine side panels, battery and battery base.
3. Remove right-hand pedestal side panel.
4. Inspect linkage for wear or damage. Replace parts as necessary.

5. After connecting swashplate arm (S) to transmission control shaft, tighten cap screw (R) to 60 N·m (44 lb-ft).
6. Adjust neutral and neutral return linkage. (See procedure in Section 250, Group 15.)
7. Adjust hydrostatic lever friction. (See procedure in Section 250, Group 15.)

MX,15905010,4 -19-08MAY95

## INSPECT AND REPAIR TRANSMISSION CONTROL LINKAGE—VERSION FOUR (ALL MODELS)



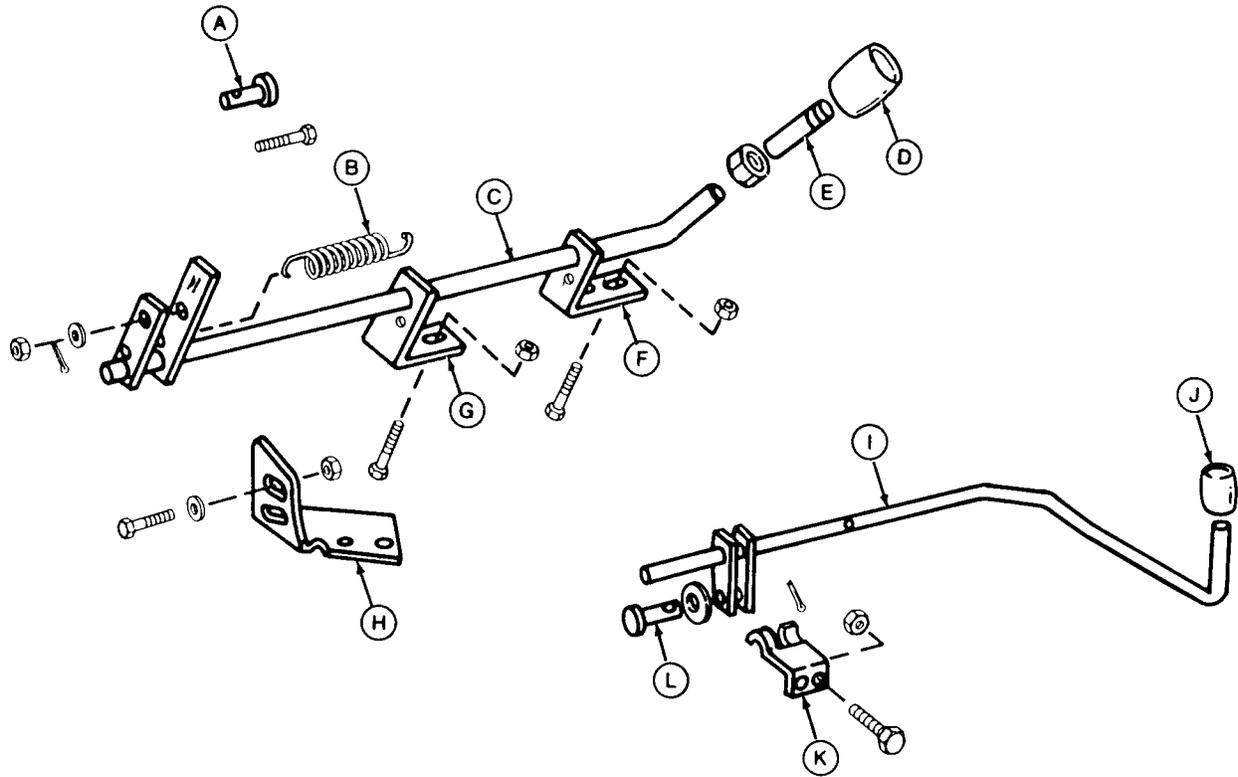
- |                          |                                |                  |                       |
|--------------------------|--------------------------------|------------------|-----------------------|
| A—Knob                   | H—Speed Control Link           | N—Ball Bearing   | T—Cap Screw           |
| B—Clip                   | I—Angle Bracket                | O—Clamp-On Nut   | U—Spacer Nut (2 used) |
| C—Speed Control Lever    | J—Detent Arm (2 used)          | P—Spring Washer  | V—Bracket             |
| D—Weld Nut               | K—Compression Spring           | Q—Nut (2 used)   | W—Torsional Dampener  |
| E—Friction Disc (2 used) | L—Pivot Pin                    | R—Bracket        | X—Compression Spring  |
| F—Bracket                | M—Adjustable Eccentric Bearing | S—Swashplate Arm |                       |
| G—Control Plate          |                                |                  |                       |

1. Remove belly screen/pan, fender deck and fuel tank.
2. Remove engine side panels, battery and battery base.
3. Remove right-hand pedestal side panel.
4. Inspect linkage for wear or damage. Replace parts as necessary.

5. After connecting swashplate arm (S) to transmission control shaft, tighten cap screw (T) to 60 N·m (44 lb-ft).
6. Adjust neutral and neutral return linkage. (See procedure in Section 250, Group 15.)
7. Adjust hydrostatic lever friction. (See procedure in Section 250, Group 15.)

MX,15905010,5 -19-08MAY95

## INSPECT AND REPAIR DIFFERENTIAL LOCK AND TWO-SPEED CONTROL LINKAGE (420)



- |                         |                       |
|-------------------------|-----------------------|
| A—Pin                   | D—Knob                |
| B—Spring                | E—Stud Extension      |
| C—Two-Speed Control Rod | F—Front Angle Bracket |

- |                         |                 |
|-------------------------|-----------------|
| G—Rear Angle Bracket    | J—Knob          |
| H—Two-Speed Bracket     | K—Clip (2 used) |
| I—Differential Lock Rod | L—Pin           |

1. Remove belly pan.
2. Inspect linkage for wear or damage. Replace parts as necessary.

3. Adjust two-speed axle lever detent, if necessary. (See procedure in Section 250, Group 15.)

MX,15905010,6 -19-07MAR95

**OTHER MATERIAL**

<b>Number</b>	<b>Name</b>	<b>Use</b>
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
T43512/TY9473/242	Thread Lock and Sealer (Medium Strength)	Apply to threads of carrier cap screws.
TY6304/TY9484/518	Flexible Sealant	Apply to mating surfaces of differential cover and case halves.

*®LOCTITE is a registered trademark of the Loctite Corp.*

MX,15905015,OTH-19-23FEB95

**SERVICE PARTS KITS**

The following kits are available through your parts catalog:

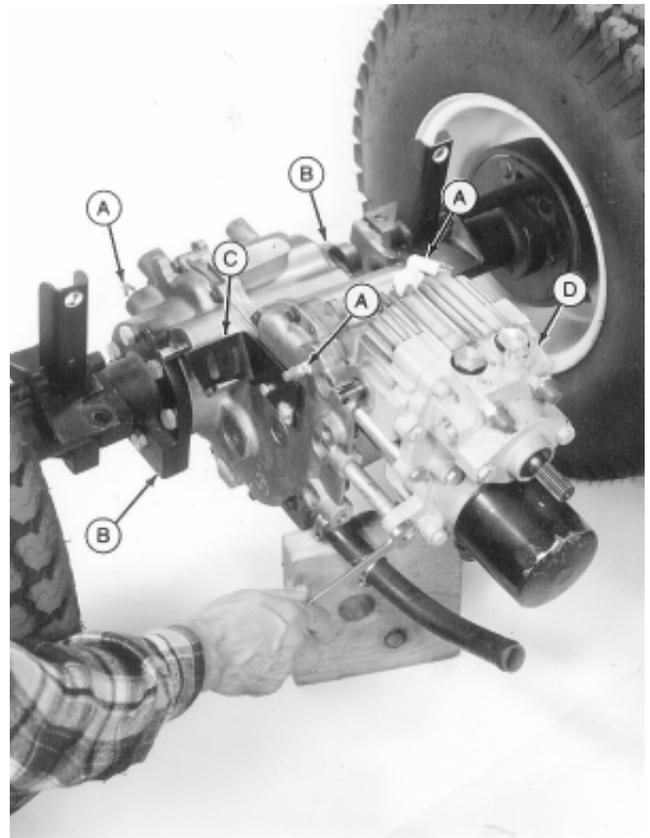
Differential Tabbed Thrust Washer Kit for Early Models

MX,15905015,KIT-19-23FEB95

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1

## REMOVE AND INSTALL DIFFERENTIAL

1. Remove transmission (D). (See procedure in Group 05.)
2. Remove both axles (B). (See procedure in Group 20.)
3. Remove bracket (C) and fittings (A).
4. Installation is done in the reverse order of removal.



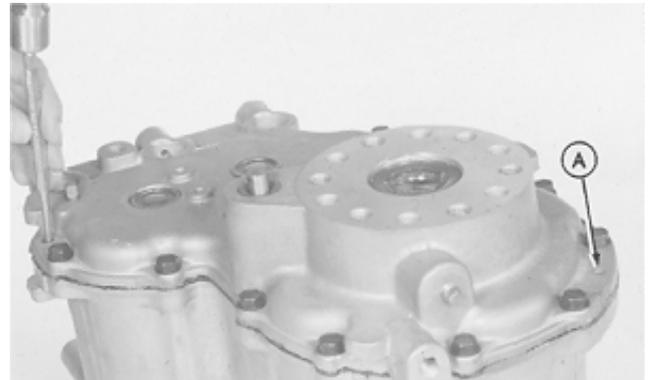
MX,15905015,1 -19-23FEB95

M36657 -JUN-19/JAN95

## DISASSEMBLE AND INSPECT DIFFERENTIAL

*NOTE: This disassembly procedure is for the One-Speed Differential (316 and 318) and the Two-Speed Differential with Differential Lock (420). The differences are noted.*

1. Drive two dowel pins (A) into differential case just far enough to clear the cover.
2. Remove cap screws to remove cover and gasket.



MX,15905015,2 -19-23FEB95

M36226 -JUN-22/NOV89

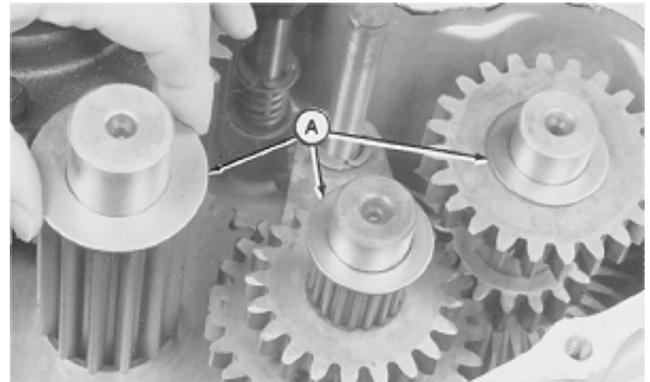
*NOTE: Early models have FLAT thrust washers. Later models have TABBED thrust washers. All service or replacement thrust washers will have the tabs.*

**IMPORTANT:** It is recommended to replace the early model (flat) thrust washers with the later model (tabbed) thrust washers. The early model washers may spin with their respective shafts, causing wear to the cover bearing surfaces.

3. Remove three thrust washers (A).



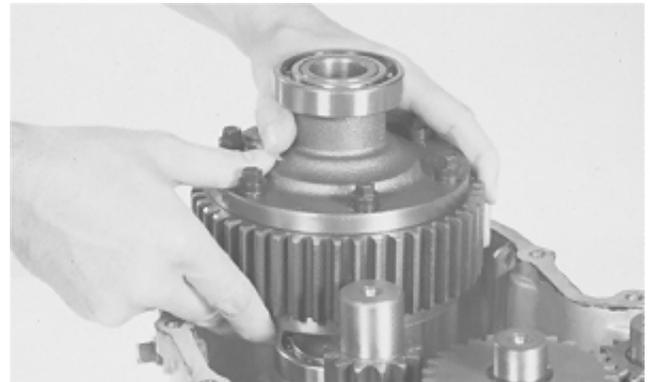
One-Speed Differential



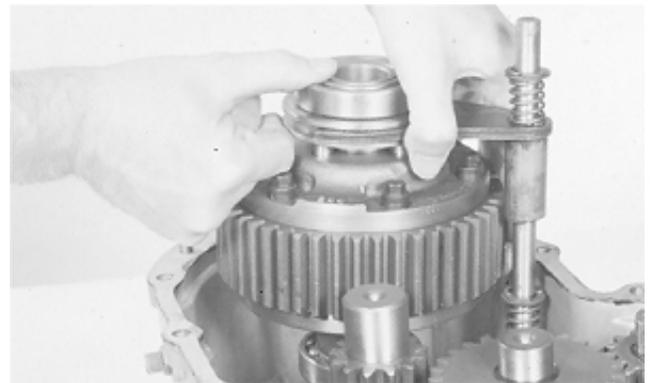
Two-Speed Differential

MX,15905015,3 -19-23FEB95

4. Remove differential; if equipped with differential lock, remove shift rod assembly with differential.



Without Differential Lock



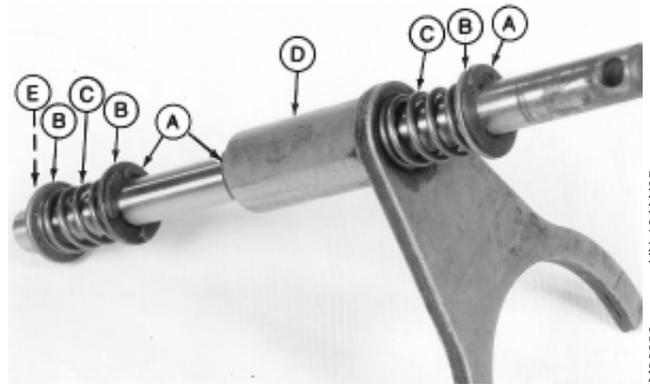
With Differential Lock

MX,15905015,4 -19-23FEB95

5. If equipped with differential lock; disassemble shift rod assembly by removing three E-Rings (A) washers (B), springs (C), fork (D), and snap ring (E).

Inspect shaft for straightness or damage. Replace if necessary.

- A—E-Ring (3 used)
- B—Washer (3 used)
- C—Spring (2 used)
- D—Fork
- E—Snap Ring



MX,15905015,5 -19-23FEB95

M36230 -UN-19JAN95

*NOTE: Early model with differential lock shown.*

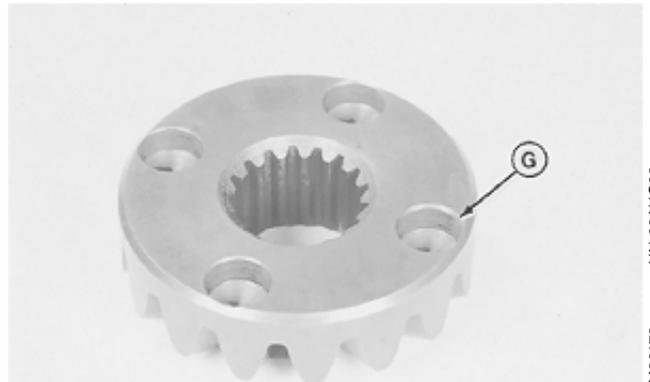
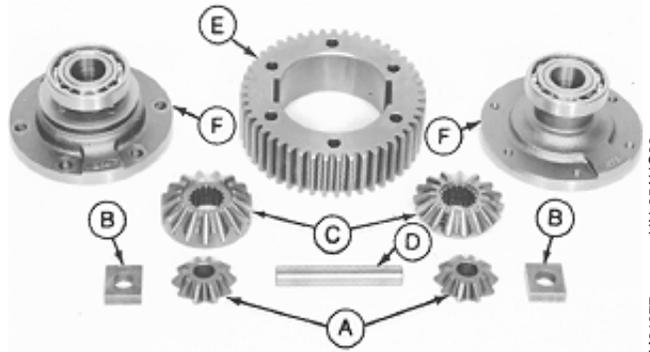
6. Remove cap screws to separate carriers (F) from ring gear (E).

7. Disassemble and inspect pinion assembly.

Inspect pinion gears (A), bevel gears (C), ring gear (E), pinion blocks (B), and cross shaft (D) for wear or damage. Replace if necessary.

If equipped with differential lock, inspect bevel gear with holes (G) for wear or damage. Replace if necessary.

- A—Pinion Gear (2 used)
- B—Pinion Block (2 used)
- C—Bevel Gear (2 used)
- D—Cross Shaft
- E—Ring Gear
- F—Carrier (2 used)
- G—Bevel Gear with Holes



MX,15905015,6 -19-20MAR95

M31977 -UN-25AUG88

M36173 -UN-29AUG88

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**NOTE:** Later models have oil grooves (E), an oil hole (D) and a thrust washer (F) in carriers.

Machines without differential lock have one thrust washer in each carrier. Machines with differential lock have one thrust washer and one new style carrier on the non-differential lock side only.

All service or replacement carriers will have these features.

Bearings (C) are press-fit on carriers. Remove bearings only if replacement is necessary.

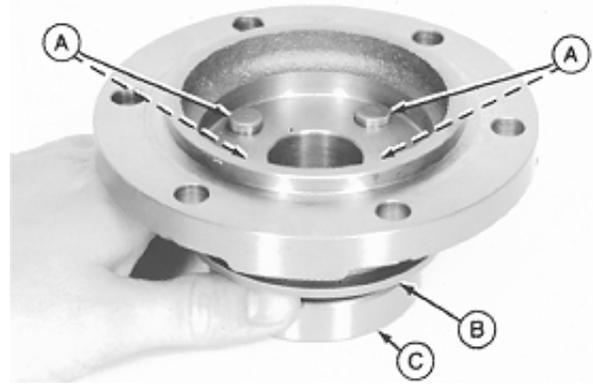
8. Inspect bearings (C) for wear or damage. Replace if necessary.

9. Remove bearings using a knife-edge puller set.

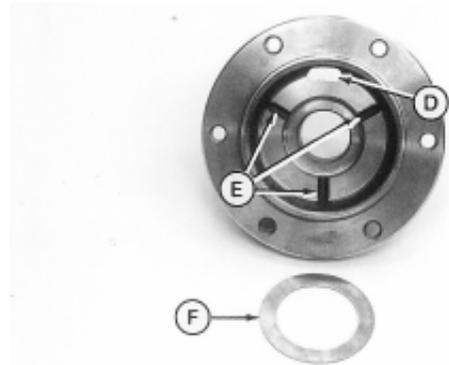
10. Inspect carriers and thrust washers (F), if equipped, for wear or damage. Replace if necessary.

11. With differential lock; inspect locking pins (A) and collar (B). Replace collar if necessary.

- A—Locking Pins
- B—Collar
- C—Bearing
- D—Oil Hole
- E—Oil Grooves
- F—Thrust Washer



With Differential Lock



-UN-03AUG89

M31971

-UN-19JAN95

M77309

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MX,15905015,7 -19-23FEB95

12. Remove and inspect countershaft assembly.

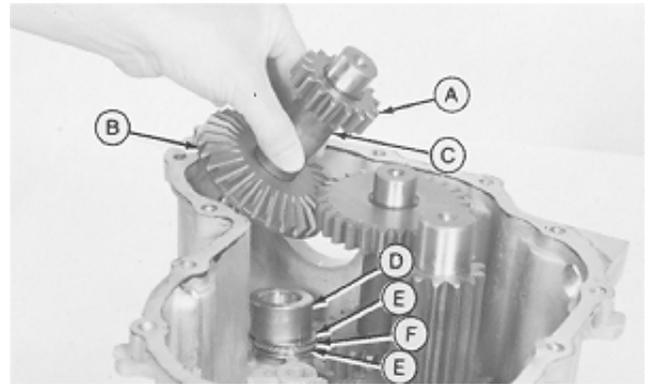
Inspect spur gear (A) and bevel gear (B) for worn or damaged teeth.

Inspect countershaft (C) for worn or damaged splines or bearing surfaces.

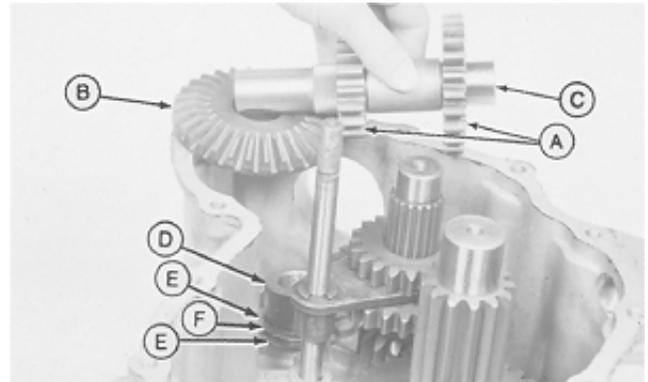
13. Remove spacer (D), thrust washers (E) and thrust bearing (F).

Inspect parts for wear or damage. Replace if necessary.

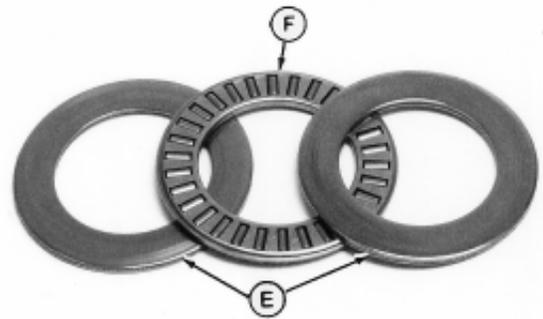
- A—Spur Gear
- B—Bevel Gear
- C—Countershaft
- D—Spacer
- E—Thrust Washer (2 used)
- F—Thrust Bearing



One-Speed Differential



Two-Speed Differential



MX.15905015.8 -19-23FEB95

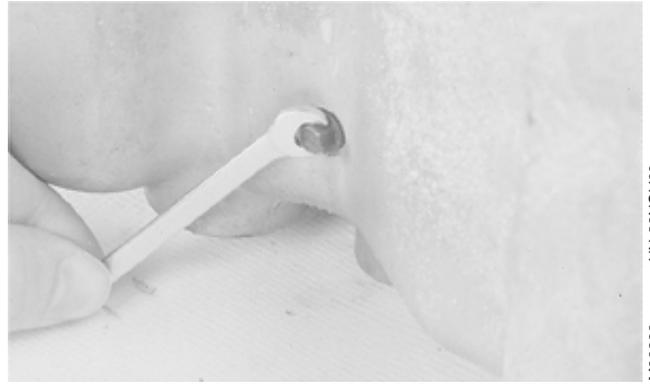
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M36175 -UN-29AUG88

M36232 -UN-22NOV89

M77905 -UN-19JAN95

14. Two-speed differential; remove set screw, spring, and detent ball.



M36233 -UN-22NOV89



M36234 -UN-22NOV89

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MX,15905015,9 -19-23FEB95

15. Remove and inspect intermediate shaft assembly; if equipped with two-speed differential, remove shift rod assembly with intermediate shaft.

Inspect intermediate gears (B and C) for worn or damaged teeth.

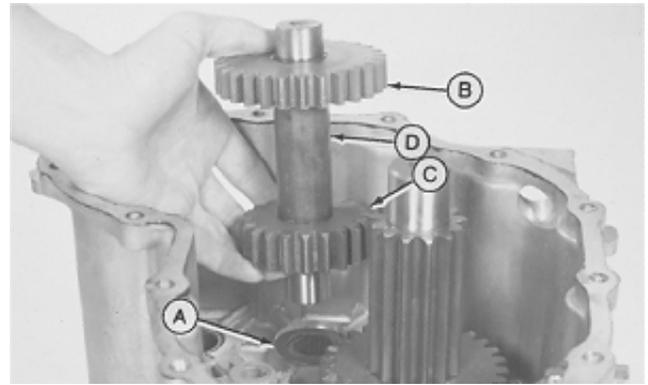
Inspect intermediate shaft (D) for worn or damaged splines or bearing surfaces.

*NOTE: Early models have a FLAT thrust washer. Later models have a TABBED thrust washer. All service or replacement thrust washers will have the tabs.*

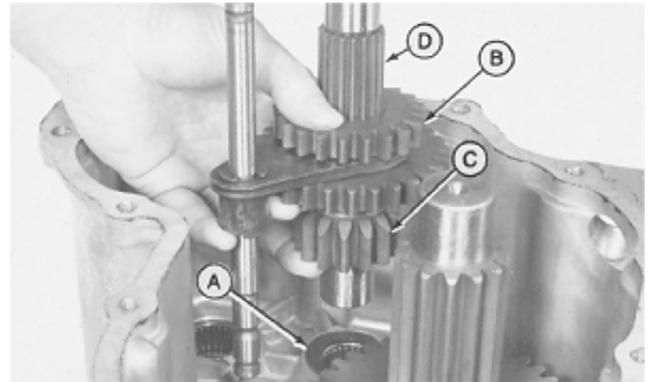
**IMPORTANT: It is recommended to replace the early model (flat) thrust washers with the later model (tabbed) thrust washers. The early model washers may spin with their respective shafts, causing wear to the case bearing surface.**

16. Remove and inspect thrust washer (A) for wear or damage.

- A—Thrust Washers
- B—Intermediate Gear
- C—Intermediate Gear
- D—Intermediate Shaft



One-Speed Differential

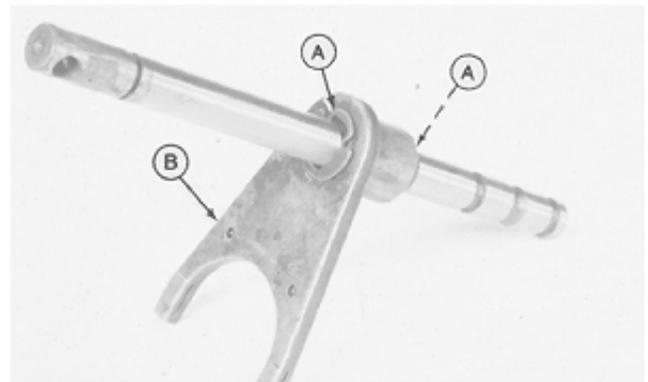


Two-Speed Differential

MX,15905015,10 -19-23FEB95

17. Two-speed differential; disassemble shift rod by removing two E-rings (A) and fork (B).

Inspect shaft for straightness, burrs, and damaged detent lands. Replace if necessary.



MX,15905015,11 -19-23FEB95

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M36176 -UN-29AUG88

M36176

M36235 -UN-22NOV89

M36235

M36236 -UN-22NOV89

M36236

18. Remove and inspect output shaft assembly.

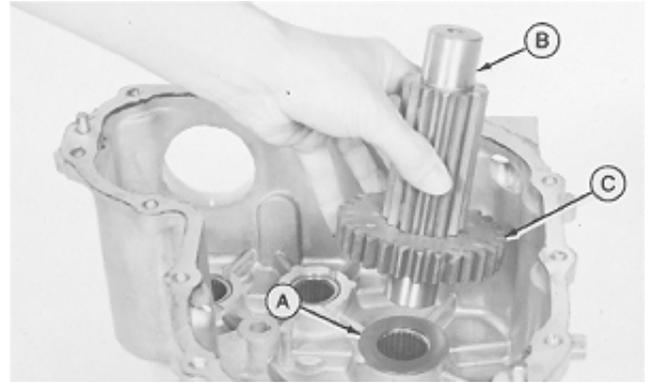
Inspect output gear (C) for worn or damaged teeth.

Inspect output shaft (B) for wear on splined surfaces.

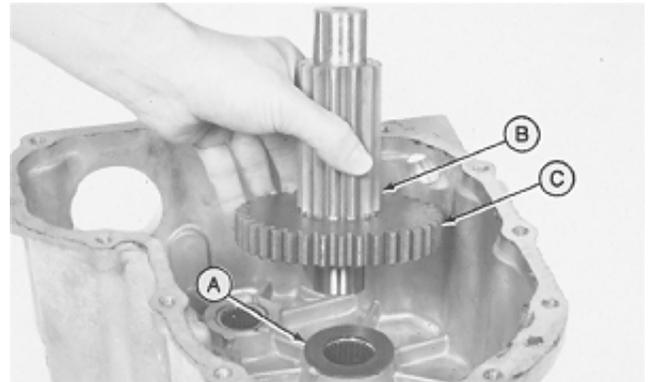
*NOTE: Early models have a FLAT thrust washer. Later models have a TABBED thrust washer. All service or replacement thrust washers will have the tabs.*

**IMPORTANT: It is recommended to replace the early model (flat) thrust washers with the later model (tabbed) thrust washers. The early model washers may spin with their respective shafts, causing wear to the case bearing surface.**

19. Remove and inspect thrust washer (A) for wear or damage.



One-Speed Differential



Two-Speed Differential

MX,15905015,12 -19-23FEB95

M36177 -UN-29AUG88

M36237 -UN-22NOV89

50-15-9

20. Inspect differential case and cover for wear, cracks or damage. Replace case and/or cover if necessary.

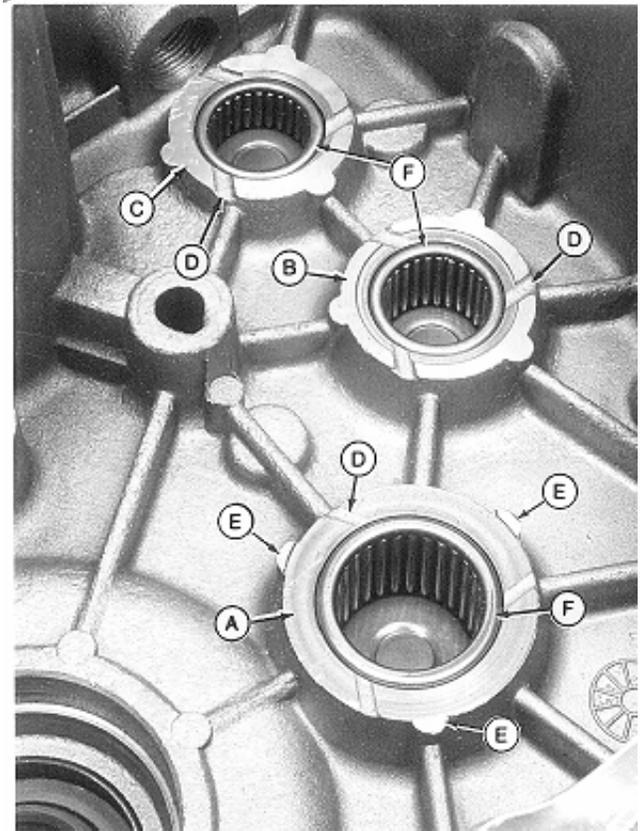
Inspect case and cover bearing surfaces of output shaft (A), intermediate shaft (B) and countershaft (C) for wear, cracks or damage.

Inspect depth of oil grooves (D) in case and cover. If depth of grooves are less than 0.25 mm (0.010 in.), replace case and/or cover.

Inspect reinforcement ribs (E). If ribs protrude above wear surface, file or grind flush.

Inspect bearing races (F) for wear. If bearing race is worn away, replace bearings.

- A—Output Shaft Bearing Surface
- B—Intermediate Shaft Bearing Surface
- C—Countershaft Bearing Surface
- D—Oil Grooves
- E—Reinforcement Ribs
- F—Bearing Races



Differential Case Shown

MX,15905015,13 -19-23FEB95

21. Inspect output shaft bearings (A), intermediate shaft bearings (B) and countershaft bearings (C) in case (D) and cover (E) for wear, damage or corrosion.

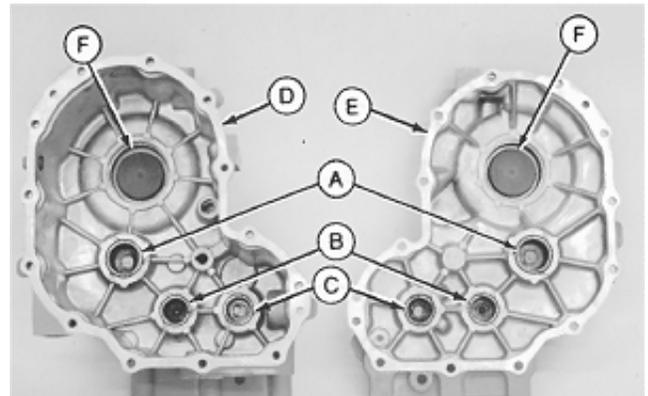
Check that bearings turn freely.

Inspect case and cover for cracks.

Inspect axle shaft seals (F) in case and cover.

Two-Speed with differential lock; inspect shift rod seals for wear or damage.

- A—Output Shaft Bearings
- B—Intermediate Shaft Bearings
- C—Countershaft Bearings
- D—Differential Case
- E—Differential Cover
- F—Axle Shaft Seals



MX,15905015,14 -19-23FEB95

*Differential/Disassemble and Inspect*

22. Replace bearings if necessary.

<b>Bearing</b>	<b>Removal or Installation</b>	<b>Side Driven From</b>	<b>Pilot Size</b>	<b>Driver Size</b>
Output Pinion Bearing	Remove	Outside	1-1/4 in.	1-9/16 in.
	Install	Inside	1-1/4 in.	1-9/16 in.
Shifter Shaft Bearing	Remove	Outside		1-1/4 in.
	Install	Inside	1 in.	1-1/4 in.
Countershaft Bearing	Remove	Outside		1-1/4 in.
	Install	Inside	1 in.	1-1/4 in.

MX,15905015,15 -19-23FEB95

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## ASSEMBLE DIFFERENTIAL

**NOTE:** This assembly procedure is for the One-Speed Differential (316 and 318) and the Two-Speed Differential with Differential Lock (420). The differences are noted.

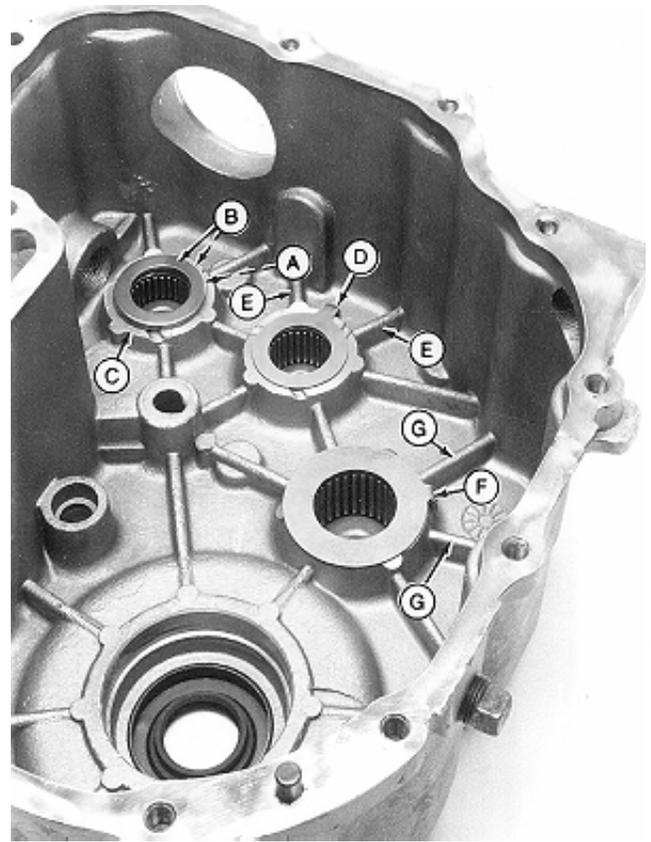
Lubricate all seals with petroleum jelly during assembly.

Early models have *FLAT* thrust washers. Later models have *TABBED* thrust washers. All service or replacement thrust washers will have the tabs.

**IMPORTANT:** It is recommended to replace the early model (flat) thrust washers with the later model (tabbed) thrust washers. The early model washers may spin with their respective shafts, causing wear to case bearing surfaces.

**Always use new seals. Damaged or used parts will leak.**

1. Put clean John Deere Low Viscosity HY-GARD® oil or an equivalent on all internal parts during assembly.
2. Put needle bearing (A) between two flat thrust washers (B). Put assembly on case countershaft bearing surface (C).
3. Put small tabbed thrust washer on intermediate shaft bearing surface with tab (D) pointing down between reinforcement ribs (E).
4. Put large tabbed thrust washer on output shaft bearing surface with tab (F) pointing down between reinforcement ribs (G).



M74075 -JUN-24FEB95

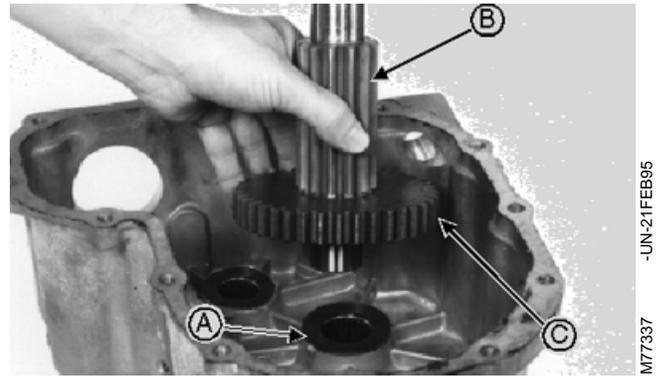
MX,15905015,18 -19-23FEB95

5. Assemble gear (C) and shaft (B).

6. Install output shaft assembly through tabbed thrust washer (A).



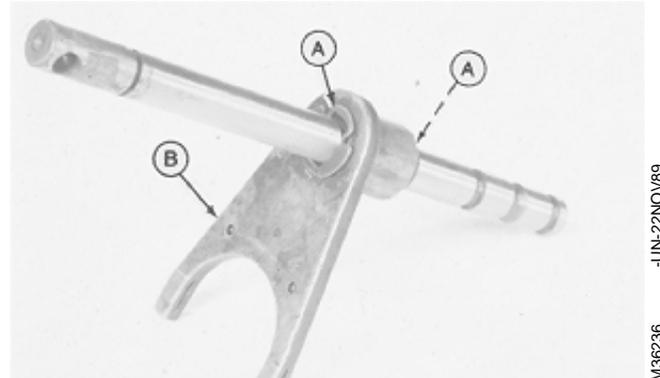
One-Speed Differential



Two-Speed Differential

MX,15905015,19 -19-14MAR95

7. Two-speed differential; assemble shift rod by installing fork (B) and two E-rings (A).

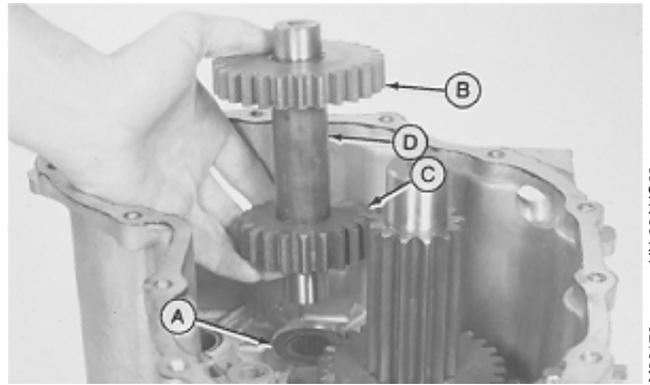


MX,15905015,20 -19-23FEB95

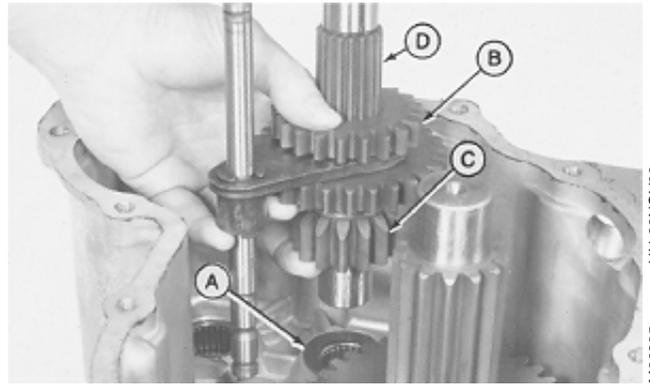
8. Assemble gears (B and C) and shaft (D).

9. Install intermediate shaft assembly through tabbed thrust washer (A); if equipped with two-speed, install shift rod assembly with intermediate shaft assembly.

- A—Thrust Washer
- B—Intermediate Gear
- C—Intermediate Gear
- D—Intermediate Shaft



One-Speed Differential



Two-Speed Differential

MX,15905015,21 -19-23FEB95

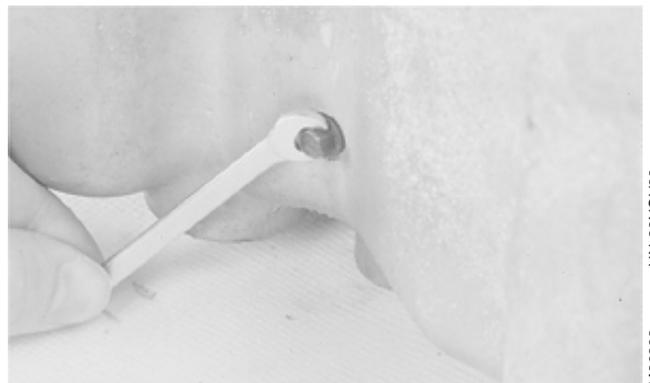
M36176 -UN-29AUG88

M36235 -UN-22NOV89

10. Two-speed differential; install detent ball, spring and set screw.



M36234 -UN-22NOV89



M36233 -UN-22NOV89

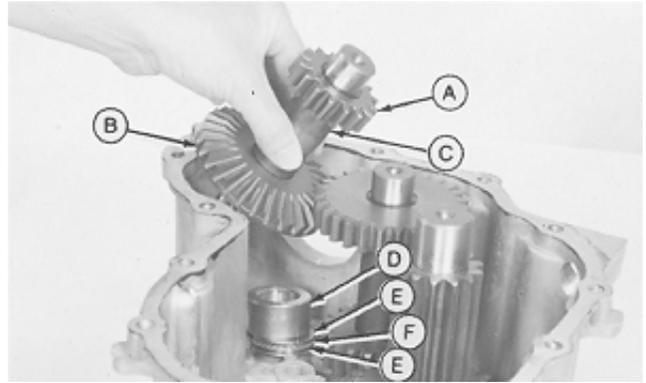
MX,15905015,22 -19-23FEB95

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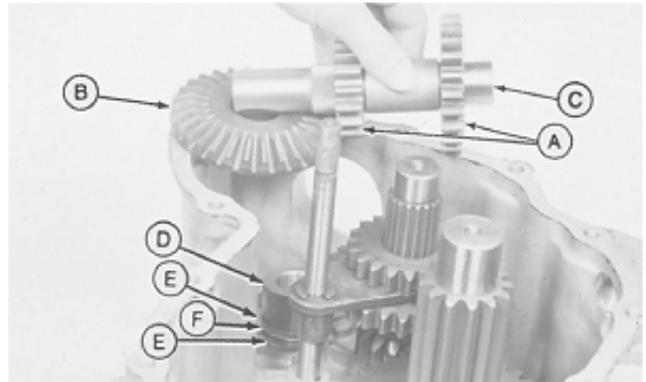
11. Assemble gears (A and B) and shaft (C).

12. Install countershaft assembly through spacer (D), thrust bearing (F) and thrust washers (E).

- A—Spur Gear
- B—Bevel Gear
- C—Countershaft
- D—Spacer
- E—Thrust Washer (2 used)
- F—Thrust Bearing



One-Speed Differential



Two-Speed Differential

MX,15905015,23 -19-23FEB95

M36175 -UN-29AUG88

M36232 -UN-22NOV89

M36232

50-15-15

*NOTE: Early model with differential lock shown.*

13. If removed, install collar (with differential lock) and bearings on carriers (F) using a driver set and a press. Install bearings flush with shaft surfaces.

*NOTE: Carriers on later models have oil grooves, an oil hole and a thrust washer in carriers.*

*Machines without differential lock have one thrust washer in each carrier. Machines with differential lock have one thrust washer and one new style carrier on the non-differential lock side only.*

*All service or replacement carriers will have these features.*

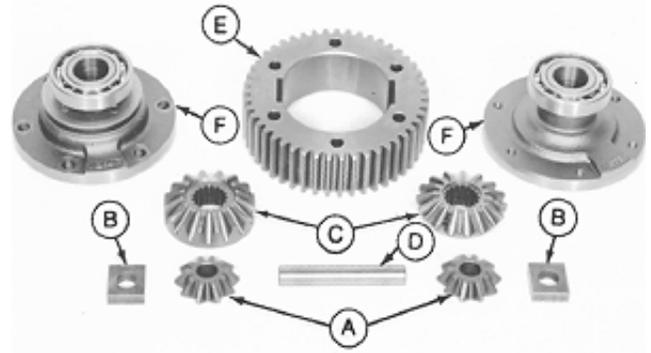
14. Install thrust washers, if equipped, in carriers (F).

15. Assemble carriers (F), ring gear (E), pinion gears (A), bevel gears (C), cross shaft (D), and pinion blocks (B).

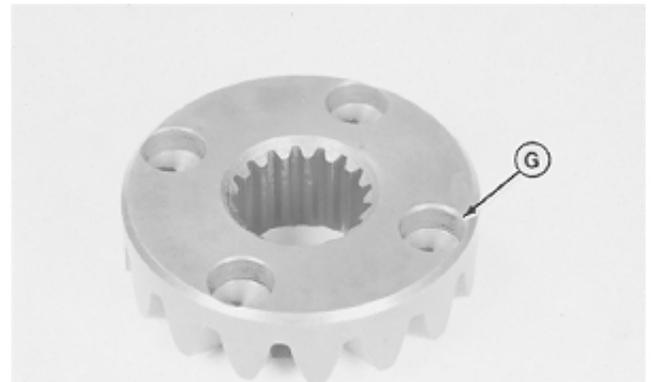
If equipped with differential lock, install bevel gear with holes (G) toward carrier with lock pins and collar.

16. Clean the threads of all six cap screws and threaded carrier, using Clean and Cure Primer. Apply thread lock and sealer (medium strength) to the threads of cap screws.

17. Install cap screws and tighten to 53 N·m (39 lb-ft).



M31977 -UN-25AUG88



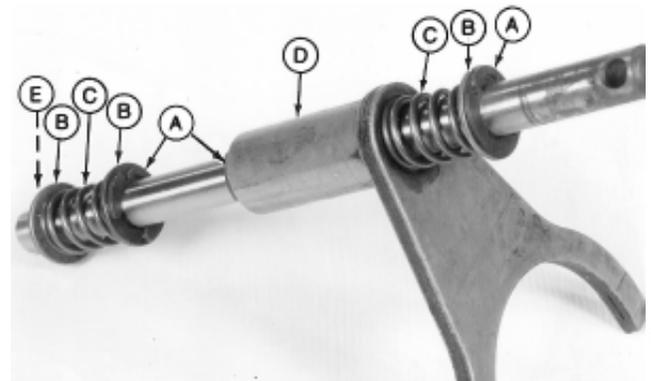
M36173 -UN-29AUG88

- A—Pinion Gear (2 used)
- B—Pinion Block (2 used)
- C—Bevel Gear (2 used)
- D—Cross Shaft
- E—Ring Gear
- F—Carrier (2 used)
- G—Bevel Gear with Holes

MX,15905015,24 -19-20MAR95

18. If equipped with differential lock, assemble shift rod, snap ring (E), washers (B), springs (C), fork (D), and E-rings (A).

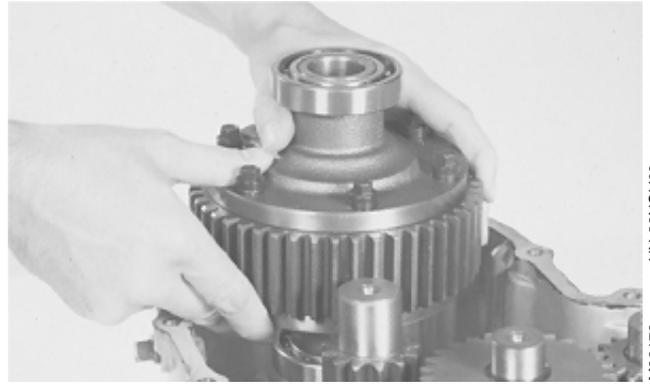
- A—E-Ring (3 used)
- B—Washer (3 used)
- C—Spring (2 used)
- D—Fork
- E—Snap Ring



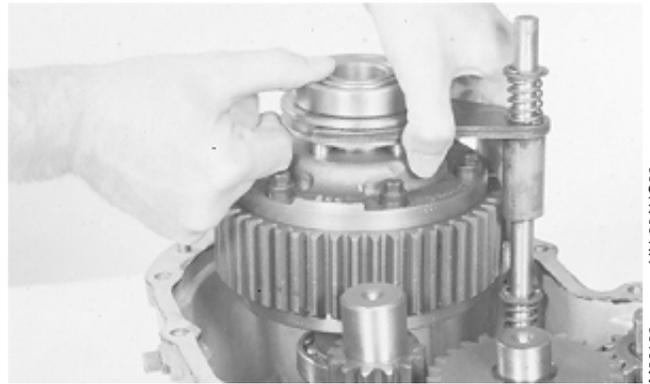
M36230 -UN-19JAN95

MX,15905015,25 -19-23FEB95

19. Install differential; if equipped with differential lock, install shift rod assembly with differential.



*Without Differential Lock*



*With Differential Lock*

MX,15905015,26 -19-23FEB95

M36170 -UN-22NOV89

M36169 -UN-29AUG88

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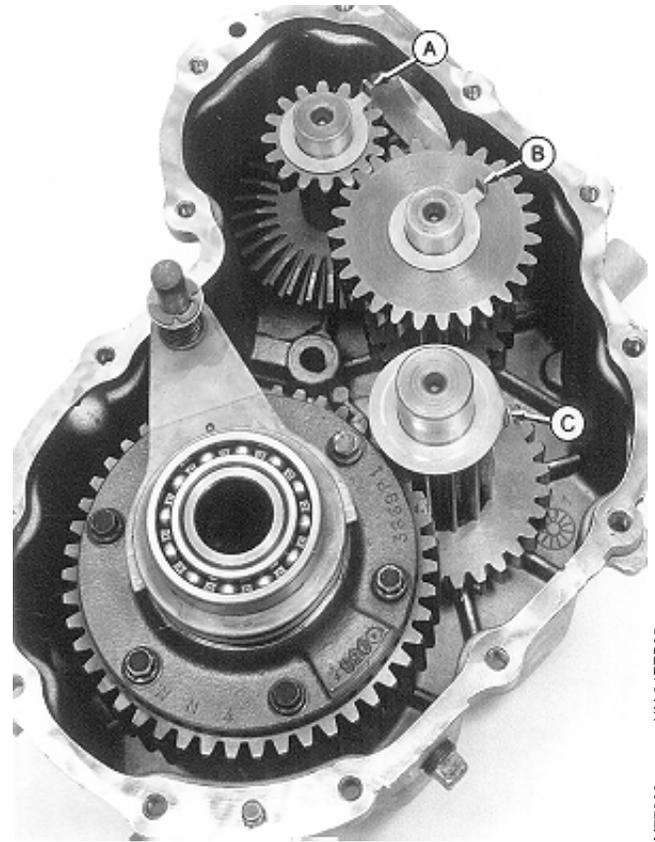
*NOTE: Early models have FLAT thrust washers. Later models have TABBED thrust washers. All service or replacement thrust washers will have the tabs.*

**IMPORTANT: It is recommended to replace the early model (flat) thrust washers with the later model (tabbed) thrust washers. The early model washers may spin with their respective shafts, causing wear to the cover bearing surfaces.**

20. Put a small tabbed thrust washer on countershaft gear with tab (A) pointing up so it will be between the two cover reinforcement ribs that correspond to the same case reinforcement ribs.

21. Put other small tabbed thrust washer on intermediate shaft gear with tab (B) pointing up so it will be between the two cover reinforcement ribs that correspond to the same case reinforcement ribs.

22. Put large tabbed thrust washer on output shaft with tab (C) pointing up so it will be between the two cover reinforcement ribs that correspond to the same case reinforcement ribs.



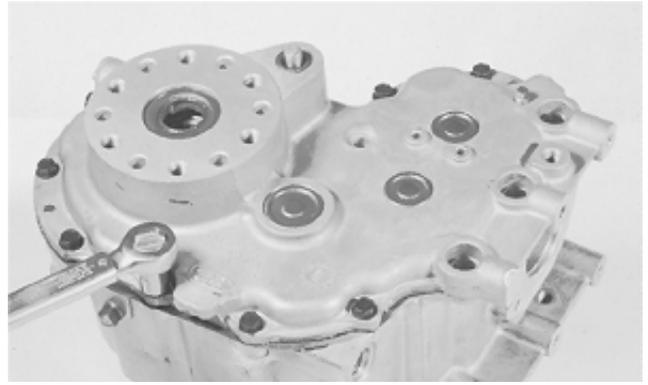
Two-Speed Differential Shown

M77906 -JUN-24FEB95

MX,15905015,27 -19-23FEB95

**IMPORTANT:** If replacement gasket is made of rubber coated laminated metal, clean mating surfaces of differential case and cover and install gasket. Do not apply sealant. It will cause oil to leak.

If replacement gasket is made of paper, clean mating surfaces of differential case and cover, apply recommended sealant, then install gasket.



M36181 -UN-29AUG88

23. Clean the mating surfaces of differential case and cover using Clean and Cure Primer. Apply a coat of Flexible Sealant or an equivalent to differential cover and case when using paper gasket only.

24. Install gasket, cover, and 13 cap screws. Install cap screws finger-tight.

25. Drive two dowel pins into differential cover.

26. Tighten cap screws to 23 N·m (204 lb-in.).

MX,15905015,28 -19-23FEB95

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15  
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## OTHER MATERIAL

Number	Name	Use
M79292	MPG-2® Multi-Purpose Polymer Grease	Prevents parts from seizing. Apply to axle shafts.
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
T43512/TY9473/242	Thread Lock and Sealer (Medium Strength)	Apply to threads of brake plate-to-axle cap screws.

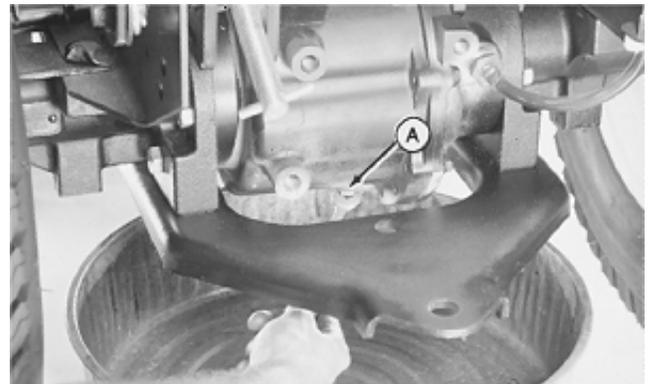
®MPG-2 is a registered trademark of DuBois USA.

®LOCTITE is a registered trademark of the Loctite Corp.

MX,15905020,OTH-19-07MAR95

## REMOVE AXLE

1. Disconnect battery negative (—) cable.
2. Remove drain plug (A) to drain transmission oil. Approximate capacity is 4.7 L (5 U.S. qt). After oil is completely drained, install and tighten drain plug.
3. Raise rear of tractor and install support stands.
4. Remove rear wheel.

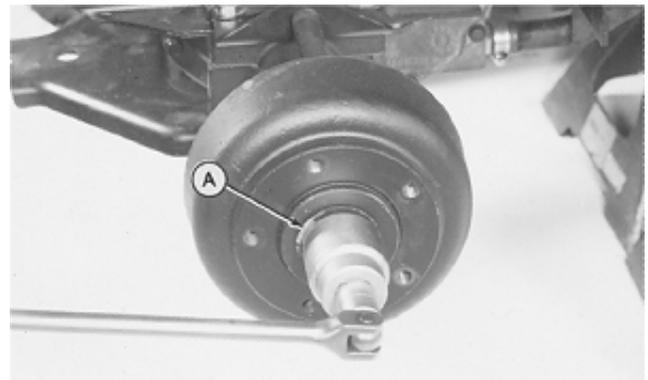


MX,15905020,1 -19-23FEB95

5. Bend edge of washer (A) flat against drum.
6. Remove nut and washer.
7. Pull drum off axle.

If drum hits shoes, turn the adjuster to reduce the drag on the drum from shoes.

If drum is tight on shaft from corrosion, remove drum using a three-leg wheel puller. Do not use impact puller.

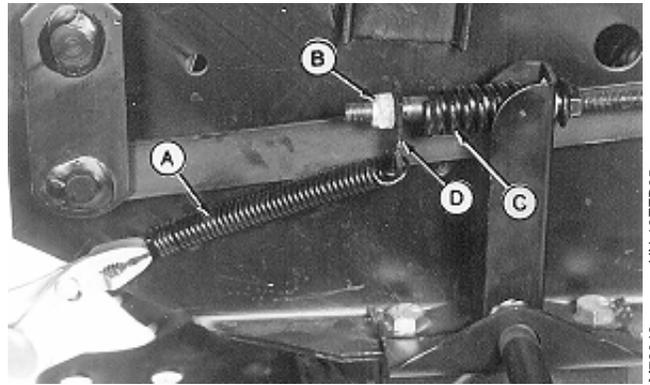


5M3,5020K,C -19-18DEC87

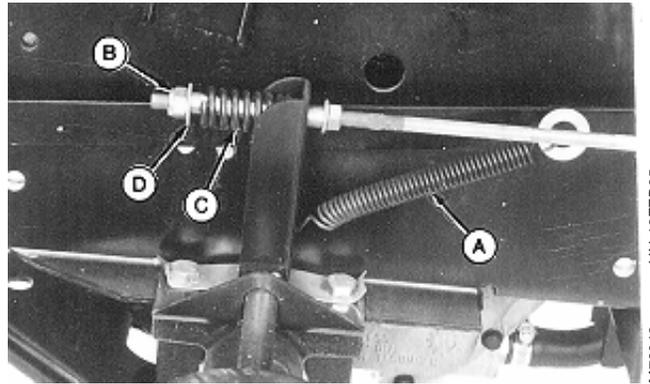
8. Disconnect spring (A).

9. Remove nut (B), plate or washer (D) and spring (C).

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)
- Washer (Later Models)



Early Models

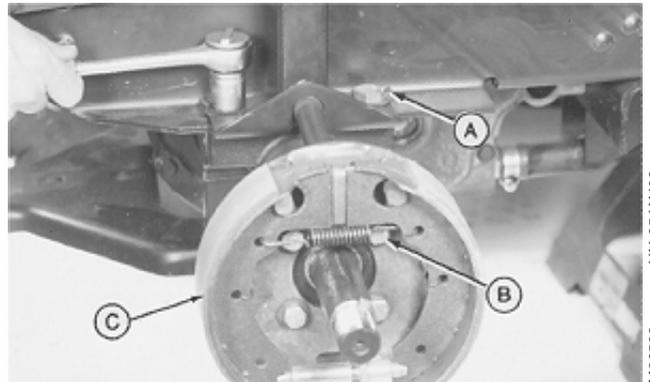


Later Models

MX,15905020,7 -19-23FEB95

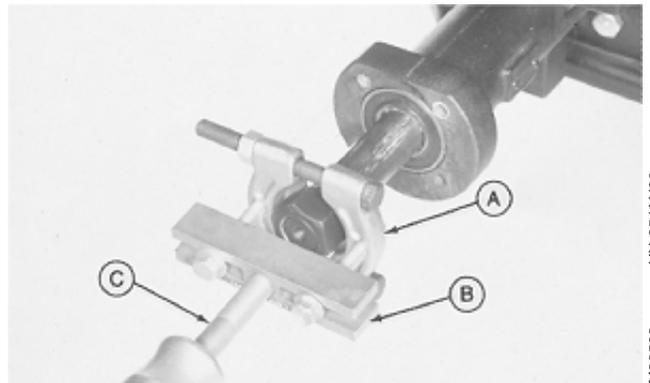
10. Bend tabs (A) flat and remove two cap screws.

11. Remove four cap screws and washers (B) to remove brake plate assembly (C).



5M3,5020K,E -19-18DEC87

12. Remove axle shaft assembly using a bearing puller (A), H-Bar (B), and slide hammer (C).



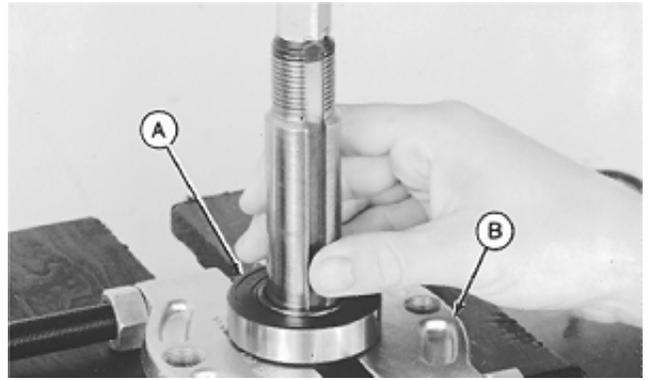
MX,15905020,2 -19-23FEB95

Rear Axles/Remove

13. Inspect bearing (A), replace if necessary.

**IMPORTANT: Be sure to hold shaft while removing bearing.**

14. Remove bearing using a bearing puller (B) and a press.

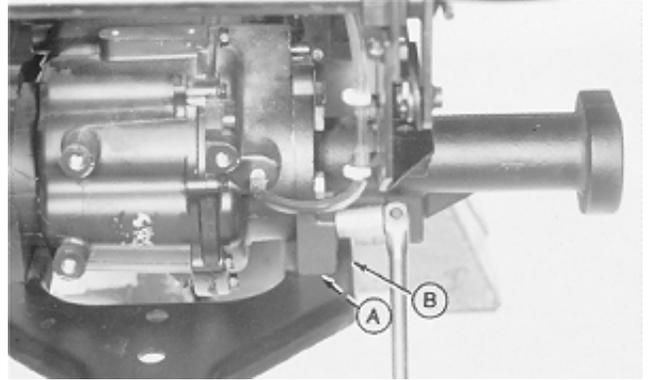


5M3,5020K,G -19-18DEC87

M31951 -JUN-25AUG88

15. Remove two cap screws (A) to disconnect axle from hitch plate (B).

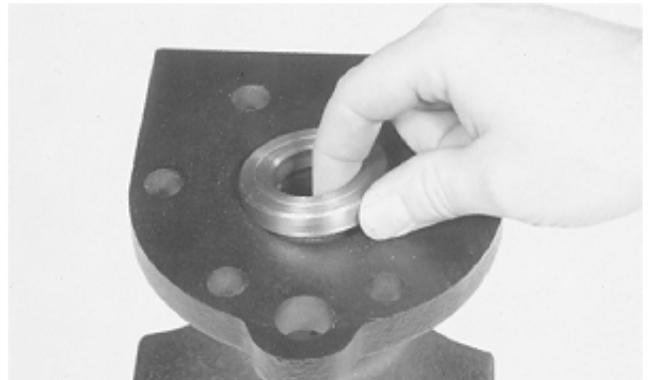
16. Remove six cap screws to remove axle housing.



5M3,5020K,H -19-18DEC87

M36564 -JUN-25JAN90

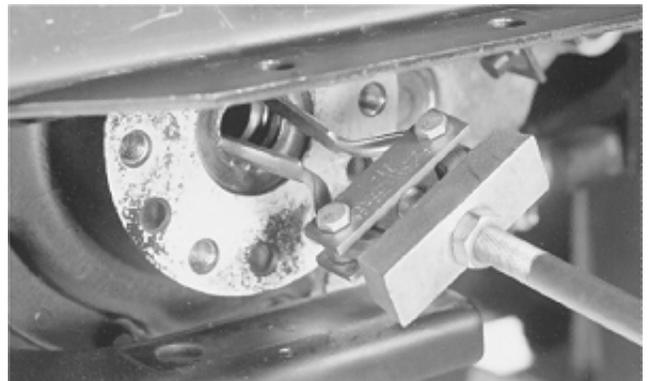
17. Remove spacer.



5M3,5020K,I -19-18DEC87

M36565 -JUN-25JAN90

18. Remove seal from differential using a 2-jaw puller and a slide hammer.



5M3,5020K,J -19-18DEC87

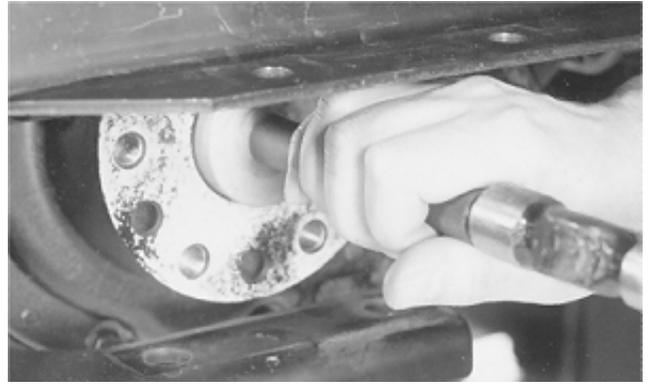
M36566 -JUN-25JAN90

## INSTALL AXLE

**IMPORTANT:** Always use new seals. Damaged or used parts will leak.

*NOTE:* Lubricate all seals with petroleum jelly during assembly.

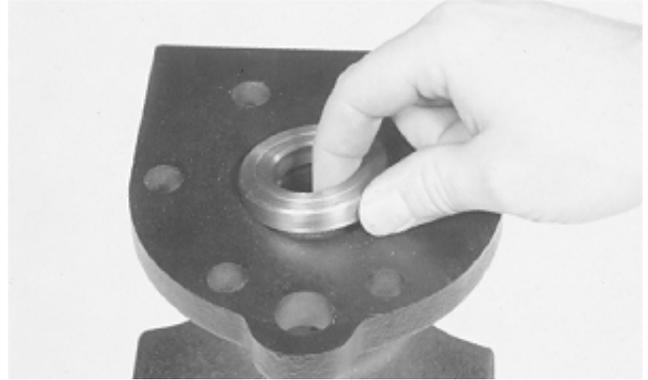
1. Install new seal 3 mm (0.118 in.) below machined surface of differential using a 2-1/16 in. driver disk.



M36567  
-UN-25JAN90

MX,15905020,3 -19-23FEB95

2. Install spacer.

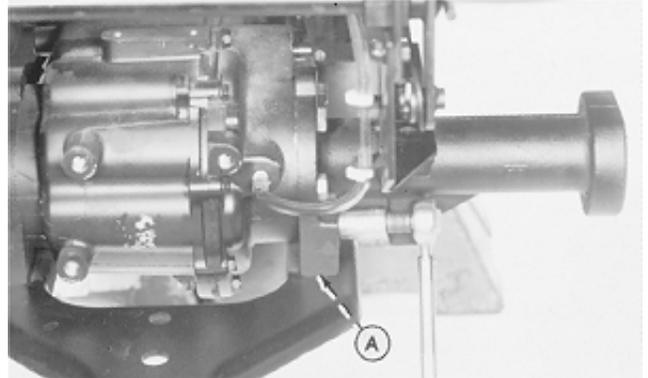


M36565  
-UN-25JAN90

M21,5020R,15 -19-14MAY85

3. Install axle housing and fasten with six cap screws. Tighten cap screws to 81 N-m (60 lb-ft).

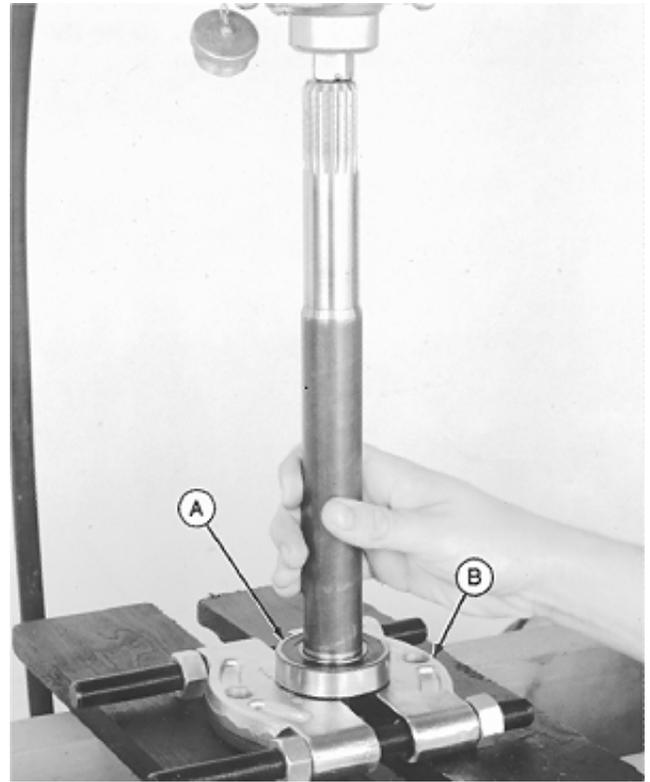
4. Install and tighten two hitch plate cap screws (A).



M36568  
-UN-25JAN90

MX,15905020,8 -19-23FEB95

5. Install bearing (A) on axle shaft using a bearing puller (B) and a press. Push bearing tight against axle shaft shoulder.



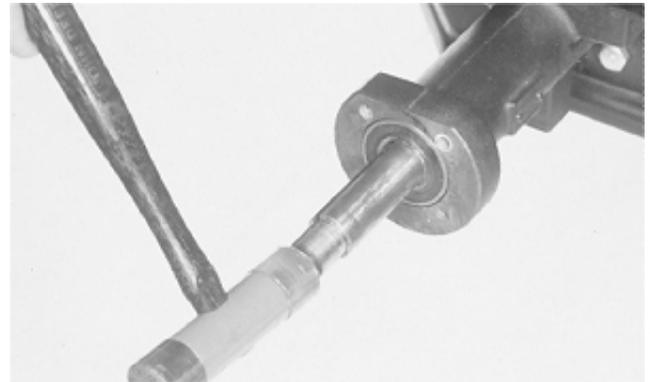
M31952  
-UN-25AUG88  
5120

M21,5020R,17 -19-14MAY85

6. Apply clean transmission fluid to the splined end of the axle shaft.

7. Carefully install axle shaft into housing and through seal in differential. Align splines on shaft with splined gear inside differential.

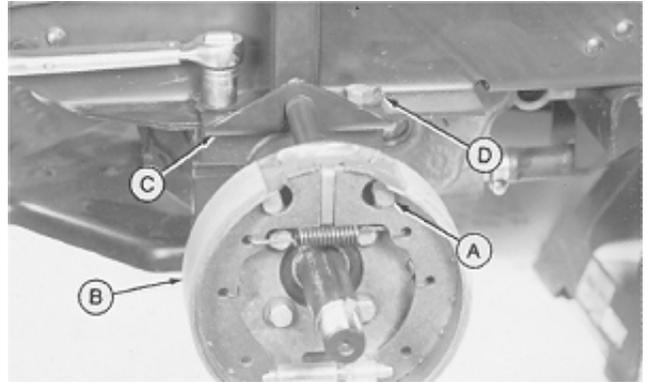
8. Tap shaft assembly into axle housing until bearing is flush with housing.



M36569  
-UN-25JAN90

M21,5020R,18 -19-14MAY85

9. Clean the threads of all four brake plate cap screws and threaded axle housing using Clean and Cure Primer.
10. Apply thread lock and sealer (medium strength) on threads of brake plate cap screws (A).
11. Install brake rod in brake arm hole.
12. Install brake plate assembly (B) on axle. Install and tighten four cap screws (A) to specifications.
13. Install brake support (C), lock plate (D) and two cap screws. Tighten cap screws to specifications. Bend lock plate tabs over flat of cap screws.



M36570 -UN-25JAN90

**TORQUE SPECIFICATIONS**

Brake Plate-to-Axle Housing	
Cap Screws . . . . .	68 N-m (50 lb-ft)
Axle Housing-to-Frame Cap Screws . . . . .	100 N-m (75 lb-ft)

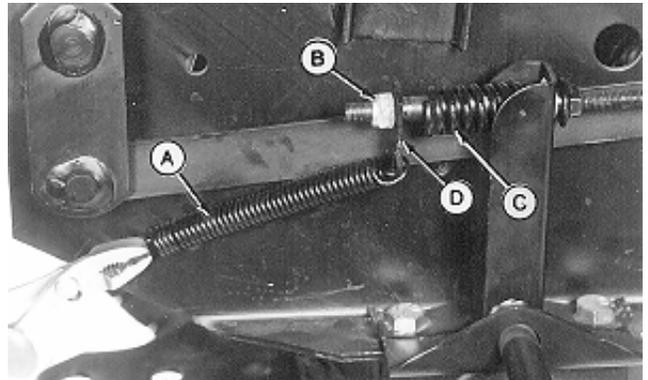
- A—Cap Screw (4 used)**
- B—Brake Plate Assembly**
- C—Brake Support**
- D—Lock Plate**

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20  
6

MX,15905020,4 -19-08MAY95

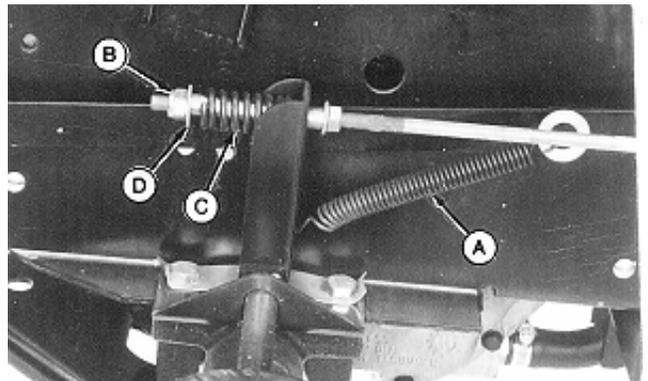
14. Install spring (C), plate or washer (D) and nut (B).
15. Connect spring (A).

- A—Return Spring**
- B—Nut**
- C—Spring**
- D—Plate (Early Models)**
- Washer (Later Models)**



M78048 -UN-13FEB95

Early Models



M78049 -UN-13FEB95

Later Models

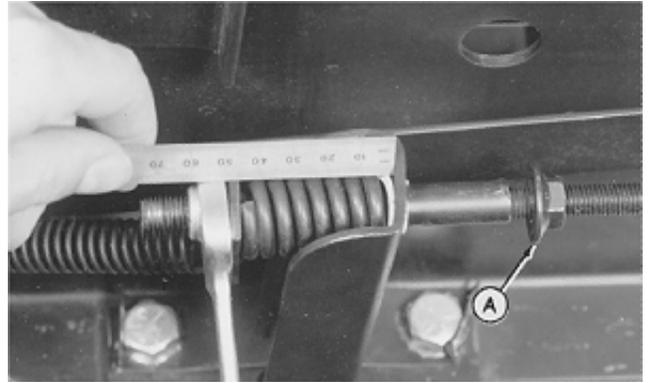
MX,15905020,9 -19-23FEB95

Rear Axles/Install

16. Lock brake pedals together (318 and 420) and apply park brake.

17. Loosen lock nut (A).

18. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.



M36554 -UN-25JAN90

MX,15905020,5 -19-23FEB95

19. Apply MPG-2® Multi-Purpose Polymer Grease on axle shaft.

20. Install key and brake drum.

21. Install washer and nut. Tighten nut to specifications.

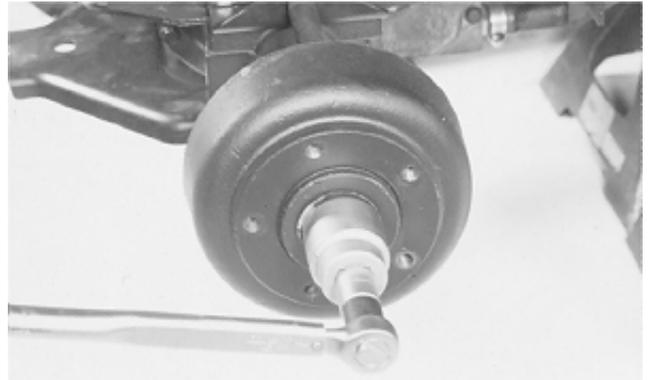
22. Bend one side of washer over nut to lock nut in place.

23. Install wheel. Tighten cap screws to specifications.

24. Remove support stands.

25. Fill differential with the recommended amount of John Deere Low Viscosity HY-GARD® oil.

26. Connect battery negative (—) cable.



M36571 -UN-25JAN90

**TORQUE SPECIFICATIONS**

Brake Drum-to-Axle Nut . . . . .	88 N-m (65 lb-ft)
Rear Wheel Cap Screws . . . . .	70 N-m (52 lb-ft)

MX,15905020,6 -19-07MAR95



**OTHER MATERIAL**

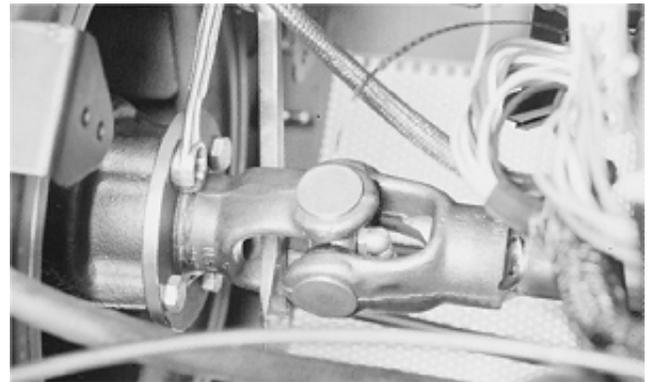
Number	Name	Use
M79292	MPG-2® Multi-Purpose Polymer Grease	Prevents parts from seizing. Apply to splines of transmission input shaft.

®MPG-2 is a registered trademark of DuBois USA.

MX,15905005,OTH-19-07MAR95

**REMOVE AND INSTALL DRIVE SHAFT—316**

1. Disconnect battery negative (—) cable.
  2. Remove right-hand engine side panel.
  3. Remove belly screen.
  4. Hold drive shaft using a screwdriver. Remove four cap screws to disconnect drive shaft from engine.
  5. Loosen two lock nuts and cap screws, if equipped, on drive shaft at transmission pump shaft end.
  6. Push drive shaft all the way back onto transmission pump shaft. Turn front flanged yoke to clear flywheel coupler.
  7. Push drive shaft forward to disconnect from transmission pump shaft.
  8. Remove drive shaft from bottom of machine.
  9. Installation is done in the reverse order of removal.
- Before installing drive shaft, apply MPG-2® Multi-Purpose Polymer Grease on splines of transmission input shaft.
  - Apply multipurpose grease to lubrication fittings.



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1  
-JUN-09DEC89  
M55037

**TORQUE SPECIFICATIONS**

Drive Shaft Cap Screws	
Flange-to-Engine . . . . .	27 N-m (20 lb-ft)
Clamping Yoke-to-Transmission	
Pump Shaft . . . . .	60 N-m (44 lb-ft)

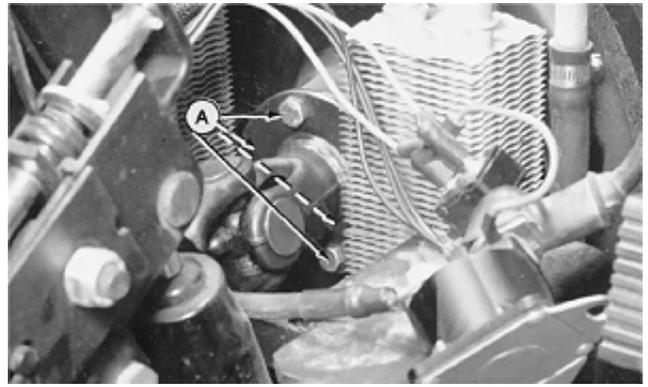
MX,15905025,1 -19-07MAR95

## REMOVE AND INSTALL DRIVE SHAFT—318 AND 420

1. Disconnect battery negative (—) cable.
2. Remove right-hand engine side panel.
3. Remove belly screen/pan.

*NOTE: Pedestal side removed for for photographic purpose only.*

4. Hold drive shaft with screwdriver and remove four cap screws (A) holding drive shaft to crankcase pulley.
5. Loosen two lock nuts and cap screws, if equipped, on drive shaft at transmission pump shaft end.
6. Pull rearward on drive shaft and turn U-joint to clear crankshaft pulley.

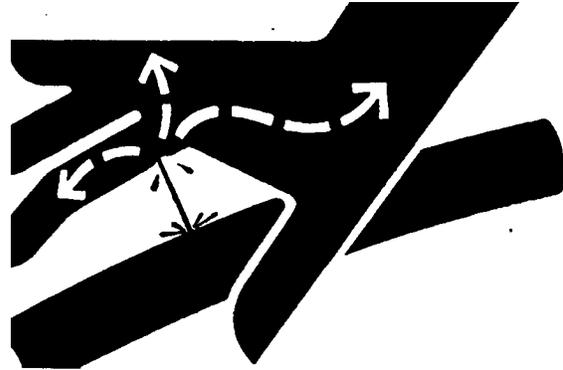


M43706 -UN-12JAN90

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MX,15905025,2 -19-07MAR95

**N** **CAUTION:** To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.



*NOTE: Fender deck and fuel tank removed for photographic purpose only.*

7. On 318; Remove hydraulic lines (A) from control valve as necessary to gain clearance for drive shaft to be pulled forward from the transmission input shaft.

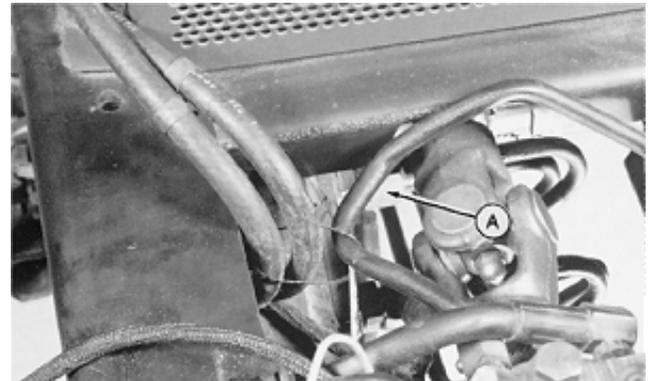
8. Remove drive shaft from tractor.

9. Installation is done in the reverse order of removal.

- Before installing drive shaft, apply MPG-2® Multi-Purpose Polymer Grease on splines of transmission input shaft.

- Apply multipurpose grease to lubrication fittings.

- Bleed hydraulic system. (See procedure in Section 270, Group 20.)



**TORQUE SPECIFICATIONS**

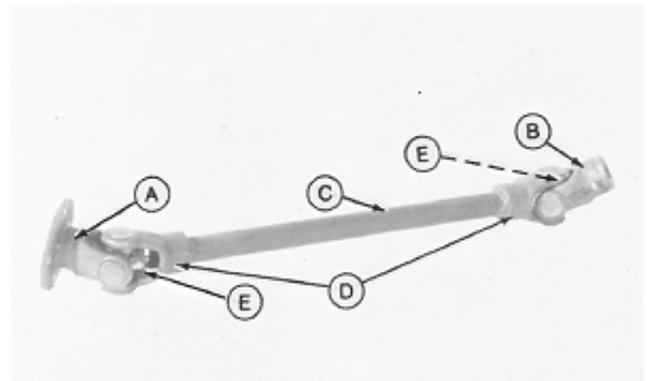
Drive Shaft Cap Screws	
Flange-to-Engine . . . . .	27 N-m (20 lb-ft)
Clamping Yoke-to-Transmission	
Pump Shaft . . . . .	60 N-m (44 lb-ft)

MX,15905025,3 -19-07MAR95

**DISASSEMBLE AND INSPECT DRIVE SHAFT**

1. Inspect flanged yoke (A), splined yoke (B), shaft (C), end yokes (D) and cross and bearing assembly (E) for cracks, wear, and bending.

- A—Flanged Yoke
- B—Splined Yoke
- C—Shaft
- D—End Yoke (2 used)
- E—Cross and Bearing Assembly (2 used)



MX,15905025,7 -19-20JAN95

-UN-23AUG88

X9811

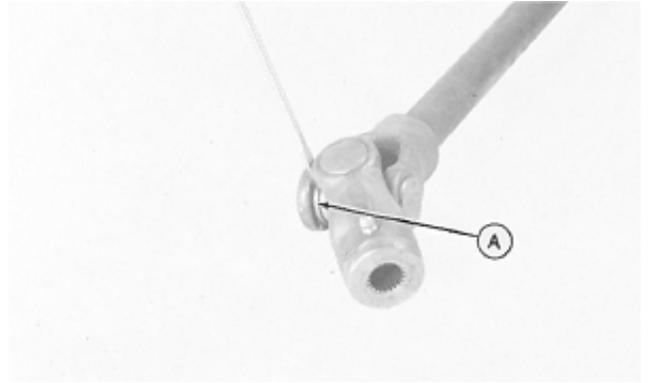
-UN-12JAN90

M43707

-UN-12JAN90

M43747

2. Remove four snap rings (A).



M43748 -UN-12JAN90

M21.5025K,8 -19-08SEP86

3. Remove cross and bearing assembly using soft metal rod. Push bearing down until it can be removed.

4. Turn cross and bearing assembly over. Push down until bearing can be removed.

5. Separate end yoke from splined yoke.

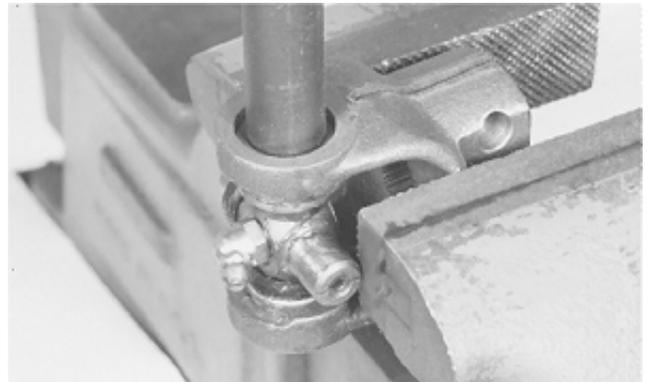


M43739 -UN-12JAN90

M21.5025K,9 -19-17SEP86

6. Remove cross and bearing assembly using a soft metal rod. Push bearing down until bottom bearing can be removed.

7. Remove cross and top bearing.



M36591 -UN-25JAN90

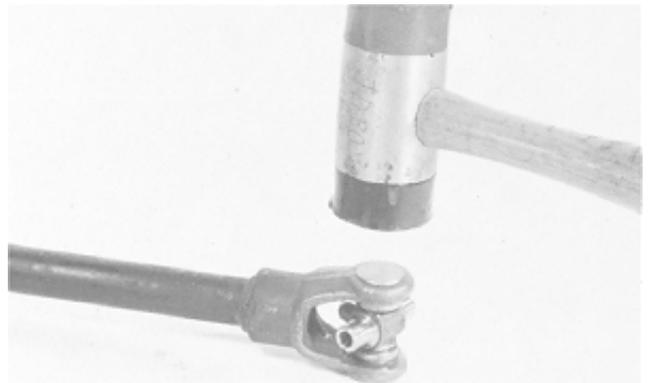
MX,15905025,4 -19-07MAR95

Clamping-Yoke Shown

## ASSEMBLE DRIVE SHAFT

**IMPORTANT: Be careful not to damage needle rollers and seal while installing cross and bearing assembly.**

1. Install cross and bearing assembly using soft-faced hammer or press. Push bearing down until snap ring groove is inside end yoke.



M43752 -UN-12JAN90

MX,15905025,8 -19-20MAR95

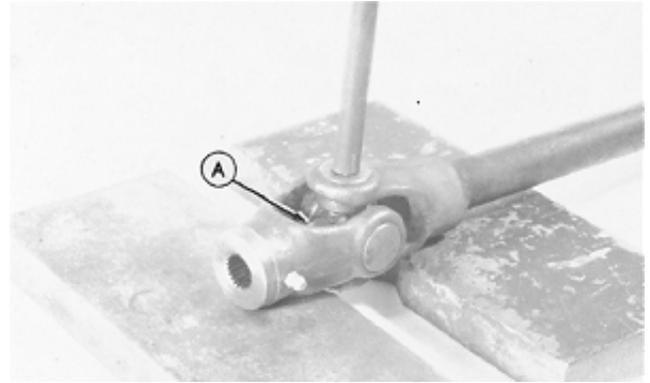
## Drive Shaft/Assemble

2. Install cross in splined yoke with grease fitting toward splined yoke (A).

3. Install bearing with soft metal rod and press or soft-faced hammer. Push bearing down only until snap ring groove is inside splined yoke.

4. Turn cross and bearing assembly over and install other bearing.

5. Install four snap rings.



MX,15905025,5 -19-20MAR95

M43753 -UN-12JAN90

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# Section 60 STEERING AND BRAKE REPAIR

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Inspect and Repair—318 . . . . .	60-10-13
Inspect and Repair—420 . . . . .	60-10-19
Inspect and Repair Park Brake Lever . . .	60-10-24



**SPECIAL OR ESSENTIAL TOOLS**

*NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).*

DX,TOOLS -19-05JUN91

Steering Gear Service Set.....JDG457

Used to service steering gearbox.

MX,JDG457 -19-01MAR95

**SERVICE PARTS KITS**

The following kits are available through your parts catalog:

Return Guide Clamp Kit

Side Cover Kit

MX,15906005,KIT-19-01MAR95

60  
05  
1

## REMOVE AND INSTALL STEERING GEARBOX AND SHAFT

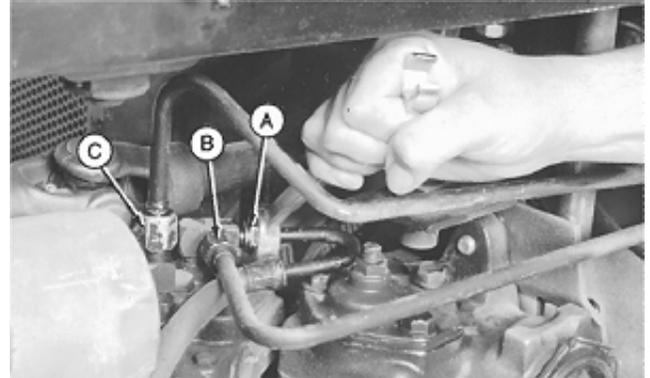
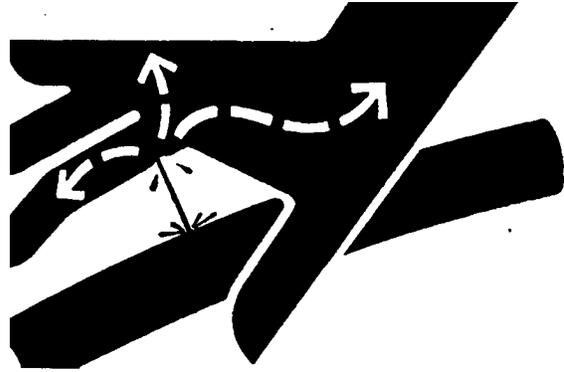
1. Remove drive shaft. (See procedure in Section 50, Group 25.)
2. Remove engine side panels, battery and battery base.
3. Remove fender deck.

**IMPORTANT:** Do not pound on end of steering shaft or damage to steering shaft will occur.

4. Remove steering wheel.

**CAUTION:** To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

5. Disconnect lines (A, B and C) from hydraulic control valve.



-UN-23AUG88

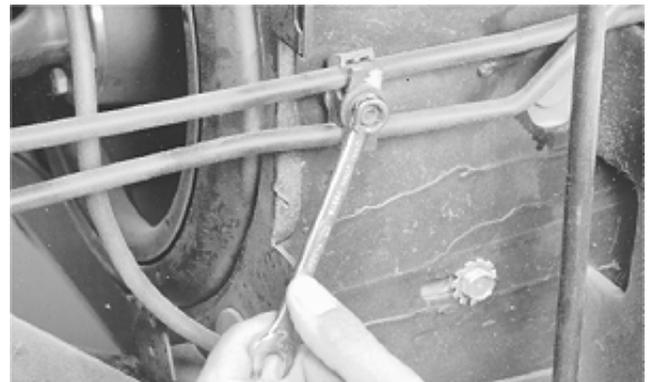
X9811

-UN-03OCT89

M33937

MX,15906005,1 -19-29MAR95

6. Remove nut and line clamp.

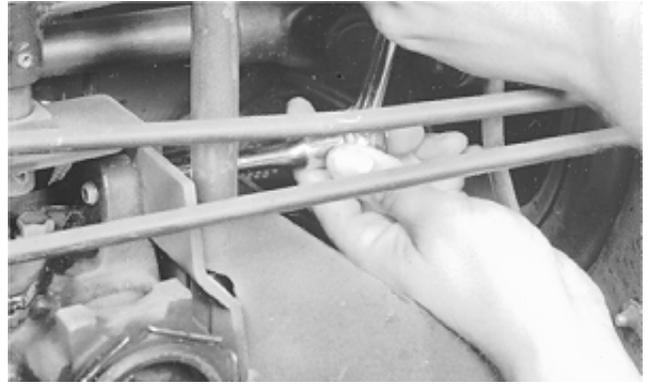


MX,15906005,2 -19-10MAR95

-UN-03OCT89

M33938

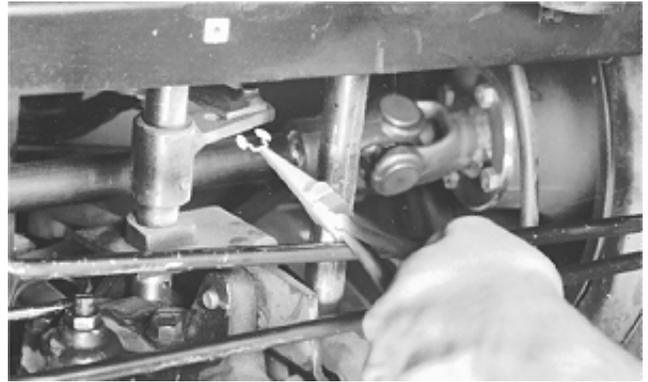
7. Remove bracket mounting cap screw.



M33939  
-UN-03OCT89

MX,15906005,3 -19-10MAR95

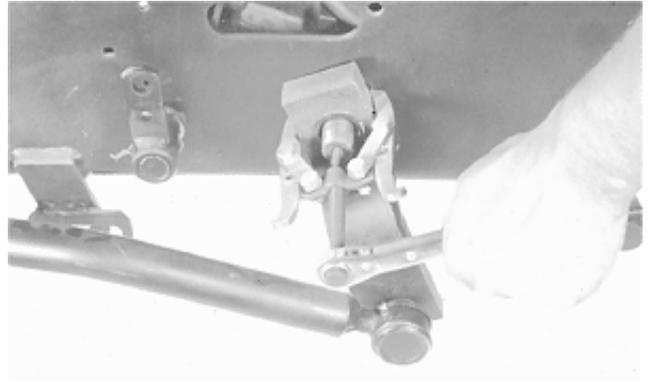
8. Remove clip and disconnect brake neutral return linkage.



M33940  
-UN-03OCT89

MX,15906005,4 -19-10MAR95

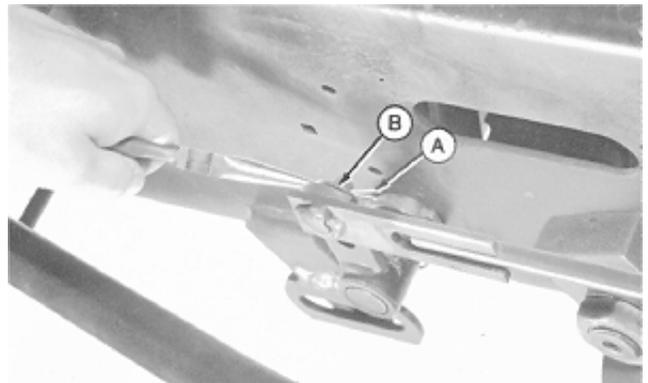
9. Remove pitman arm nut and washer. Remove pitman arm using a two-jaw puller.



M33942  
-UN-03OCT89

MX,15906005,5 -19-10MAR95

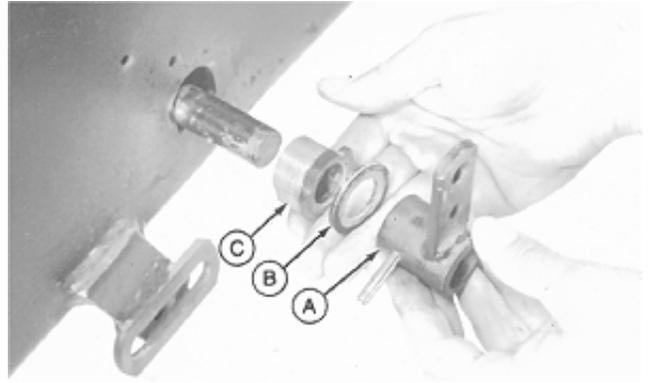
10. Remove cotter pin (A) and washer (B) to disconnect brake linkage on left side of machine frame.



M33943  
-UN-03OCT89

MX,15906005,6 -19-10MAR95

11. Remove safety wire and spring pin to remove brake arm (A), washer (B) and bushing (C).

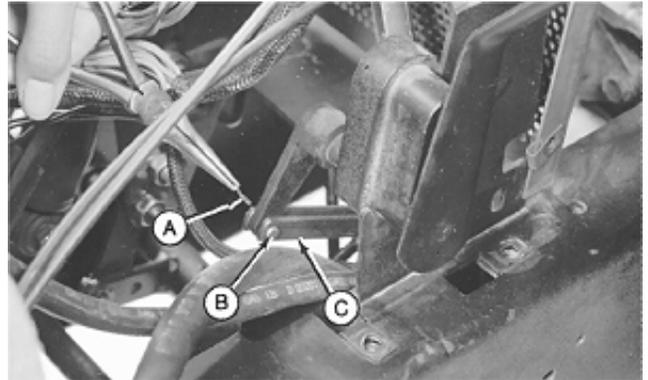


MX,15906005,7 -19-10MAR95

M33958 -UN-03OCT89

12. Remove left side of pedestal.

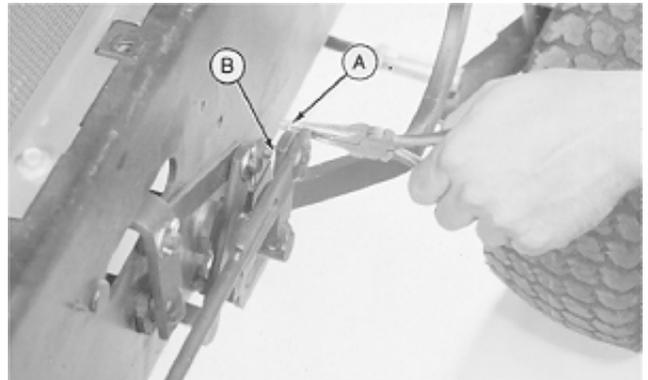
13. Remove cotter pin (A) and draft pin (B). Turn rockshaft control valve linkage (C) to gain access for steering shaft removal.



MX,15906005,8 -19-10MAR95

M33961 -UN-03OCT89

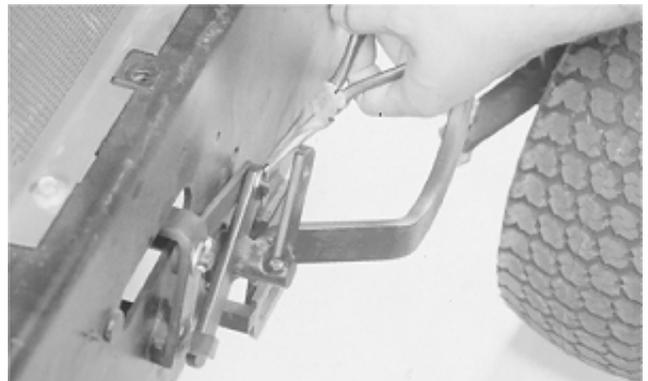
14. Remove cotter pins (A) and washers (B) to disconnect brake linkage on right side of machine frame.



MX,15906005,9 -19-10MAR95

M34170 -UN-08NOV89

15. Remove cotter pin and washer to disconnect link from brake linkage.

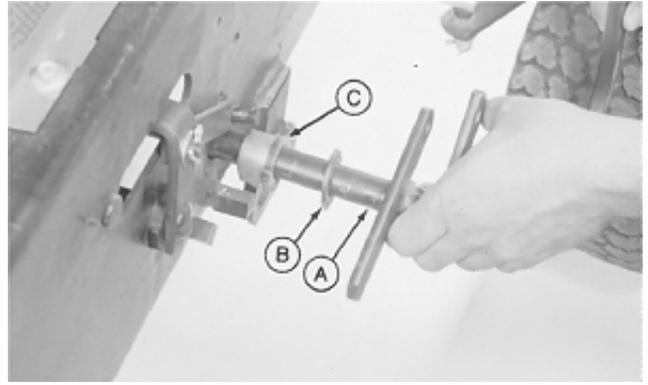


MX,15906005,10 -19-10MAR95

M33962 -UN-03OCT89

60-05-4

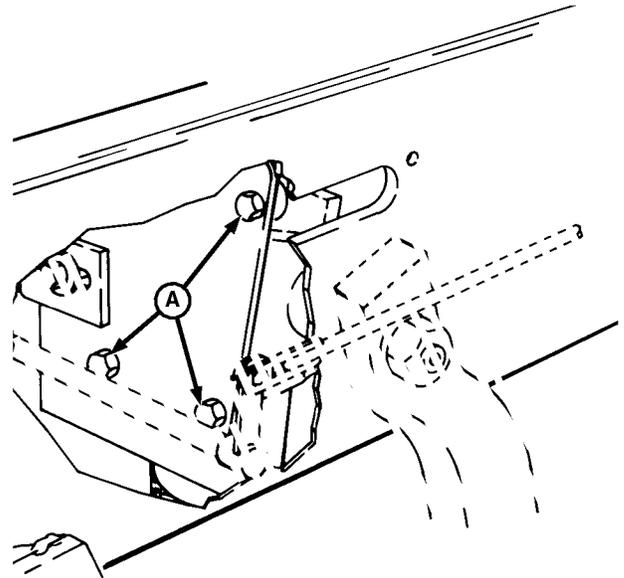
16. Remove brake arm (A), washer (B) and bushing (C).



M33963 -UN-03OCT89

MX,15906005,11 -19-10MAR95

17. Remove three cap screws (A) from gearbox mounting plate.

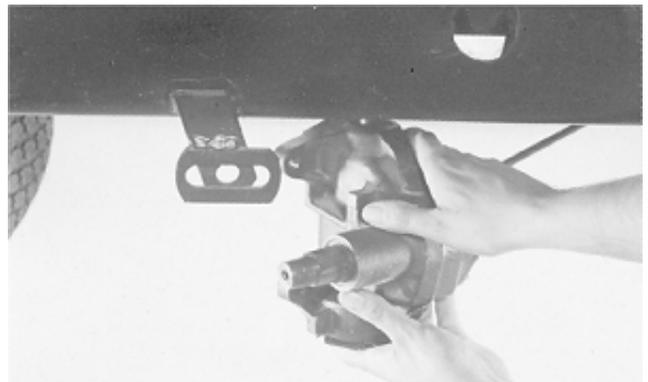


M77339 -UN-14MAR95

MX,15906005,12 -19-10MAR95

18. Remove steering gearbox and shaft as an assembly, from bottom of machine.

19. Make repairs as necessary. (See procedure in this group.)



M33965 -JUN-03OCT89

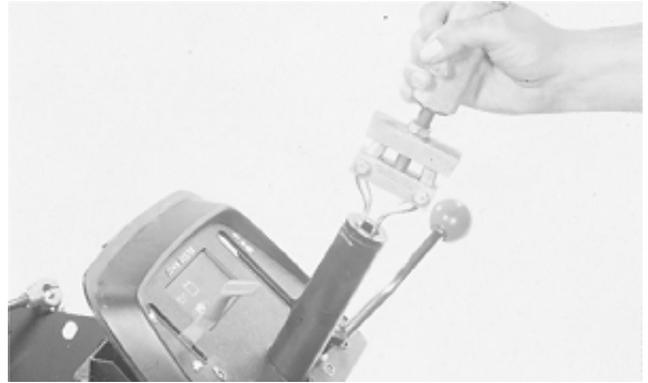
MX,15906005,13 -19-10MAR95

20. Inspect steering shaft bushings for wear or damage. Replace if necessary.

21. Remove bushings using a pilot bearing puller.

22. Installation is done in the reverse order of removal.

- If removed, install steering shaft bushings using a driver set.
- Apply multipurpose grease to I.D. of steering shaft bushings.



M34018 -UN-03OCT89

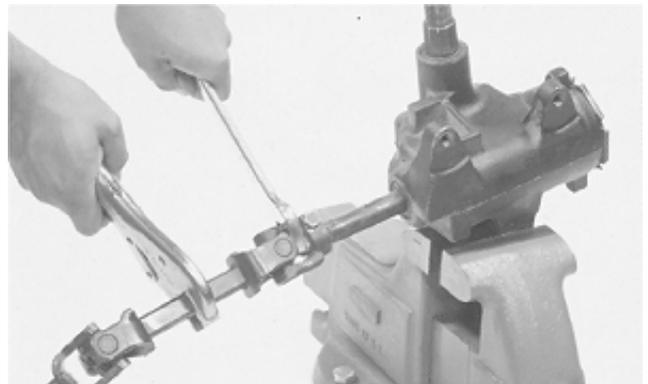
**TORQUE SPECIFICATIONS**

Gearbox Mounting Cap Screws . . . . .	95 N·m (70 lb-ft)
Steering Wheel-to-Shaft Nut . . . . .	15 N·m (133 lb-in.)
Pitman Arm Nut . . . . .	224 N·m (165 lb-ft)

MX,15906005,14 -19-10MAR95

**DISASSEMBLE AND INSPECT STEERING GEARBOX AND SHAFT**

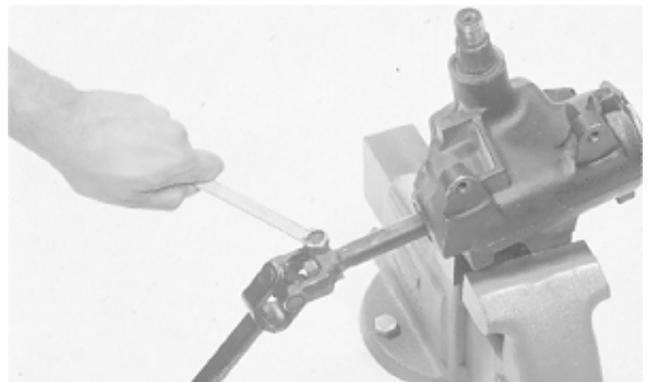
1. Put an open-end wrench between both steering shaft universal joints.
2. Turn steering shaft using locking pliers to determine amount of play at universal joints. Replace steering shaft if play exists.



M33966 -UN-03OCT89

MX,15906005,15 -19-01MAR95

3. Remove cap screw and washer from universal joint.
4. Remove steering shaft from gearbox.
5. Inspect steering shaft spline for wear or damage. Replace if necessary.



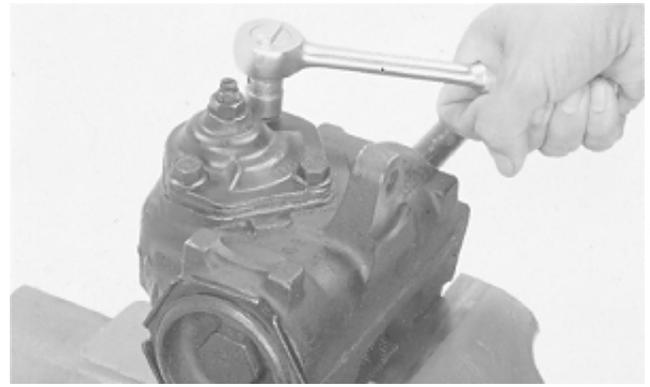
M33967 -UN-03OCT89

MX,15906005,16 -19-01MAR95

60-05-6

6. Put gearbox in a vise.

7. Remove three side cover cap screws.

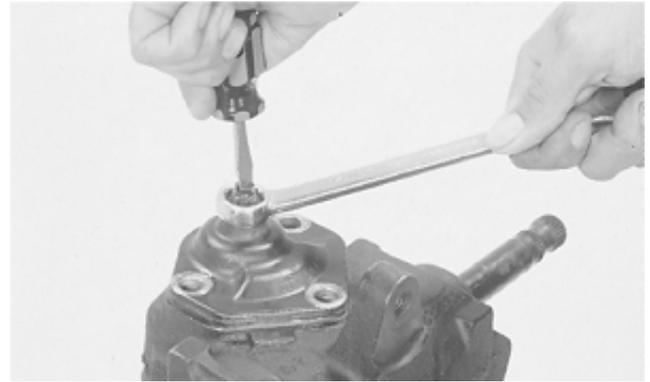


M33969 -UN-03OCT89

MX,15906005,17 -19-01MAR95

*NOTE: If replacing side cover gasket only, it is not necessary to remove preload adjuster nut.*

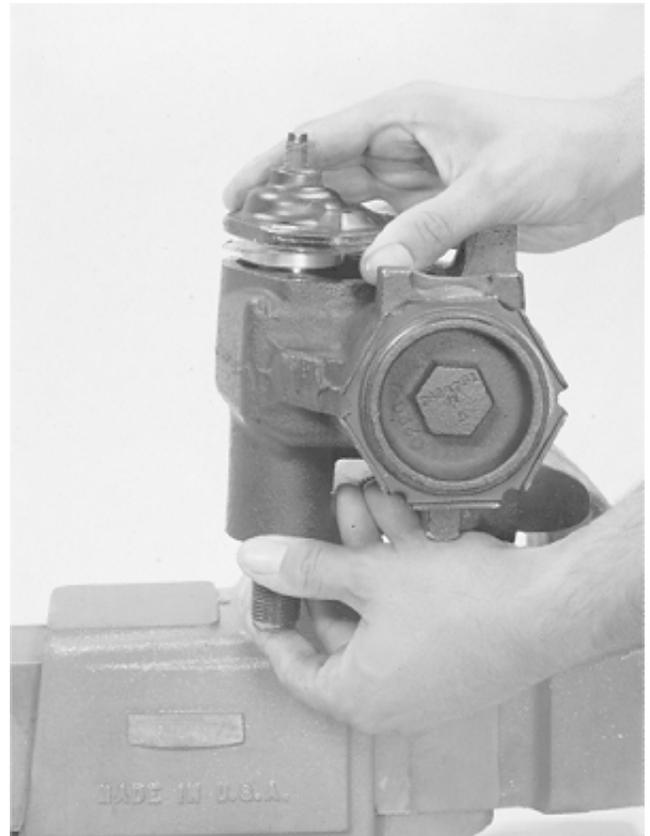
8. Hold preload adjuster screw and remove adjuster nut.



M33970 -UN-03OCT89

MX,15906005,18 -19-01MAR95

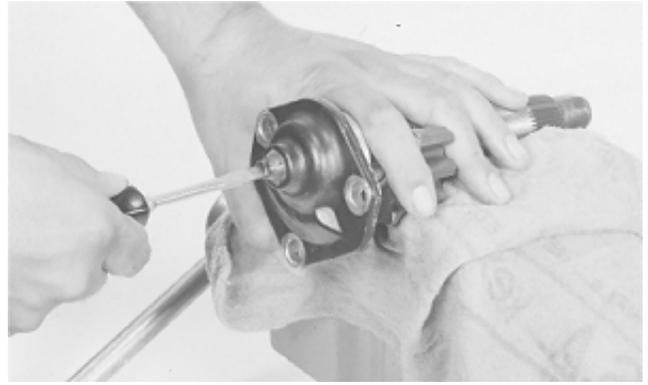
9. Remove pitman shaft, gasket and side cover as an assembly.



M33971 -UN-03OCT89

MX,15906005,19 -19-01MAR95

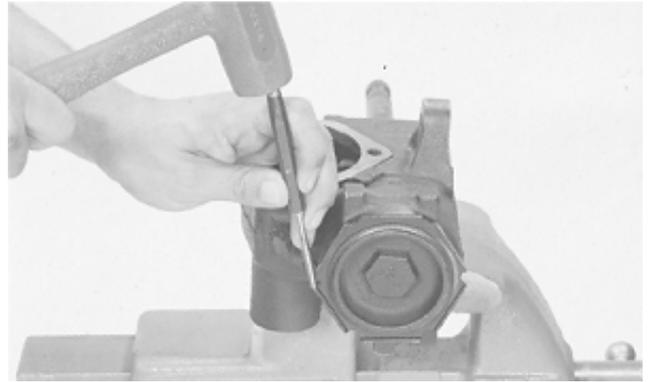
10. Remove preload adjuster and shim, if equipped, from side cover.



M33972 -UN-03OCT89

MX,15906005,20 -19-01MAR95

11. Remove worm bearing adjuster lock nut using a punch and hammer.



M33973 -UN-03OCT89

MX,15906005,21 -19-01MAR95

12. Remove worm bearing adjuster.

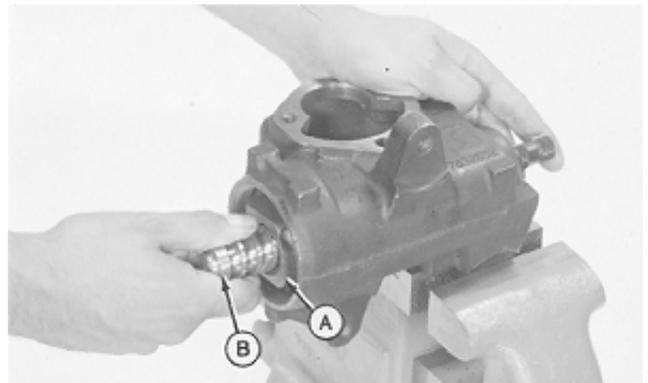


M33974 -UN-08NOV89

MX,15906005,22 -19-01MAR95

**IMPORTANT: Do not allow worm shaft to turn to the end of its travel or damage can occur to the ends of the ball guides.**

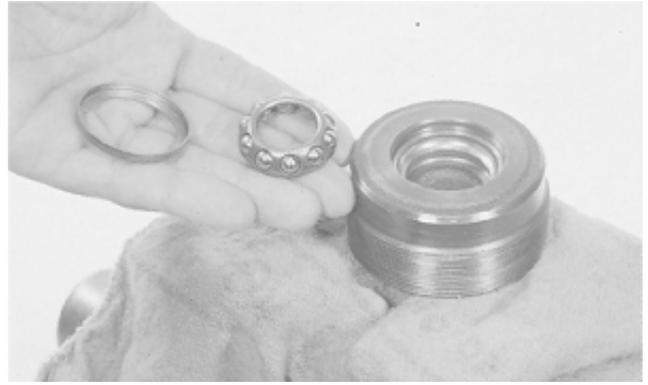
13. Remove ball nut (A) and worm shaft (B).



M33978 -UN-03OCT89

MX,15906005,23 -19-01MAR95

14. Pry out lower bearing retainer using a screwdriver.
15. Remove lower worm bearing cone.



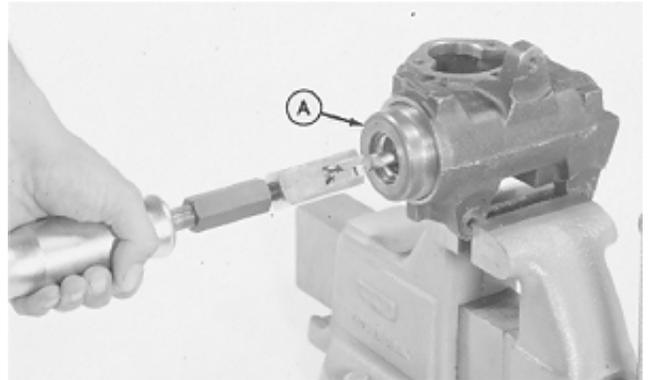
M33976 -UN-03OCT89

MX,15906005,24 -19-01MAR95

*NOTE: Bearing cup is press-fit in bearing adjuster. Remove bearing cup only if replacement is necessary.*

*Bearing cups and cones are matched and must be replaced as complete assemblies.*

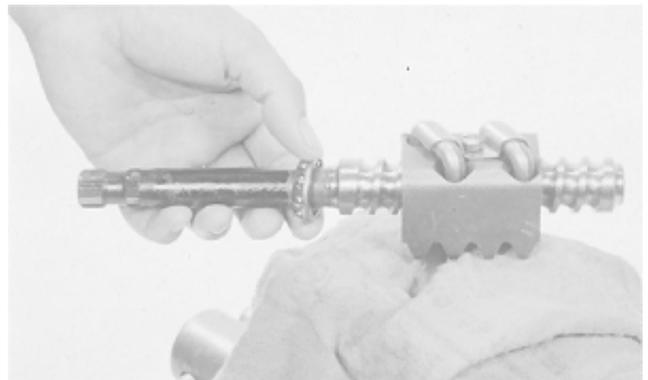
16. Inspect bearing cup in bearing adjuster for wear or damage. Replace if necessary.
17. Screw bearing adjuster (A) into gearbox housing. Remove bearing cup using a slide hammer and puller from JDG457 Steering Gear Service Set.



M33977 -UN-03OCT89

MX,15906005,25 -19-01MAR95

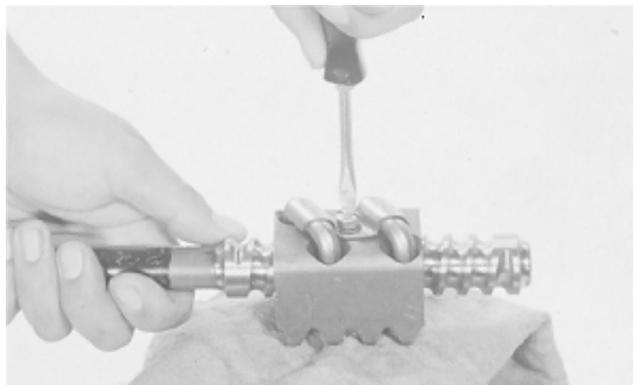
18. Remove upper worm bearing cone from shaft or gearbox housing.



M33979 -UN-03OCT89

MX,15906005,26 -19-01MAR95

19. Remove ball guide screw and clamp.



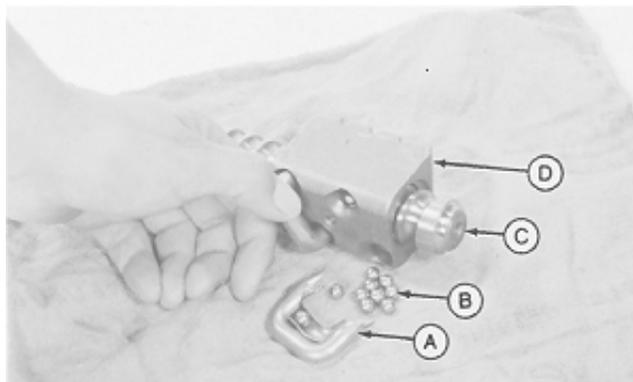
M33980 -UN-03OCT89

MX,15906005,27 -19-01MAR95

20. Remove ball guides (A), balls (B) and ball nut (D) from worm shaft (C).

*NOTE: Ball nut and worm shaft are matched and must be replaced as a complete assembly.*

*If any ball becomes lost or damaged, install new balls as a complete set.*



M33981 -UN-03OCT89

21. Inspect all parts for wear or damage. Replace as necessary.

- A—Ball Guides
- B—Balls (50 used)
- C—Worm Shaft
- D—Ball Nut

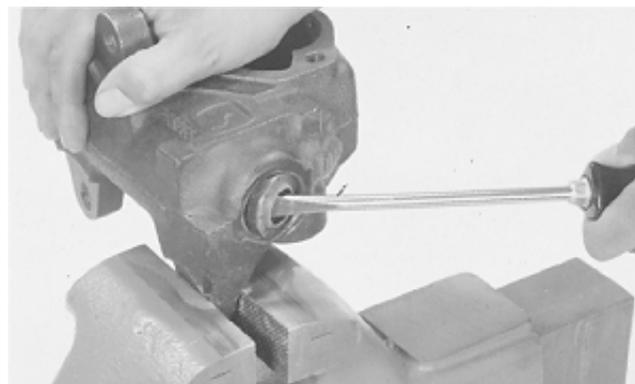
MX,15906005,28 -19-01MAR95

60  
05  
10

22. Remove pitman shaft and worm shaft seals from gearbox housing.



Pitman Shaft Seal



Worm Shaft Seal

MX,15906005,29 -19-01MAR95

M34019 -UN-03OCT89

M34020 -UN-03OCT89

60  
05  
11

*NOTE: Pitman shaft needle bearing and worm shaft bearing cup are press-fit in gearbox housing. Remove bearing or cup only if replacement is necessary.*

*Lip (B) is part of gearbox housing, not part of bearing race.*

23. Inspect needle bearing and bearing cup (A) in gearbox housing for wear or damage. Replace if necessary.

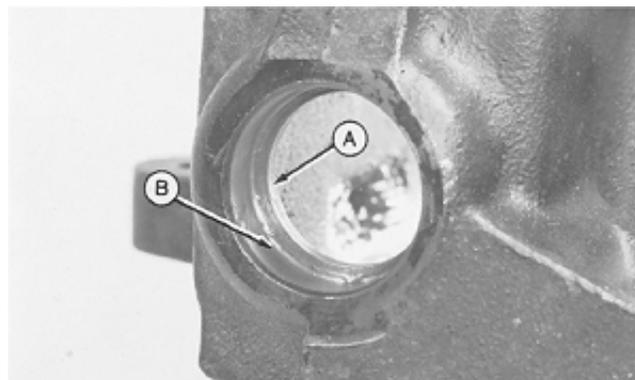
24. Remove needle bearing using a driver from JDG457 Steering Gear Service Set.

25. Remove bearing cup using a driver set.

26. Inspect pitman shaft for roller wear or other damage. Replace if necessary.



Needle Bearing



Bearing Cup

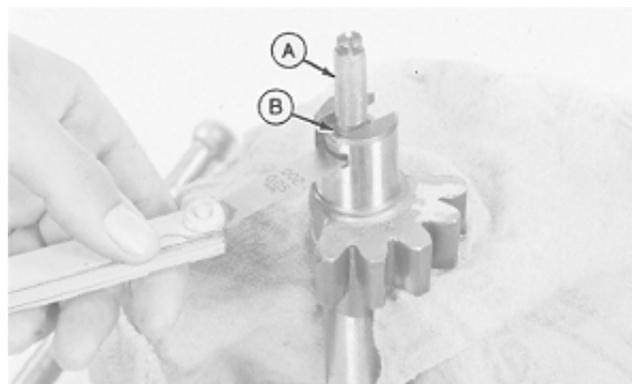
MX,15906005,30 -19-10MAR95

M33987 -UN-03OCT89

M34021 -UN-03OCT89

*NOTE: A steering gearlash adjustment shim is available through the parts catalog.*

27. Check preload adjuster (A) end clearance with a feeler gauge as shown. If clearance is greater than 0.05 mm (0.002 in.), order and install shim (B).



MX,15906005,31 -19-10MAR95

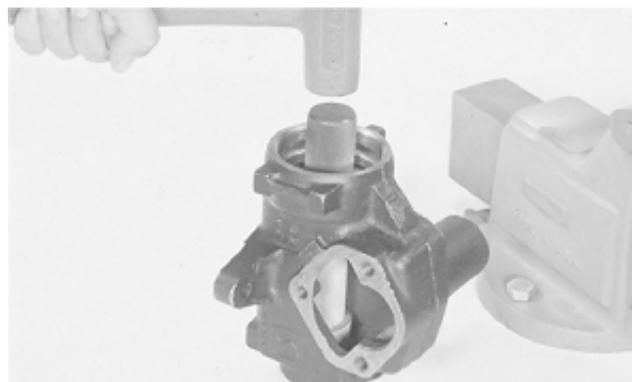
M33989 -UN-03OCT89

## ASSEMBLE STEERING GEARBOX AND SHAFT

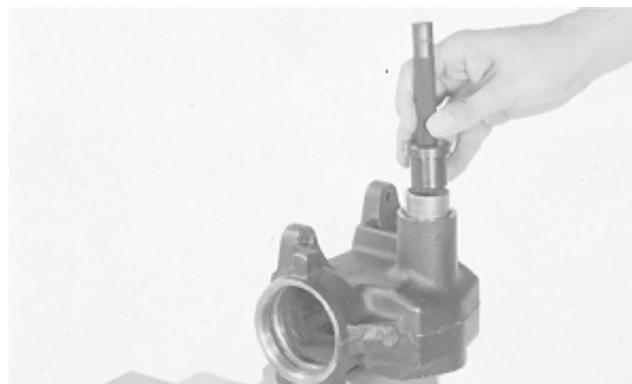
**IMPORTANT: Always use new seals and gasket. Damaged or used parts will leak.**

*NOTE: Apply clean multipurpose grease on all internal parts during assembly.*

1. Install new worm shaft bearing cup in gearbox housing, if removed, using a driver set.
2. Install new needle bearing in gearbox housing, if removed, using a driver from JDG457 Steering Gear Service Set.



Bearing Cup



Needle Bearing

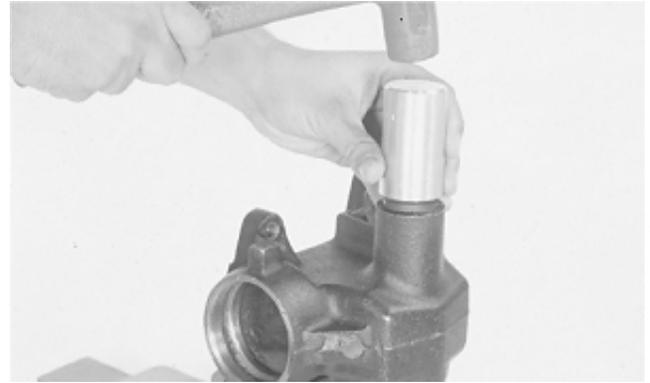
MX,15906005,32 -19-01MAR95

M34159 -UN-08NOV89

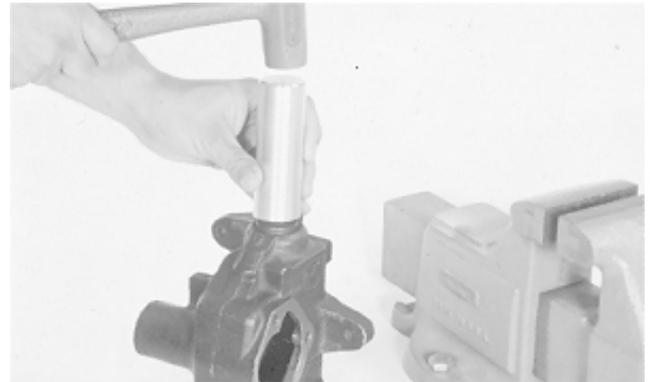
M34160 -UN-08NOV89

3. Install new pitman shaft and worm shaft seals into gearbox housing using drivers from JDG457 Steering Gear Service Set.

4. Apply multipurpose grease to lip of seals.



Pitman Shaft Seal



Worm Shaft Seal

MX,15906005,33 -19-01MAR95

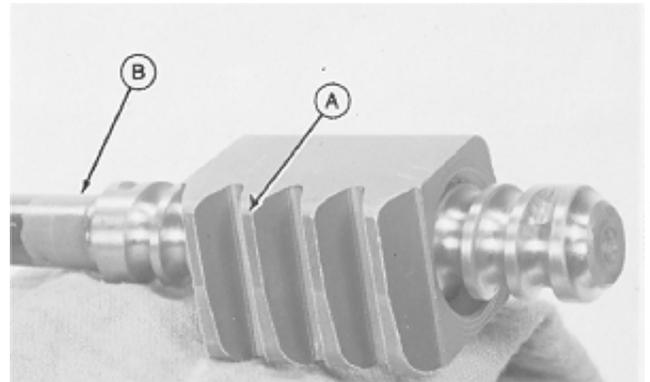
M34161 -UN-08NOV89

M34158 -UN-08NOV89

60-05-13

**IMPORTANT:** Install ball nut onto worm shaft as shown. An improperly installed ball nut could cause gear damage or steering lockup.

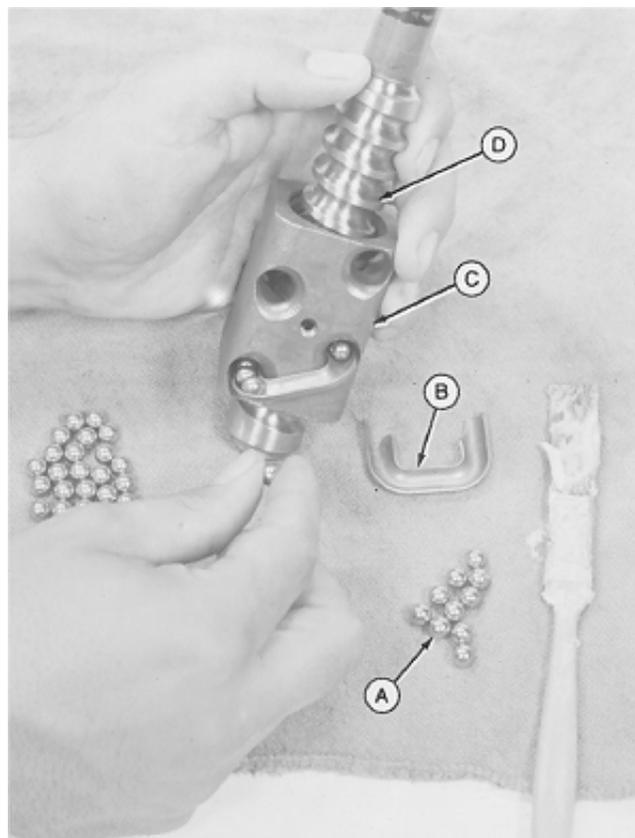
5. Assemble ball nut and worm shaft (B) with narrow end of ball nut teeth up (A) and worm shaft at the left.



MX,15906005,34 -19-01MAR95

M33988 -UN-03OCT89

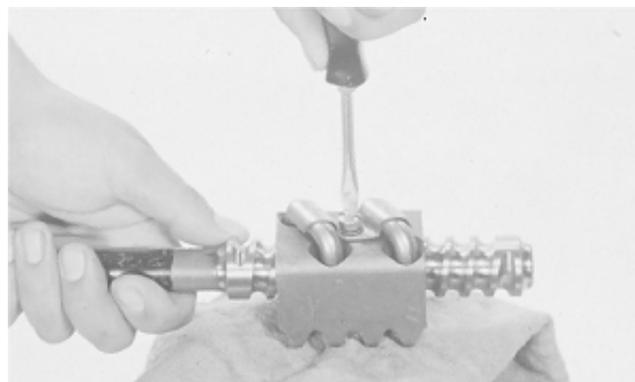
6. Insert ball guide half into ball nut (C) as shown.
7. Fill circuit with 27 balls (A) and install other half of ball guide (B).
8. Repeat procedures on other circuit with remaining balls and guides.



MX,15906005,35 -19-01MAR95

M33992 -UN-03OCT89

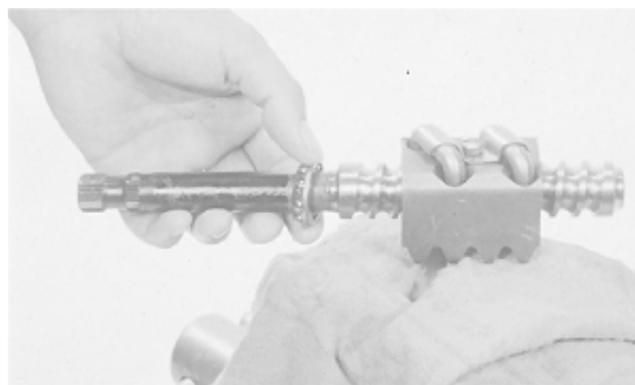
9. Install ball guide clamp with screws and tighten securely.



MX,15906005,36 -19-01MAR95

M33980 -UN-03OCT89

10. Pack upper worm bearing cone with multipurpose grease.
11. Install upper worm bearing on shaft with small O.D. facing away from ball nut.

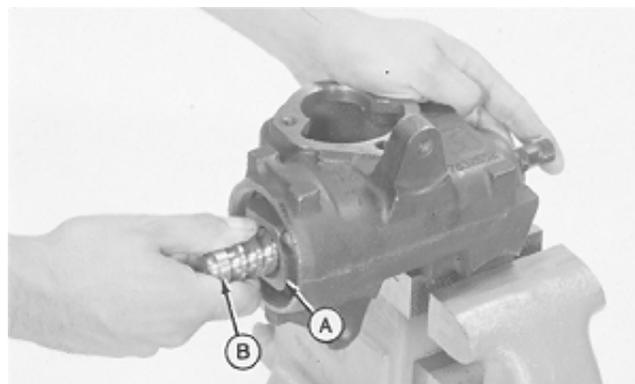


MX,15906005,37 -19-01MAR95

M33979 -UN-03OCT89

**IMPORTANT: Tape splined end of worm shaft to prevent seal damage during shaft installation.**

12. Apply tape around splined end of worm shaft.
13. Install ball nut (A) and worm shaft (B) with bearing cone, into gearbox housing. Remove tape.



MX,15906005,38 -19-01MAR95

M33978 -UN-03OCT89

14. Install new bearing cup in worm bearing adjuster, if removed, using a driver set.
15. Pack lower worm bearing cone with multipurpose grease.
16. Install lower worm bearing cone into worm bearing adjuster with large O.D. facing away from threaded end of adjuster.
17. Install retainer until flush with outside surface of adjuster, using a plastic hammer.
18. Apply a coat of a lithium base grease to threads of worm bearing adjuster.



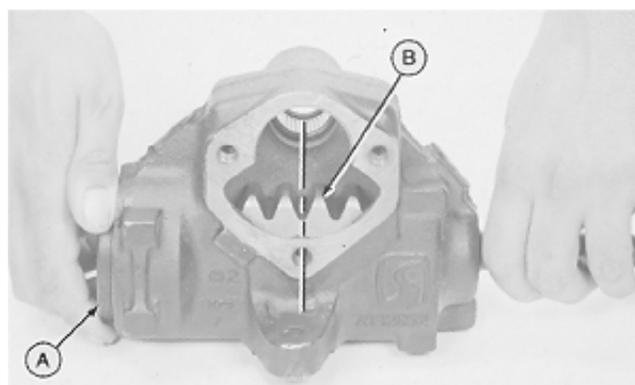
MX,15906005,39 -19-01MAR95

M33996 -UN-03OCT89

19. Install worm bearing adjuster (A).

**IMPORTANT: Ball nut must be centered during assembly. If not, the steering will only turn fully in one direction and damage can be done by bottoming the worm drive against the ball nut.**

20. Center ball nut (B) in gearbox housing as shown.
21. Fill gearbox with approximately 312 g (11 oz) of multipurpose grease.



MX,15906005,40 -19-01MAR95

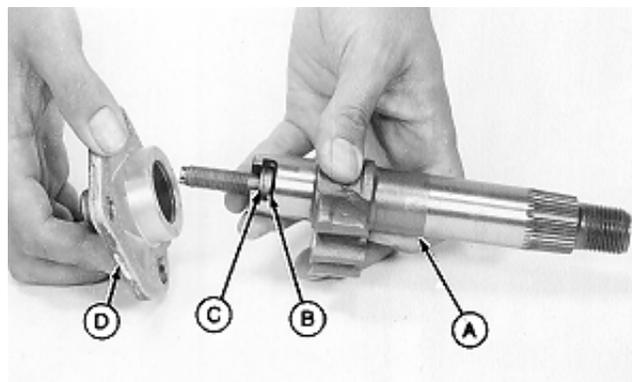
M33997 -UN-03OCT89

22. Assemble pitman shaft (A) with preload adjuster (B) and shim (C), if equipped.

23. Install side cover (D) onto shaft with preload adjuster.

24. Turn preload adjuster screw counterclockwise until it bottoms. Then, back screw off one-half turn.

- A—Pitman Shaft
- B—Preload Adjuster
- C—Shim (if equipped)
- D—Side Cover



M33999 -UN-06MAR95

MX,15906005,41 -19-01MAR95

25. Install new gasket on side cover.

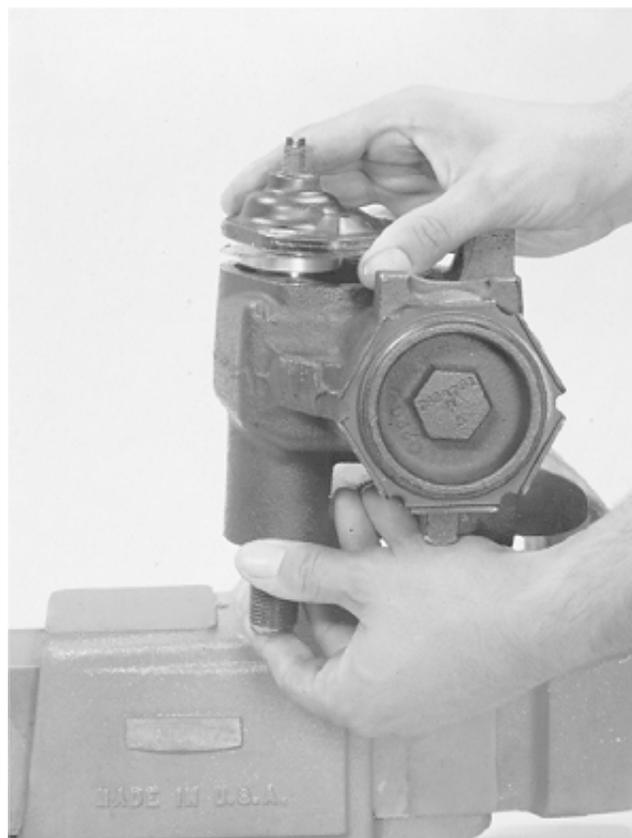
**IMPORTANT: Tape end of pitman shaft to prevent seal damage during shaft installation.**

26. Apply tape around end of pitman shaft.

27. Center teeth of pitman shaft with teeth on ball nut.

28. Install pitman shaft into gearbox housing. Remove tape.

29. Install three side cover cap screws. Tighten cap screws to 40 N·m (30 lb-ft).

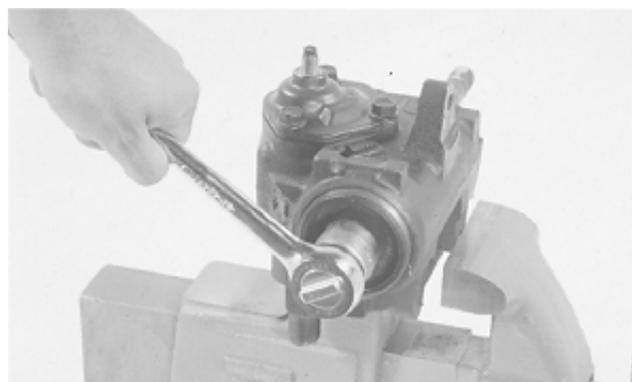


M33971 -UN-03OCT89

MX,15906005,42 -19-01MAR95

30. Adjust worm bearing preload:

- Tighten worm bearing adjuster until it bottoms, then loosen one-quarter turn.

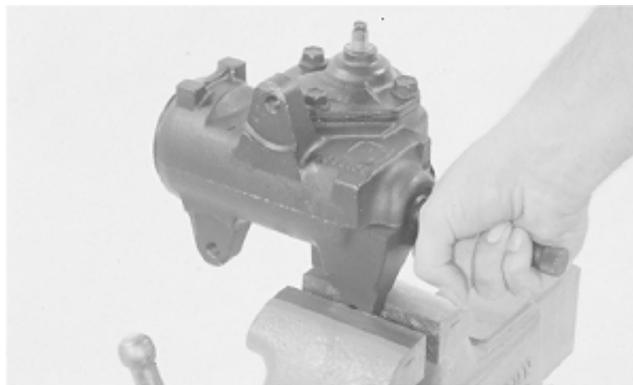


M34006 -UN-03OCT89

MX,15906005,43 -19-01MAR95

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16

- Carefully turn worm shaft all the way to end of travel, then turn back one-half turn.



M34003 -UN-03OCT89

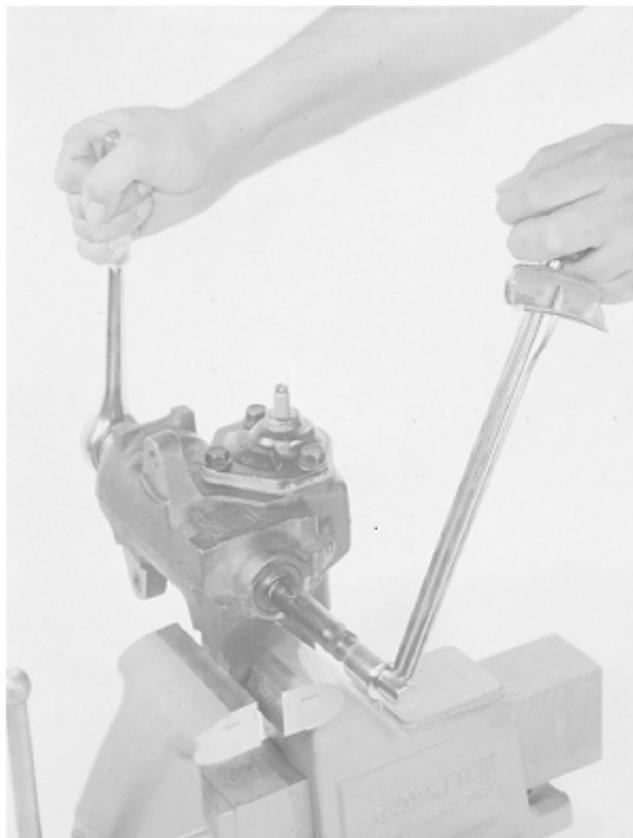
MX,15906005,44 -19-01MAR95

*NOTE: Due to tolerances, some 11/16 in. sockets require a wrapping of card stock around the serrations on end of worm shaft.*

- Install 1-1/8 in. socket with ratchet on worm bearing adjuster and an 11/16 in. 12-point socket with torque wrench on end of worm shaft.

*NOTE: If worm shaft begins to bottom while reading the torque wrench, back worm shaft out and start torque reading again.*

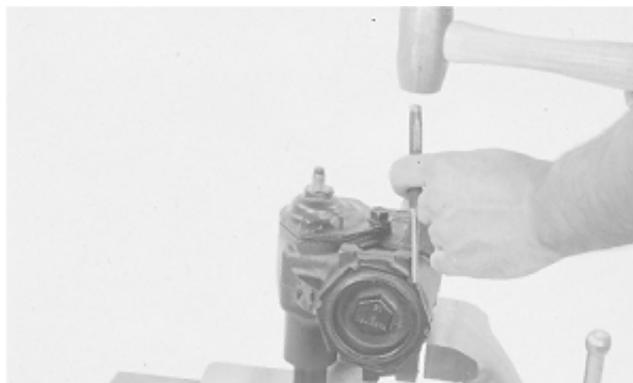
- Tighten worm bearing adjuster until torque wrench reads 0.60—1.0 N·m (5—8 lb-in.) rolling torque.



M34004 -UN-03OCT89

MX,15906005,45 -19-01MAR95

- Install lock nut on worm bearing adjuster and tighten using a punch and hammer.



M34005 -UN-03OCT89

MX,15906005,46 -19-01MAR95

31. Adjust over center preload:

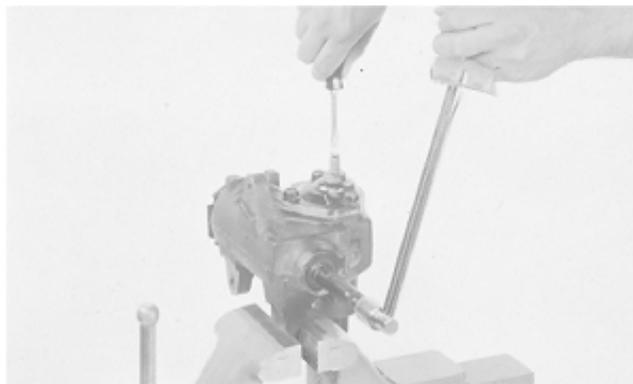
- Back off preload adjuster until it stops, then turn it in one full turn.
- Center gear travel by rotating shaft.
- Check torque required to turn worm shaft. Record reading.



MX,15906005,47 -19-01MAR95

M34002  
-UN-03OCT89

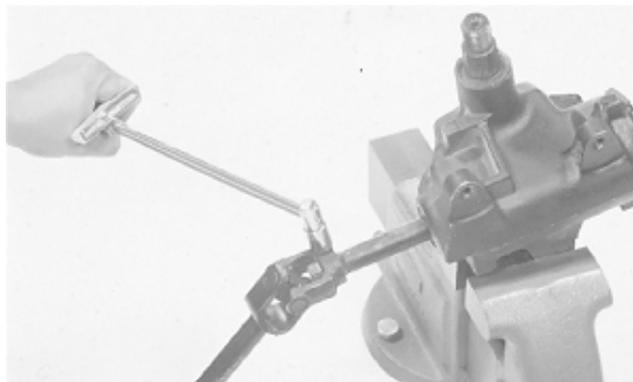
- Turn preload adjuster in, until rolling torque required to turn worm shaft is 0.50—1.20 N·m (4—10 lb-in.) more than first reading.
- Install lock nut. Hold preload adjuster screw and tighten lock nut to 34 N·m (25 lb-ft).



MX,15906005,48 -19-01MAR95

M34008  
-UN-03OCT89

32. Install steering shaft onto worm shaft as shown. Tighten cap screws to 24 N·m (212 lb-in.).



MX,15906005,49 -19-01MAR95

M34010  
-UN-03OCT89

**OTHER MATERIAL**

Number	Name	Use
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
TY9369/NA/222	Thread Lock and Sealer (Low Strength)	Apply to threads of metering assembly screws.

®LOCTITE is a registered trademark of the Loctite Corp.

MX,15906006,OTH-19-01MAR95

**SERVICE PARTS KITS**

The following kits are available through your parts catalog:

- Steering Column (Tube) Bushing Kit
  
- Steering Valve
  - Seal Kit
  - Needle Roller Kit
  - Metering Kit
  - Spring Kit
  - Port Cover and Check Valve Kit

MX,15906006,KIT-19-01MAR95

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06  
1

## REMOVE AND INSTALL STEERING VALVE AND COLUMN

*NOTE: Removal and installation procedures for later models may vary slightly.*

1. Remove fender deck.
2. Remove engine side panels.
3. Remove battery and battery base.

*NOTE: On some machines, it may be necessary to remove hour meter, starter solenoid and circuit breaker to remove right-hand pedestal side.*

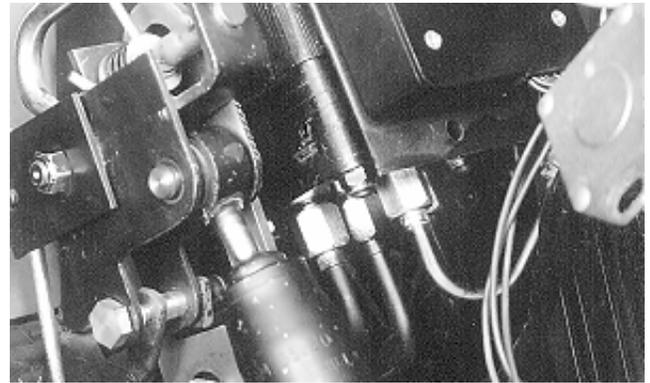
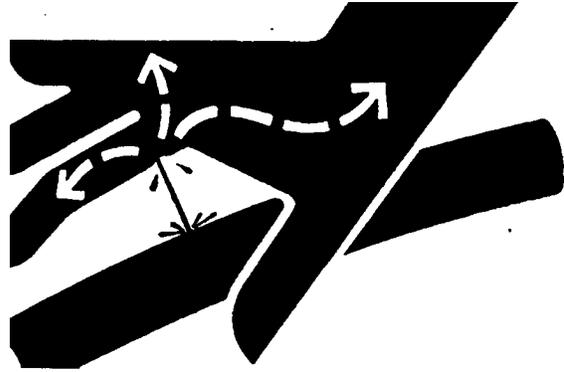
4. Remove right-hand pedestal side.
5. Remove drive shaft. (See procedure in Section 50, Group 25.)

**IMPORTANT: Do not pound on end of steering shaft or damage to steering shaft will occur.**

6. Remove steering wheel.

**N CAUTION:** To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

7. Disconnect hydraulic lines from bottom of steering valve.



-UN-23AUG88

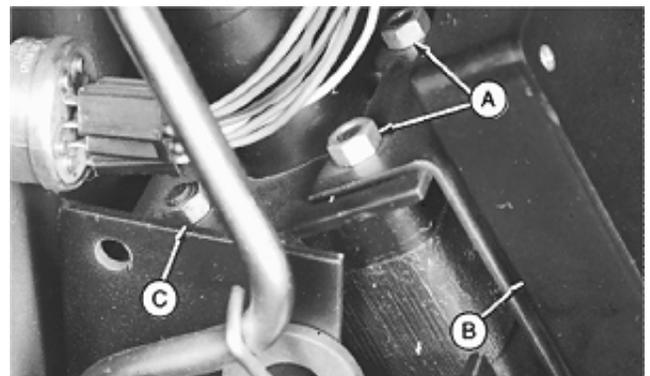
X9811

-UN-06MAR95

M31838

MX,15906006,1 -19-10MAR95

8. Remove two nuts (A). Move electric module (B) away from steering unit.
9. Mark forward face of steering unit to aid in installation.
10. Hold top of steering column and remove nuts (C).



-UN-28JUL89

M31839

MX,15906006,2 -19-10MAR95

11. Remove steering unit from bottom of machine.
12. Make repairs as necessary. (See procedure in this group.)
13. Installation is done in the reverse order of removal.
  - Install steering unit with marks made during removal or with alignment grooves in port manifold and cover, facing toward engine.
  - Tighten steering wheel-to-shaft nut to 15 N·m (133 lb-in.).
  - Bleed hydraulic system. (See procedure in Section 270, Group 20.)



M31840  
-UN-28JUL89

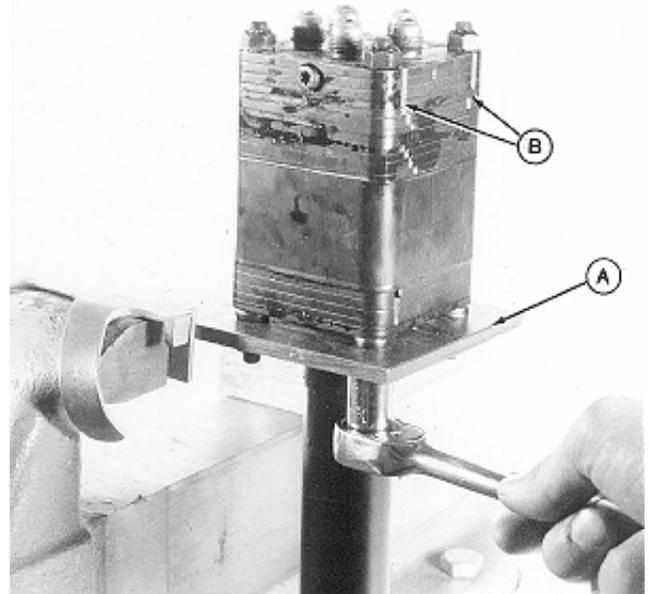
MX,15906006,3 -19-10MAR95

## DISASSEMBLE AND INSPECT STEERING VALVE AND COLUMN

*NOTE: Machines may be equipped with a four or five-port steering valve. The four-port and early five-port have a plug, O-ring and check ball in the side of the port cover. The later five-port has a check ball in the center of the port cover (internal) and no external plug or O-ring.*

**IMPORTANT: Use DFMX1 Steering Valve Fixture when servicing control valve. Holding control valve in a vise can damage valve.**

1. Install DFMX1 Steering Valve Fixture (A) in a vise. (See Section 299 for instructions to make fixture.)
2. Install steering valve, with steering column down, in fixture. Fasten valve to fixture using four 5/16-24 UNF nuts.
3. Check position of alignment grooves (B) to aid in assembly.



Early Five-Port Shown

M43839  
-UN-06MAR95

MX,15906006,4 -19-10MAR95

4. Four-port and early five-port; Loosen plug one turn.



M77338  
-JUN-21FEB95

MX,15906006,5 -19-14MAR95

**IMPORTANT: Do not damage fittings during nut removal. Do not nick or scratch the machined surfaces of the steering valve.**

5. Remove nuts to remove port cover assembly (four plates bonded together).

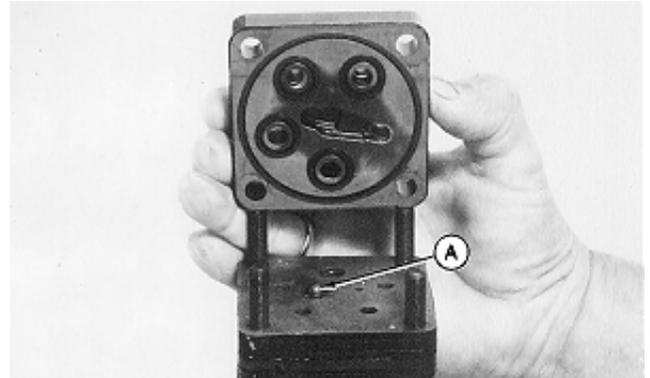


M43841  
-JUN-08JAN90

MX,15906006,6 -19-10MAR95

*Early Five-Port Shown*

6. Later five-port; Remove port cover and check ball (A).



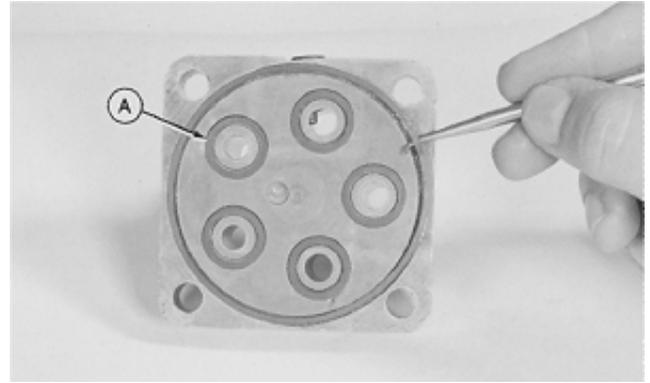
M77303  
-JUN-06MAR95

MX,15906006,7 -19-10MAR95

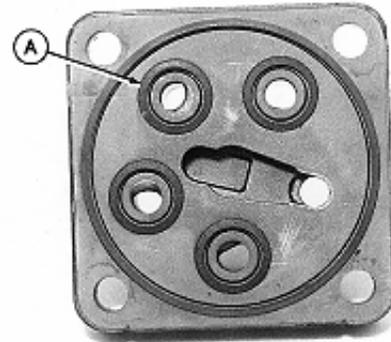
*NOTE: Four-port not shown. Unit is similar to early five-port.*

7. Remove seal ring and O-rings (A).

8. Inspect port cover for scratches on machined surfaces or damage to fittings. Replace cover if damaged.



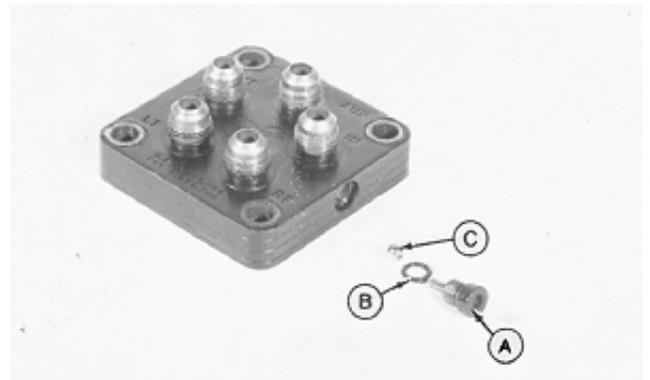
Early Five-Port



Later Five-Port

MX,15906006,8 -19-29MAR95

9. Four-port and early five-port; Remove plug (A), O-ring (B) and check ball (C).



Five-Port Shown

MX,15906006,9 -19-10MAR95

*NOTE: Port manifold has three springs which may come loose during disassembly.*

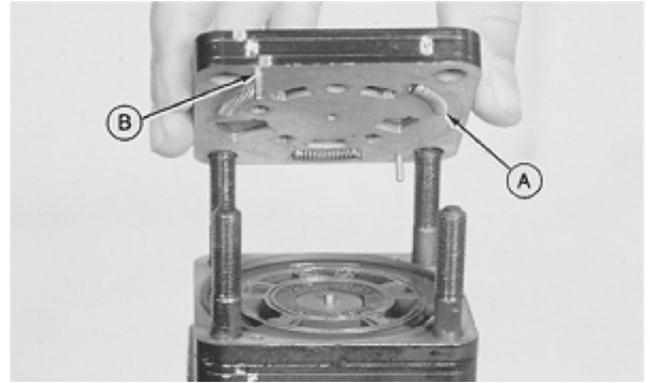
10. Carefully remove port manifold (three plates bonded together).

**IMPORTANT: Do not interchange springs. The steering valve has two sets of springs. Keep springs with respective manifold.**

11. Remove three springs (A).

*NOTE: If one or more springs are damaged, all six springs in valve must be replaced.*

12. Inspect springs and pins (B) for distortion, wear, or damage.

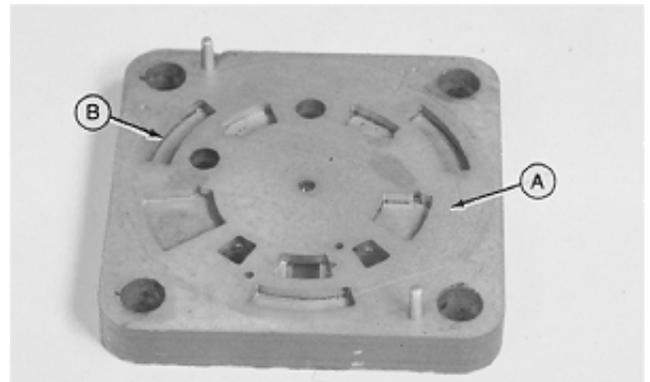


M36636 -UN-29AUG88

MX,15906006,10 -19-10MAR95

13. Inspect port manifold machined surfaces (A) for scratches or scoring. A polished pattern from the rotation of the valve plate and hex drive assembly is normal. All edges (B) must be sharp, free of nicks and burrs.

*NOTE: Scoring is indicated by fine scratches or grooves cut into the manifold. When these scratches can be detected by feel finger nail or lead pencil, the manifold should be replaced.*



M36637 -UN-29AUG88

MX,15906006,11 -19-01MAR95

14. Remove the valve ring and two seal rings (A). Check valve ring for nicks and scoring. If the valve ring is damaged, it must be replaced.

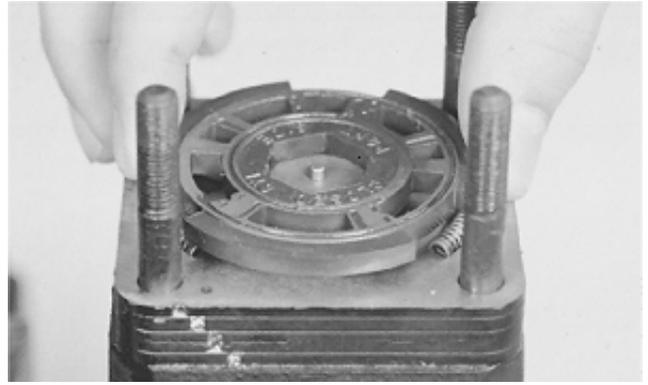


M36638 -UN-29AUG88

MX,15906006,12 -19-01MAR95

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15. Remove valve plate. Inspect the slots and ground surfaces for nicks or wear. If the valve plate is scored or the edges are not sharp, the valve plate and valve ring both must be replaced.



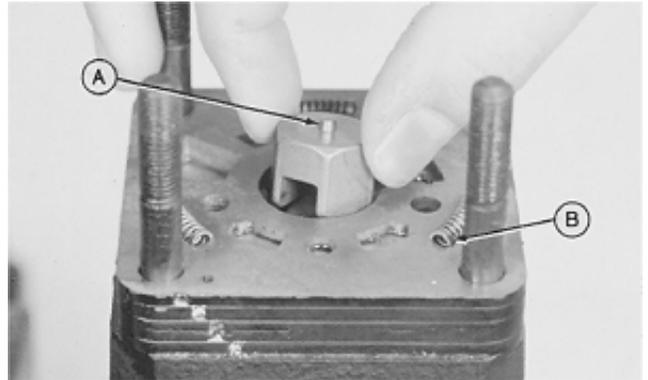
MX,15906006,13 -19-01MAR95

M36639 -UN-29AUG88

16. Remove and inspect hex drive assembly. Check sides and slot for wear, grooves, or scoring. Pin (A) should be tight and show no wear or damage.

17. Remove three springs (B).

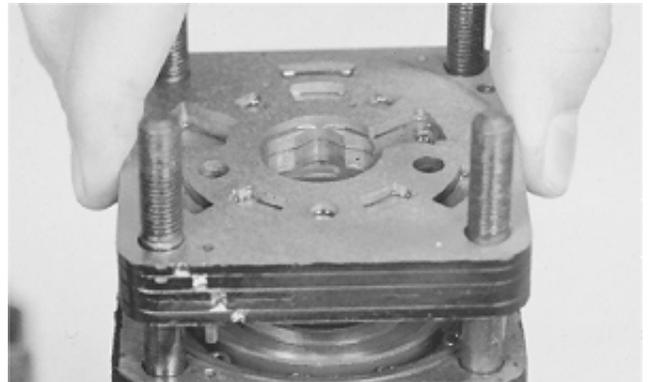
18. Inspect springs for broken coils, wear, or damage.



MX,15906006,14 -19-01MAR95

M36840 -UN-29AUG88

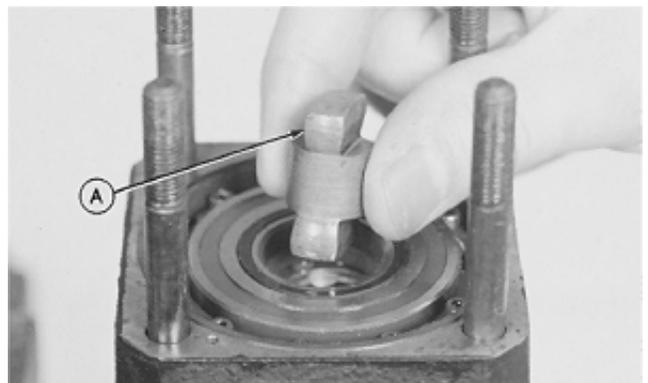
19. Remove the isolation manifold (four plates bonded together). Check manifold surface, holes and edges for nicks, or unusual wear. A polished pattern from the rotation of the valve plate and commutator cover is normal.



MX,15906006,15 -19-01MAR95

M36841 -UN-29AUG88

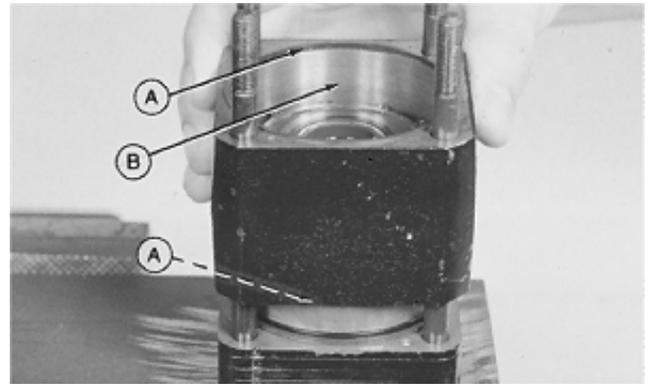
20. Remove drive link. Check the four crowned surfaces (A) for wear or scoring.



MX,15906006,16 -19-01MAR95

M36642 -UN-29AUG88

21. Remove metering ring and upper and lower seals (A). If the bore (B) is scored, the metering ring must be replaced.

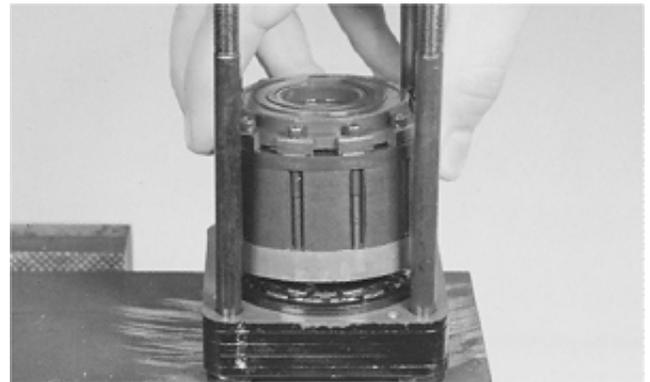


MX,15906006,17 -19-01MAR95

M36643 -UN-29AUG88

**IMPORTANT: Do not clamp metering assembly in a vise.**

22. Remove metering assembly. Put assembly on a clean surface.



MX,15906006,18 -19-01MAR95

M36644 -UN-29AUG88

23. Remove commutator seal (A).

24. Remove 11 screws to remove commutator cover. Inspect screws for damage and replace if necessary.

25. Check commutator cover machined surface for nicks, burrs, scoring, or unusual wear. A polished pattern due to rotation of the commutator is normal.



MX,15906006,19 -19-01MAR95

M36645 -UN-29AUG88

**IMPORTANT: Handle commutator ring with care; it is easily broken.**

26. Remove commutator ring and inspect for wear, burrs, cracks, or scoring.

*NOTE: The commutator ring and commutator are a matched set. If either is worn or damaged, both must be replaced.*



MX,15906006,20 -19-01MAR95

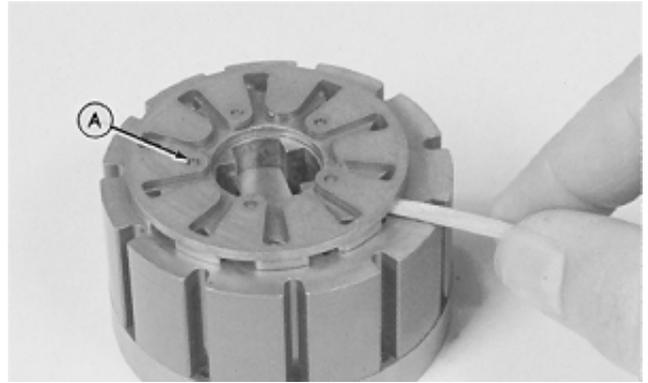
M36647 -UN-29AUG88

**IMPORTANT: DO NOT use a screwdriver to remove commutator. Commutator can be damaged.**

27. Remove commutator and five pins (A) using a wood dowel or equivalent.

*NOTE: The commutator is made up of two plates bonded together. It is a permanent assembly and cannot be disassembled.*

28. Check commutator machined surface, holes and edges for nicks. Edges must be sharp.



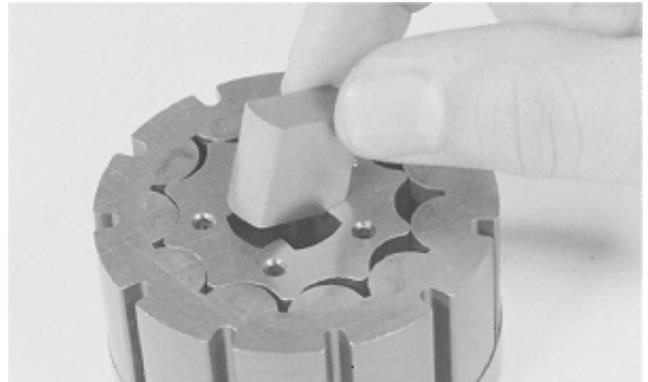
M36648 -UN-29AUG88

MX,15906006,21 -19-01MAR95

29. Remove drive link spacer. Check spacer for grooves, wear, or damage.

30. The rotor should rotate and orbit freely within the stator. Check commutator side of stator face for grooves or scoring.

*NOTE: Stator and rotor are a matched set. If either are worn or damaged, both must be replaced.*

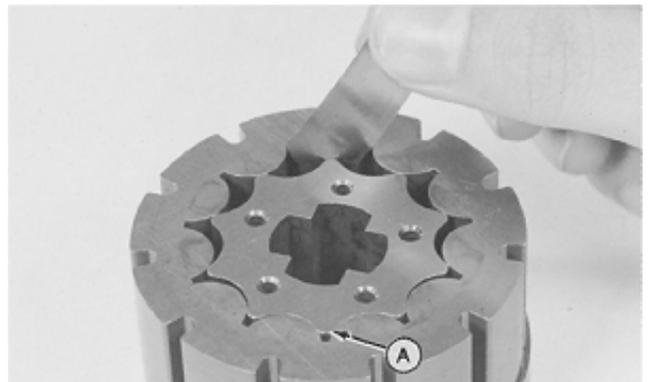


M36649 -UN-29AUG88

MX,15906006,22 -19-01MAR95

31. Measure rotor-to-stator clearance. Center rotor lobe (A) between stator lobes and check clearance directly opposite lobe (A).

If rotor-to-stator clearance is more than 0.08 mm (0.003 in.), replace rotor and stator.



M36650 -UN-29AUG88

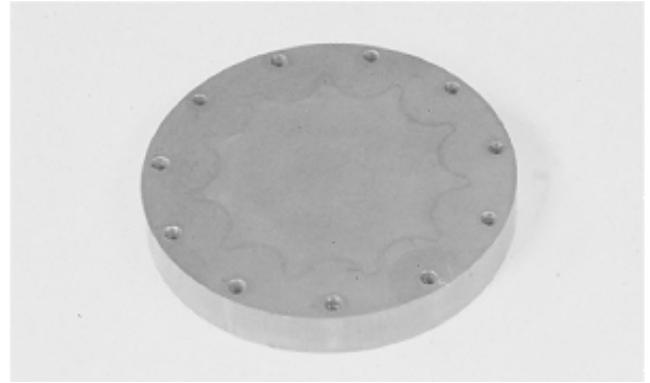
MX,15906006,23 -19-01MAR95

32. Lift the rotor and stator from the drive plate.

33. Check the drive plate side of the rotor assembly for nicks, grooves, or scoring. A spiral pattern due to rotor movement is normal.

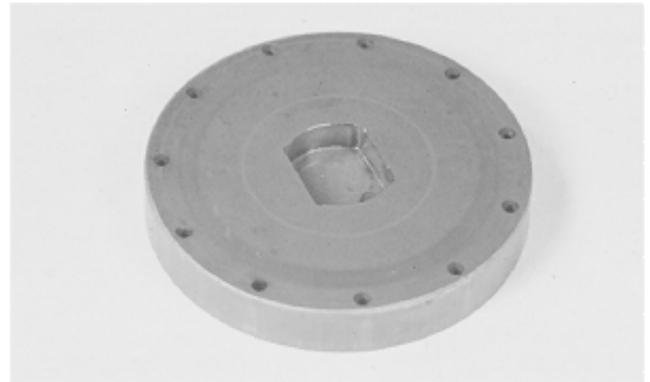
The thrust bearing side of the plate should also show a normal wear pattern without grooves, flaking, or dents.

The flat sides of the input shaft hole should not be grooved or worn.



Drive Plate Side

M36651 -UN-29AUG88



Thrust Bearing Side

M36852 -UN-29AUG88

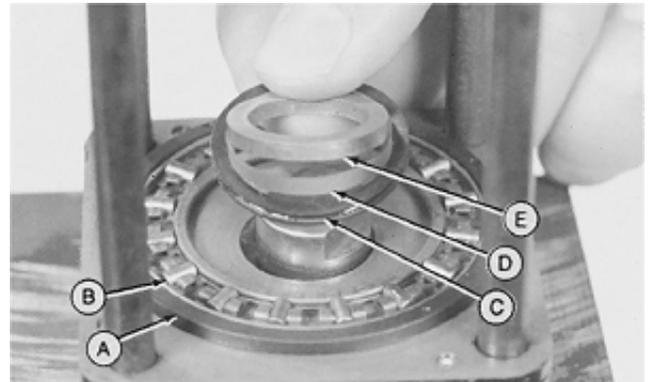
MX,15906006,24 -19-01MAR95

**NOTE:** Four-port and early five-port have a seal spacer and backup ring. Later five-port has a seal spacer only.

34. Remove parts (A—E).

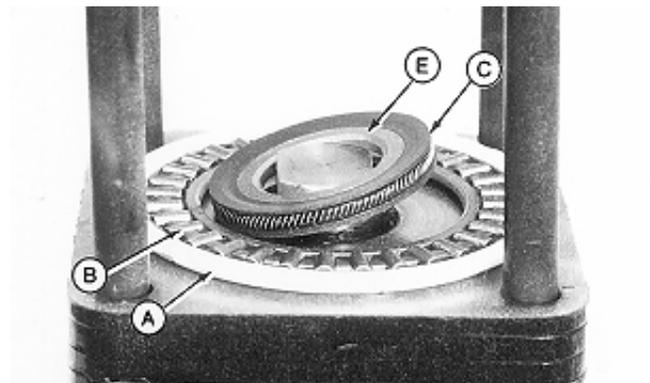
35. Inspect parts for wear or damage. Replace if necessary.

- A—Thrust Bearing Spacer
- B—Thrust Bearing
- C—Face Seal
- D—Backup-Ring (4-Port and Early 5-Port)
- E—Seal Spacer



Four-Port and Early Five-Port

M36853 -UN-29AUG88



Later Five-Port

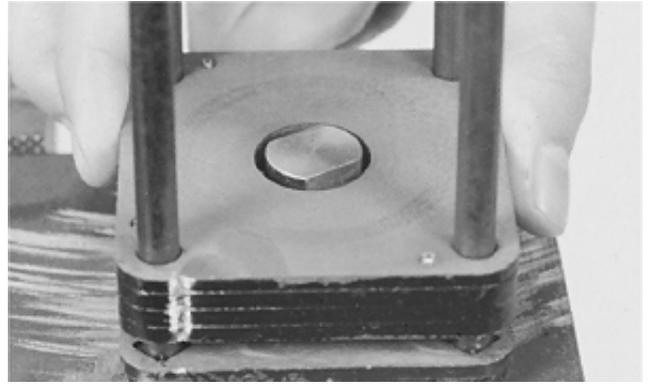
M77305 -UN-06MAR95

MX,15906006,25 -19-10MAR95

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36. Remove upper cover plate (four plates bonded together).

37. Check plate surface for grooves, dents, or metal flakes. A polished pattern due to the action of the seal is normal.

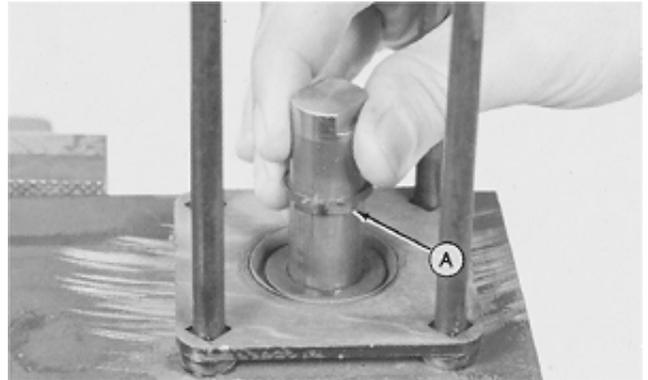


MX,15906006,26 -19-01MAR95

M36654  
-UN-29AUG88

38. Remove steering shaft and snap ring (A).

39. Inspect steering shaft serrations, threads, and flats for grooves, wear, or damage.

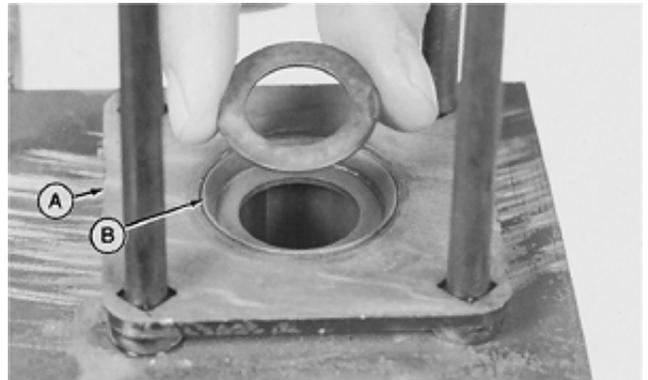


MX,15906006,27 -19-01MAR95

M36855  
-UN-29AUG88

40. Remove washer and steering tube (A).

*NOTE: Steering tube and retaining plate (B) are a matched set. If either part is worn or damaged, both must be replaced.*



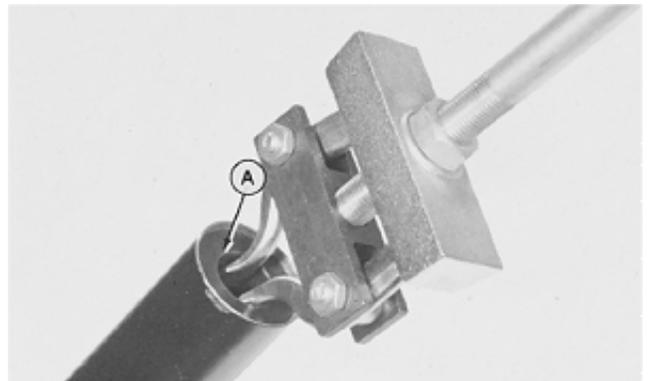
MX,15906006,28 -19-01MAR95

M36856  
-UN-29AUG88

**IMPORTANT: Hold steering tube in a soft-jaw vice.  
Be careful not to crush steering tube.**

41. Inspect bushing (A) for wear or damage. If bushing replacement is necessary, straighten crimped area of steering tube using a punch.

42. Remove bushing using a 2-jaw puller and slide hammer.

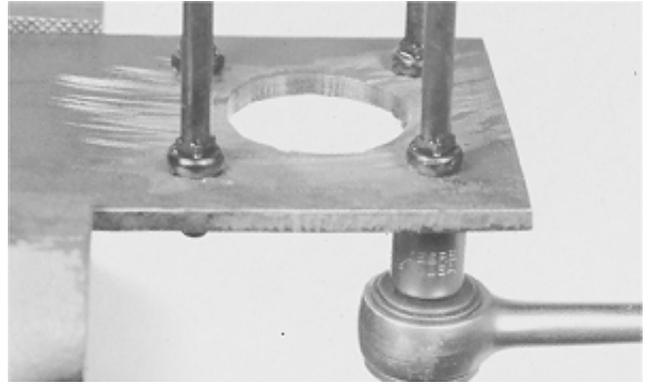


MX,15906006,29 -19-01MAR95

M36657  
-UN-29AUG88

43. Remove nuts holding the four bolts to the fixture, and remove the bolts.

44. Inspect bolts for wear or damage. Replace if necessary.



MX,15906006,30 -19-01MAR95

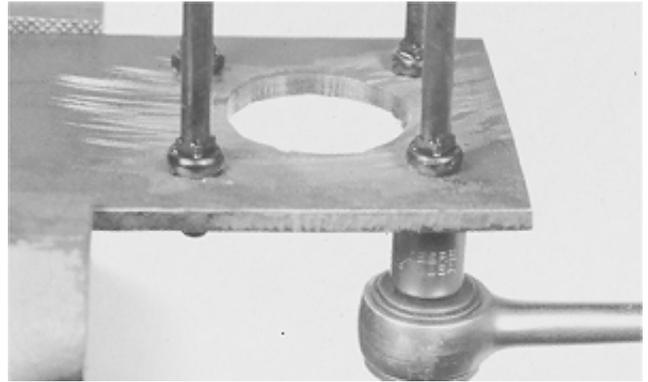
M36658 -JUN-29AUG88

## ASSEMBLE STEERING VALVE AND COLUMN

**IMPORTANT:** Always use new seals and O-rings. Damaged or used parts will leak.

*NOTE:* Lubricate all seals and O-rings with petroleum jelly during assembly.

1. Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts.
2. Install four bolts, with short threaded end down, in fixture. Install nuts and tighten finger tight.



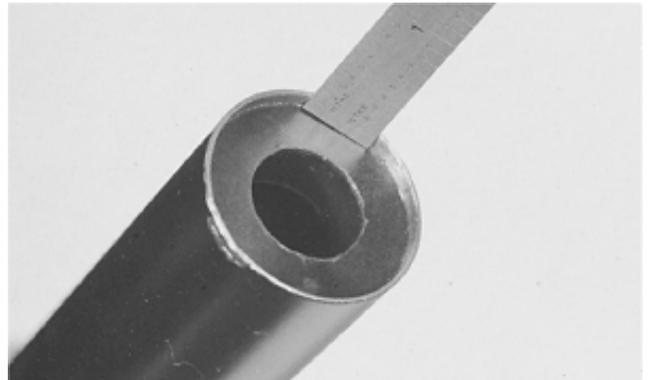
MX,15906006,31 -19-10MAR95

M36658 -JUN-29AUG88

3. Install bushing into steering tube with recess facing into tube, using a driver set. Install bushing 2.5 mm (0.100 in.) below top of steering tube.

4. Slightly bend edges of steering tube over bushing using a punch.

5. Apply multipurpose grease to inside of bushing.



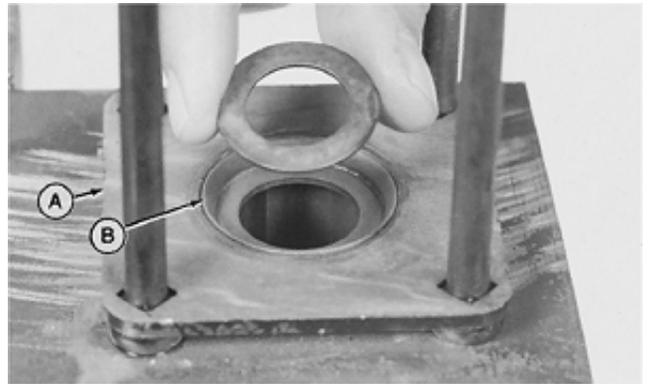
MX,15906006,32 -19-01MAR95

M36660 -JUN-29AUG88

6. Install steering tube (A) on bolts. Be sure the square holes in the steering tube are seated on the square shoulders of the bolts.

7. Apply multipurpose grease on retainer plate (B) and washer.

8. Install washer.

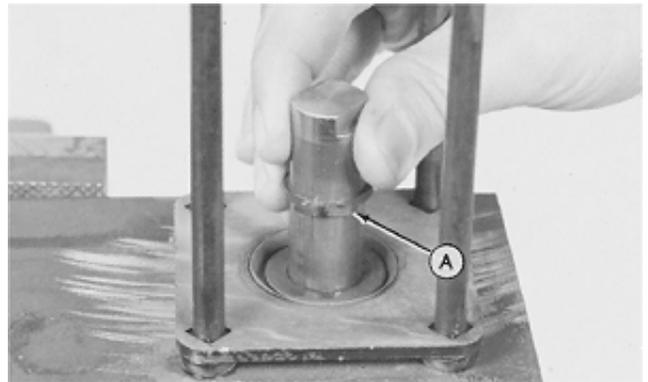


MX,15906006,33 -19-01MAR95

M36656 -UN-29AUG88

9. Install snap ring (A) on steering shaft.

10. Install steering shaft with threaded end down into steering tube.

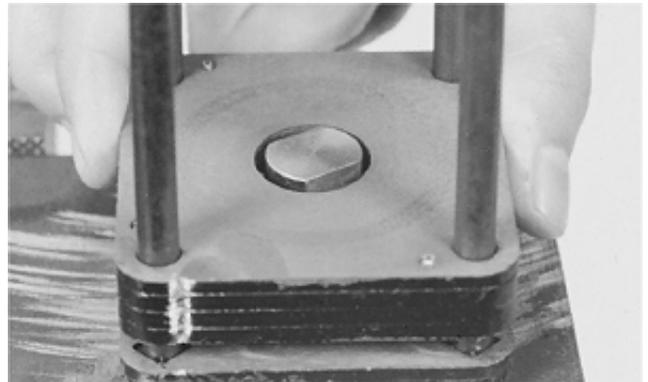


MX,15906006,34 -19-01MAR95

M36855 -UN-29AUG88

**IMPORTANT: Alignment grooves must be on only one side of steering valve for proper valve operation.**

11. Install upper cover plate over four bolts with the highly polished surface up.



MX,15906006,35 -19-01MAR95

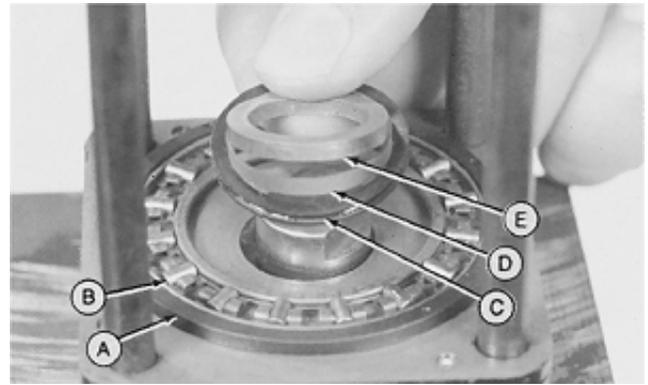
M36854 -UN-29AUG88

12. Apply multipurpose grease on the face of the upper cover plate, steering shaft end and thrust bearing (B).

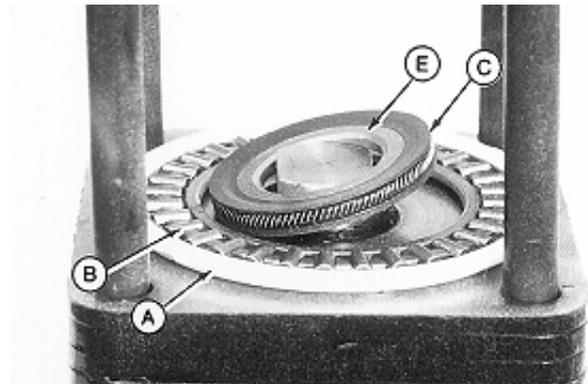
*NOTE: Wide shoulder of spacer (A) faces up, away from upper cover plate.*

13. Install parts (A—E).

- A—Thrust Bearing Spacer
- B—Thrust Bearing
- C—Face Seal
- D—Backup-Ring (4-Port and Early 5-Port)
- E—Seal Spacer



Four-Port and Early Five-Port



Later Five-Port

MX,15906006,36 -19-10MAR95

M36653 -UN-29AUG88

M77305 -UN-06MAR95

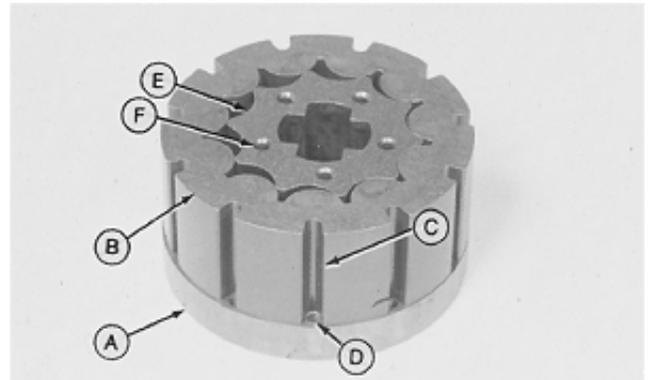
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14. Put drive plate (A) on a clean surface with slot downward.

15. Install and turn stator (B) until the stator slots (C) are aligned with drive plate holes (D).

16. Install rotor (E) with five pin holes (F) up.

- A—Drive Plate
- B—Stator
- C—Stator Slot (11)
- D—Drive Plate Hole (11)
- E—Rotor
- F—Pin Hole (5)

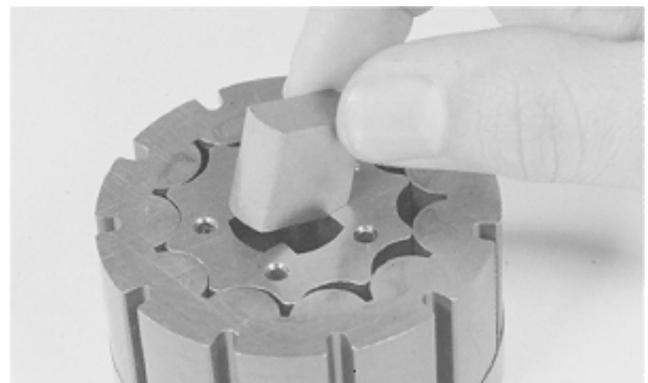


MX,15906006,37 -19-01MAR95

M36861 -UN-29AUG88

17. Apply multipurpose grease on spacer.

18. Install spacer in rotor drive slot.



MX,15906006,38 -19-01MAR95

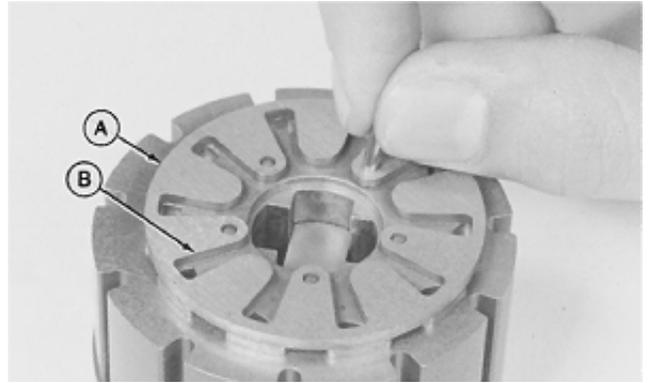
M36649 -UN-29AUG88

19. Install commutator (A) on rotor, with long grooves (B) upward.

**IMPORTANT: Pins must be installed below the surface of the commutator to prevent commutator cover damage.**

20. Align commutator holes with rotor holes and install five pins.

21. Put a few drops of clean John Deere Low Viscosity HY-GARD® oil into each groove of the commutator.



M36662 -UN-29AUG88

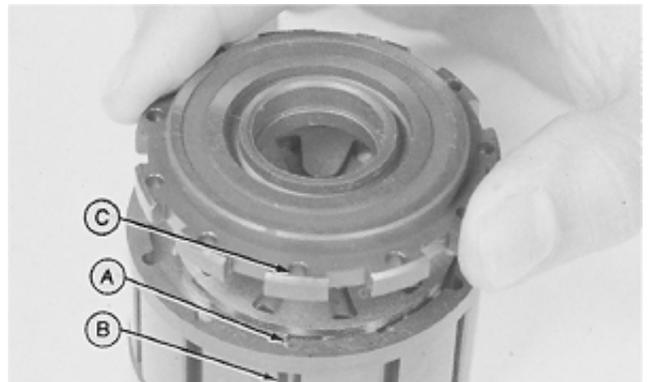
MX,15906006,39 -19-01MAR95

22. Align commutator ring slots (A) with stator slots (B) and install commutator ring.

23. Align commutator cover holes (C) with commutator ring slots. Install commutator cover with flat surface toward commutator.

24. Clean screw threads using Clean and Cure Primer. Apply Thread Lock and Sealer (low strength) to threads of commutator cover-to-commutator screws.

25. Install 11 screws into metering assembly. DO NOT tighten screws at this time.



M36663 -UN-29AUG88

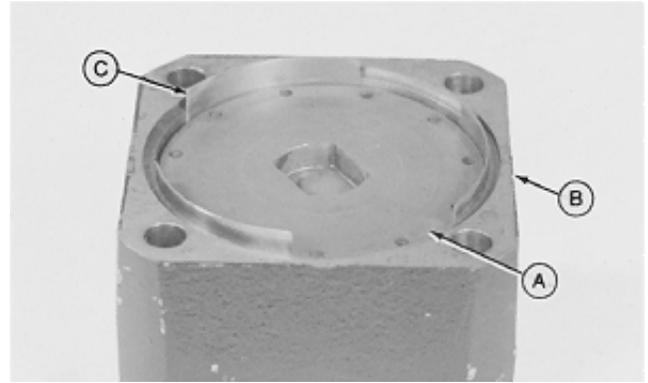
MX,15906006,40 -19-01MAR95

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**IMPORTANT:** The following procedure must be used to minimize an out-of-round condition between commutator ring and drive plate. The commutator ring is self-centering when the drive plate is shimmed. Use DFMX2 Alignment Shims.

26. Install metering assembly, with drive plate (A) up into metering ring (B).

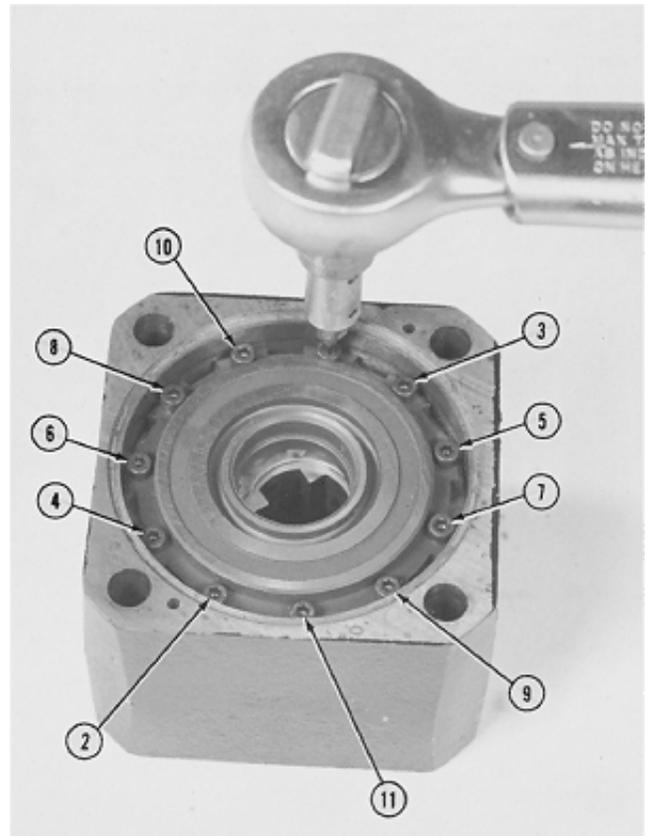
27. Install two DFMX2 Alignment Shims (C) each between drive plate and metering ring 120° apart. (See Section 299 for instructions to make shims.)



M36664 -UN-29AUG88

MX,15906006,41 -19-10MAR95

28. Turn metering ring over on a flat surface and push metering assembly down. Tighten 11 screws in several steps and in the sequence shown to 1.4 N-m (12 lb-in.).



M36665 -UN-29AUG88

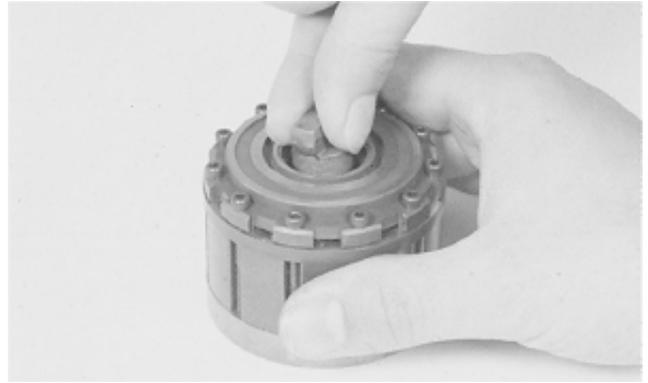
MX,15906006,42 -19-01MAR95

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29. Remove Shims and metering assembly from metering ring.

30. Install THICK end of drive link into the slot in the rotor. Hold the drive link and rotate the metering assembly by hand. The rotor should turn freely inside the stator.

If the rotor binds or does not move, disassemble and inspect to find the cause.



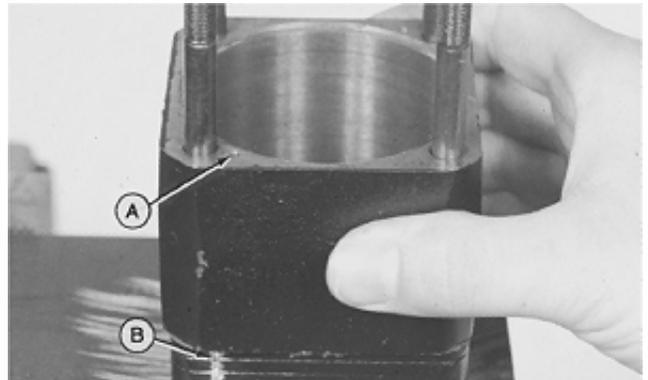
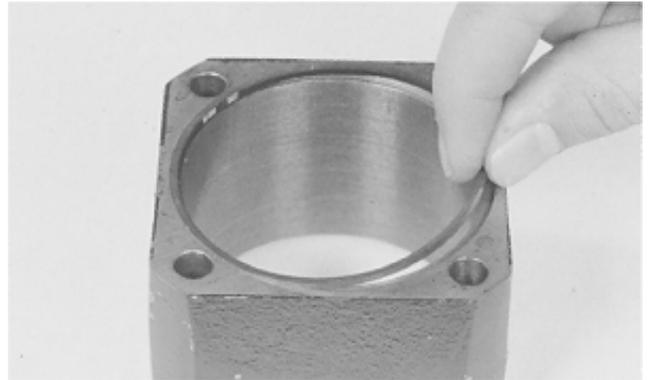
MX,15906006,43 -19-29MAR95

M36666 -UN-29AUG88

31. Apply petroleum jelly on seal ring. Install seal ring on metering ring end without pin holes.

**IMPORTANT: Align pin hole (A) in metering ring with groove (B) on upper cover plate so that remaining parts can be aligned correctly.**

32. Install metering ring over bolts with pin holes up.



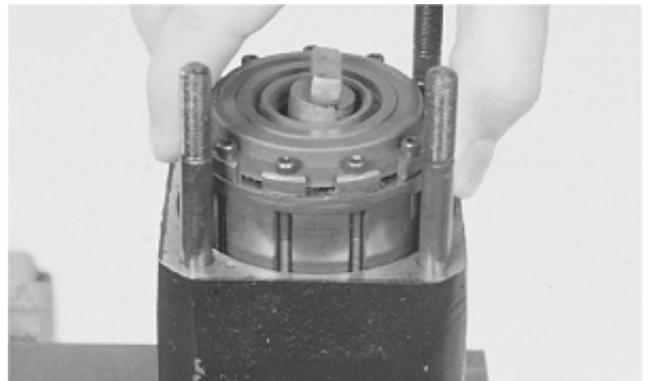
MX,15906006,44 -19-01MAR95

M36667 -UN-29AUG88

M36679 -UN-29AUG88

33. Apply multipurpose grease on drive plate surface.

34. Install metering assembly, with drive plate down, into metering ring. Turn metering assembly until the steering shaft engages the drive plate hole. When properly seated, the metering assembly is below the surface of the metering ring.



MX,15906006,45 -19-01MAR95

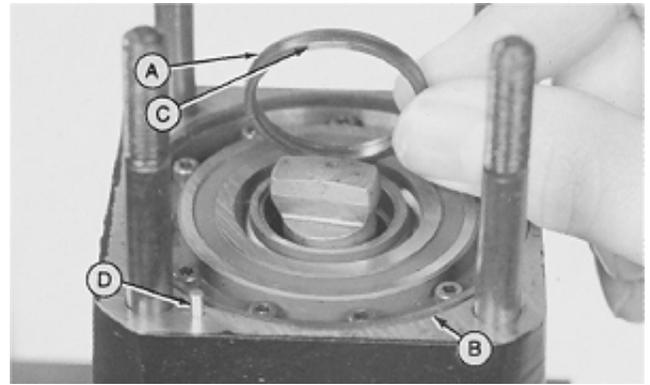
M36668 -UN-29AUG88

35. Apply petroleum jelly on new commutator seal (A) and seal ring (B).

36. Install new commutator seal with yellow mark (C) or narrow edge, down into commutator cover.

37. Install seal ring (B) and pins (D).

- A—Commutator Seal
- B—Seal Ring
- C—Yellow Mark or Narrow Edge
- D—Pin (2 used)



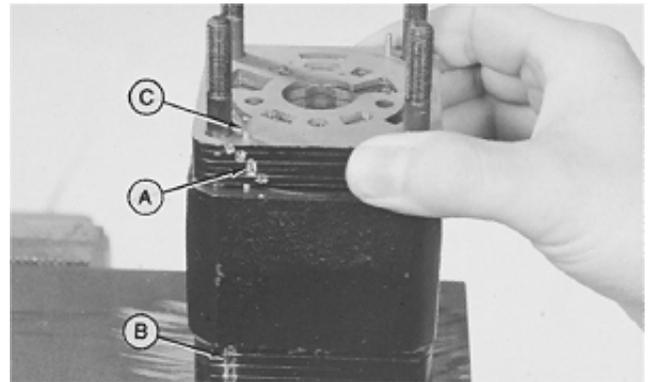
MX,15906006,46 -19-01MAR95

M36669 -UN-29AUG88

**IMPORTANT: Align grooves (A) in isolation manifold with groove (B) in upper cover plate.**

38. Install isolation manifold, with recessed slots up, on metering ring.

39. Install pins (C).

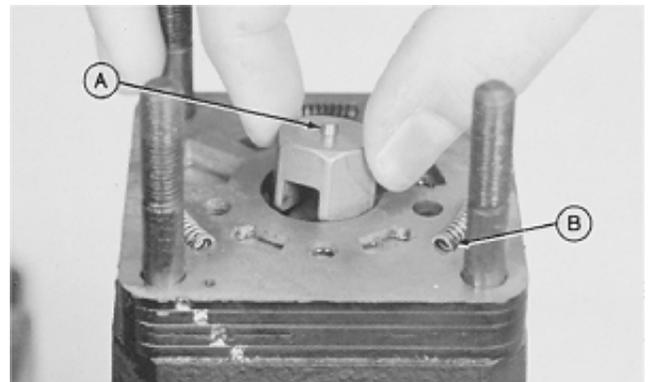


MX,15906006,47 -19-01MAR95

M36870 -UN-29AUG88

40. Install three 13 mm (1/2 in.) springs (B) in recessed slots of the isolation manifold.

41. Install hex drive assembly, with pin (A) up, on drive link.

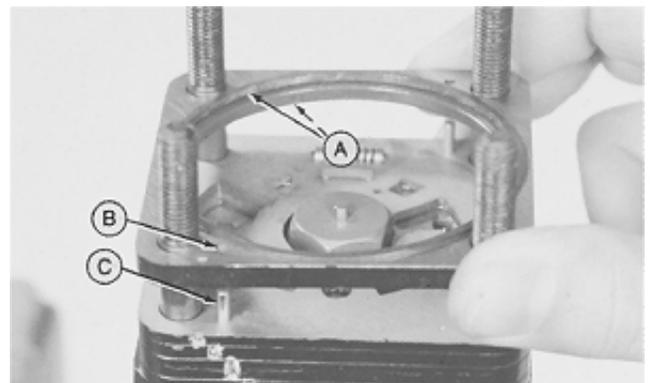


MX,15906006,48 -19-01MAR95

M36840 -UN-29AUG88

42. Apply petroleum jelly on new seal rings (A). Install seal rings on valve ring.

43. Align valve ring holes (B) with pins (C) to install valve ring.

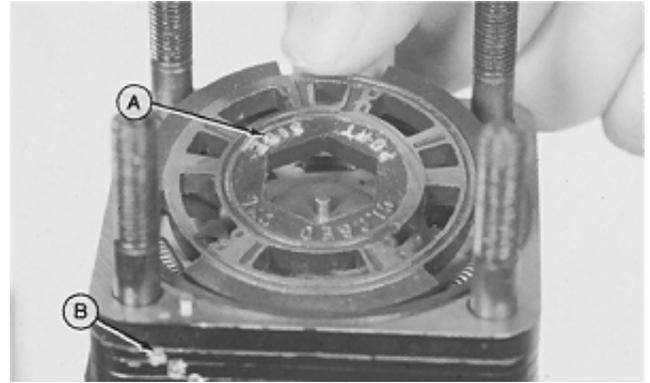


MX,15906006,49 -19-01MAR95

M36671 -UN-29AUG88

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06  
18

**IMPORTANT:** Valve plate must be installed with “PORT SIDE” (A) directly opposite (12 o’clock position) from alignment grooves (B) for proper operation. Valve plate spring slots and springs must be aligned to prevent spring damage when installing port manifold.



M36672 -UN-29AUG88

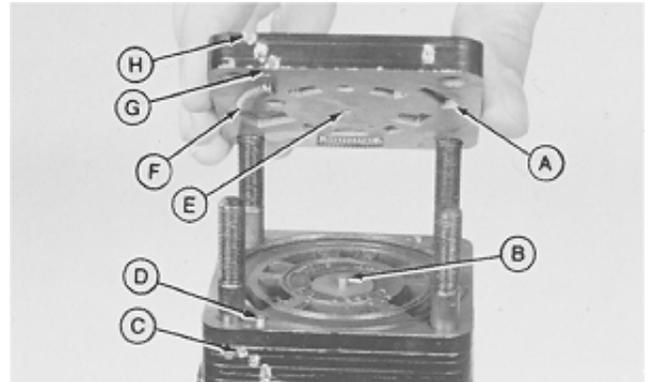
44. Install valve plate, with “PORT SIDE” up, on isolation manifold. Turn valve plate to make sure springs are centered in valve plate spring slots.

45. Apply clean John Deere Low Viscosity HY-GARD® oil on valve plate.

MX,15906006.50 -19-01MAR95

46. Install three 25 mm (1 in.) springs (F) in recessed slots (A) of the port manifold.

**IMPORTANT:** Align grooves (H) in port manifold with grooves (C) in isolation manifold. Be careful not to damage springs while installing port manifold.



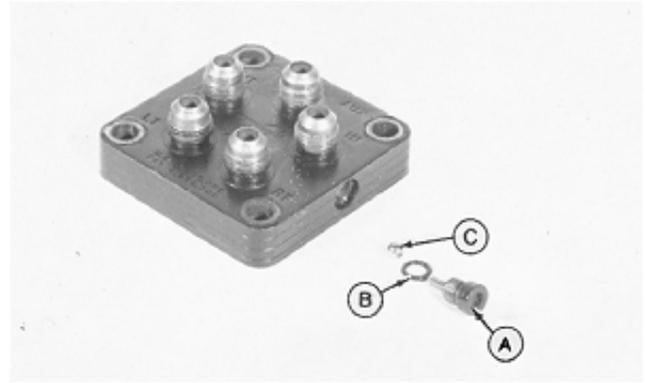
M36673 -UN-29AUG88

47. Install port manifold with springs toward valve plate. Be sure pins (D) engage alignment holes (G) in port manifold. Be sure hex drive assembly pin (B) engages center hole (E) in port manifold.

- A—Recessed Slots
- B—Hex Drive Assembly Pin
- C—Isolation Manifold Grooves
- D—Pin (2 used)
- E—Port Manifold Center Hole
- F—25 mm (1 in.) Spring (3 used)
- G—Port Manifold Alignment Hole (2 used)
- H—Port Manifold Grooves

MX,15906006.51 -19-12MAY95

48. Four-port and early five-port; Install new O-ring (B) on plug (A). Install check ball (C). Be sure check ball is seated in bottom of hole. Install plug. Do not tighten.



Five-Port Shown

MX,15906006,52 -19-10MAR95

M43832 -UN-08JAN90

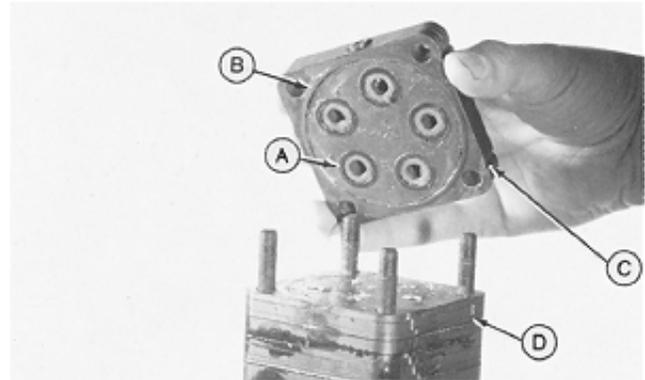
*NOTE: Four-port not shown. Unit is similar to early five-port.*

49. Later five-port; Install check ball (E) in countersunk hole (hole closest to the center of the port manifold).

50. Apply petroleum jelly on new O-rings (A) and new seal ring (B). Install O-rings and seal ring in port cover.

**IMPORTANT: Align grooves (C) in port cover with grooves (D) in manifold.**

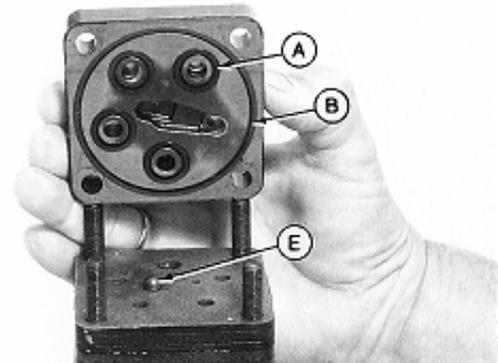
51. Install port cover with seals toward port manifold.



Early Five-Port

M43843 -UN-08JAN90

- A—O-Ring(s)
- B—Seal Ring
- C—Port Cover Alignment Grooves
- D—Port Manifold Alignment Grooves
- E—Check Ball (Later Five-Port)

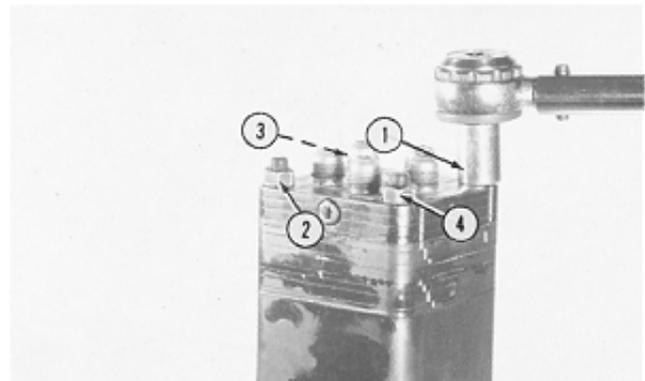


Later Five-Port

MX,15906006,53 -19-29MAR95

M78055 -UN-06MAR95

52. Install and tighten four nuts in the sequence shown. Tighten in several steps to 30 N-m (22 lb-ft).



Early Five-Port Shown

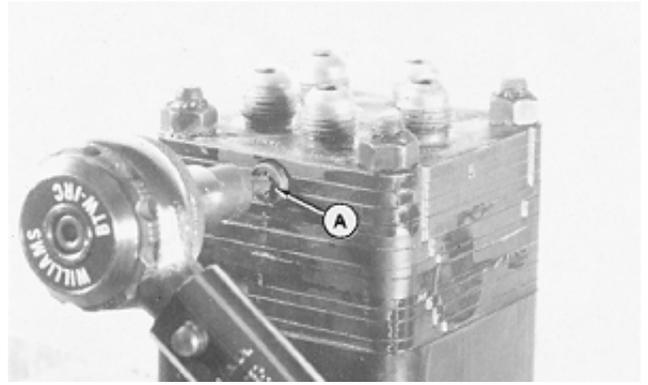
MX,15906006,54 -19-10MAR95

M43845 -UN-11NOV89

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53. Four-port and early five-port; Tighten plug (A) to 14 N·m (124 lb-in.).

54. Remove steering valve from fixture.



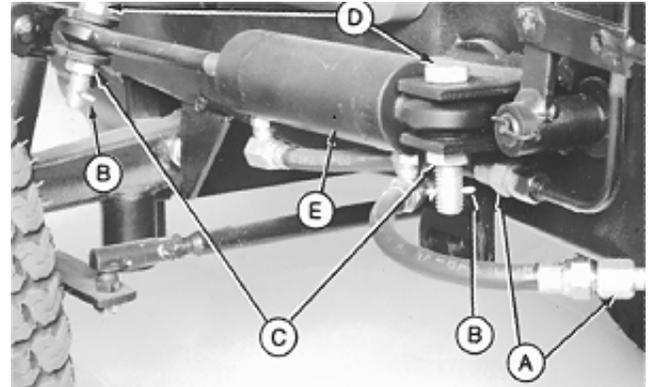
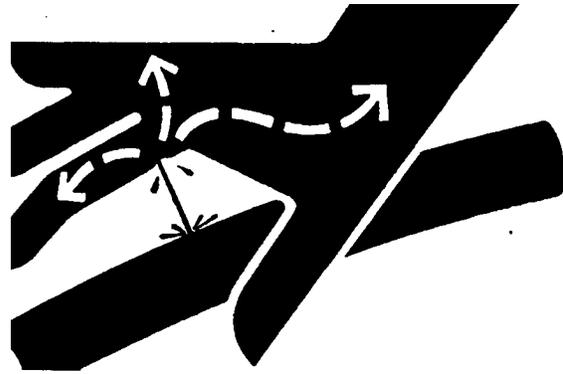
M43544 -UN-08JAN90

MX,15906006,55 -19-10MAR95

## REMOVE AND INSTALL STEERING CYLINDER

**N** **CAUTION:** Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



Early Model Shown

1. Disconnect hydraulic hoses at lines (A).
2. Support cylinder and remove cotter pins (B), if equipped, nuts (C) and bolts (D).
3. Remove steering cylinder (E).

*NOTE: Cylinder is not repairable. If defective, replace complete assembly.*

4. Installation is done in the reverse order of removal.

- Tighten nuts (C) to 163 N·m (120 lb-ft).
- Bleed the hydraulic system. (See procedure in Section 270, Group 20.)

A—Hydraulic Lines  
 B—Cotter Pins (if equipped)  
 C—Nuts (Early Models)  
 —Lock Nuts (Later Models)  
 D—Bolts  
 E—Steering Cylinder

MX,15906006,56 -19-10MAR95

**OTHER MATERIAL**

<b>Number</b>	<b>Name</b>	<b>Use</b>
M79292	MPG-2® Multi-Purpose Polymer Grease	Prevents parts from seizing. Apply to axle shafts.
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
T43512/TY9473/242	Thread Lock and Sealer (Medium Strength)	Apply to threads of brake plate-to-axle cap screws.

®MPG-2 is a registered trademark of DuBois USA.

®LOCTITE is a registered trademark of the Loctite Corp.

MX,15905020,OTH-19-07MAR95

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1

## REMOVE BRAKES

**N** **CAUTION:** Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

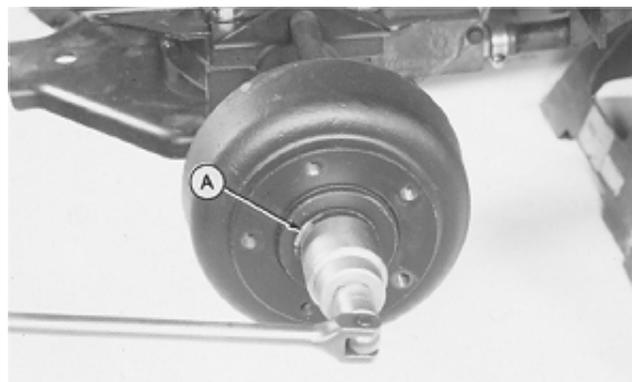
Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.

Keep bystanders away from the area.

1. Disconnect battery negative (—) cable.
2. Raise rear of machine and install support stands under frame.
3. Remove rear wheel.
4. Bend edge of washer (A) flat against drum.
5. Remove nut and washer.
6. Pull drum off axle.

If drum hits shoes, turn the adjuster to reduce the drag on drum.

If drum is tight on shaft from corrosion, remove drum using a three-leg wheel puller. DO NOT use an impact puller.



-UN-23AUG88

TS220

-UN-25JAN90

M36560

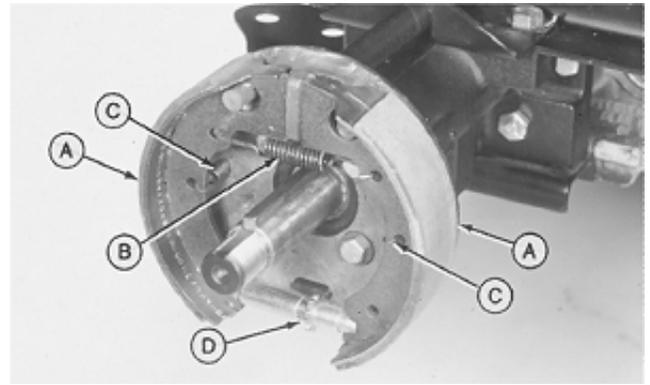
MX,15905010,19 -19-14FEB95

7. Inspect lining on brake shoes (A) for wear or oil contamination. Replace shoes if worn. Inspect axle oil seal if shoes are oily.

8. Inspect return spring (B) and hold-down springs (C) for wear or stretching.

9. Check adjuster assembly (D) for ease of movement.

10. Remove brake return spring (B), hold-down springs (C), adjuster (D), and shoes (A).



M36673 -UN-25JAN90

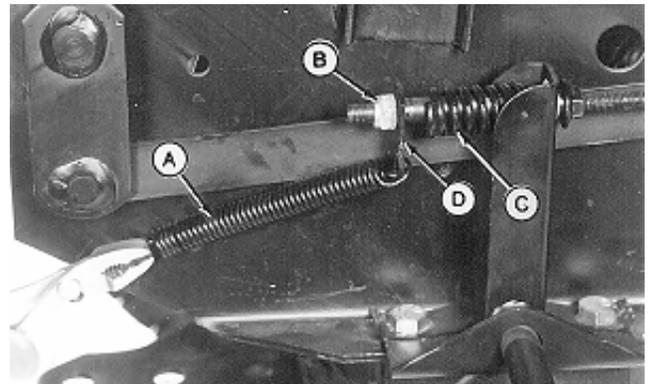
- A—Brake Shoes
- B—Return Spring
- C—Hold-Down Springs
- D—Adjuster Assembly

MX,15905010,20 -19-14FEB95

11. Disconnect return spring (A).

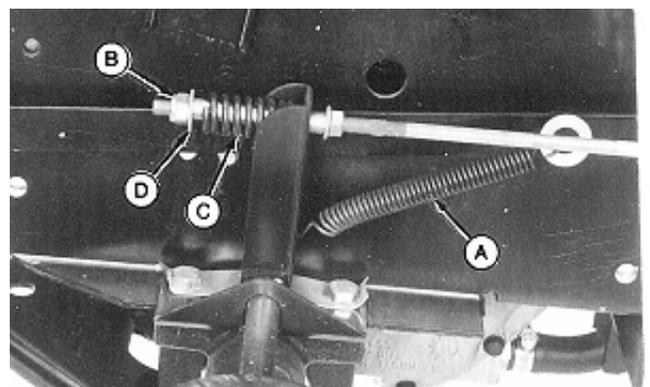
12. Remove nut (B), plate or washer (D) and spring (C).

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)
- Washer (Later Models)



Early Models

M78048 -UN-13FEB95



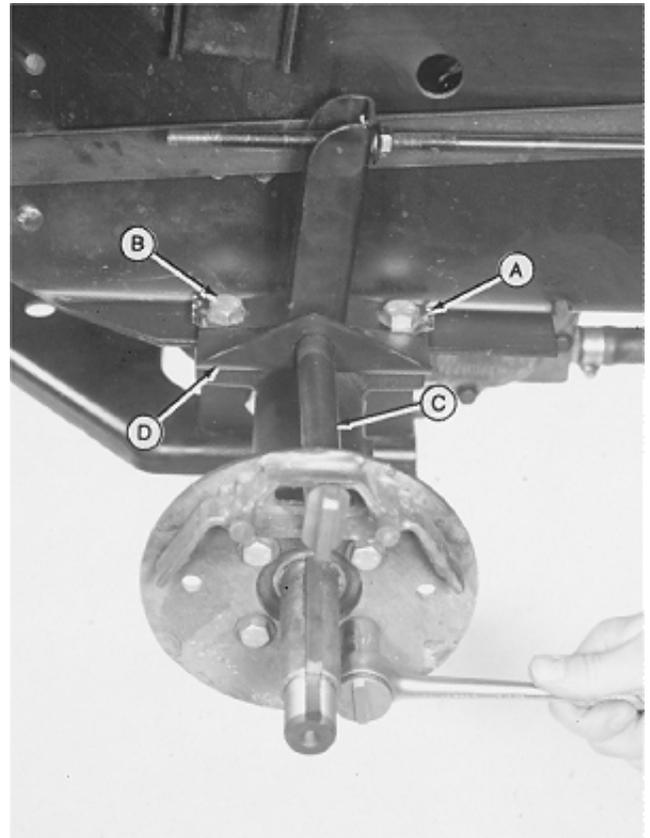
Later Models

M78049 -UN-13FEB95

MX,15905010,21 -19-07MAR95

13. Bend lock plate tabs (A) flat. Remove two cap screws (B).
14. Remove four cap screws and washers to remove brake plate assembly.
15. Remove brake arm (C) and brake support (D).

- A—Lock Plate Tab (2)
- B—Cap Screw (2 used)
- C—Brake Arm
- D—Brake Support



M36576 -JUN-25JAN90

MX,15905010,22 -19-07MAR95

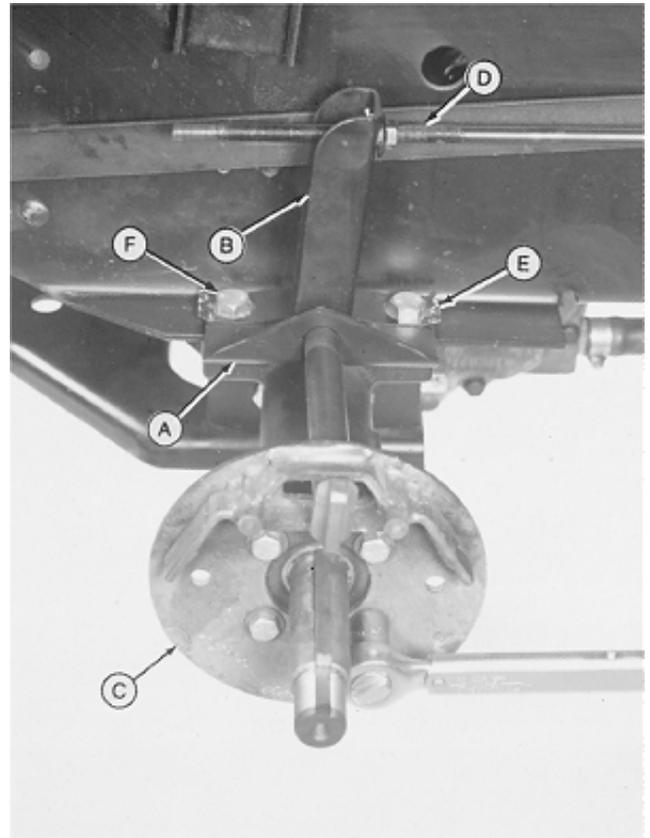
## INSTALL BRAKES

1. Install brake support (A) on brake arm (B).
2. Install brake arm in brake plate (C).
- 3 Clean the threads of all four brake plate cap screws and threaded axle housing using Clean and Cure Primer.
- 4 Apply thread lock and sealer (medium strength) on threads of brake plate cap screws.
5. Install brake rod (D) in brake arm hole.
6. Install brake plate assembly on axle. Install and tighten four cap screws to specifications.
7. Install brake support (A), lock plate (E) and two cap screws (F). Tighten cap screws to specifications. Bend lock plate tabs over flat of cap screws.

### TORQUE SPECIFICATIONS

Brake Plate-to-Axle Housing	
Cap Screws	68 N-m (50 lb-ft)
Axle Housing-to-Frame Cap Screws	100 N-m (75 lb-ft)

- A—Brake Support
- B—Brake Arm
- C—Brake Plate
- D—Brake Rod
- E—Lock Plate
- F—Cap Screw (2 used)



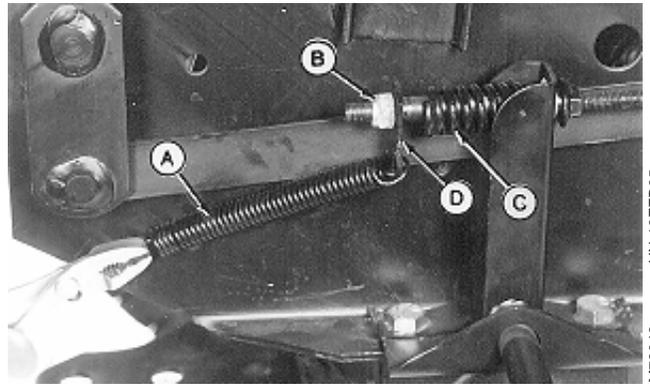
M36577 -JUN-25/JAN90

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5-10

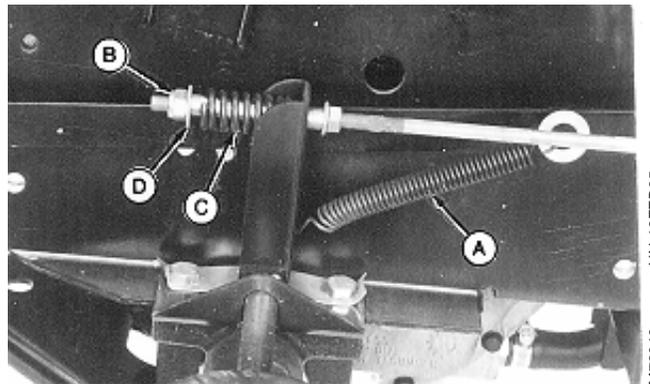
MX,15905010,23 -19-08MAY95

8. Install spring (C), plate or washer (D) and nut (B).
9. Connect return spring (A).

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)  
—Washer (Later Models)



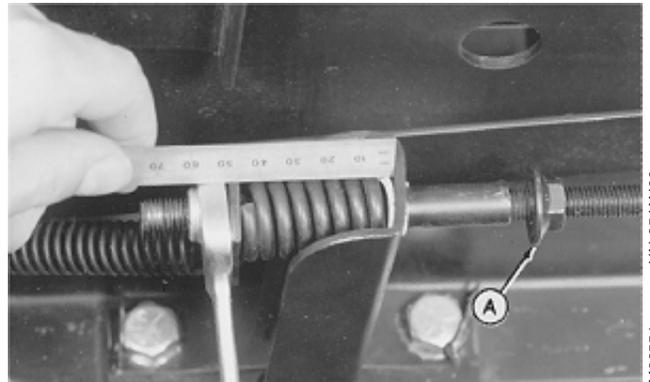
Early Models



Later Models

MX,15905010,24 -19-07MAR95

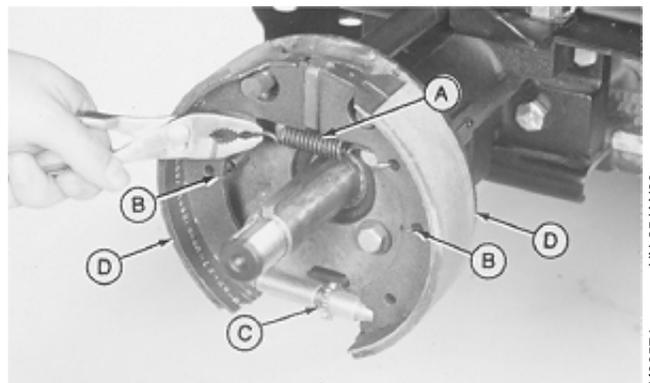
10. Lock brake pedals together (318 and 420) and apply park brake.
11. Loosen lock nut (A).
12. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.



MX,15905010,25 -19-14FEB95

13. Install shoes (D), adjuster (C), hold-down springs (B), and brake return spring (A).

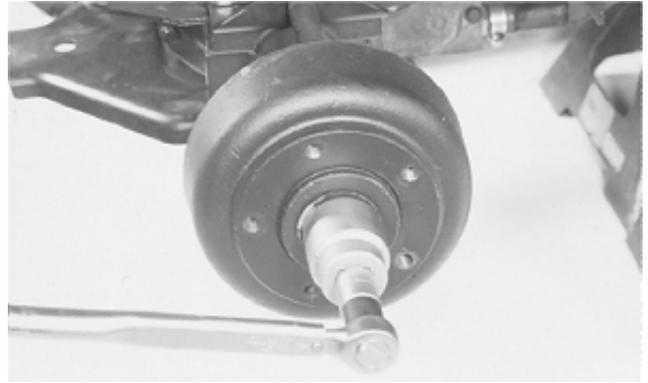
- A—Brake Return Spring
- B—Hold-Down Springs
- C—Adjuster
- D—Shoes



MX,M21,6010R,12-19-24JUN85

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6

14. Apply MPG-2® Multi-Purpose Polymer Grease to axle shaft.
15. Install key and brake drum.
16. Install washer and nut. Tighten nut to specifications.
17. Bend one side of washer over nut to lock nut in place.
18. Install wheel. Tighten cap screws to specifications.
19. Remove support stands.
20. Connect battery negative (—) cable.
21. Adjust brakes. (See procedure in this group.)



M36571 -UN-25JAN90

**TORQUE SPECIFICATIONS**

Brake Drum-to-Axle Nut . . . . .	88 N-m (65 lb-ft)
Rear Wheel Cap Screws . . . . .	70 N-m (52 lb-ft)

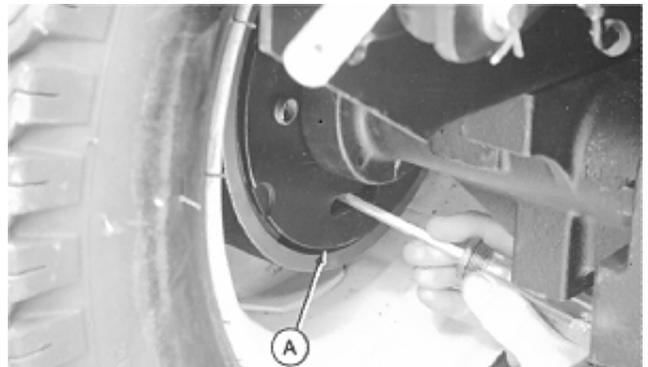
MX,15905020,26 -19-07MAR95

**ADJUST BRAKES**

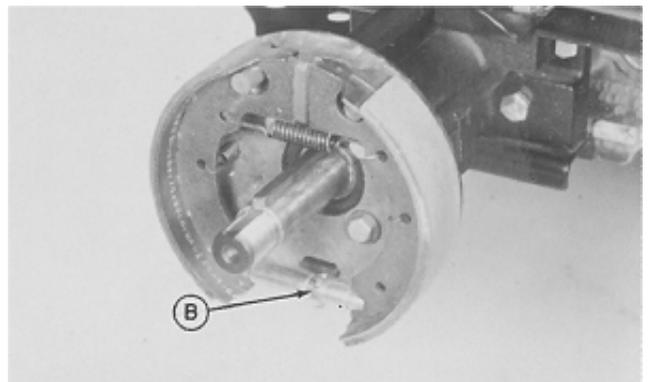
1. Disconnect battery negative (—) cable.
2. Raise rear of machine and install support stands under frame.

*NOTE: Wheel and brake drum are removed for photographic purpose only.*

3. Reach through slot in back plate (A) with screwdriver for access to star adjuster (B).
4. Turn wheel by hand. Turn adjusting star until brake shoes begin to drag on drum.
5. Push brake pedal(s) down firmly to seat brake shoes and check adjustment. Adjust brakes so brake shoes just clear drums and do not drag when pedal(s) are released.



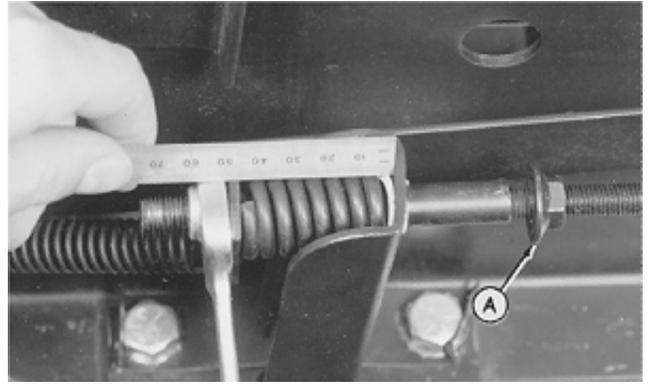
M31941 -UN-28JUL89



M36881 -UN-25JAN90

MX,15905010,27 -19-14FEB95

6. Lock brake pedals together (318 and 420) and apply parking brake.
7. Check length of spring on both sides of machine. Spring should be approximately 42 mm (1.650 in.).
8. If necessary, adjust length of spring.
9. Loosen lock nut (A).
10. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.
11. Remove support stands.
12. Connect battery negative (—) cable.



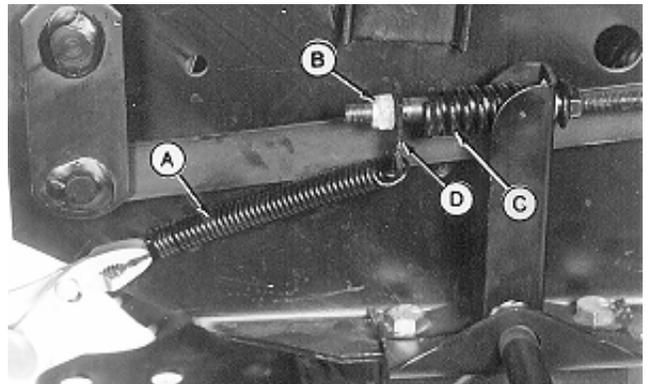
M36554 -UN-25JAN90

MX,15905010,28 -19-07MAR95

### INSPECT AND REPAIR BRAKE PEDAL AND NEUTRAL RETURN LINKAGE—316

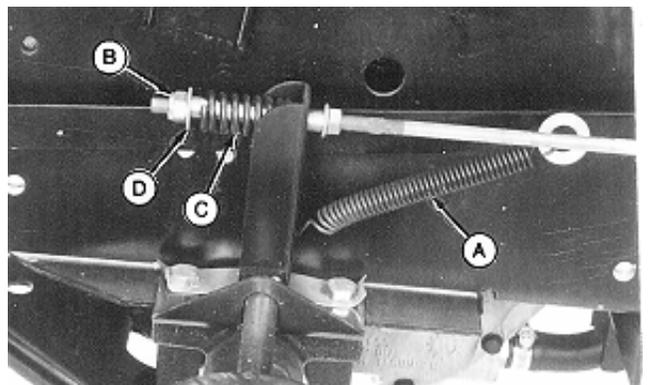
1. Remove belly screen and fender deck.
- NOTE: Disconnect brake rods from both sides of machine.*
2. Disconnect return spring (A).
  3. Remove nut (B), plate or washer (D) and spring (C). Inspect springs for weak coils.
  4. Disconnect brake rods from brake pedal.

- A—Return Spring
- B—Nut
- C—Spring
- D—Plate (Early Models)
- Washer (Later Models)



Early Models

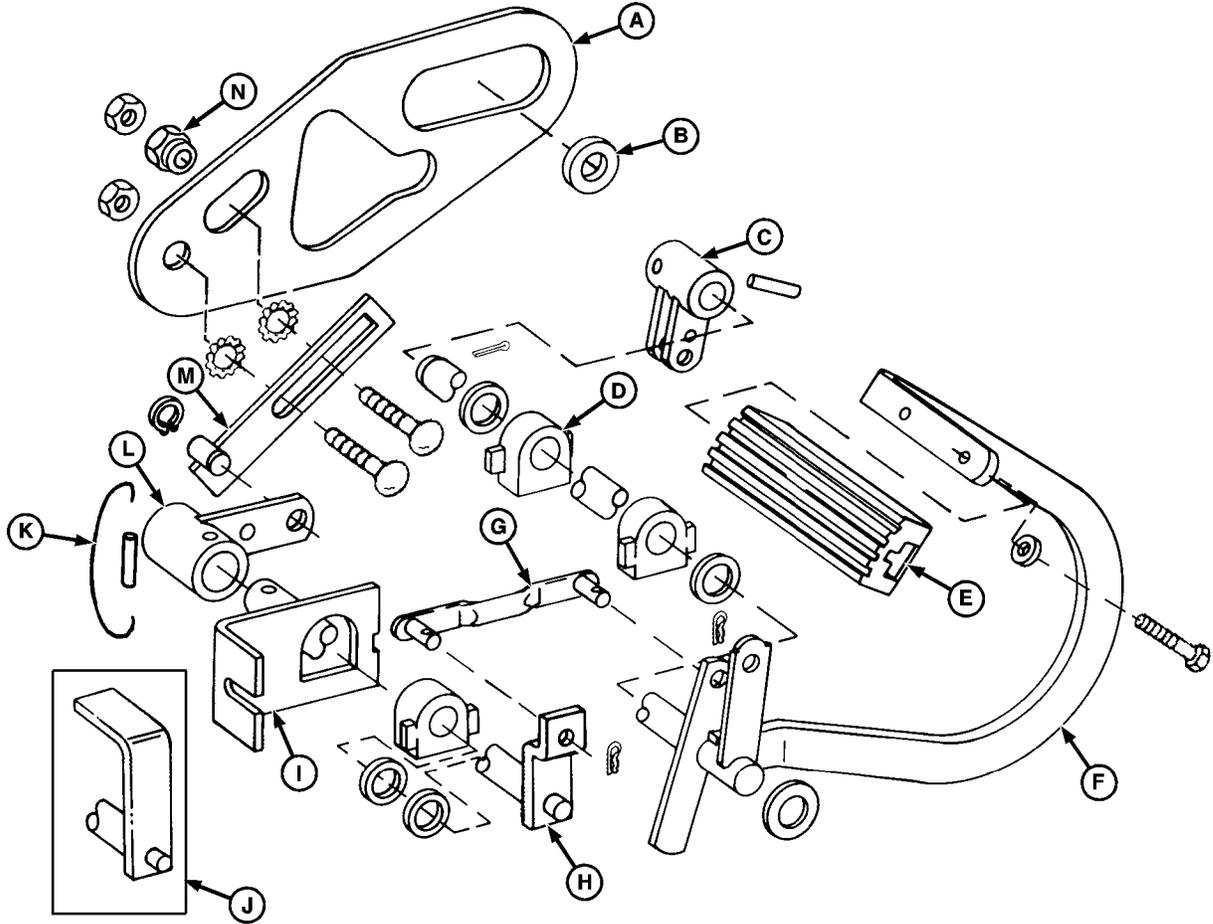
M78048 -UN-13FEB95



Later Models

M78049 -UN-13FEB95

MX,15906010,1 -19-07MAR95



- |                            |  |  |                                   |
|----------------------------|--|--|-----------------------------------|
| A—Neutral Return Cam Plate | F—Brake Pedal                            | I—Bracket                                | L—Neutral Return Arm              |
| B—Spacer                   | G—Neutral Return Link                    | J—Neutral Return Shaft<br>(Early Models) | M—Neutral Return Sliding<br>Lever |
| C—Left-Hand Brake Arm      | H—Neutral Return Shaft<br>(Later Models) | K—Lock Wire and Spring Pin               | N—Eccentric Adjustment Nut        |
| D—Bearing (4 used)         |  |  |                                   |
| E—Pedal Pad                |  |  |                                   |

Version One (316)

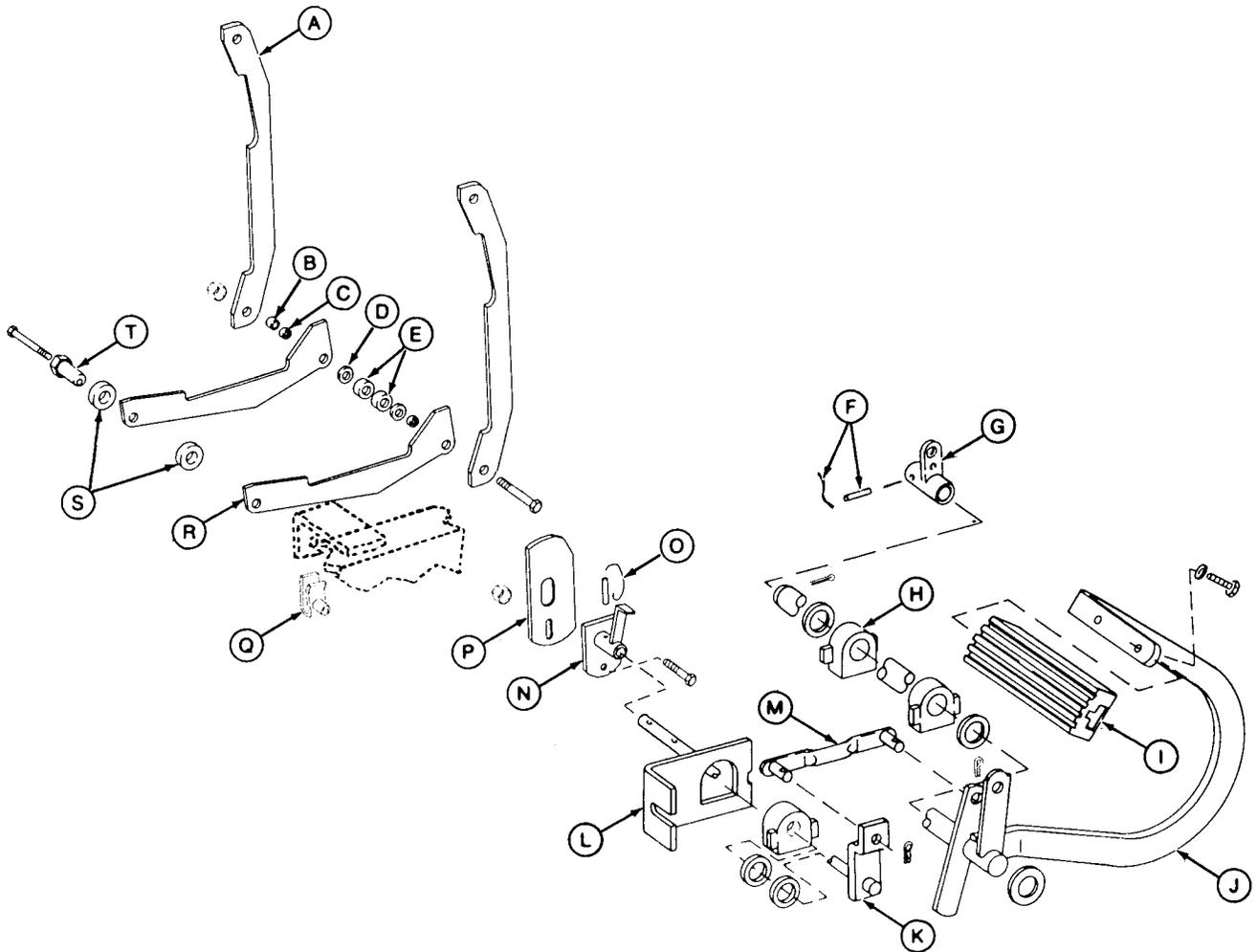
**NOTE:** Brake pedal and neutral return linkage—Version One, is used on machines equipped with transmission control linkage—Versions One or Two for 316 and 318 only.

6. If necessary to replace neutral return cam plate (A), remove transmission control lever assembly. (See Inspect and Repair Transmission Control Linkage—Version One or Version Two for 316 and 318 in Section 50, Group 10.)

5. Inspect linkage for wear or damage. Replace parts as necessary.

60-10-9  
M77914 -JUN-14-MAR95

Brakes/Brake Pedal(s) and Neutral Return Linkage



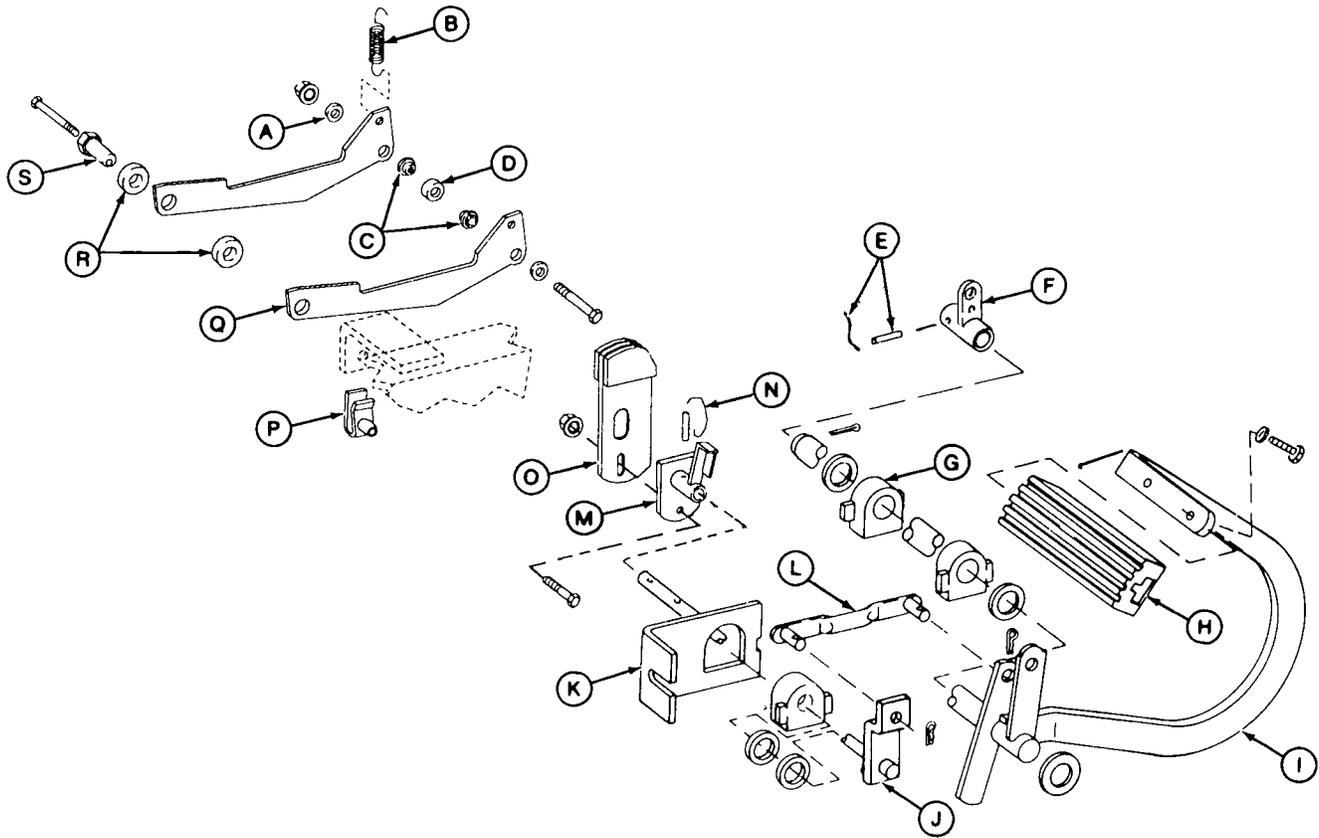
- |                              |                        |                            |                              |
|------------------------------|------------------------|----------------------------|------------------------------|
| A—Strap (2 used)             | G—Left-Hand Brake Arm  | L—Bracket                  | Q—Clamp-On Nut               |
| B—Spacer                     | H—Bearing (4 used)     | M—Neutral Return Link      | R—Speed Control Arm (2 used) |
| C—Bushing (2 used)           | I—Pedal Pad            | N—Neutral Return Arm       | S—Bushings                   |
| D—Washer (2 used)            | J—Brake Pedal          | O—Lock Wire and Spring Pin | T—Eccentric Adjustment Nut   |
| E—Ball Bearings              | K—Neutral Return Shaft | P—Neutral Return Cam       |                              |
| F—Safety Wire and Spring Pin |                        |                            |                              |

Version Two (316)

**NOTE:** Brake pedal and neutral return linkage—Version Two, is used on machines equipped with transmission control linkage—Version Three only.

M77915 -UN-13FEB95

Brakes/Brake Pedal(s) and Neutral Return Linkage



- |                              |                        |                            |                              |
|------------------------------|------------------------|----------------------------|------------------------------|
| A—Washer (2 used)            | F—Left-Hand Brake Arm  | K—Bracket                  | P—Clamp-On nut               |
| B—Spring                     | G—Bearing (4 used)     | L—Neutral Return Link      | Q—Speed Control Arm (2 used) |
| C—Bushings                   | H—Pedal Pad            | M—Neutral Return Arm       | R—Bushings                   |
| D—Ball Bearing               | I—Brake Pedal          | N—Lock Wire and Spring Pin | S—Eccentric Adjustment Nut   |
| E—Safety Wire and Spring Pin | J—Neutral Return Shaft | O—Neutral Return Cam       |                              |

Version Three (316)

*NOTE: Brake pedal and neutral return linkage—Version Three, is used on machines equipped with transmission control linkage—Version Four only.*

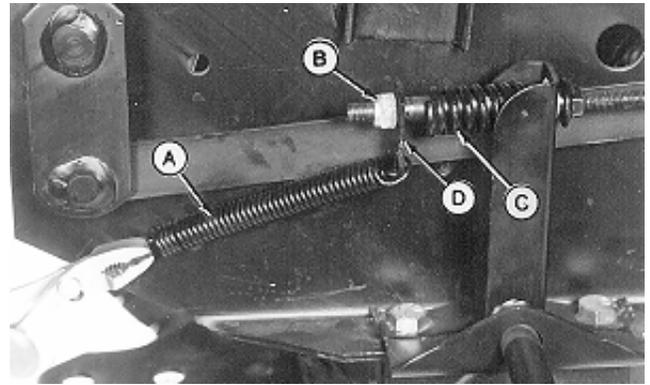
MX,15906010,4 -19-07MAR95

M77916 -JUN-13-FEB95 60-10-11

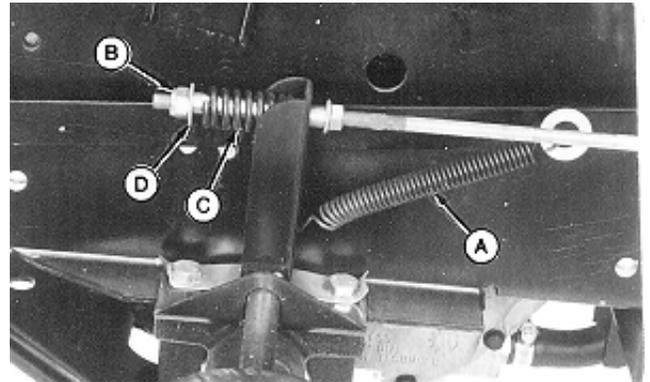
Brakes/Brake Pedal(s) and Neutral Return Linkage

7. Install all parts.
8. Connect brake rods to brake pedal.
9. Install spring (C), plate or washer (D) and nut (B).
10. Connect return spring (A).

A—Return Spring  
B—Nut  
C—Spring  
D—Plate (Early Models)  
—Washer (Later Models)



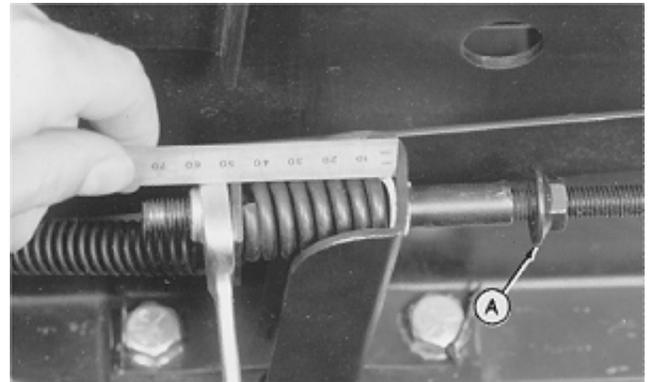
Early Models



Later Models

MX,15906010,5 -19-07MAR95

11. Apply parking brake.
12. Loosen lock nut (A).
13. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.
14. Install fender deck and belly screen.



MX,15906010,6 -19-14FEB95

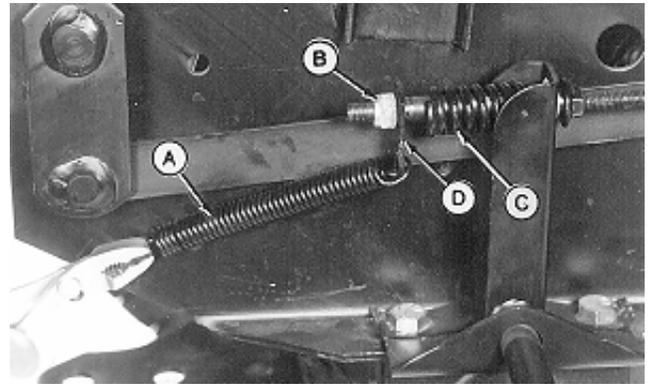
## INSPECT AND REPAIR BRAKE PEDALS AND NEUTRAL RETURN LINKAGE—318

1. Remove belly screen and fender deck.

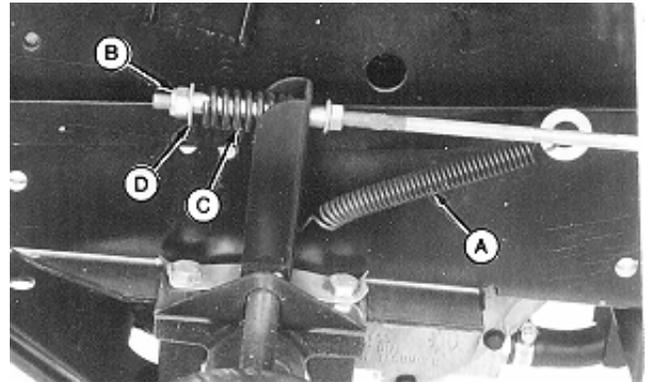
*NOTE: Disconnect brake rods from both sides of machine.*

2. Disconnect return spring (A).
3. Remove nut (B), plate or washer (D) and spring (C). Inspect springs for weak coils.
4. Disconnect brake rods from brake pedal.

A—Return Spring  
B—Nut  
C—Spring  
D—Plate (Early Models)  
—Washer (Later Models)



Early Models



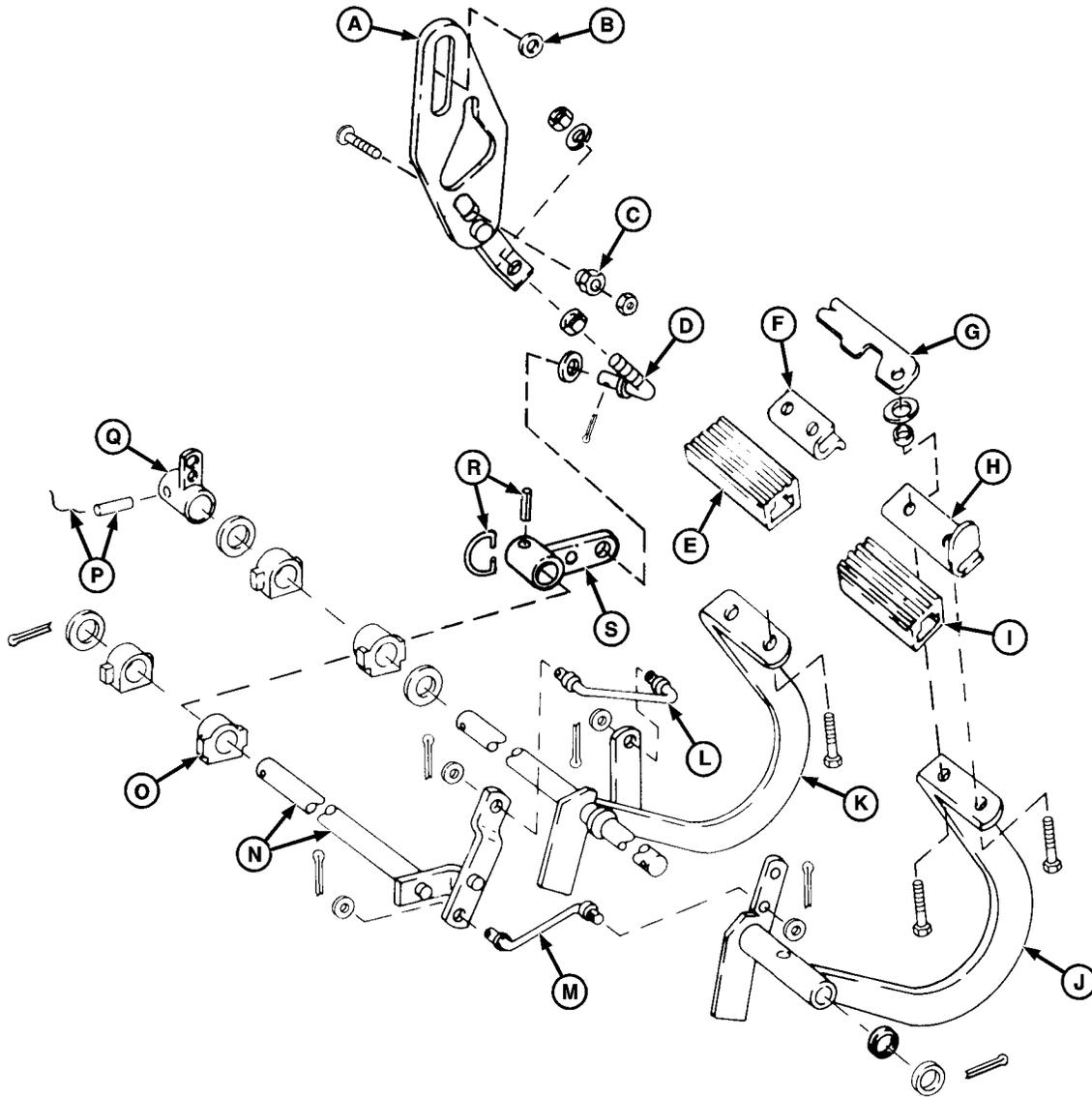
Later Models

MX,15906010,7 -19-07MAR95

M78048 -UN-13FEB95

M78049 -UN-13FEB95

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13



- |                            |                     |                        |                            |
|----------------------------|---------------------|------------------------|----------------------------|
| A—Neutral Return Cam Plate | F—Plate             | K—Left Brake Pedal     | P—Lock Wire and Spring Pin |
| B—Spacer                   | G—Strap             | L—Neutral Return Link  | Q—Left-Hand Brake Arm      |
| C—Eccentric Adjustment Nut | H—Support           | M—Neutral Return Link  | R—Lock Wire and Spring Pin |
| D—J-Bolt                   | I—Right Pedal Pad   | N—Neutral Return Shaft | S—Neutral Return Arm       |
| E—Left Pedal Pad           | J—Right Brake Pedal | O—Bearing (4 used)     |                            |

Version One (318)

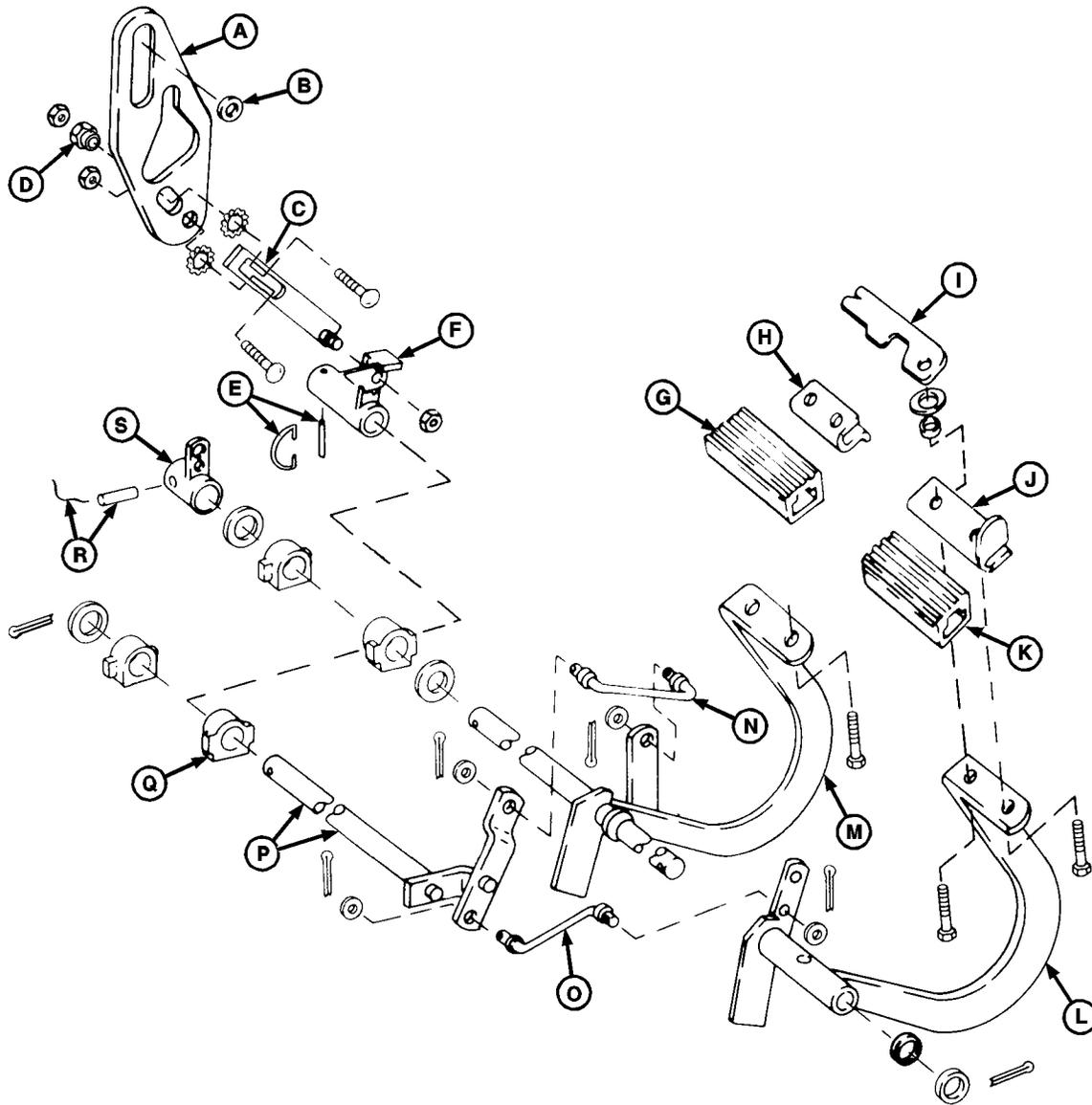
**NOTE:** Brake pedal and neutral return linkage—Version One, is used on machines equipped with transmission control linkage—Version One only.

6. If necessary to replace neutral return cam plate (A), remove transmission control lever assembly. (See Inspect and Repair Transmission Control Linkage—Version One in Section 50, Group 10.)

5. Inspect linkage for wear or damage. Replace parts as necessary.

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14

M77917 -JUN-14/MAR95



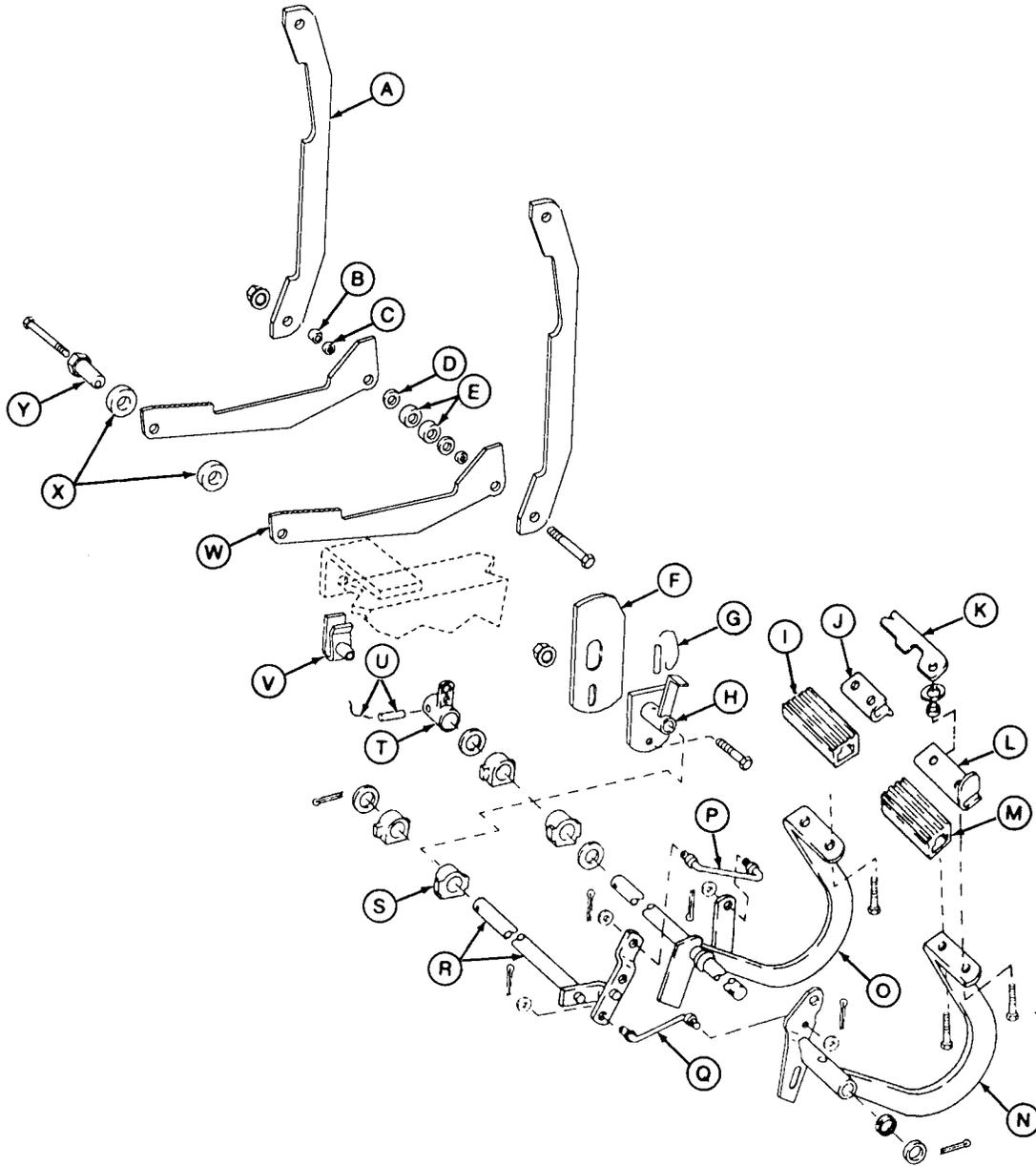
- |                                   |                            |                       |                            |
|-----------------------------------|----------------------------|-----------------------|----------------------------|
| A—Neutral Return Cam Plate        | E—Lock Wire and Spring Pin | J—Support             | O—Neutral Return Link      |
| B—Spacer                          | F—Neutral Return Arm       | K—Right Pedal Pad     | P—Neutral Return Shaft     |
| C—Neutral Return Sliding<br>Lever | G—Left Pedal Pad           | L—Right Brake Pedal   | Q—Bearing (4 used)         |
| D—Eccentric Adjustment Nut        | H—Plate                    | M—Left Brake Pedal    | R—Lock Wire and Spring Pin |
|                                   | I—Strap                    | N—Neutral Return Link | S—Left-Hand Brake Arm      |

Version Two (318)

**NOTE:** Brake pedal and neutral return linkage—Version Two, is used on machines equipped with transmission control linkage—Version Two for 316 and 318 only.

If necessary to replace neutral return cam plate (A), remove transmission control lever assembly. (See Inspect and Repair Transmission Control Linkage—Version Two for 316 and 318 in Section 50, Group 10.)

Brakes/Brake Pedal(s) and Neutral Return Linkage



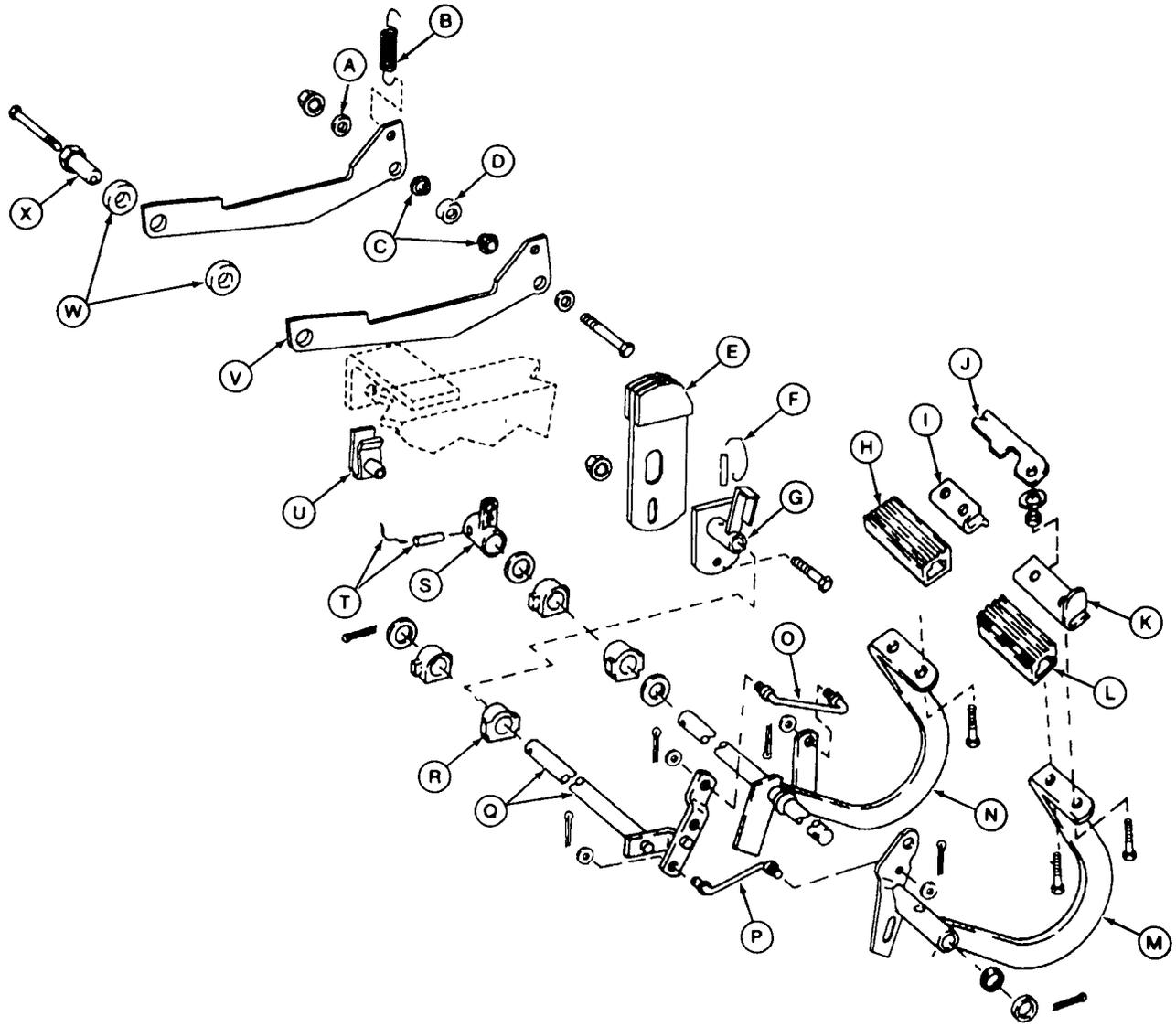
- |                              |                      |                        |                              |
|------------------------------|----------------------|------------------------|------------------------------|
| A—Strap (2 used)             | H—Neutral Return Arm | O—Left Brake Pedal     | U—Lock Wire and Spring Pin   |
| B—Spacer                     | I—Left Pedal Pad     | P—Neutral Return Link  | V—Clamp-On Nut               |
| C—Bushing (2 used)           | J—Plate              | Q—Neutral Return Link  | W—Speed Control Arm (2 used) |
| D—Washer (2 used)            | K—Strap              | R—Neutral Return Shaft | X—Bushings                   |
| E—Ball Bearings              | L—Support            | S—Bearing (4 used)     | Y—Eccentric Adjustment Nut   |
| F—Neutral Return Cam         | M—Right Pedal Pad    | T—Left-Hand Brake Arm  |                              |
| G—Safety Wire and Spring Pin | N—Right Brake Pedal  |                        |                              |

Version Three (318)

**NOTE:** Brake pedal and neutral return linkage—Version Three, is used on machines equipped with transmission control linkage—Version Three only.

M77919 -UN-13FEB95

MX,15906010,10 -19-07MAR95



- |                              |                      |                        |                              |
|------------------------------|----------------------|------------------------|------------------------------|
| A—Washer (2 used)            | G—Neutral Return Arm | N—Left Brake Pedal     | T—Lock Wire and Spring Pin   |
| B—Spring                     | H—Left Pedal Pad     | O—Neutral Return Link  | U—Clamp-On Nut               |
| C—Bushings                   | I—Plate              | P—Neutral Return Link  | V—Speed Control Arm (2 used) |
| D—Ball Bearing               | J—Strap              | Q—Neutral Return Shaft | W—Bushings                   |
| E—Neutral Return Cam         | K—Support            | R—Bearing (4 used)     | X—Eccentric Adjustment Nut   |
| F—Safety Wire and Spring Pin | L—Right Pedal Pad    | S—Left-Hand Brake Arm  |                              |
|                              | M—Right Brake Pedal  |                        |                              |

Version Four (318)

**NOTE:** Brake pedal and neutral return linkage—Version Four, is used on machines equipped with transmission control linkage—Version Four only.

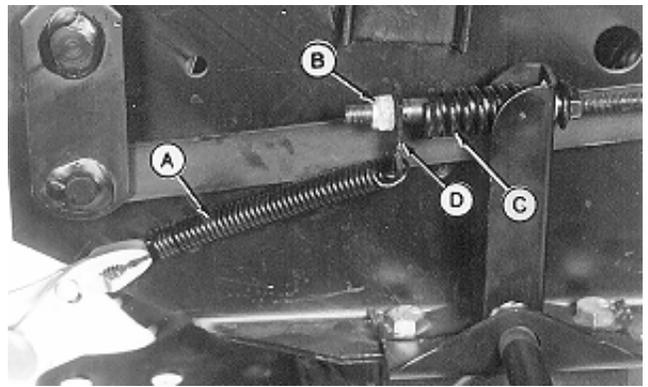
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M78040 -UN-13JAN95

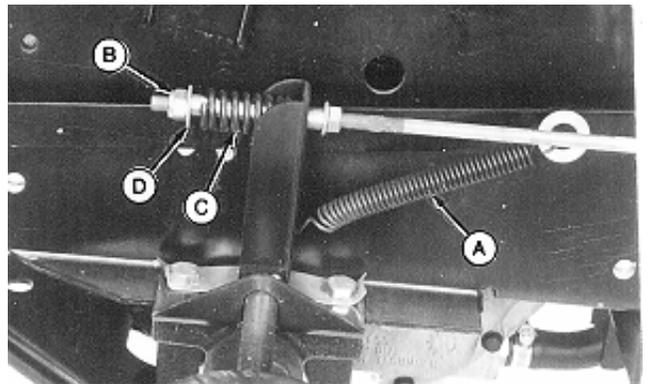
## Brakes/Brake Pedal(s) and Neutral Return Linkage

7. Install all parts.
8. Connect brake rods to brake pedal.
9. Install spring (C), plate or washer (D) and nut (B).
10. Connect return spring (A).

A—Return Spring  
B—Nut  
C—Spring  
D—Plate (Early Models)  
—Washer (Later Models)



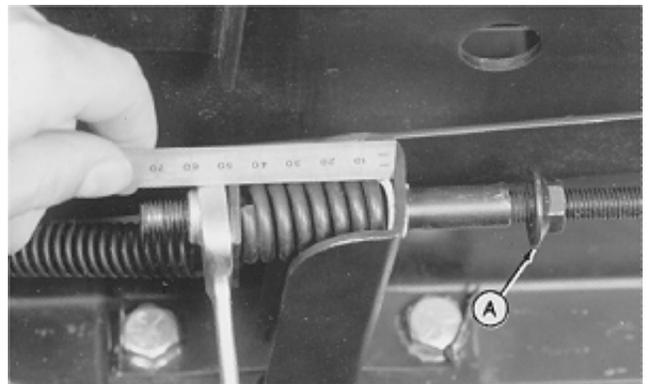
Early Models



Later Models

MX,15906010,5 -19-07MAR95

11. Lock brake pedals together and apply parking brake.
12. Loosen lock nut (A).
13. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.
14. Install fender deck and belly screen.



MX,15906010,12 -19-14FEB95

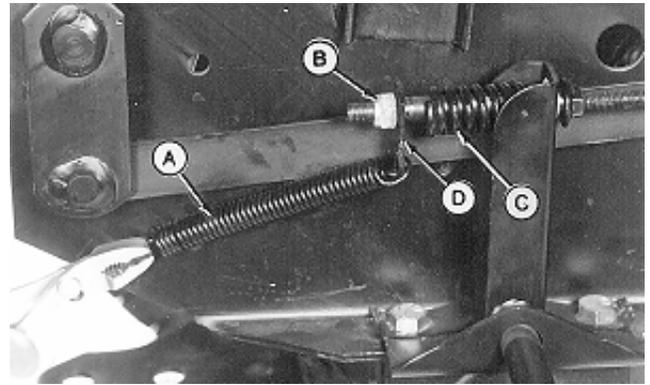
## INSPECT AND REPAIR BRAKE PEDALS AND NEUTRAL RETURN LINKAGE—420

1. Remove belly pan and fender deck.

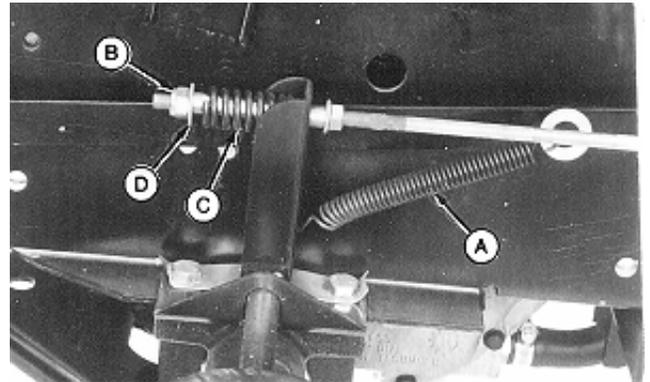
*NOTE: Disconnect brake rods from both sides of machine.*

2. Disconnect return spring (A).
3. Remove nut (B), plate or washer (D) and spring (C). Inspect springs for weak coils.
4. Disconnect brake rods from brake pedal.

A—Return Spring  
B—Nut  
C—Spring  
D—Plate (Early Models)  
—Washer (Later Models)



Early Models



Later Models

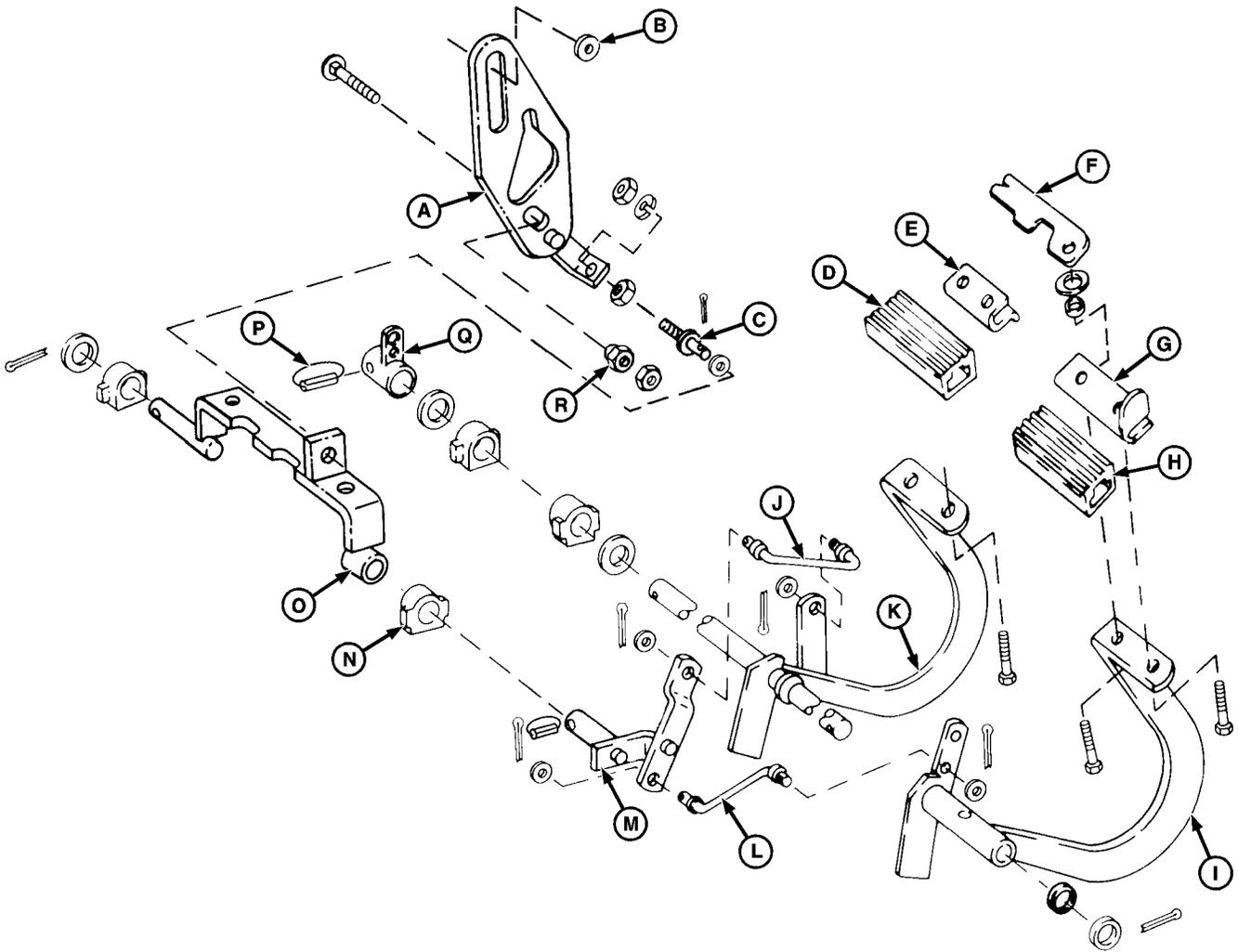
MX,15906010,13 -19-07MAR95

M78048 -UN-13FEB95

M78049 -UN-13FEB95

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Brakes/Brake Pedal(s) and Neutral Return Linkage



- |                            |                       |                               |                            |
|----------------------------|-----------------------|-------------------------------|----------------------------|
| A—Neutral Return Cam Plate | F—Strap               | K—Left Brake Pedal            | P—Lock Wire and Spring Pin |
| B—Spacer                   | G—Support             | L—Neutral Return Link         | Q—Left-Hand Brake Arm      |
| C—J-Bolt                   | H—Right Pedal Pad     | M—Neutral Return Shaft        | R—Eccentric Adjustment Nut |
| D—Left Pedal Pad           | I—Right Brake Pedal   | N—Bearing (4 used)            |                            |
| E—Plate                    | J—Neutral Return Link | O—Neutral Return Welded Shaft |                            |

Version One (420)

**NOTE:** Brake pedal and neutral return linkage—Version One, is used on machines equipped with transmission control linkage—Versions One or Two for 420 only.

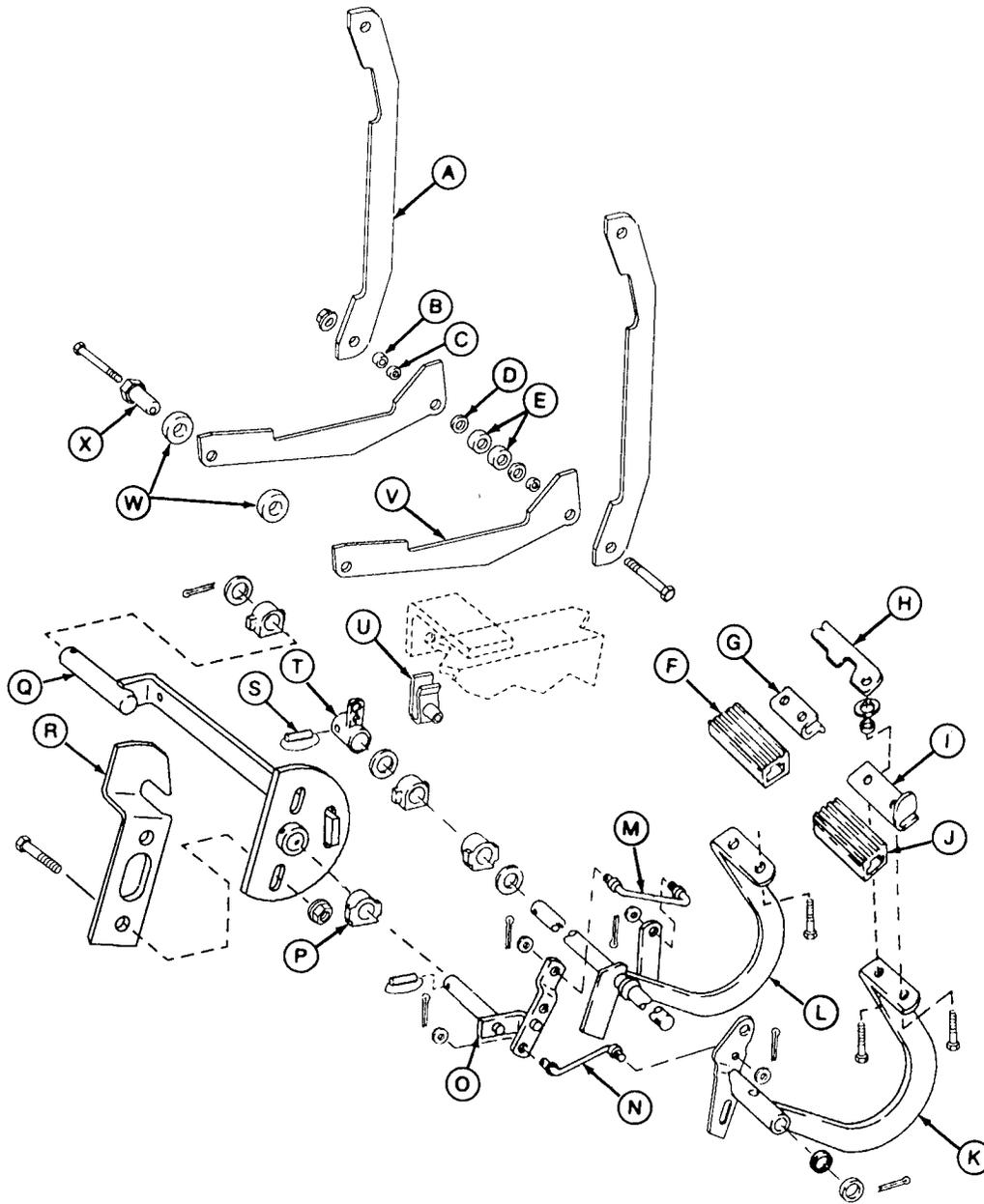
5. Inspect linkage for wear or damage. Replace parts as necessary.

6. If necessary to replace neutral return cam plate (A), remove transmission control lever assembly. (See Inspect and Repair Transmission Control Linkage—Version One or Version Two for 420 only in Section 50, Group 10.)

-JUN-14/MAR95  
MT8041

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Brakes/Brake Pedal(s) and Neutral Return Linkage



- |                    |                       |                                |                              |
|--------------------|-----------------------|--------------------------------|------------------------------|
| A—Strap (2 used)   | H—Strap               | O—Neutral Return Shaft (Short) | T—Left-Hand Brake Arm        |
| B—Spacer           | I—Support             | P—Bearing (4 used)             | U—Clamp-On Nut               |
| C—Bushing (2 used) | J—Right Pedal Pad     | Q—Neutral Return Shaft (Long)  | V—Speed Control Arm (2 used) |
| D—Washer (2 used)  | K—Right Brake Pedal   | R—Neutral Return Cam           | W—Bushings                   |
| E—Ball Bearings    | L—Left Brake Pedal    | S—Lock Wire and Spring Pin     | X—Eccentric Adjustment Nut   |
| F—Left Pedal Pad   | M—Neutral Return Link |                                |                              |
| G—Plate            | N—Neutral Return Link |                                |                              |

Version Two (420)

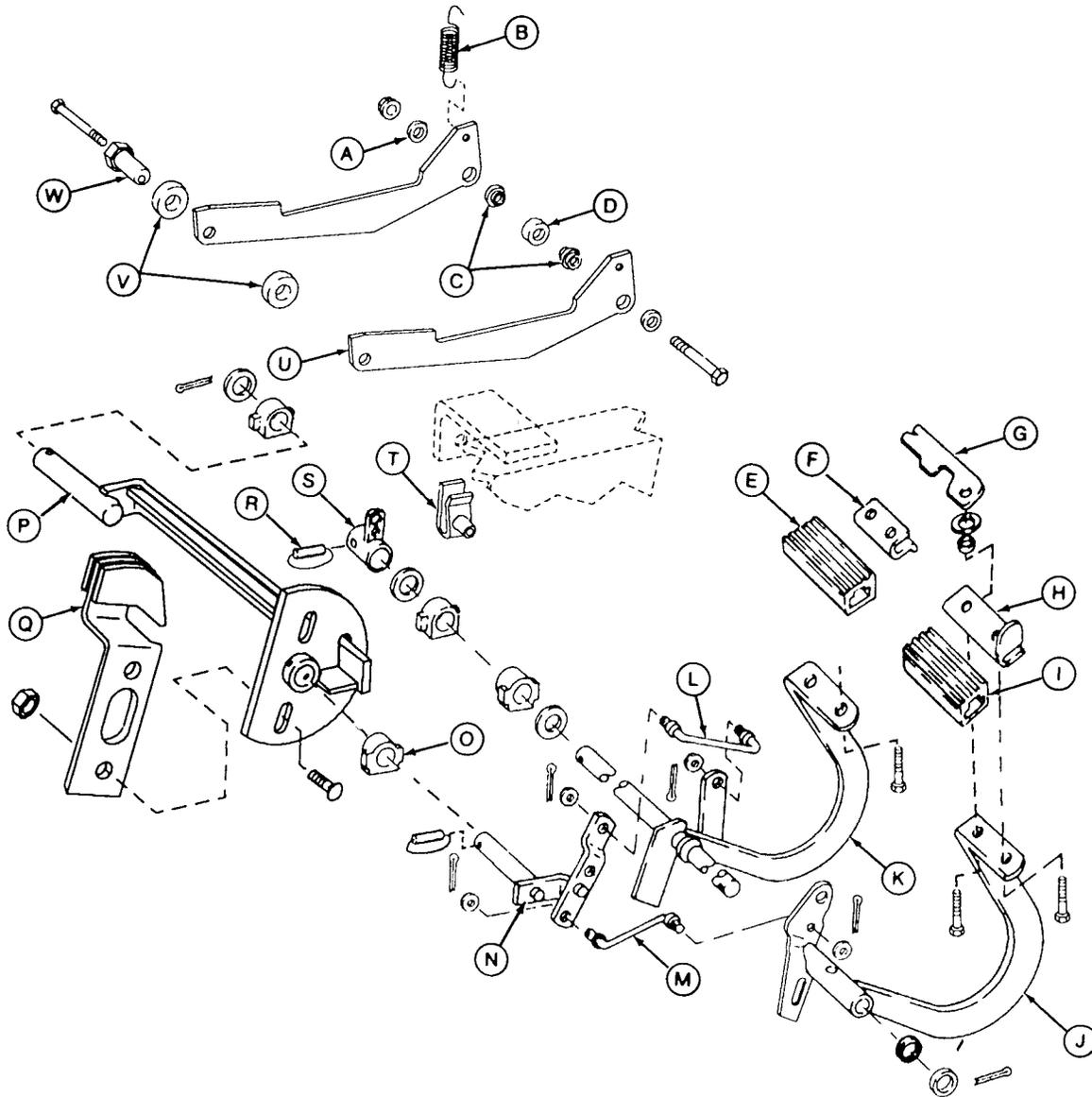
**NOTE:** Brake pedal and neutral return linkage—Version Two, is used on machines equipped with transmission control linkage—Version Three only.

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21

M78042 -UN-13MAR95

MX,15906010,15 -19-07MAR95

Brakes/Brake Pedal(s) and Neutral Return Linkage



- |                   |                                |                               |                              |
|-------------------|--------------------------------|-------------------------------|------------------------------|
| A—Washer (2 used) | H—Support                      | O—Bearing (4 used)            | T—Clamp-On Nut               |
| B—Spring          | I—Right Pedal Pad              | P—Neutral Return Shaft (Long) | U—Speed Control Arm (2 used) |
| C—Bushings        | J—Right Brake Pedal            | Q—Neutral Return Cam          | V—Bushings                   |
| D—Ball Bearing    | K—Left Brake Pedal             | R—Lock Wire and Spring Pin    | W—Eccentric Adjustment Nut   |
| E—Left Pedal Pad  | L—Neutral Return Link          | S—Left-Hand Brake Arm         |                              |
| F—Plate           | M—Neutral Return Link          |                               |                              |
| G—Strap           | N—Neutral Return Shaft (Short) |                               |                              |

Version Three (420)

**NOTE:** Brake pedal and neutral return linkage—Version Three, is used on machines equipped with transmission control linkage—Version Four only.

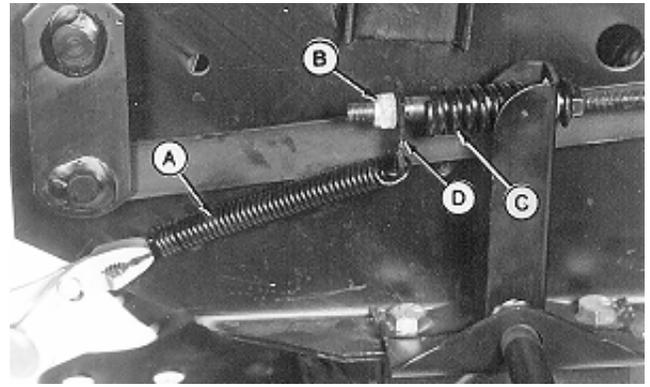
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22

M78043 -UN-13MAR95

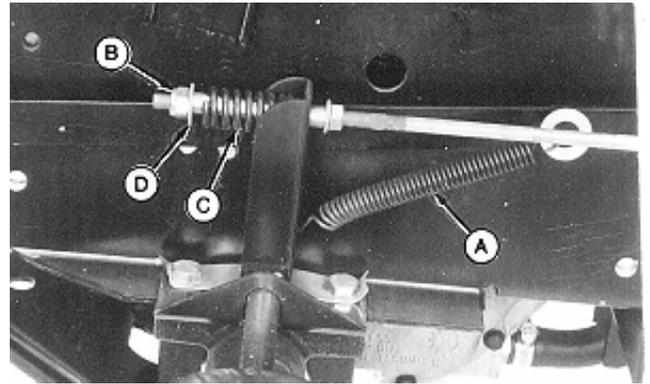
## Brakes/Brake Pedal(s) and Neutral Return Linkage

7. Install all parts.
8. Connect brake rods to brake pedal.
9. Install spring (C), plate or washer (D) and nut (B).
10. Connect return spring (A).

A—Return Spring  
B—Nut  
C—Spring  
D—Plate (Early Models)  
—Washer (Later Models)



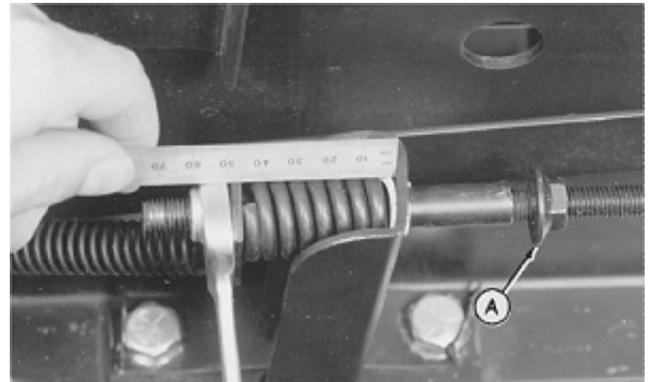
Early Models



Later Models

MX,15906010,5 -19-07MAR95

11. Lock brake pedals together and apply parking brake.
12. Loosen lock nut (A).
13. Turn nut until spring is 42 mm (1.650 in.) long. Tighten lock nut.
14. Install fender deck and belly pan.

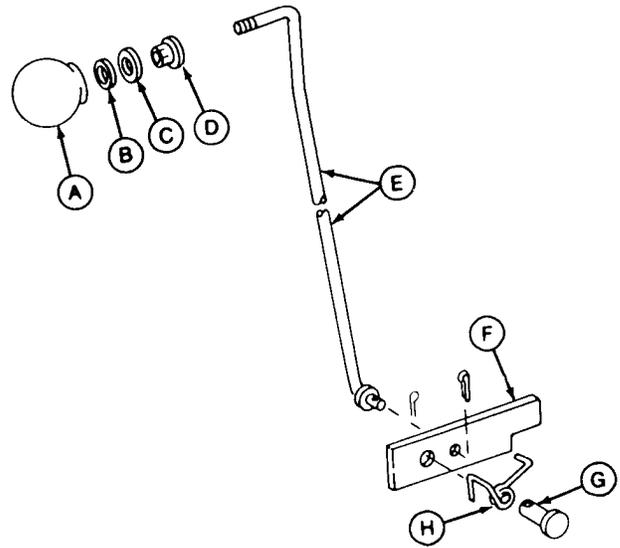


MX,15906010,17 -19-14FEB95

## INSPECT AND REPAIR PARK BRAKE LEVER

1. Remove belly screen/pan.
2. Inspect all parts for wear or damage. Replace as necessary.

- A—Knob
- B—Lock Washer
- C—Washer
- D—Weld Nut
- E—Park Brake Rod
- F—Lock Plate
- G—Pin
- H—Torsion Spring



M77913 -UN-13FEB95

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24

MX.15906010,18 -19-12MAY95

# Section 70 HYDRAULIC REPAIR

## Contents

### Page

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316 and 318 . . . . .	70-05-2
420 . . . . .	70-05-4
Disassemble, Inspect and Assemble	
Single-Spool . . . . .	70-05-5
Two-Spool . . . . .	70-05-6
Three-Spool . . . . .	70-05-9



**OTHER MATERIAL**

Number	Name	Use
M79292	MPG-2® Multi-Purpose Polymer Grease	Prevents parts from seizing. Apply to spool springs and end cap cavities.
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
T43512/TY9473/242	Thread Lock and Sealer (Medium Strength)	Apply to threads spool screws.

*®MPG-2 is a registered trademark of DuBois USA.*

*®LOCTITE is a registered trademark of the Loctite Corp.*

MX.15907005,OTH-19-20APR95

**SERVICE PARTS KITS**

The following kits are available through your parts catalog:

Single-Spool Valve  
   Spring Center Kit  
   Load Check Kit  
   Seal Kit

Two-Spool Valve  
   Version One  
     Seal Kit  
   Versions Two and Three  
     Seal Kit  
     Detent Replacement Kit  
   Versions Four and Five  
     Seal Kit  
     Load Check Kit  
     Spring Center Kit  
     Float Detent Kit  
     Valve Detent Kit

Three-Spool Valve  
   Version One, Two and Three  
     Seal Kit  
     Detent Replacement Kit  
   Version Four  
     Seal Kit  
     Load Check Kit  
     Spring Center Kit  
     Float Detent Kit

MX.15907005,KIT-19-20APR95

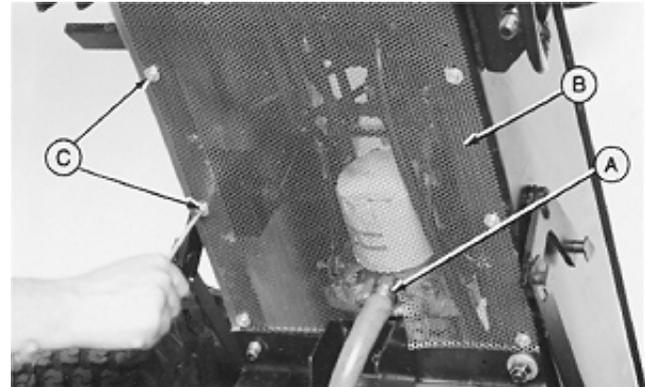
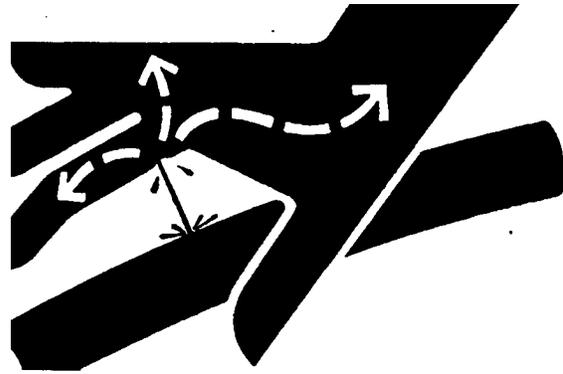
## REMOVE AND INSTALL HYDRAULIC CONTROL VALVE—316 AND 318

**N** **CAUTION:** Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

*NOTE: Removal and installation procedures for later models may vary slightly.*

1. Remove ten cap screws (C) and belly screen (B).
2. Disconnect suction hose (A) to drain transmission oil. Approximate capacity is 4.7 L (5 U.S. qt).
3. Remove hydraulic filter.



-UN-23AUG88

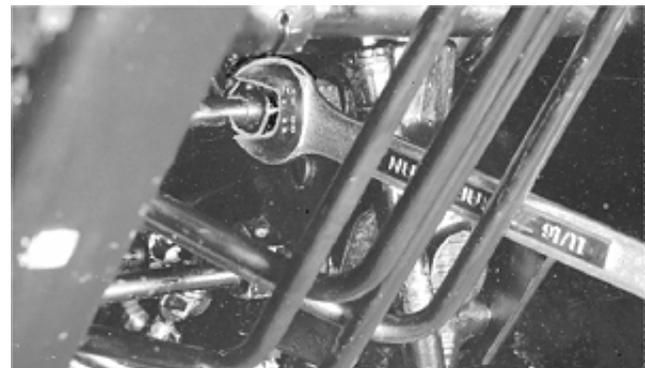
X9811

-UN-28JUL89

M31751

MX,15907005.1 -19-20APR95

4. On 316; Remove fender deck.
5. On 316; Remove both engine side panels, battery, battery base and left-hand side pedestal panel.
6. Disconnect hydraulic lines from control valve.



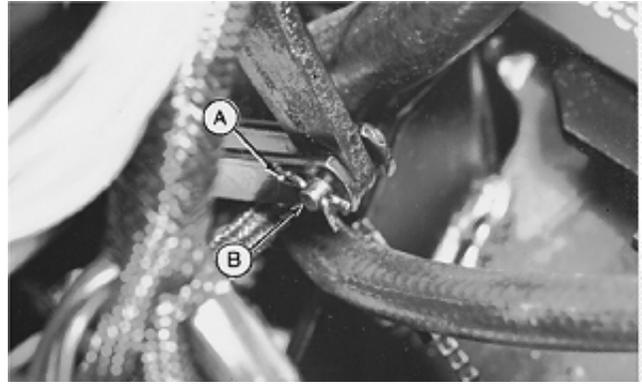
-UN-03AUG89

M32026

MX,15907005.2 -19-20APR95

## Hydraulic Control Valve/Remove and Install

7. Remove cotter pin(s) (A) from draft pin(s) (B).  
Disconnect control linkage.



316 Shown

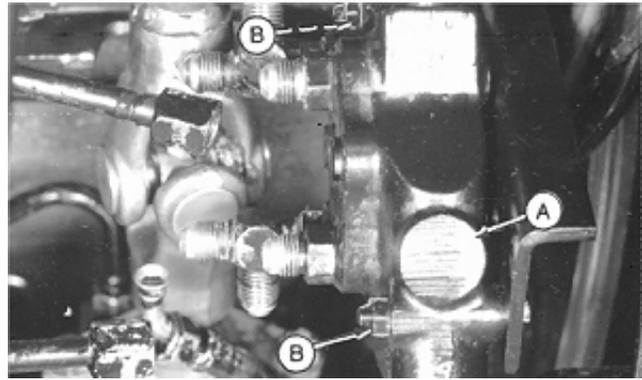
MX,15907005.3 -19-20APR95

M55071  
-UN-09DEC89

8. Remove two mounting bolts (B) and control valve (A).

9. Installation is done in the reverse order of removal.

- Fill transmission with the recommended amount of John Deere Low Viscosity HY-GARD® oil.
- Bleed the hydraulic system. (See procedure in Section 270, Group 20.)



MX,15907005.4 -19-20APR95

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-UN-03AUG89

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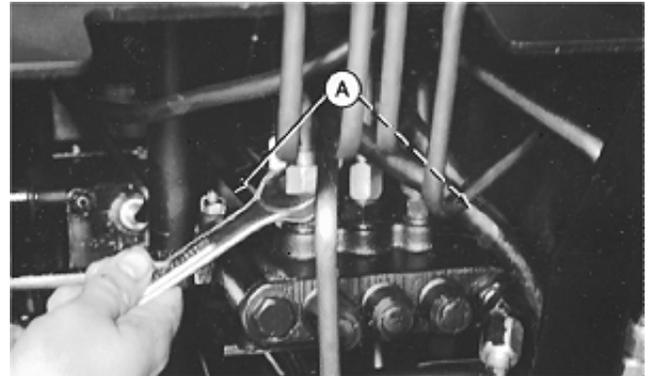
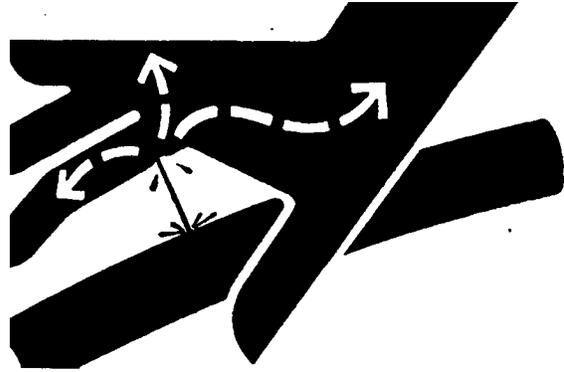
## REMOVE AND INSTALL HYDRAULIC CONTROL VALVE—420

**N** **CAUTION:** Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

*NOTE: Removal and installation procedures for later models may vary slightly.*

1. Remove belly pan.
  2. Disconnect hydraulic lines from control valve.
  3. Disconnect control linkage.
  4. Remove two mounting bolts (A) and control valve.
  5. Installation is done in the reverse order of removal.
- Bleed the hydraulic system. (See procedure in Section 270, Group 20.)



-UN-23AUG88

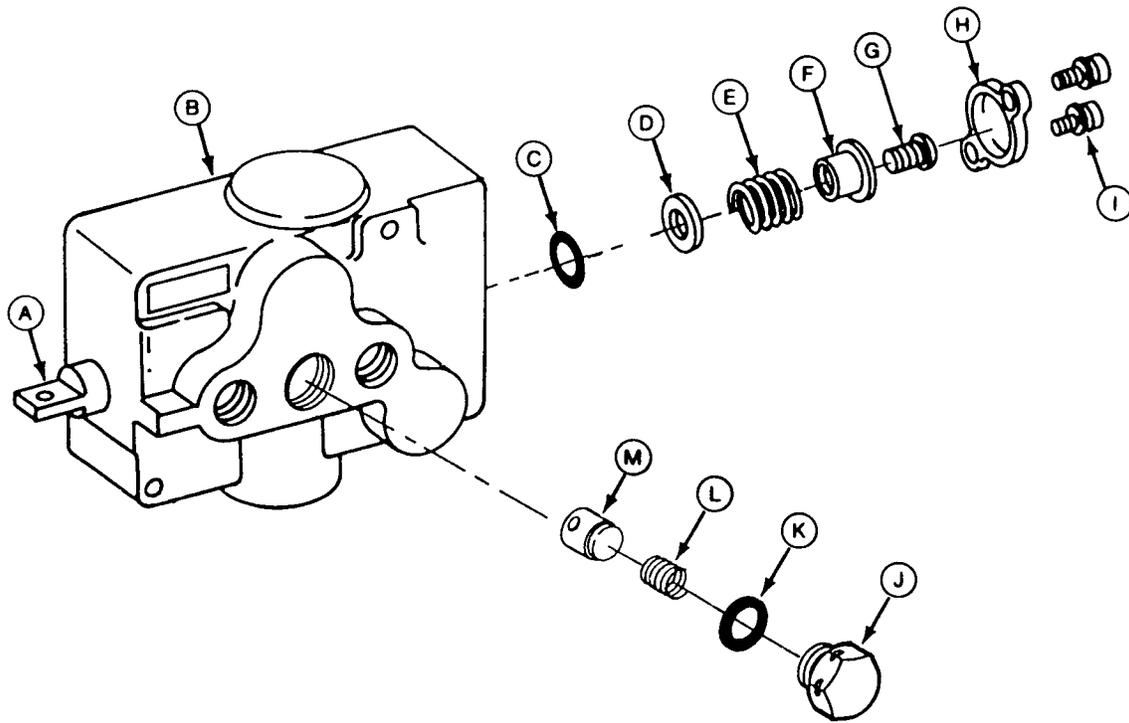
X9811

-UN-28JUL89

M31895

MX,15907005.5 -19-20APR95

## DISASSEMBLE, INSPECT AND ASSEMBLE HYDRAULIC CONTROL VALVE—SINGLE-SPOOL



A—Spool  
B—Body  
C—O-Ring  
D—Washer

E—Spring  
F—Spring Retainer  
G—Screw

H—Cap  
I—Screw (2 used)  
J—Plug

K—O-Ring  
L—Spring  
M—Poppet

**IMPORTANT:** Spool and body are matched and must be replaced as a unit.

**Always use new O-rings. Damaged or used parts will leak.**

*NOTE:* Note location and position of fittings and linkage to aid in assembly.

*Lubricate all O-rings with petroleum jelly during assembly.*

Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.

- Clean threads in end of spool (A) and on screw (G) using Clean and Cure Primer. Apply thread lock and sealer (medium strength) on threads of screw (G).

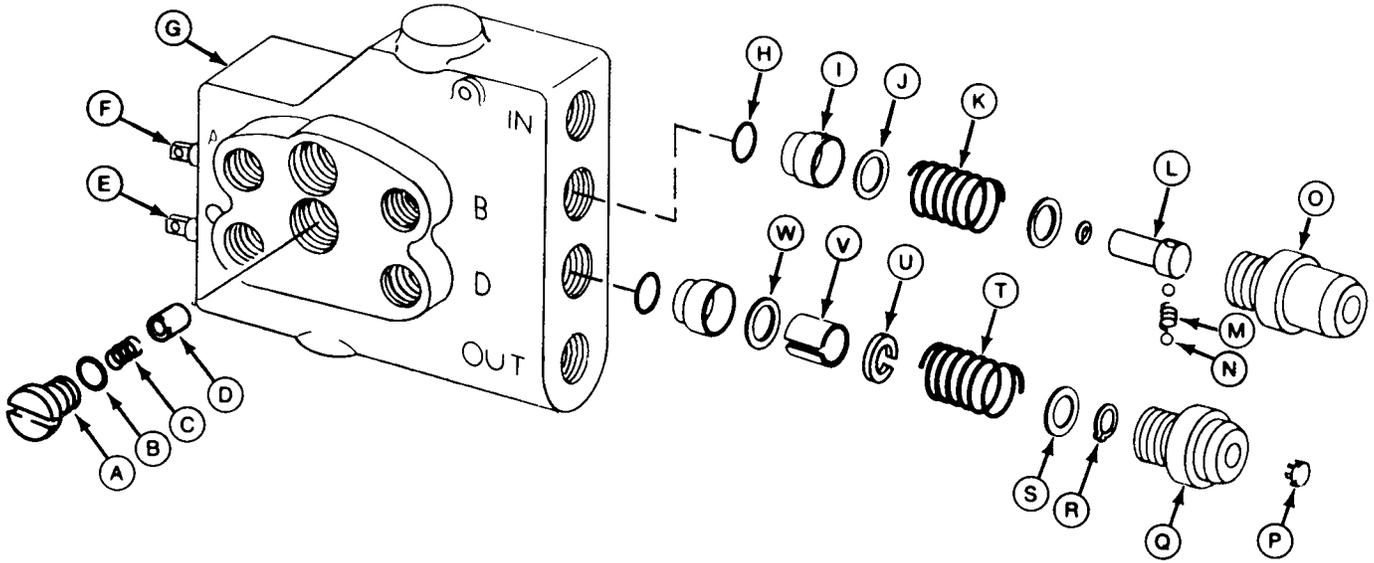
- Apply MPG-2® Multi-Purpose Polymer Grease on spring (E) and inside of cap (H).

- Tighten screws (G and I) and plug (J) to specifications.

### TORQUE SPECIFICATIONS

Screws (G and I) . . . . . 4 N-m (35 lb-in.)  
Plug (J) . . . . . 31 N-m (23 lb-ft)

**DISASSEMBLE, INSPECT AND ASSEMBLE HYDRAULIC CONTROL VALVE—TWO-SPOOL**



A—Check Valve Plug (2 used)  
 B—O-Ring (2 used)  
 C—Spring (2 used)  
 D—Poppet (2 used)  
 E—Spool

F—Float Detent Spool  
 G—Body  
 H—O-Ring (2 used)  
 I—Bushing (2 used)  
 J—Washer (2 used)  
 K—Spring

L—Detent  
 M—Spring  
 N—Ball (2 used)  
 O—Cap  
 P—Plug  
 Q—Cap

R—Snap Ring  
 S—Washer  
 T—Spring  
 U—Snap Ring  
 V—Sleeve  
 W—Washer (as required)

Version One

**NOTE:** There are five versions of this valve. Disassembly and assembly procedures may vary slightly.

**IMPORTANT:** Spools and body are matched and must be replaced as a unit. Spools must be installed into the same bores from which they were removed for proper operation of each function.

**Always use new O-rings. Damaged or used parts will leak.**

**NOTE:** Note location and position of fittings and linkages to aid in assembly.

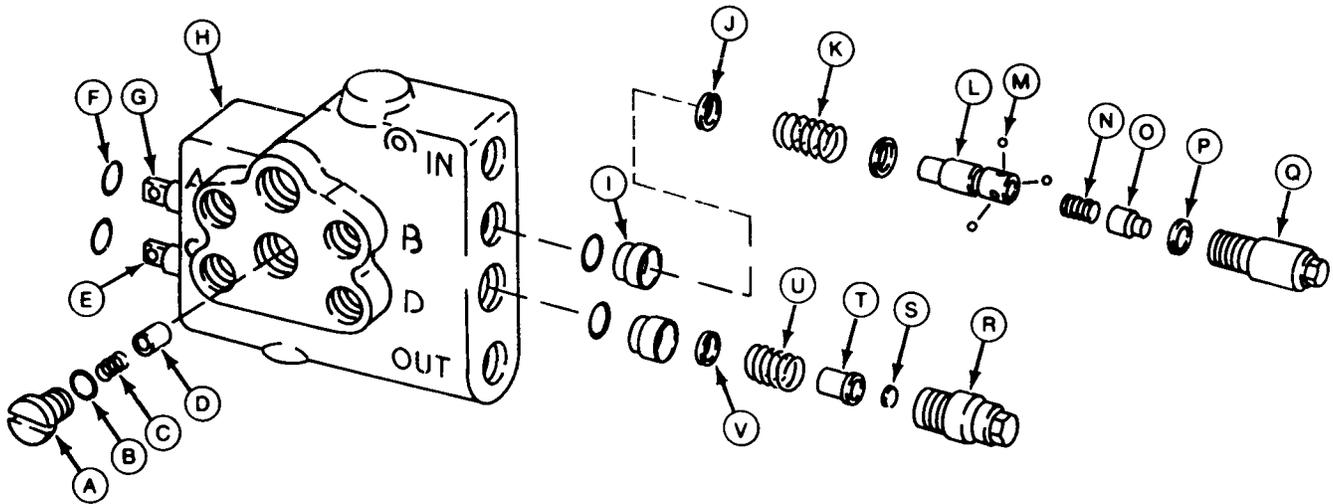
Lubricate all O-rings with petroleum jelly during assembly.

Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.
- Apply MPG-2® Multi-Purpose Polymer Grease on springs (K and T) and inside of caps (O and Q).
- Tighten caps (O and Q) to 31 N·m (23 lb-ft).

70  
05  
6

M78059 -JUN-14APR95



A—Check Valve Plug (2 used)  
 B—O-Ring (2 used)  
 C—Spring (2 used)  
 D—Poppet (2 used)  
 E—Spool

F—O-Ring (4 used)  
 G—Float Detent Spool  
 H—Body  
 I—Bushing (2 used)  
 J—Washer (2 used)  
 K—Spring

L—Detent  
 M—Ball (3 used)  
 N—Spring  
 O—Cap  
 P—Washer  
 Q—Cap

R—Cap  
 S—Snap Ring  
 T—Spacer  
 U—Spring  
 V—Washer

Versions Two and Three

**IMPORTANT:** Spools and body are matched and must be replaced as a unit. Spools must be installed into the same bores from which they were removed for proper operation of each function.

**Always use new O-rings. Damaged or used parts will leak.**

*NOTE:* Note location and position of fittings and linkages to aid in assembly.

*Lubricate all O-rings with petroleum jelly during assembly.*

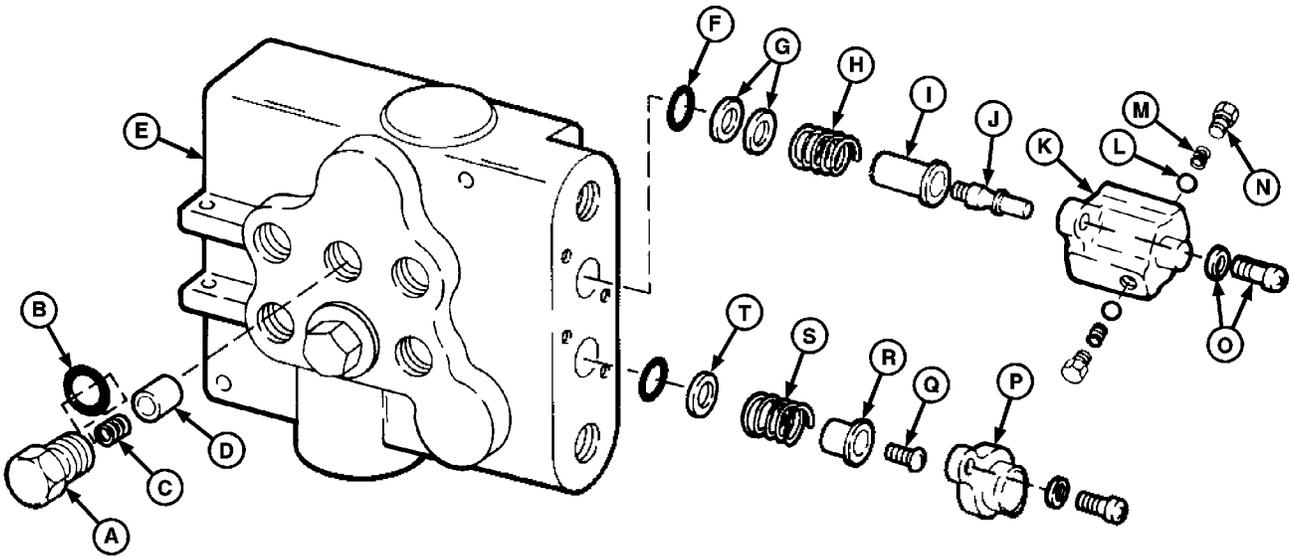
Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.
- Apply MPG-2® Multi-Purpose Polymer Grease on springs (K, N and U) and inside of caps (Q and R).
- Tighten caps (Q and R) to 31 N·m (23 lb-ft).

MX,15907005.8 -19-20APR95

M78840 -JUN-14APR95

70  
05  
7



A—Check Valve Plug (2 used)  
 B—O-Ring (2 used)  
 C—Spring (2 used)  
 D—Poppet (2 used)  
 E—Spools and Body

F—O-Ring (4 used)  
 G—Washers  
 H—Spring  
 I—Spacer  
 J—Detent  
 K—Cap

L—Ball (2 used)  
 M—Spring (2 used)  
 N—Plug (2 used)  
 O—Screw and Washer (4 used)

P—Cap  
 Q—Screw  
 R—Spacer  
 S—Spring  
 T—Washer

Versions Four and Five

**IMPORTANT:** Spools and body are matched and must be replaced as a unit. Spools must be installed into the same bores from which they were removed for proper operation of each function.

**Always use new O-rings. Damaged or used parts will leak.**

*NOTE:* Note location and position of fittings and linkages to aid in assembly.

*Lubricate all O-rings with petroleum jelly during assembly.*

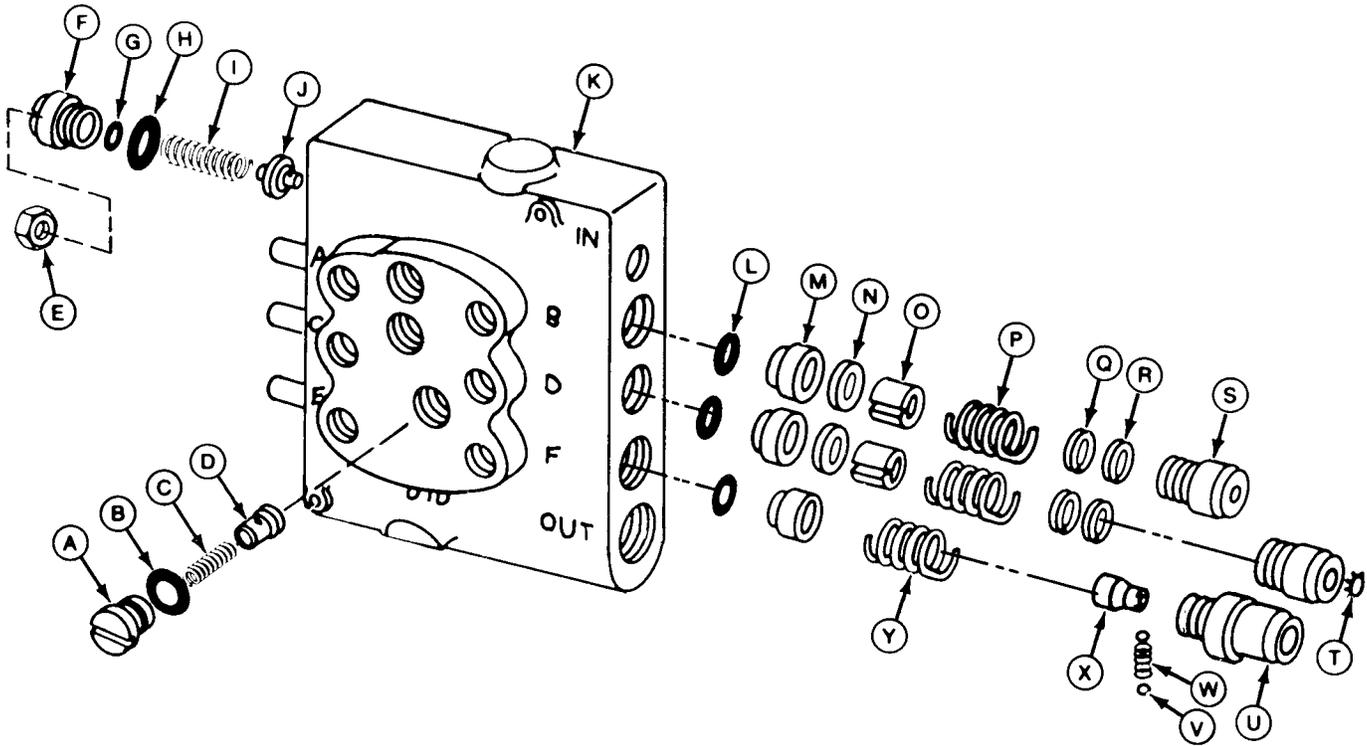
Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.
- Clean threads in end of spools, detent (J) and screw (Q) using Clean and Cure Primer. Apply thread lock and sealer (medium strength) on threads of detent (J) and screw (Q).
- Apply MPG-2® Multi-Purpose Polymer Grease on springs (H and S) and inside of caps (K and P).
- Tighten detent (J), screw (Q), screw and washers (O) and plugs (A) to specifications.

**TORQUE SPECIFICATIONS**

Detent (J), Screw (Q) and Screw and Washers (O) . . . . .	4 N·m (35 lb-in.)
Plugs (A) . . . . .	31 N·m (23 lb-ft)

## DISASSEMBLE, INSPECT AND ASSEMBLE HYDRAULIC CONTROL VALVE—THREE-SPOOL



A—Check Valve Plug (3 used)  
 B—O-Ring (3 used)  
 C—Spring (3 used)  
 D—Poppet (3 used)  
 E—Lock Nut (Version Three only)

F—Cap  
 G—Shim (as required)  
 H—O-Ring  
 I—Spring  
 J—Poppet  
 K—Spools and Body  
 L—O-Ring (6 used)

M—Bushing (3 used)  
 N—Washer (2 used)  
 O—Spacer (2 used)  
 P—Spring (2 used)  
 Q—Washer (2 used)  
 R—Snap Ring (2 used)  
 S—Cap (2 used)

T—Plug (2 used, Version Two only)  
 U—Cap  
 V—Ball (2 used)  
 W—Spring  
 X—Detent  
 Y—Spring

Versions One, Two and Three

**NOTE:** There are four versions of this valve. Disassembly and assembly procedures may vary slightly.

**IMPORTANT:** Spools and body are matched and must be replaced as a unit. Spools must be installed into the same bores from which they were removed for proper operation of each function.

**Always use new O-rings. Damaged or used parts will leak.**

**NOTE:** Note location and position of fittings and linkages to aid in assembly.

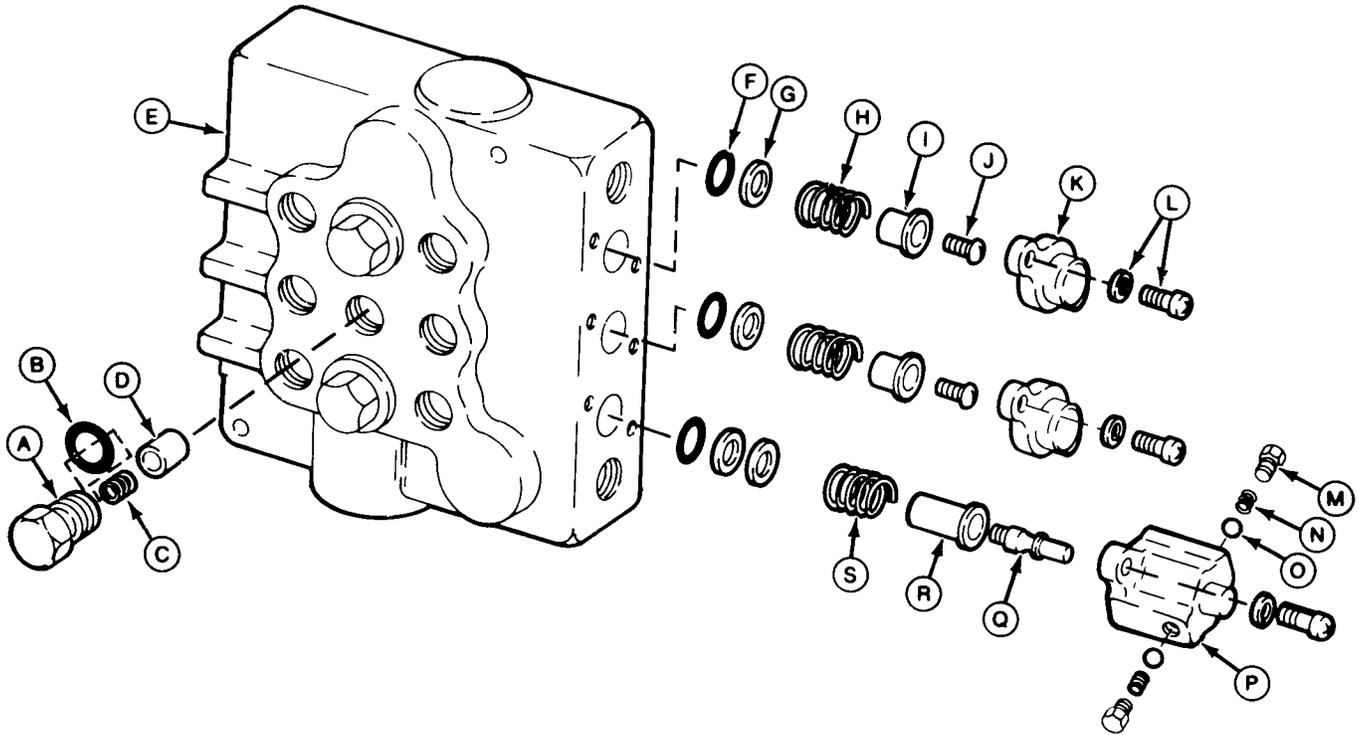
Lubricate all O-rings with petroleum jelly during assembly.

Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.
- Apply MPG-2® Multi-Purpose Polymer Grease on springs (P and Y) and inside of caps (S and U).
- Tighten lock nut (E), if equipped, and caps (S and U) to 31 N-m (23 lb-ft).

M75842 -JUN-24-APR95

70  
05  
9



A—Check Valve Plug (3 used)  
 B—O-Ring (3 used)  
 C—Spring (3 used)  
 D—Poppet (3 used)  
 E—Spools and Body

F—O-Ring (6 used)  
 G—Washer (4 used)  
 H—Spring (2 used)  
 I—Spacer (2 used)  
 J—Screw (2 used)

K—Cap (2 used)  
 L—Screw and Washer (6 used)  
 M—Plug (2 used)  
 N—Spring (2 used)

O—Ball (2 used)  
 P—Cap  
 Q—Detent  
 R—Spacer  
 S—Spring

Version Four

**IMPORTANT:** Spools and body are matched and must be replaced as a unit. Spools must be installed into the same bores from which they were removed for proper operation of each function.

**Always use new O-rings. Damaged or used parts will leak.**

*NOTE:* Note location and position of fittings and linkages to aid in assembly.

*Lubricate all O-rings with petroleum jelly during assembly.*

Inspect all parts for wear or damage. Replace as necessary.

- Apply clean John Deere Low Viscosity HY-GARD® oil on all internal parts during assembly.

- Clean threads in end of spools, detent (Q) and screws (J) using Clean and Cure Primer. Apply thread lock and sealer (medium strength) on threads of detent (Q) and screws (J).

- Apply MPG-2® Multi-Purpose Polymer Grease on springs (H and S) and inside of caps (K and P).

- Tighten detent (Q), screws (J), screw and washers (L) and plugs (A) to specifications.

**TORQUE SPECIFICATIONS**

Detent (Q), Screws (J) and	
Screw and Washers (L)	4 N·m (35 lb-in.)
Plugs (A)	31 N·m (23 lb-ft)

M78843 -JUN-14-APR95

70  
05  
10

# Section 80 MISCELLANEOUS REPAIR

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**SPECIAL OR ESSENTIAL TOOLS**

*NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).*

DX,TOOLS -19-05JUN91

Installer Sleeve.....JDM8-3

For 420 tractor; Used to install PTO shaft assembly into pivot pin.

MX,15908005,A -19-08MAR95

**REMOVE AND INSTALL FRONT AXLE—316 AND 318**

*NOTE: The 316 has manual steering and is connected to the steering arm by a drag link. The 318 has power steering and is connected to the steering arm by a cylinder.*

1. Raise front of machine and block securely with jack stands.
2. Remove cotter pin, if equipped, from steering link/cylinder at steering arm on spindle.
3. Remove nut and bolt (318) from arm.
4. Disconnect steering link/cylinder from spindle.



318 Shown

M31963 -UN-28JUL89

MX,15908005,1 -19-20MAR95

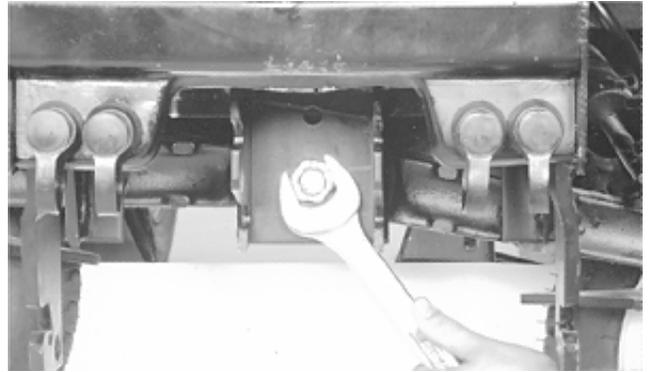
5. Loosen axle deflector adjustment bolts and turn in to allow maximum clearance.



M32000 -UN-03AUG89

MX,15908005,2 -19-15FEB95

6. Place a floor jack under center of axle.
7. Remove cotter pin from pivot bolt.
8. Remove pivot bolt nut and remove bolt through axle (towards rear). Remove axle.
9. Inspect axle and pivot bushings for damage or wear. (See procedure in this group.)
10. Installation is done in the reverse order of removal.



-UN-03AUG89  
M32002

- Apply multipurpose grease to pivot bolt before installing.
- Tighten pivot bolt nut until axle is snug, but still free to pivot.
- Adjust axle deflector adjustment bolts for smooth up and down operation of axle. Axle should move freely without sticking in one spot.

MX,15908005,3 -19-08MAR95

### INSPECT AND REPLACE PIVOT BUSHINGS—316 AND 318

1. Inspect pivot bushings (A) and pivot bolt for wear or damage. The pivot bolt should not be bent or have stripped threads.
2. Replace bushings if necessary, using a driver set.
3. Inspect the axle for bends, cracks, or damage. Replace any damaged components.



-UN-17FEB95  
M31582

MX,15908005,4 -19-07MAR95

### REMOVE FRONT AXLE—420

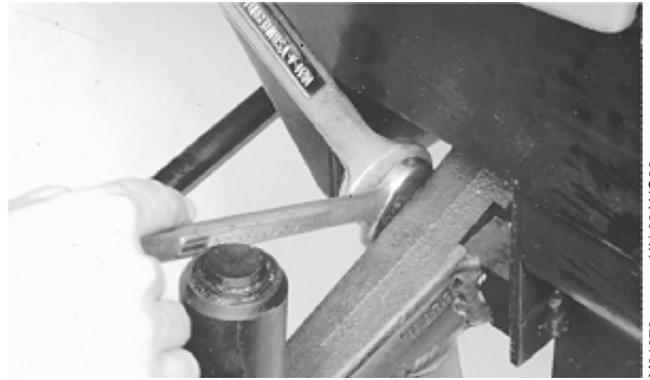
1. Raise front of machine and block securely with jack stands.
2. Remove cotter pin, if equipped, from steering cylinder at steering arm on spindle.
3. Remove nut and bolt from steering arm.
4. Disconnect steering cylinder from spindle.



-UN-28JUL89  
M31963

MX,15908005,5 -19-07MAR95

5. Loosen axle deflector adjustment bolts and turn in to allow maximum clearance.

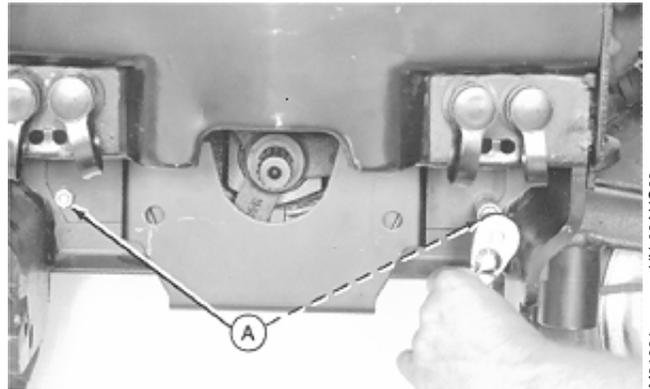


M31970 -UN-03AUG89

MX,15908005,6 -19-15FEB95

6. Remove front grille.

7. Remove two nuts (A) and belt guard.

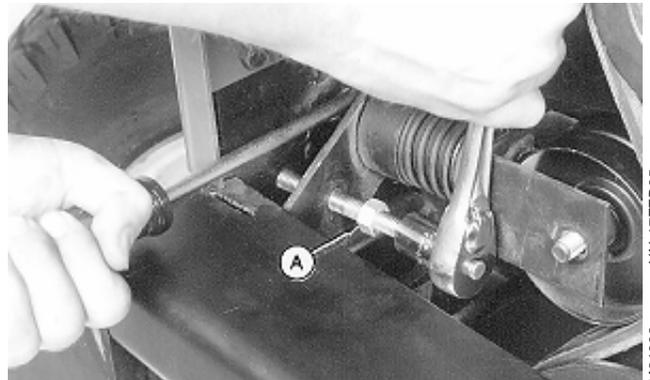


M31991 -UN-03AUG89

MX,15908005,7 -19-07MAR95

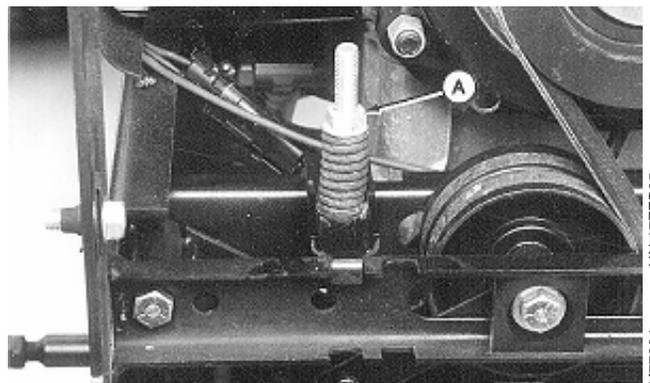
8. Loosen belt adjuster (A), using a screwdriver or bar to keep the adjuster from cocking as it is loosened.

9. Remove both belts from sheaves.



M31992 -UN-17FEB95

Horizontal Adjuster

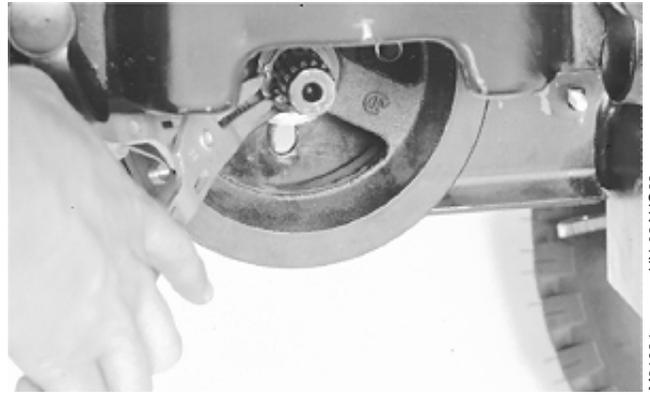


M77304 -UN-17FEB95

Vertical Adjuster

MX,15908005,8 -19-07MAR95

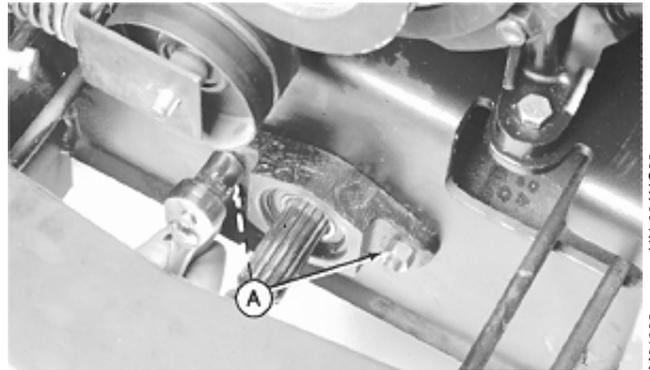
10. Remove snap ring from drive pulley.
11. Remove drive pulley from PTO shaft.



MX,15908005,9 -19-15FEB95

M31994  
-UN-03AUG89

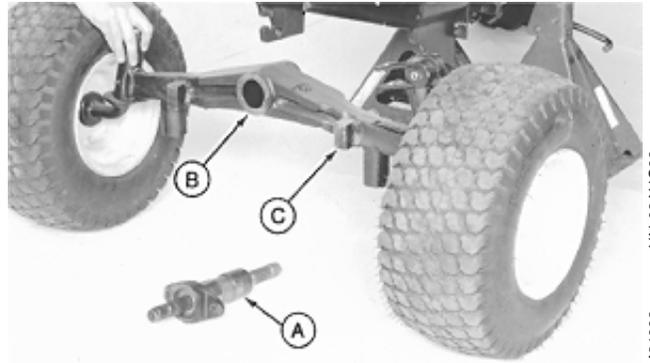
12. Remove two pivot pin retaining nuts (A).



MX,15908005,10 -19-15FEB95

M31996  
-UN-03AUG89

13. Place a floor jack under center of axle.
14. Slide pivot pin (A) out towards front of tractor. Remove axle.
15. Inspect pivot pin bore (B) and axle (C) for damage or excessive wear. Replace axle if necessary.
16. Inspect pivot pin for damage or wear. (See procedure in this group.)



MX,15908005,11 -19-15FEB95

M31998  
-UN-03AUG89

### DISASSEMBLE AND INSPECT PIVOT PIN—420

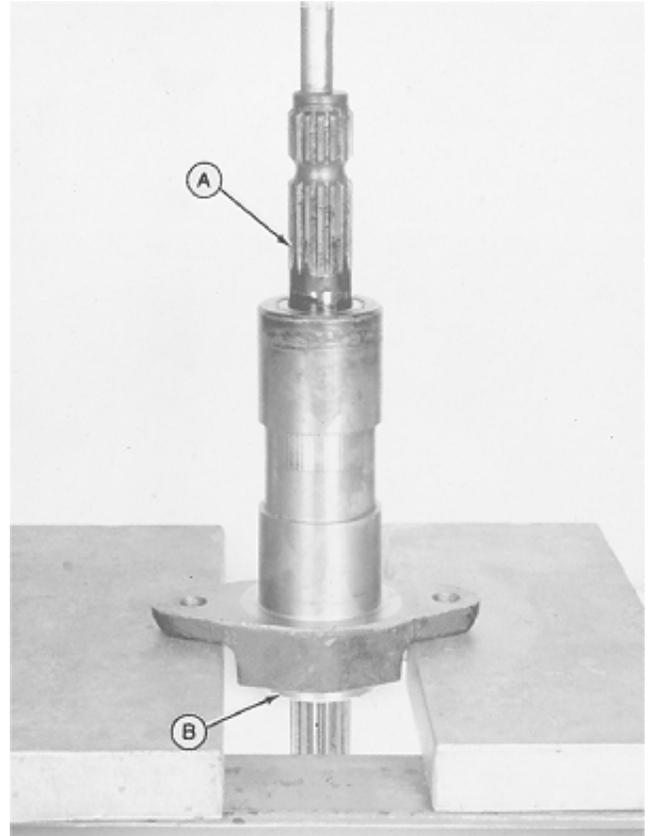
1. Remove snap ring (A).



MX,15908005,12 -19-15FEB95

M36602  
-UN-29JAN90

2. Push PTO shaft (A) and bearing (B) from pivot pin using a press.



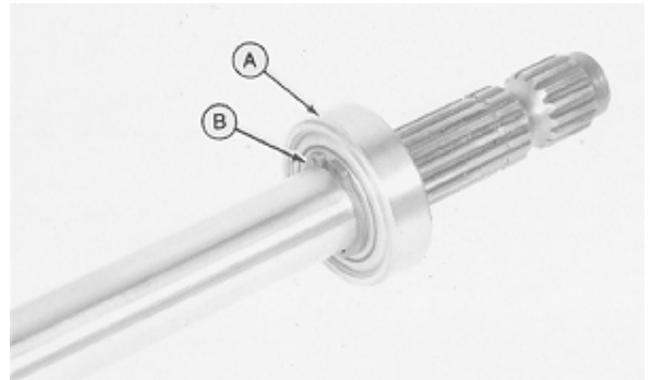
MX,15908005,13 -19-15FEB95

M36803 -JUN-25/JAN90

3. Inspect PTO shaft bearing (A) for wear or damage. Replace if necessary.

4. If replacing bearing, remove snap ring (B).

5. Push PTO shaft from bearing using a press and a knife-edge puller.



MX,15908005,14 -19-15FEB95

M36804 -JUN-29/JAN90

6. Inspect caged needle bearing (A) for wear or damage. Replace if necessary.

7. Remove needle bearing using a blind hole puller set and a slide hammer.

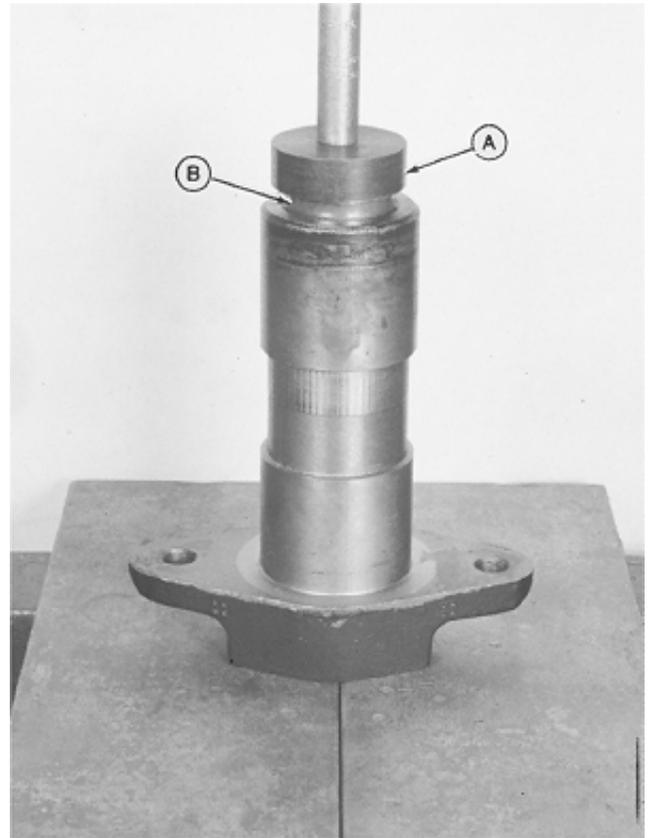


MX,15908005,15 -19-15FEB95

M36806 -JUN-25/JAN90

### ASSEMBLE PIVOT PIN—420

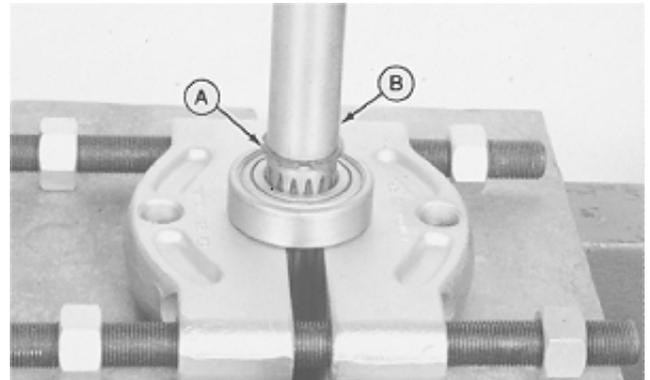
1. Support pivot pin on a press. Put a driver disk (A) on bearing (B). Install bearing using a press until disk bottoms on pivot pin.



MX,15908005,16 -19-15FEB95

M36808  
-JUN-25/JAN90

2. Install snap ring (A) on PTO shaft.
3. Support bearing on a knife-edge puller. Press PTO shaft (B) into bearing until it bottoms on snap ring.

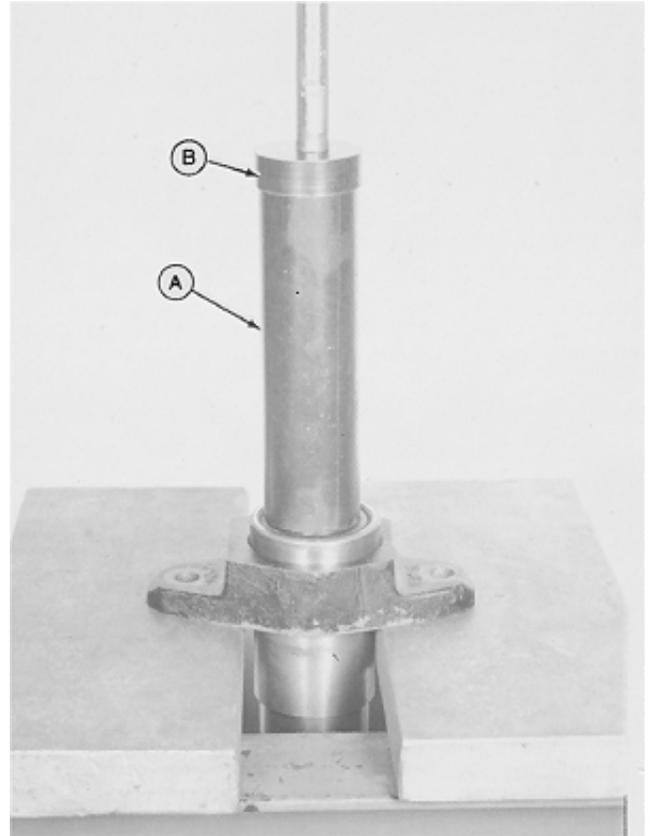


MX,15908005,17 -19-07MAR95

M36809  
-JUN-25/JAN90

60510

4. Support pivot pin on a press. Install PTO shaft assembly into pivot pin.
5. Put JDM8-3 Installation Sleeve (A) or a piece of pipe over PTO shaft. Put a suitable size driver disk (B) on Sleeve or pipe.
6. Press shaft assembly into pivot pin until bearing bottoms in bore.



MX,15908005,18 -19-07MAR95

M36810 -JUN-25/JAN90

7. Install snap ring (A).

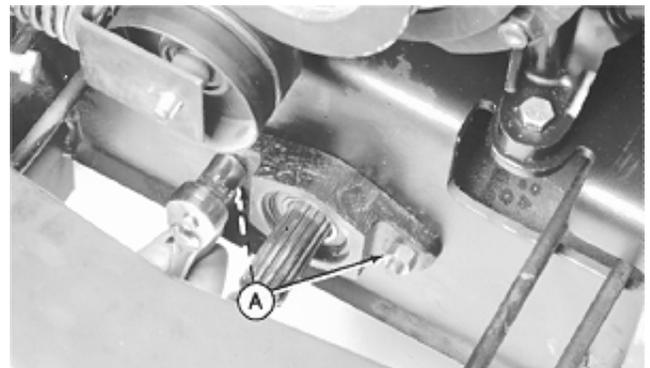


MX,15908005,19 -19-15FEB95

M36802 -JUN-29/JAN90

### INSTALL FRONT AXLE—420

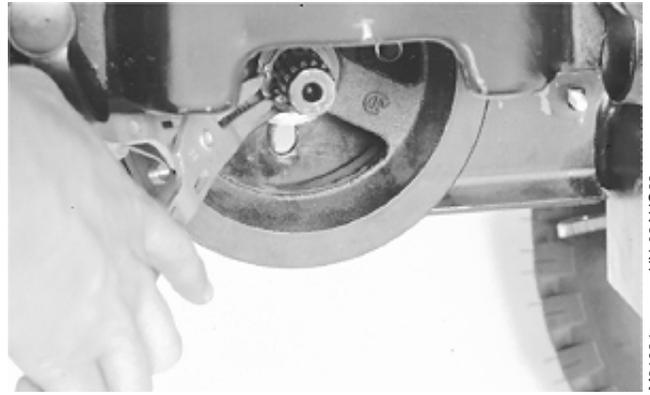
1. Slide axle up into machine and align pivot hole with hole in frame.
2. Slide pivot pin through frame and axle.
3. Secure pivot pin to frame with retaining nuts (A).



MX,15908005,20 -19-15FEB95

M31996 -JUN-03/AUG89

4. Slide drive pulley onto PTO shaft.
5. Install snap ring in PTO shaft groove.
6. Install belts on lower drive sheave and work onto upper sheave.



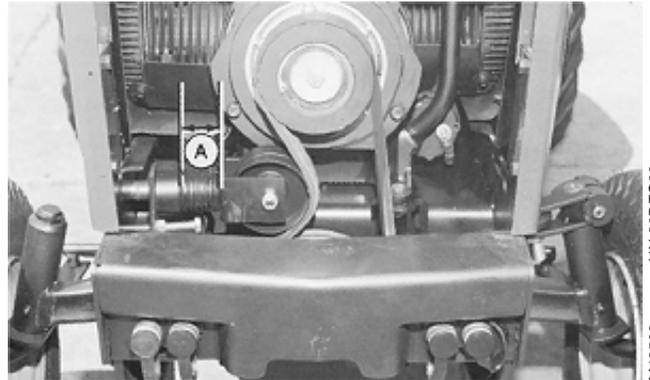
MX,15908005,21 -19-15FEB95

M31994  
-UN-03AUG89

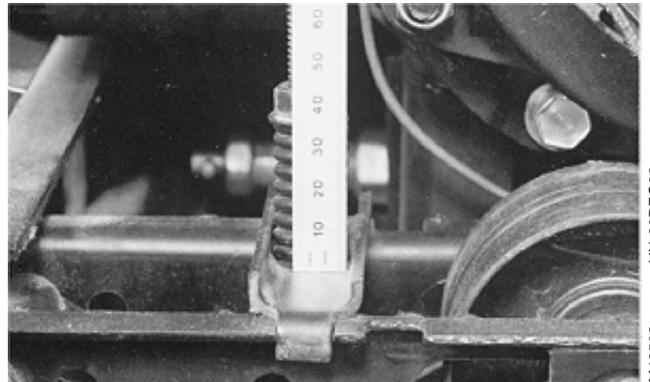
7. Tighten belt adjuster:

When adjusting PTO belt tension on horizontal adjuster, tighten bolt until spring measures 41 mm (1.600 in.).

When adjusting PTO belt tension on vertical adjuster, tighten nut until spring measures 35 mm (1.380 in.).



Horizontal Adjuster



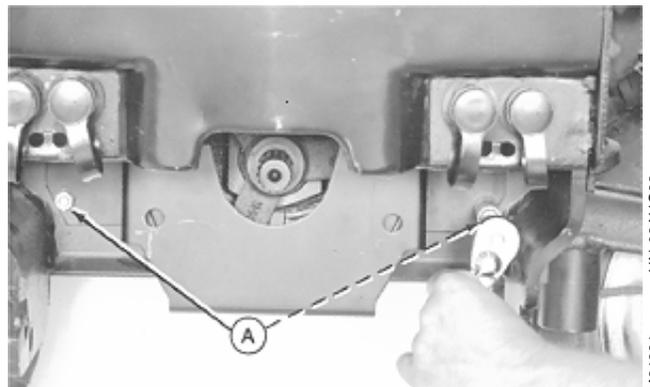
Vertical Adjuster

MX,15908005,22 -19-15FEB95

M49503  
-UN-20DEC89

M49502  
-UN-20DEC89

8. Install belt guard with two nuts (A).
9. Install front grille.



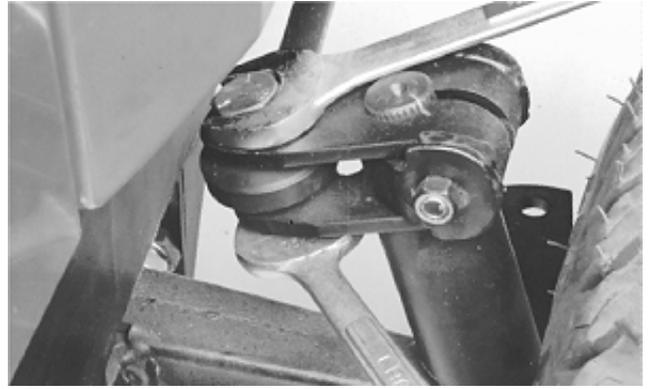
MX,15908005,23 -19-07MAR95

M31991  
-UN-03AUG89

80-05-8

## Front Axle/Spindles

10. Connect steering cylinder to spindle.
11. Install bolt and nut through steering arm and cylinder.
12. Install cotter pin, if equipped, in steering arm bolt.



MX,15908005,24 -19-07MAR95

M31963  
-UN-28JUL89

13. Adjust axle deflector bolts for smooth up and down operation of axle.
14. Test for proper axle deflector adjustment, by pushing down on a wheel. The axle should move freely without sticking in one spot. Readjust if necessary.
15. Lower tractor from jack stands.



MX,15908005,25 -19-15FEB95

M31970  
-UN-03AUG89

## REMOVE AND INSTALL SPINDLES

*NOTE: The 316 has manual steering and is connected to the steering arm by a drag link. The 318 and 420 have power steering and are connected to the steering arm by a cylinder.*

1. Raise front of machine and block securely with jack stands.
2. Remove front wheels.
3. Remove cotter pin, if equipped, from steering link/cylinder at steering arm on left spindle.
4. Remove nut and bolt (318 and 420) from arm.
5. Disconnect steering link/cylinder from steering arm.



420 Shown

MX,15908005,26 -19-20MAR95

M32067  
-UN-03AUG89  
9080

Front Axle/Spindles

6. Disconnect both tie rod ends and remove tie rod.

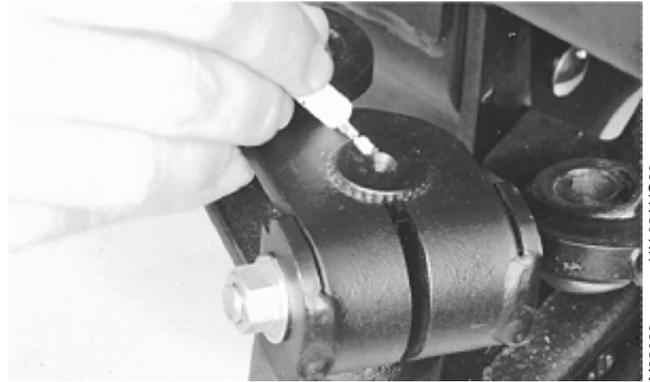


M32068 -UN-03AUG89

MX,15908005,27 -19-15FEB95

7. Put an alignment mark across top of steering arm and left spindle to aid in installation.

8. Remove nut, washer (if equipped), bolt and steering arm from left spindle.



M32069 -UN-03AUG89

MX,15908005,28 -19-15FEB95

9. Slide left spindle down out of axle to remove.



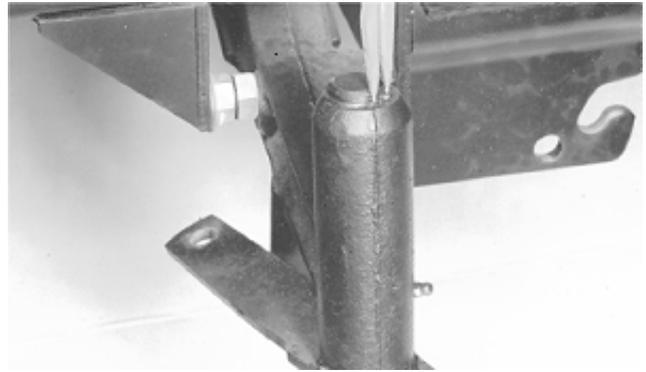
M78701 -UN-14MAR95

MX,15908005,29 -19-14MAR95

80  
05  
10

## Front Axle/Spindles

10. Remove snap ring from top of right spindle.
  11. Slide right spindle down out of axle to remove.
  12. Inspect spindles for wear or damage. Replace if necessary.
  13. Inspect bushings for wear or damage. Replace if necessary. (See procedure in this group.)
  14. Installation is done in the reverse order of removal.
- On left-hand side; align marks made on steering arm and spindle shaft.
  - Apply multipurpose grease to lubrication fittings.
  - Adjust toe-in. (See procedure in this group.)

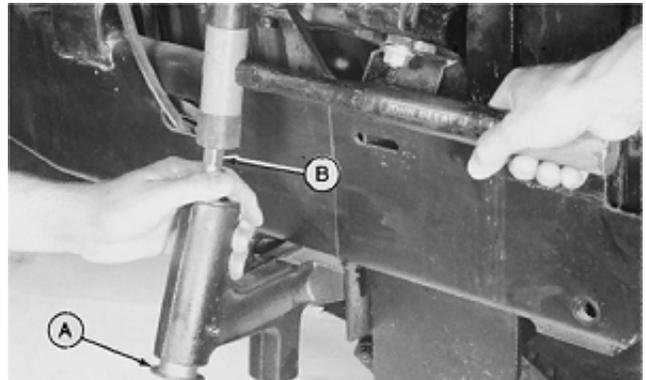


M32072 -UN-03AUG89

MX,15908005,30 -19-07MAR95

### INSPECT AND REPLACE SPINDLE BUSHINGS

1. Remove spindles. (See procedure in this group.)
2. Remove bushings (A) from axle using a long brass drift and a plastic headed hammer.
3. Install new bushings using a plastic headed hammer. Install bushings until they bottom against axle.



M36815 -UN-25JAN90  
80-05-11

MX,15908005,31 -19-15FEB95

## INSPECT AND REPLACE WHEEL BEARINGS

1. Remove front wheels.
2. The front wheels are equipped with sealed roller bearings in both the front and rear of hub. Check the bearings for damage by spinning the inner race by hand. If the bearing binds or shows excessive wear, it must be replaced.
3. Tap the bearings out from the back side with a long drift and a hammer.
4. Install new bearings using a driver set.

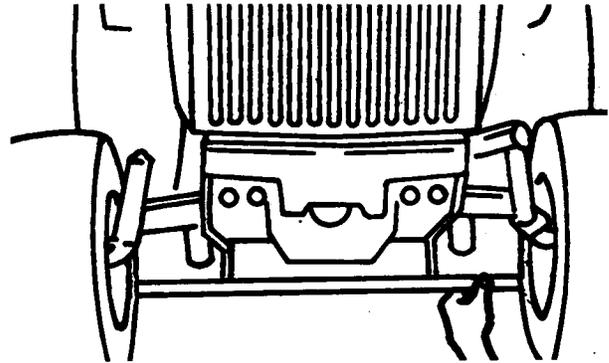


M32007 -UN-03AUG89

MX,15908005,32 -19-12MAY95

## ADJUST TOE-IN

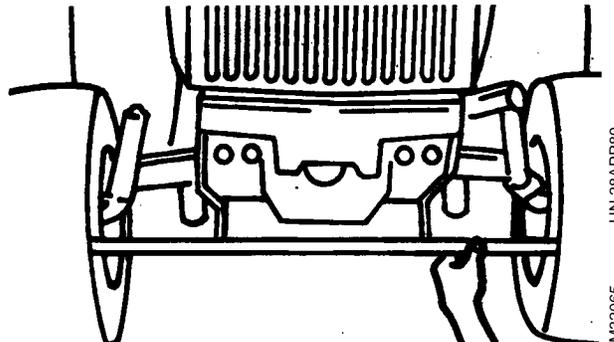
1. Position wheels so they are pointing straight ahead.
2. Measure distance between the inner edges of the tires at the rear.



M32064 -UN-28APR89

MX,15908005,33 -19-12MAY95

3. Measure front distance between tires. When properly adjusted, front distance should be 4.8 mm (3/16 in.) shorter than rear distance (a slight toe-in).



M32065 -UN-28APR89

MX,15908005,34 -19-15FEB95

80-05-12

## Front Axle/Adjust Toe-in

4. Loosen jam nuts and adjust tie rod to lengthen or shorten distance.

**IMPORTANT: Make sure there is free movement of ball joints after tightening jam nuts.**

5. Make certain to securely tighten jam nuts after adjusting tie rod.



M32066 -UN-03AUG89

MX,M21.7005K,X -19-04NOV82

80  
05  
13

80  
05  
14

**SERVICE MOWER BLADE SPINDLES—38 (EARLY), 46 AND 50-INCH MOWER**

*NOTE: On 50-Inch, Three-Point Hitch Mowers; some spindles may have a grease zerk in the top end of the spindle shaft.*

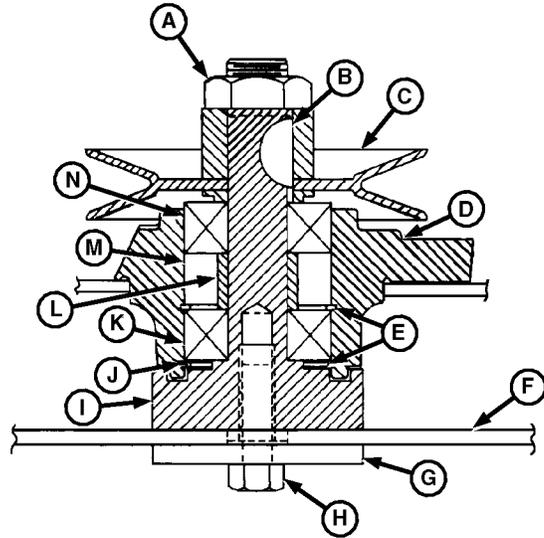
If, for any reason the spindle must be disassembled, be sure to lubricate and torque parts as required.

When assembling bearings and spacer, fill cavities (J and M) 75 percent full of multipurpose grease.

**TORQUE SPECIFICATIONS**

Lock Nut (A) . . . . . 140 N·m (103 lb-ft)  
Cap Screw (H) . . . . . 73 N·m (54 lb-ft)

- |                 |                 |
|-----------------|-----------------|
| A—Lock Nut      | H—Cap Screw     |
| B—Key           | I—Spindle       |
| C—Driven Sheave | J—Grease Cavity |
| D—Hub           | K—Bearing       |
| E—Snap Rings    | L—Spacer        |
| F—Mower Blade   | M—Grease Cavity |
| G—Washer        | N—Bearing       |



M78050 -UN-21FEB95

MX,15908010,1 -19-13MAR95

**SERVICE MOWER BLADE SPINDLES—38-INCH MOWER (LATER)**

*NOTE: Some spindles may not have fan (C).*

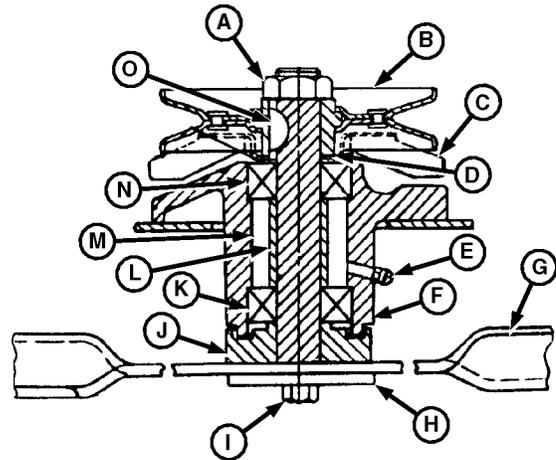
If, for any reason the spindle must be disassembled, be sure to lubricate and torque parts as required.

After assembly, fill grease cavity (M) by applying multipurpose grease to grease zerk (E).

**TORQUE SPECIFICATIONS**

Lock Nut (A) . . . . . 140 N·m (103 lb-ft)  
Cap Screw (I) . . . . . 73 N·m (54 lb-ft)

- |                 |                 |
|-----------------|-----------------|
| A—Lock Nut      | I—Cap Screw     |
| B—Driven Sheave | J—Spindle       |
| C—Fan           | K—Bearing       |
| D—Washer        | L—Spacer        |
| E—Grease Zerk   | M—Grease Cavity |
| F—Hub           | N—Bearing       |
| G—Mower Blade   | O—Key           |
| H—Washer        |                 |



M78051 -UN-21FEB95

MX,15908010,2 -19-15FEB95

### SERVICE MOWER BLADE SPINDLES—EARLY 60-INCH AND 260 ROTARY MOWER

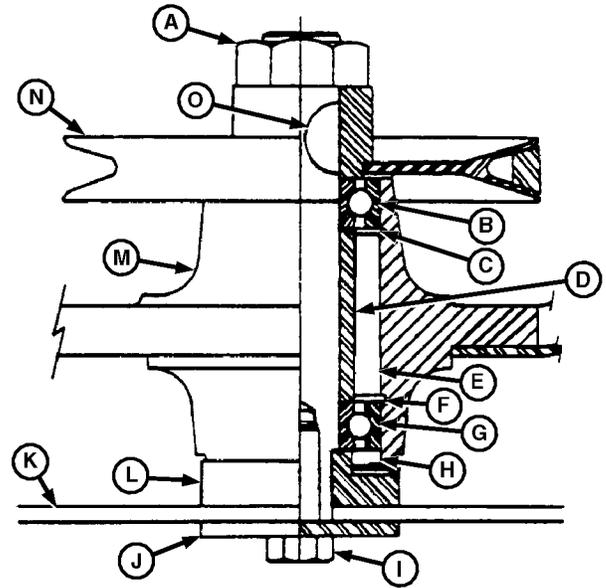
If, for any reason the spindle must be disassembled, be sure to lubricate and torque parts as required.

When assembling bearings and spacer, fill cavities (E and H) 75 percent full of multipurpose grease.

#### TORQUE SPECIFICATIONS

Lock Nut (A) . . . . . 140 N·m (103 lb-ft)  
 Cap Screw (I) . . . . . 73 N·m (54 lb-ft)

- |                 |                 |
|-----------------|-----------------|
| A—Lock Nut      | I—Cap Screw     |
| B—Bearing       | J—Washer        |
| C—Snap Ring     | K—Mower Blade   |
| D—Spacer        | L—Spindle       |
| E—Grease Cavity | M—Hub           |
| F—Snap Ring     | N—Driven Sheave |
| G—Bearing       | O—Key           |
| H—Grease Cavity |                 |



M78052 -UN-21FEB95

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## SERVICE MOWER BLADE SPINDLES—LATER 60-INCH AND 260 ROTARY MOWER

If, for any reason the spindle must be disassembled, be sure to lubricate and torque parts as required.

**IMPORTANT:** Bushing (F) must be installed with grease grooves on end of bushing facing bearing (R) or bearings won't get any grease.

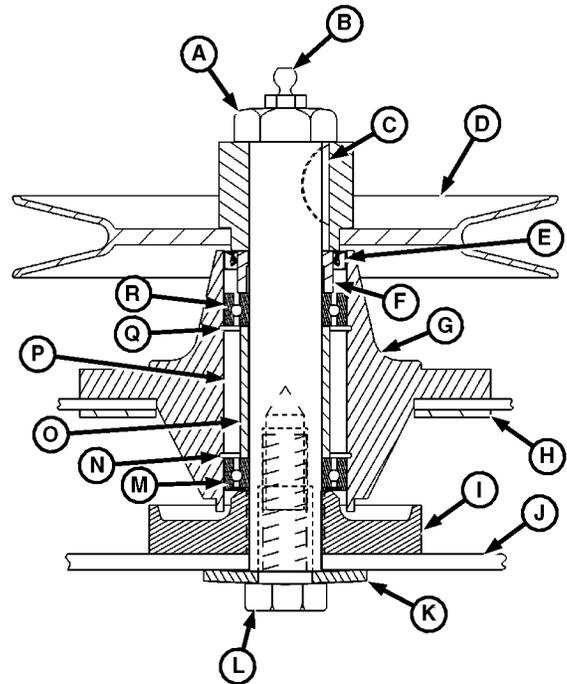
**Bearing (M) must be install with sealed surface side facing away from snap ring (N) to keep grease within grease cavity (P) and bearing.**

During assembly, install bushing (F) with grease grooves on end of bushing facing toward bearing (R). Also, install bearing (M) with sealed surface side facing away from snap ring (N).

After assembly, fill grease cavity (P) by applying multipurpose grease to grease zerk (B).

### TORQUE SPECIFICATIONS

Lock Nut (A) . . . . . 140 N-m (103 lb-ft)  
 Cap Screw (L) . . . . . 73 N-m (54 lb-ft)



- A—Lock Nut
- B—Grease Zerk
- C—Key
- D—Driven Sheave
- E—Seal
- F—Bushing
- G—Hub
- H—Washer
- I—Spindle
- J—Mower Blade
- K—Washer
- L—Cap Screw
- M—Bearing
- N—Snap Ring
- O—Spacer
- P—Grease Cavity
- Q—Snap Ring
- R—Bearing

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M78053 -UN-21FEB95

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## SERVICE MOWER BLADE JACK SHEAVES—46 AND 50-INCH MOWER

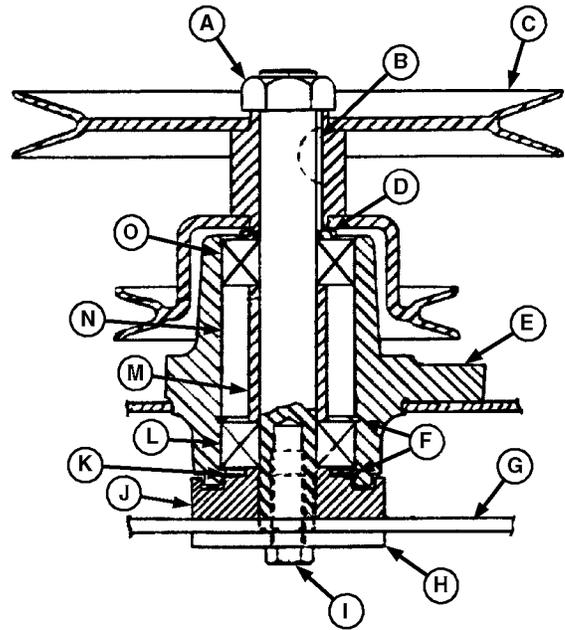
Mower blade jack sheaves normally require no lubrication or service. If, for any reason the jack sheave must be disassembled, be sure to lubricate and torque parts as required.

When assembling bearings and spacer, fill cavities (K and N) 75 percent full of multipurpose grease.

### TORQUE SPECIFICATIONS

Lock Nut (A) ..... 140 N·m (103 lb-ft)  
 Cap Screw (I) ..... 73 N·m (54 lb-ft)

- |               |                 |
|---------------|-----------------|
| A—Lock Nut    | I—Cap Screw     |
| B—Key         | J—Spindle       |
| C—Jack Sheave | K—Grease Cavity |
| D—Washer      | L—Bearing       |
| E—Hub         | M—Spacer        |
| F—Snap Rings  | N—Grease Cavity |
| G—Mower Blade | O—Bearing       |
| H—Washer      |                 |



M78054 -UN-21FEB95

MX,15908010,5 -19-15FEB95

**OTHER MATERIAL**

Number	Name	Use
LOCTITE® PRODUCTS U.S./Canadian/LOCTITE No.		
TY6305/TY9485/764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
TY15130/NA/395	Form-In-Place Gasket Sealant	Early 60-Inch Mower and 260 Rotary Mower; Apply to mating surfaces of gear case and caps.

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MX,15908015,OTH-19-22FEB95

**DISASSEMBLE AND INSPECT MOWER GEAR CASE—50-INCH MOWER**

1. Remove drain plugs (A and B) and drain oil from gear case.



MX,15908015,1 -19-22FEB95

M77316 -UN-24FEB95

**80-15-1**

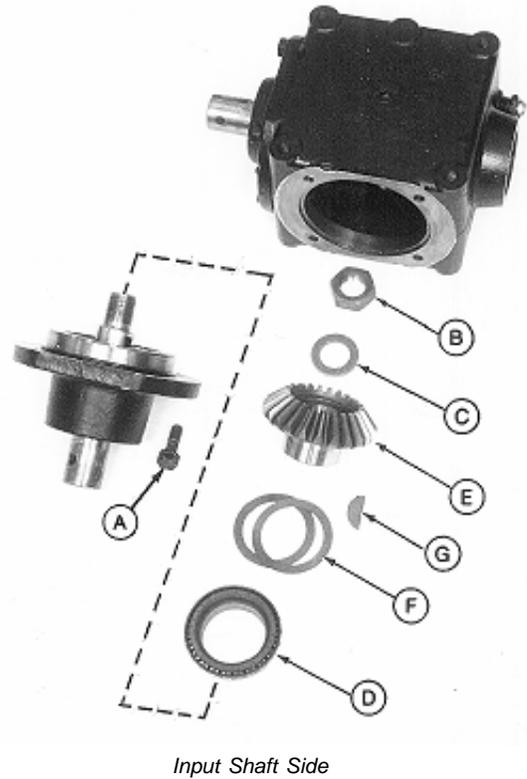
2. Remove four cap screws (A) and input shaft assembly.
3. Remove lock nut (B), washer (C) and bevel gear (E) and bearing from shaft.

*NOTE: Bearing cone is press-fit on bevel gear. Remove bearing only if replacement is necessary.*

*Bearing cone, cup in pillow block and shim(s) are matched and must be replaced as complete assemblies.*

4. Inspect bearing cone (D) for wear or damage. Replace if necessary.
5. Remove bearing cone from bevel gear using a knife-edge puller and a press.
6. Remove shim(s) (F) and key (G).

- A—Cap Screw (4 used)
- B—Lock Nut
- C—Washer
- D—Bearing Cone
- E—Bevel Gear
- F—Shims (as required)
- G—Key



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MX,15908015,2 -19-22FEB95

7. Press on threaded end of input shaft (C) to remove seal (A) and input shaft assembly from pillow block (I).

*NOTE: Bearing cone is press-fit on input shaft. Remove bearing only if replacement is necessary.*

*Bearing cups are press-fit in pillow block. Remove cups only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

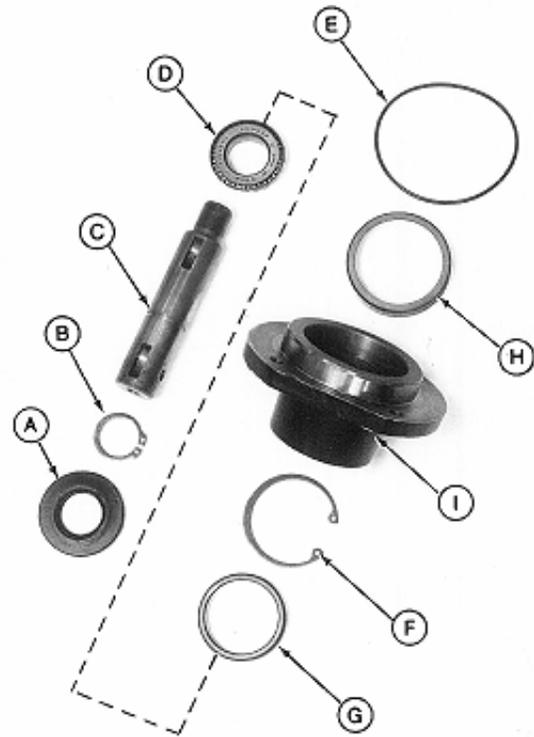
8. Inspect bearing cone (D) and cups (G and H) for wear or damage. Replace as necessary.

9. Remove snap ring (B) and press input shaft (C) from bearing (D).

10. Remove O-ring (E) and snap ring (F).

**IMPORTANT: Remove bearing cups using a press and driver disk, if possible. Using a punch and hammer can damage pillow block. Use only if necessary.**

11. Remove bearing cups (G and H) using a press and driver set or punch and hammer.



Input Shaft Assembly

- A—Seal
- B—Snap Ring
- C—Input Shaft
- D—Bearing Cone
- E—O-Ring
- F—Snap Ring
- G—Bearing Cup
- H—Bearing Cup
- I—Pillow Block

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3

12. Remove vent plug (A) and adapter (B) from gear case (C).

13. Remove four cap screws (D). Remove retainer (L) and output shaft assembly (M).

14. Remove output shaft assembly (M) from retainer (L).

**IMPORTANT: Remove and discard crush ring (I). A new crush ring must be installed during assembly to achieve proper output shaft end play.**

15. Remove O-ring (G), shim (J), bearing cup (H) and crush ring (I). Discard crush ring.

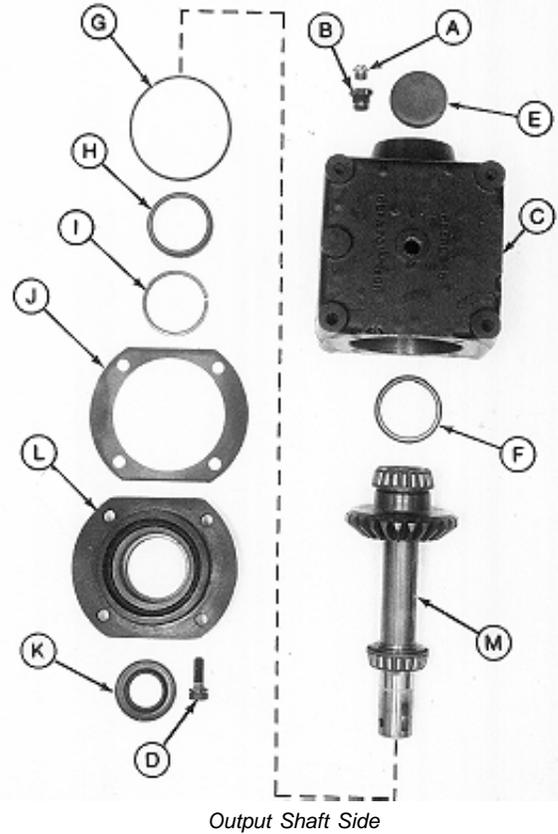
16. Press out seal (K) from retainer (L).

*NOTE: Bearing cup (F) and plug (E) are press-fit in gear case. Remove bearing cup (F) only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

17. Inspect bearing cups (F and H) for wear or damage. Replace as necessary.

18. Press out plug (E) and bearing cup (F).



- A—Vent Plug
- B—Adapter
- C—Gear Case
- D—Cap Screw (4 used)
- E—Plug
- F—Bearing Cup
- G—O-Ring
- H—Bearing Cup
- I—Crush Ring
- J—Shim (as required)
- K—Seal
- L—Retainer
- M—Output Shaft Assembly

MX,15908015,4 -19-29MAR95

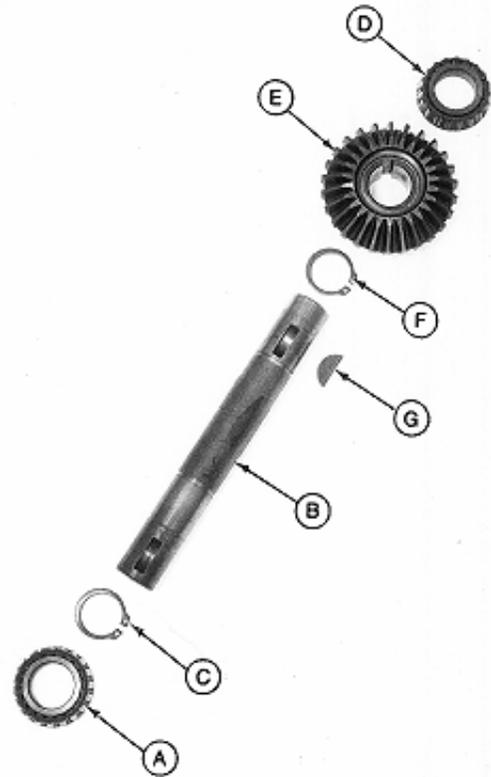
M77319 -JUN-24FEB95

**NOTE:** Bearing cones are press-fit on output shaft.  
Remove bearings only if replacement is necessary.

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

20. Inspect bearing cones (A and D) for wear or damage. Replace if necessary.
21. Press output shaft (B) from bearing cone (A). Remove snap ring (C).
22. Remove bearing cone (D) from output shaft (B) using a knife-edge puller and a press.
23. Remove bevel gear (E), snap ring (F) and key (G).
24. Inspect all parts for wear or damage. Replace as necessary.

- A—Bearing Cone
- B—Output Shaft
- C—Snap Ring
- D—Bearing Cone
- E—Bevel Gear
- F—Snap Ring
- G—Key



Output Shaft Assembly

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MX,15908015,5 -19-29MAR95

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## ASSEMBLE MOWER GEAR CASE—50-INCH MOWER

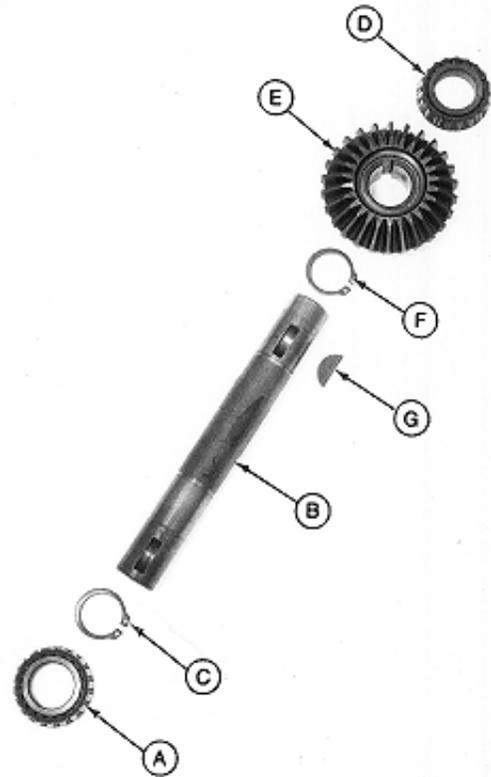
**IMPORTANT:** Always use new seals and O-rings.  
Damaged or used parts will leak.

*NOTE:* Lubricate all O-rings with petroleum jelly during assembly.

*Apply clean gear case oil on all internal parts during assembly.*

1. Install snap ring (F), key (G) and bevel gear (E).  
Install bevel gear on output shaft, small O.D. first.
2. Press bearing cone (D) on output shaft (B) with small O.D. facing away from bevel gear (E). Install bearing until it bottoms against bevel gear.
3. Install snap ring (C).
4. Press bearing cone (A) on output shaft with small O.D. facing away from bevel gear (E). Install bearing until it bottoms against snap ring.

A—Bearing Cone  
B—Output Shaft  
C—Snap Ring  
D—Bearing Cone  
E—Bevel Gear  
F—Snap Ring  
G—Key



Output Shaft Assembly

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5. Install new bearing cup (F), if removed, using a driver set.

6. Press plug (E) into gear case (C) with lip facing away from gear case. Install plug until recessed 1.59 mm (0.062 in.) below gear case surface.

7. Install adapter (B) and vent plug (A).

8. Press new seal (K) into retainer (L) until top of seal is recessed 2.54 mm (0.100 in.) below retainer surface.

9. Apply multipurpose grease to lip of seal.

**IMPORTANT: A new crush ring must be installed during assembly. The ring collapses when retainer is tightened to gear case to achieve proper output shaft end play.**

10. Install new crush ring (I) and bearing cup (H).

11. Install shim (J) and new O-ring (G).

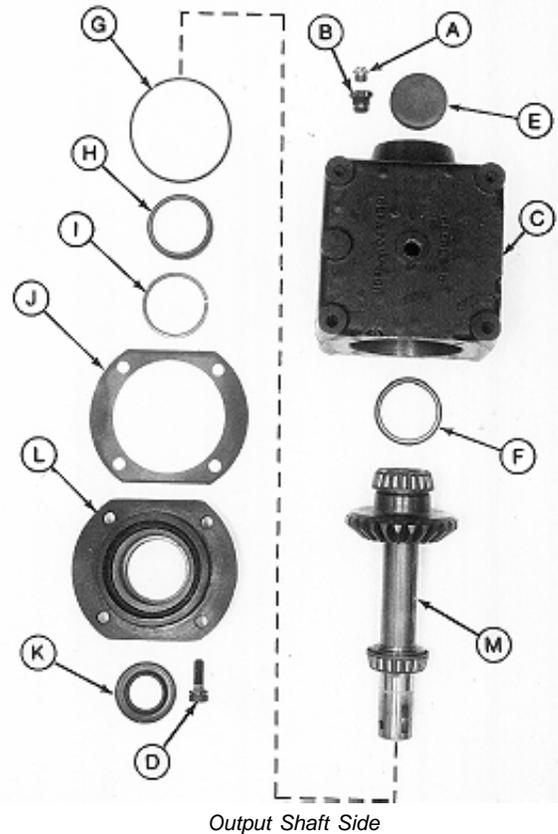
**IMPORTANT: Tape end of output shaft to prevent seal damage during shaft installation.**

12. Apply tape around end of output shaft.

13. Assemble output shaft assembly (M) and retainer (L). Remove tape.

14. Install retainer and output shaft assembly into gear case (C).

15. Install four cap screws (D) and tighten to 30 N·m (22 lb-ft).



- A—Vent Plug
- B—Adapter
- C—Gear Case
- D—Cap Screw (4 used)
- E—Plug
- F—Bearing Cup
- G—O-Ring
- H—Bearing Cup
- I—Crush Ring
- J—Shim (as required)
- K—Seal
- L—Retainer
- M—Output Shaft Assembly

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16. Install snap ring (F).

17. Install new bearing cups (G and H), if removed, using a driver set. Press into pillow block (I) until seated against snap ring and housing.

18. Install snap ring (B) on input shaft (C).

19. Press bearing cone (D) on input shaft with small O.D. facing away from snap ring (B). Install bearing until it bottoms against snap ring.

**IMPORTANT: Tape end of input shaft to prevent seal damage during seal installation.**

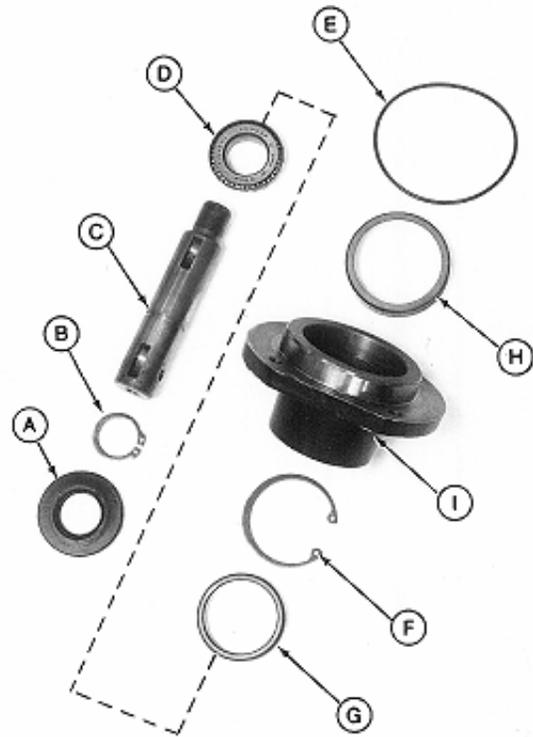
20. Apply tape around large end of input shaft.

21. Install input shaft assembly into pillow block (I).

22. Apply multipurpose grease to lip of new seal (A).

23. Press new seal (A) into pillow block (I) until top of seal is recessed 2.54 mm (0.100 in.) below block surface. Remove tape from end of shaft.

24. Install new O-ring (E).



Input Shaft Assembly

- A—Seal
- B—Snap Ring
- C—Input Shaft
- D—Bearing Cone
- E—O-Ring
- F—Snap Ring
- G—Bearing Cup
- H—Bearing Cup
- I—Pillow Block

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25. Install shims (F) on bevel gear (E).

26. Press bearing cone (D) on bevel gear (E) with small O.D. facing away from bevel gear. Install bearing until it bottoms against shims.

27. Install key (G) into input shaft.

28. Install bevel gear assembly onto input shaft.

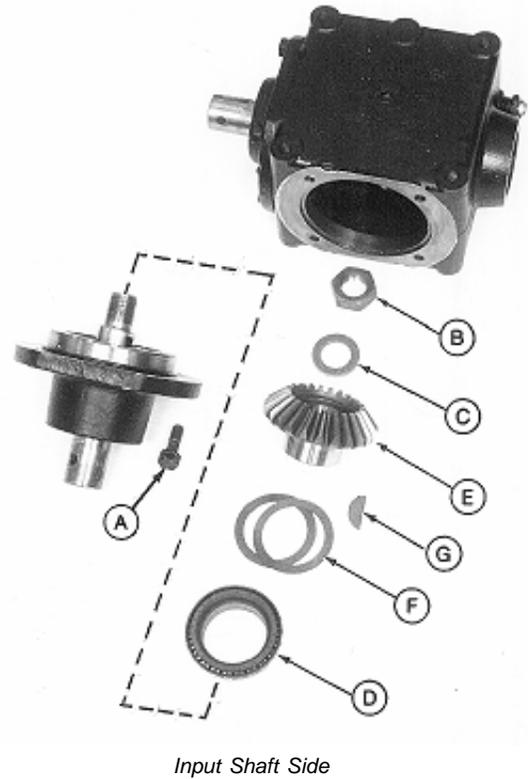
**IMPORTANT: DO NOT overtighten lock nut (B). Overtightening can damage bearing cone (D).**

29. Install washer (C) and lock nut (B). Tighten lock nut until there is zero endplay in input shaft.

30. Install input shaft assembly into gear case.

31. Install four cap screws (A) and tighten to 30 N-m (22 lb-ft).

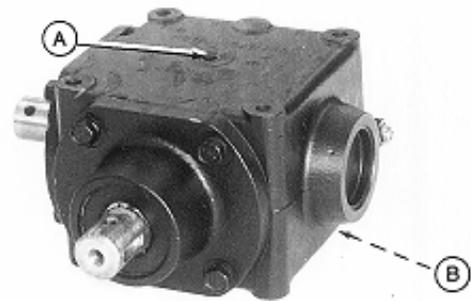
- A—Cap Screw (4 used)
- B—Lock Nut
- C—Washer
- D—Bearing Cone
- E—Bevel Gear
- F—Shims (as required)
- G—Key



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32. AFTER installing gear case on mower deck, fill gear case to proper level with John Deere API GL-5 Gear Oil.

33. Install plugs (A and B).



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## DISASSEMBLE AND INSPECT MOWER GEAR CASE—EARLY 60-INCH MOWER (CURTIS)

1. Remove drain plugs (A and B) and drain oil from gear case.
2. Scribe an alignment mark across caps and gear case. Mark both caps in relation to the case side they are removed from to aid in assembly.



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3. Remove four cap screws and lock plates (A).
4. Remove cap (B) and input shaft assembly from gear case (C).
5. Remove shims (D) and input shaft assembly from cap (B).
6. Pry out seal (E).

*NOTE: Bearing cup is press-fit in cap. Remove bearing cup only if replacement is necessary.*

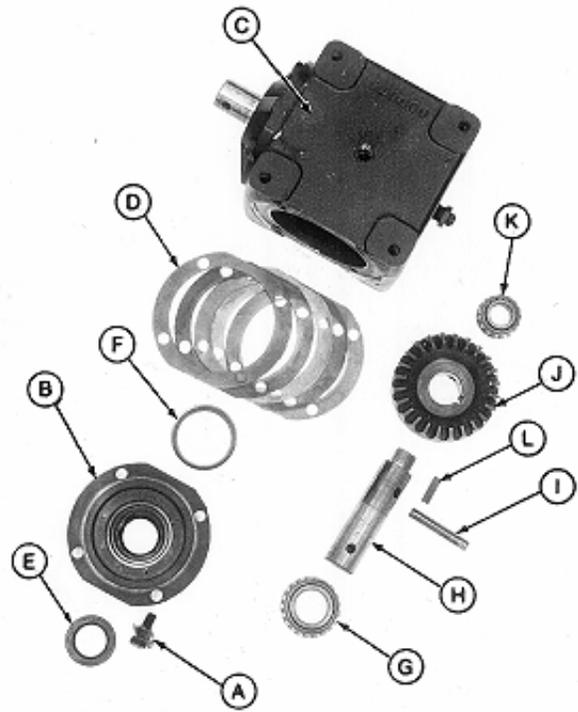
*Bearing cone (K) is press-fit on input shaft.*

*Bearing cones and cups (one in gear case housing) are matched and must be replaced as complete assemblies.*

7. Inspect bearing cup (F) for wear or damage. Replace if necessary.

**IMPORTANT: Remove bearing cups using a press and driver disk, if possible. Using a punch and hammer can damage cap. Use only if necessary.**

8. Remove bearing cup (F) using a press and driver set or punch and hammer.
9. Slide bearing cone (G) off of input shaft (H).
10. Remove spring pin (I) using a punch and hammer.
11. Press shaft (H) from bevel gear (J) and bearing cone (K).
12. Remove key (L).



Input Shaft Side

- A—Cap Screw and Lock Plate (4 used)
- B—Cap
- C—Gear Case
- D—Shims (as required)
- E—Seal
- F—Bearing Cup
- G—Bearing Cone
- H—Input Shaft
- I—Spring Pin
- J—Bevel Gear
- K—Bearing Cone
- L—Key

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13. Remove four cap screws and lock plates (A).

14. Remove cap (B) and output shaft assembly from gear case (C).

15. Remove shims (D) and output shaft assembly from cap (B).

16. Pry out seal (E).

*NOTE: Bearing cup is press-fit in cap. Remove bearing cup only if replacement is necessary.*

*Bearing cone (K) is press-fit on input shaft.*

*Bearing cones and cups (one in gear case housing) are matched and must be replaced as complete assemblies.*

17. Inspect bearing cup (F) for wear or damage. Replace if necessary.

**IMPORTANT: Remove bearing cups using a press and driver disk, if possible. Using a punch and hammer can damage cap. Use only if necessary.**

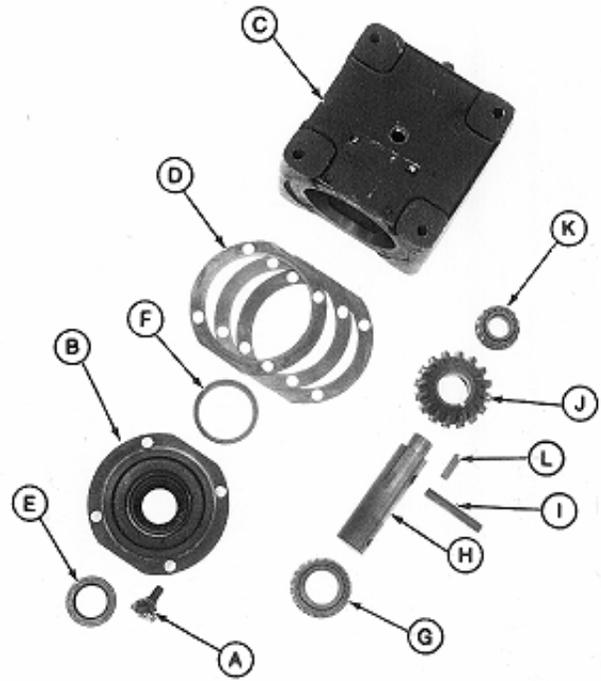
18. Remove bearing cup (F) using a press and driver set or punch and hammer.

19. Slide bearing cone (G) off of output shaft (H).

20. Remove spring pin (I) using a punch and hammer.

21. Press shaft (H) from bevel gear (J) and bearing cone (K).

22. Remove key (L).



Output Shaft Side

- A—Cap Screw and Lock Plate (4 used)
- B—Cap
- C—Gear Case
- D—Shims (as required)
- E—Seal
- F—Bearing Cup
- G—Bearing Cone
- H—Output Shaft
- I—Spring Pin
- J—Bevel Gear
- K—Bearing Cone
- L—Key

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23. Remove vent plug (A) and adapter (B).

*NOTE: Bearing cups are press-fit in gear case. Remove bearing cups only if replacement is necessary.*

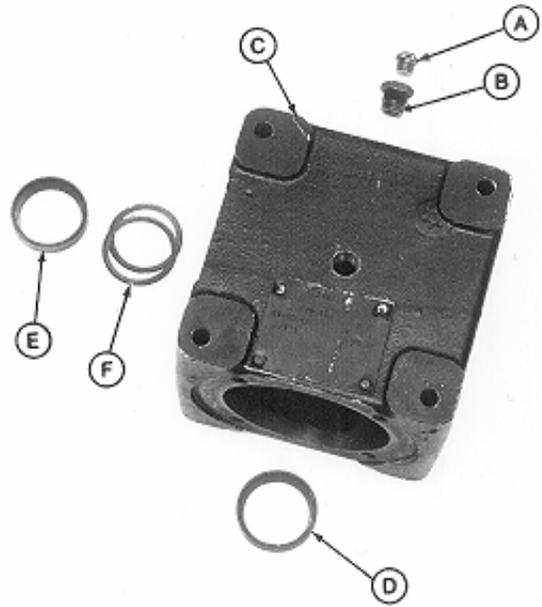
*Bearing cups and cones are matched and must be replaced as complete assemblies.*

24. Inspect bearing cups (D and E) for wear or damage. Replace if necessary.

**IMPORTANT: Remove bearing cups using a slide hammer and inside puller, if possible. Using a punch and hammer can damage gear case. Use only if necessary.**

25. Remove bearing cups from gear case (C) using a slide hammer and inside puller or punch and hammer.

26. Remove shims (F), if equipped.



- A—Vent Plug
- B—Adapter
- C—Gear Case
- D—Bearing Cup
- E—Bearing Cup
- F—Shims (as required)

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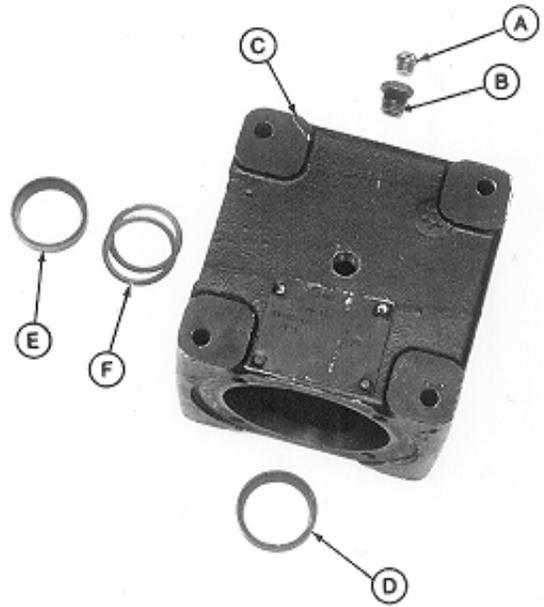
## ASSEMBLE MOWER GEAR CASE—EARLY 60-INCH MOWER (CURTIS)

**IMPORTANT:** Always use new seals. Damaged or used seals will leak.

*NOTE:* Apply clean gear case oil on all internal parts during assembly.

1. Install shims (F), if equipped, into gear case (C).
2. Install new bearing cups (E and D), if removed, using a driver set.
3. Install adapter (B) and vent plug (A).

A—Vent Plug  
B—Adapter  
C—Gear Case  
D—Bearing Cup  
E—Bearing Cup  
F—Shims (as required)



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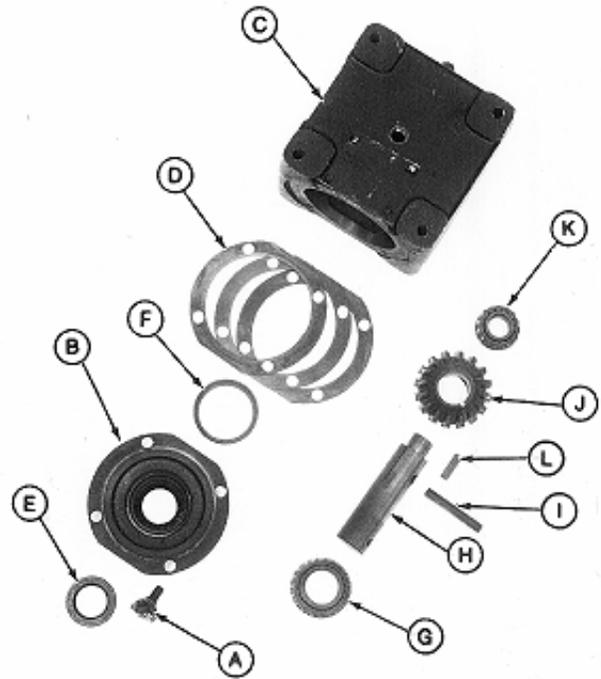
MX,15908015,15 -19-13MAR95

4. Install key (L) and bevel gear (J), shoulder end first, onto shaft (H).
5. Align holes in bevel gear and shaft and install spring pin (I).
6. Press bearing cone (K) on shaft with small O.D. facing away from bevel gear (J). Install bearing cone until seated.
7. Slide bearing cone (G) onto other end of output shaft (H).

**IMPORTANT: Do not press seal in until seated or bottomed out. Seal will become damaged and will leak.**

8. Press new seal (E) into cap (B) until seal is flush with first recess in bottom of cap.
9. Install new bearing cup (F), if removed, using a driver set.
10. Apply multipurpose grease to lip of seal.

- |                                     |                |
|-------------------------------------|----------------|
| A—Cap Screw and Lock Plate (4 used) | G—Bearing Cone |
| B—Cap                               | H—Output Shaft |
| C—Gear Case                         | I—Spring Pin   |
| D—Shims (as required)               | J—Bevel Gear   |
| E—Seal                              | K—Bearing Cone |
| F—Bearing Cup                       | L—Key          |



Output Shaft Side

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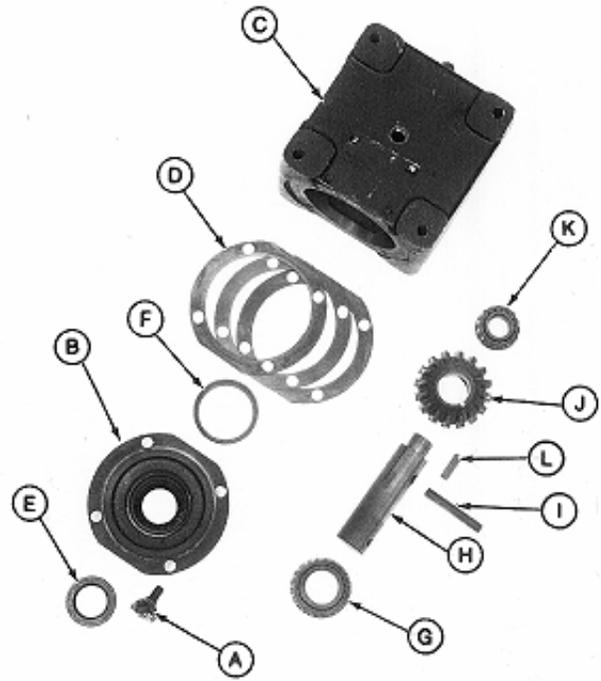
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**IMPORTANT: Tape end of output shaft to prevent seal damage during shaft installation.**

11. Apply tape around end of output shaft.
12. Assemble output shaft assembly and cap (B).  
Remove tape.

*NOTE: Flat sides of cap must align with flat sides of gear case. Gear case mounting surface must be flat to install gear case on mower deck.*

13. Install shims (D). Align marks made during disassembly and install output shaft assembly into gear case (C).
14. Install four cap screws and lock plates (A) and tighten to 30 N·m (22 lb-ft).
15. Check output shaft endplay. Endplay should be within 0.025—0.076 mm (0.001—0.003 in.). If necessary, remove cap and output shaft assembly and add or remove shims (D) as needed.
16. Again, remove four cap screws and lock plates (A) and cap and output shaft assembly.
17. Clean mating surfaces of cap, shims and gear case using Clean and Cure Primer. Apply a bead of Form-In-Place Gasket, or an equivalent, between inside edge of top shim and lip on cap (B).
18. Align and install cap and output shaft assembly into gear case. Install four cap screws and lock plates (A) and tighten to 30 N·m (22 lb-ft). Bend lock plates up around cap screws.



Output Shaft Side

- A—Cap Screw and Lock Plate (4 used)
- B—Cap
- C—Gear Case
- D—Shims (as required)
- E—Seal
- F—Bearing Cup
- G—Bearing Cone
- H—Output Shaft
- I—Spring Pin
- J—Bevel Gear
- K—Bearing Cone
- L—Key

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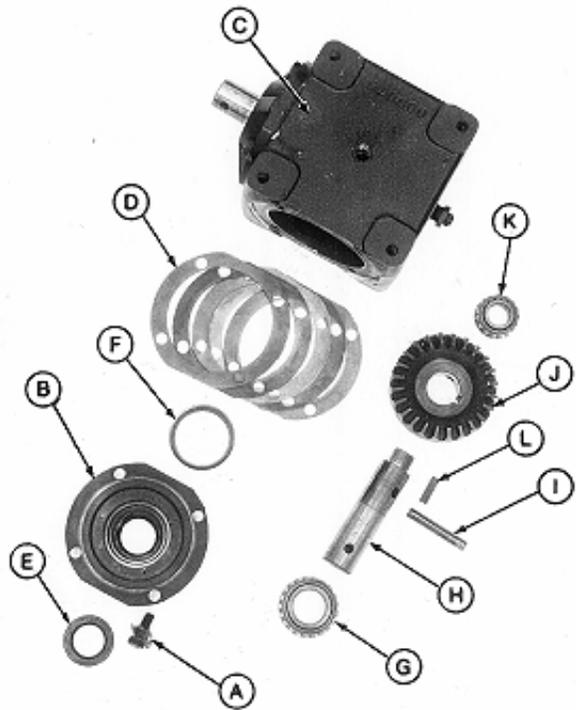
M77330 -JUN-24FEB95

19. Install key (L) and bevel gear (J), shoulder end first, onto shaft (H).
20. Align holes in bevel gear and shaft and install spring pin (I).
21. Press bearing cone (K) on shaft with small O.D. facing away from bevel gear (J). Install bearing until seated.
22. Slide bearing cone (G) onto other end of input shaft (H).

**IMPORTANT: Do not press seal in until seated or bottomed out. Seal will become damaged and will leak.**

23. Press new seal (E) into cap (B) until seal is flush with first recess in bottom of cap.
24. Install new bearing cup (F), if removed, using a driver set.
25. Apply multipurpose grease to lip of seal.

- |                                     |                |
|-------------------------------------|----------------|
| A—Cap Screw and Lock Plate (4 used) | G—Bearing Cone |
| B—Cap                               | H—Input Shaft  |
| C—Gear Case                         | I—Spring Pin   |
| D—Shims (as required)               | J—Bevel Gear   |
| E—Seal                              | K—Bearing Cone |
| F—Bearing Cup                       | L—Key          |



Input Shaft Side

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**IMPORTANT: Tape end of input shaft to prevent seal damage during shaft installation.**

26. Apply tape around end of input shaft.

27. Assemble input shaft assembly and cap (B). Remove tape.

*NOTE: Flat sides of cap must align with flat sides of gear case. Gear case mounting surface must be flat to install gear case on mower deck.*

28. Install shims (D). Align marks made during disassembly and install input shaft assembly into gear case (C).

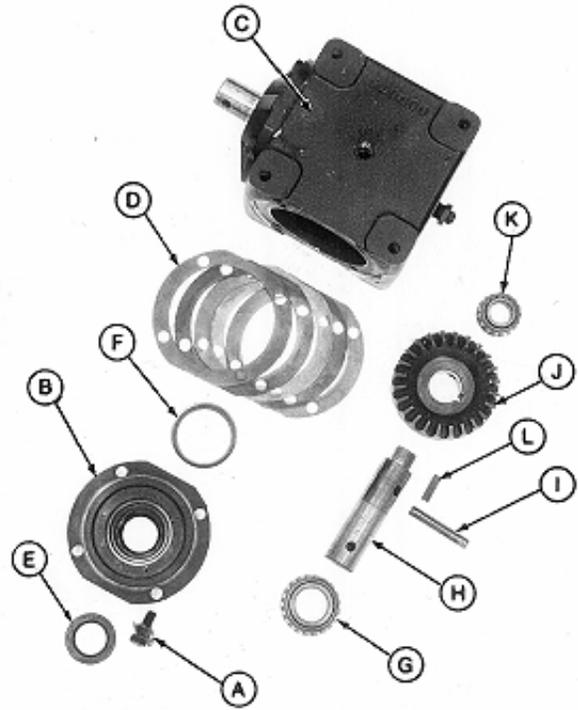
29. Install four cap screws and lock plates (A) and tighten to 30 N·m (22 lb-ft).

30. Hold output shaft securely and check input shaft backlash. Backlash should be within 0.076—0.130 mm (0.003—0.005 in.). If necessary, remove cap and input shaft assembly and add or remove shims (D) as needed.

31. Again, remove four cap screws and lock plates (A) and cap and input shaft assembly.

32. Clean mating surfaces of cap, shims and gear case using Clean and Cure Primer. Apply a bead of Form-In-Place Gasket, or an equivalent, between inside edge of top shim and lip on cap (B).

33. Align and install cap and input shaft assembly into gear case. Install four cap screws and lock plates (A) and tighten to 30 N·m (22 lb-ft). Bend lock plates up around cap screws.



Input Shaft Side

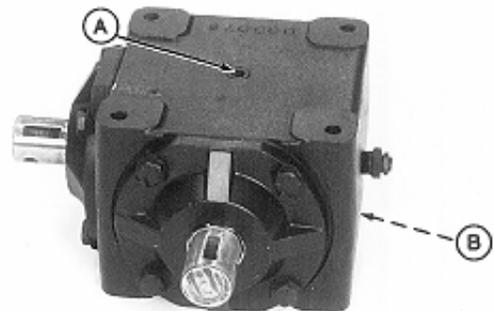
- A—Cap Screw and Lock Plate (4 used)
- B—Cap
- C—Gear Case
- D—Shims (as required)
- E—Seal
- F—Bearing Cup
- G—Bearing Cone
- H—Input Shaft
- I—Spring Pin
- J—Bevel Gear
- K—Bearing Cone
- L—Key

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34. AFTER installing gear case on mower deck, fill gear case to proper level with John Deere API GL-5 Gear Oil.

35. Install plugs (A and B).



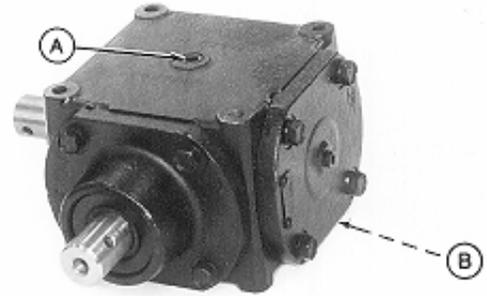
MX,15908015,18 -19-22FEB95

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## DISASSEMBLE AND INSPECT MOWER GEAR CASE—LATER 60-INCH MOWER (PEERLESS)

1. Remove drain plugs (A and B) and drain oil from gear case.



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2. Remove four cap screws (A) and input shaft assembly.

3. Remove lock nut (B), washer (C) and bevel gear (E) and bearing from shaft.

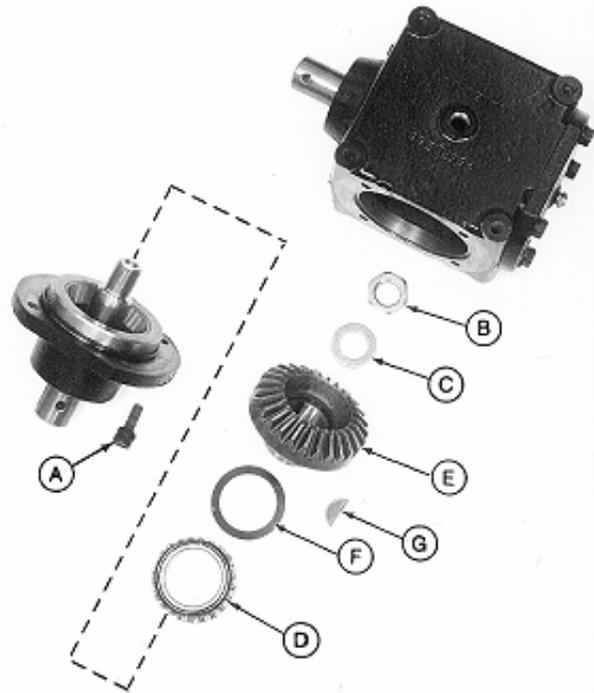
*NOTE: Bearing cone is press-fit on bevel gear. Remove bearing cone only if replacement is necessary.*

*Bearing cone, cup in pillow block and shim(s) are matched and must be replaced as complete assemblies.*

4. Inspect bearing cone (D) for wear or damage. Replace if necessary.

5. Remove bearing cone from bevel gear using a knife-edge puller and a press.

6. Remove shim(s) (F) and key (G).



Input Shaft Side

- A—Cap Screw (4 used)
- B—Lock Nut
- C—Washer
- D—Bearing Cone
- E—Bevel Gear
- F—Shim (as required)
- G—Key

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7. Press on threaded end of input shaft (C) to remove seal (A) and input shaft assembly from pillow block (H).

*NOTE: Bearing cone is press-fit on input shaft. Remove bearing only if replacement is necessary.*

*Bearing cups are press-fit in pillow block. Remove cups only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

8. Inspect bearing cone (D) and cups (F and G) for wear or damage. Replace as necessary.

9. Remove snap ring (B) and press shaft (C) from bearing (D).

10. Remove bearing cups (F and G) using a brass drift or punch and hammer.

11. Remove O-ring (E).

- A—Seal
- B—Snap Ring
- C—Input Shaft
- D—Bearing Cone
- E—O-Ring
- F—Bearing Cup
- G—Bearing Cup
- H—Pillow Block



Input Shaft Assembly

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12. Remove vent plug (A) from retainer (G).
13. Remove four cap screws (B). Remove retainer (G) and output shaft assembly (K) by tapping on end of shaft with a rubber mallet.
14. Remove output shaft assembly (K) from retainer (G).
15. Remove O-ring (F) and shim (C) from retainer (G).

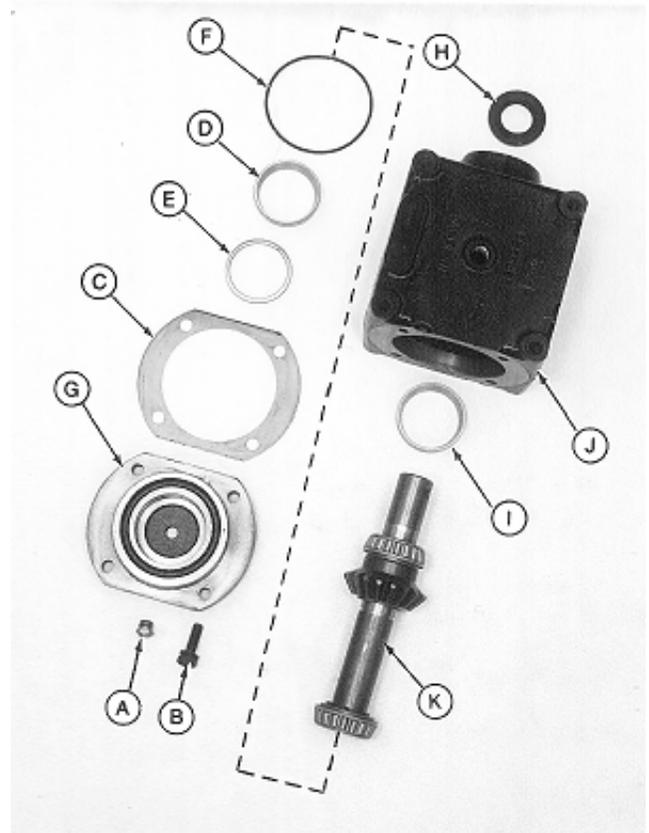
**IMPORTANT: Remove and discard crush ring (E). A new crush ring must be installed during assembly to achieve proper output shaft end play.**

16. Remove bearing cup (D) and crush ring (E). Discard crush ring.
17. Pry out seal (H).

*NOTE: Bearing cup is press-fit in gear case. Remove bearing cup only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

18. Inspect bearing cups (D and I) for wear or damage. Replace as necessary.
19. Remove bearing cup (I) using a brass drift or punch and hammer.



Output Shaft Side

- A—Vent Plug
- B—Cap Screw (4 used)
- C—Shim (as required)
- D—Bearing Cup
- E—Crush Ring
- F—O-Ring
- G—Retainer
- H—Seal
- I—Bearing Cup
- J—Gear Case
- K—Output Shaft Assembly

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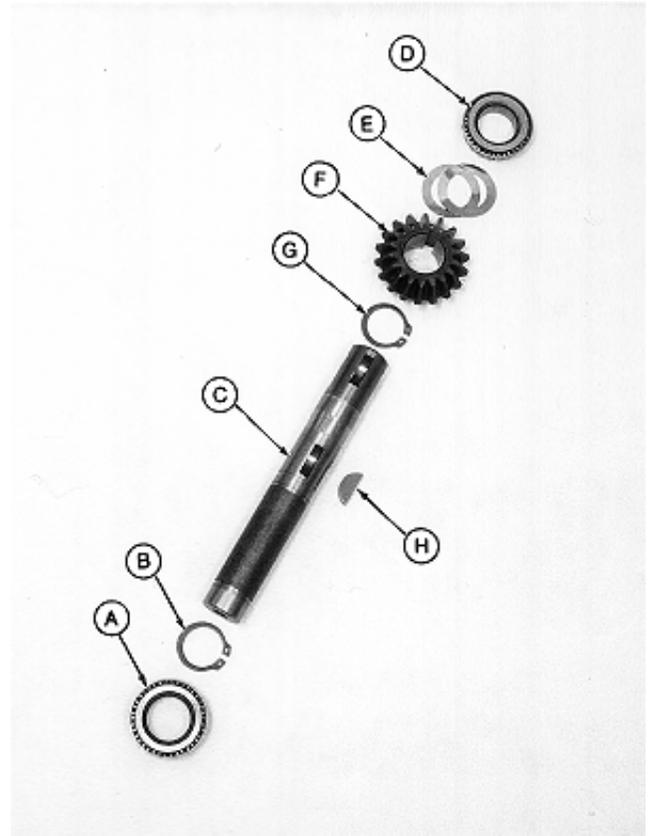
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**NOTE:** Bearing cones are press-fit on output shaft.  
Remove bearings only if replacement is necessary.

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

20. Inspect bearing cones (A and D) for wear or damage. Replace if necessary.
21. Press shaft (C) from bearing cone (A). Remove snap ring (B).
22. Remove bearing cone (D) from shaft (C) using a knife-edge puller and a press.
23. Remove shims (E), bevel gear (F), snap ring (G) and key (H).
24. Inspect all parts for wear or damage. Replace as necessary.

- A—Bearing Cone
- B—Snap Ring
- C—Output Shaft
- D—Bearing Cone
- E—Shims (as required)
- F—Bevel Gear
- G—Snap Ring
- H—Key



Output Shaft Assembly

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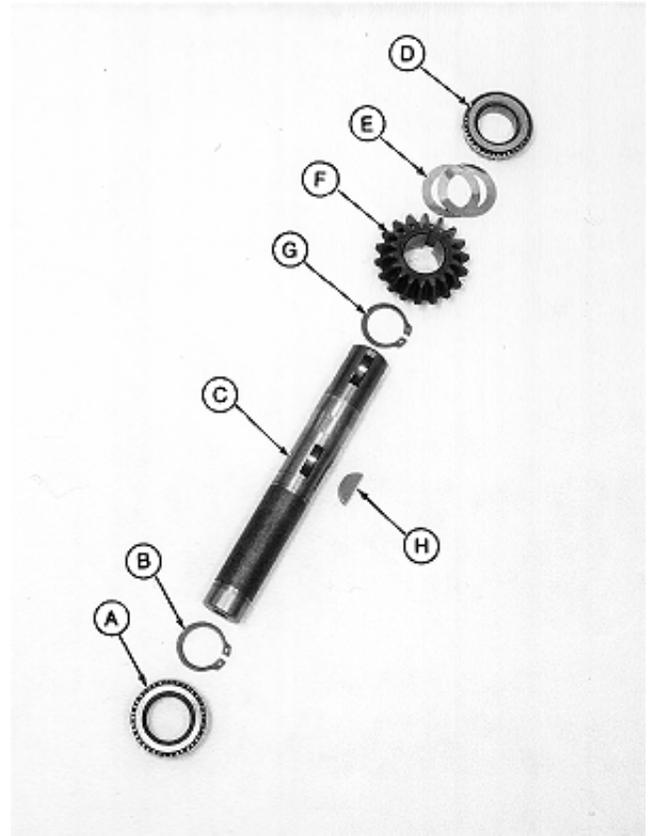
## ASSEMBLE MOWER GEAR CASE—LATER 60-INCH MOWER (PEERLESS)

**IMPORTANT:** Always use new seals and O-rings.  
Damaged or used parts will leak.

*NOTE:* Lubricate all O-rings with petroleum jelly during assembly.

*Apply clean gear case oil on all internal parts during assembly.*

1. Install snap ring (G) in first groove under keyway for key (H).
2. Install key (H), bevel gear (F) and shims (E). Install bevel gear on shaft with shoulder facing away from snap ring (G).
3. Press bearing cone (D) on output shaft (C) with small O.D. facing away from shims (E). Install bearing cone until it bottoms against shims.
4. Install snap ring (B).
5. Press bearing cone (A) on output shaft with small O.D. facing away from bevel gear (F). Install bearing cone until it bottoms against snap ring.



Output Shaft Assembly

- A—Bearing Cone
- B—Snap Ring
- C—Output Shaft
- D—Bearing Cone
- E—Shims (as required)
- F—Bevel Gear
- G—Snap Ring
- H—Key

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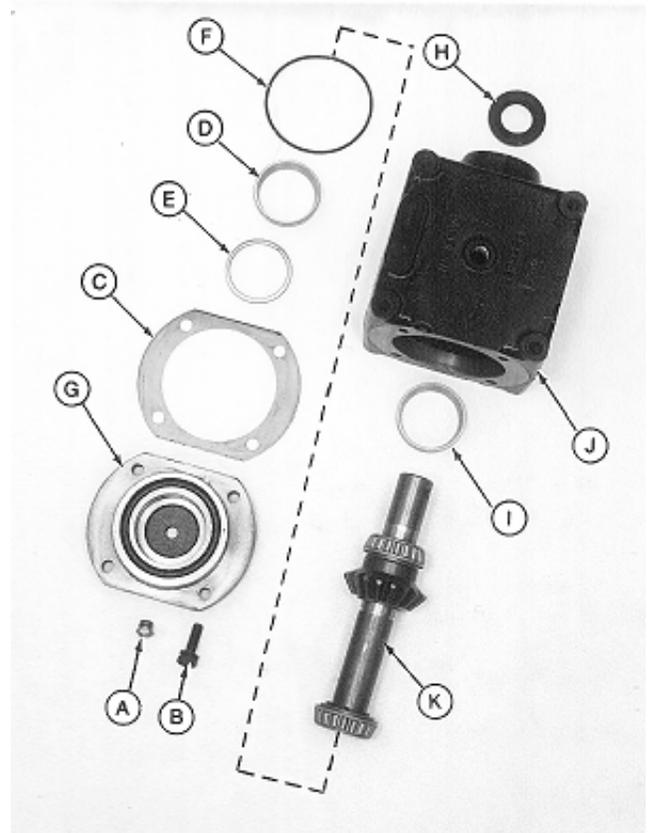
6. Install new bearing cup (I), if removed, into gear case (J) using a driver set.
7. Press new seal (H) into gear case (J) until top of seal is recessed 2.54 mm (0.100 in.) below gear case surface.
8. Apply multipurpose grease to lip of seal.
9. Install vent plug (A).

**IMPORTANT: A new crush ring must be installed during assembly. The ring collapses when retainer is tightened to gear case to achieve proper output shaft end play.**

10. Install new crush ring (E) and bearing cup (D).
11. Install shim (C) and new O-ring (F).

**IMPORTANT: Tape end of output shaft to prevent seal damage during shaft installation.**

12. Apply tape around end of output shaft.
13. Install output shaft assembly (K) into gear case (J). Remove tape.
14. Install retainer assembly and four cap screws (B). Tighten cap screws to 30 N·m (22 lb-ft).



Output Shaft Side

- A—Vent Plug
- B—Cap Screw (4 used)
- C—Shim (as required)
- D—Bearing Cup
- E—Crush Ring
- F—O-Ring
- G—Retainer
- H—Seal
- I—Bearing Cup
- J—Gear Case
- K—Output Shaft Assembly

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15. Install new bearing cups (F and G), if removed, using a driver set. Press into pillow block (H) until seated against housing.

16. Install snap ring (B) onto input shaft (C).

17. Press bearing cone (D) on input shaft with small O.D. facing away from snap ring (B). Install bearing until it bottoms against snap ring.

**IMPORTANT: Tape end of input shaft to prevent seal damage during seal installation.**

18. Apply tape around large end of input shaft.

19. Install input shaft assembly into pillow block (H).

20. Apply multipurpose grease to lip of new seal (A).

21. Press new seal (A) into pillow block (H) until top of seal is recessed 2.54 mm (0.100 in.) below pillow block surface. Remove tape from end of shaft.

22. Install new O-ring (E).

- A—Seal
- B—Snap Ring
- C—Input Shaft
- D—Bearing Cone
- E—O-Ring
- F—Bearing Cup
- G—Bearing Cup
- H—Pillow Block



*Input Shaft Assembly*

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23. Install shim (F) on bevel gear (E).

24. Press bearing cone (D) on bevel gear (E) with small O.D. facing away from bevel gear. Install bearing until it bottoms against shim.

25. Install key (G) into input shaft.

26. Install bevel gear assembly onto input shaft.

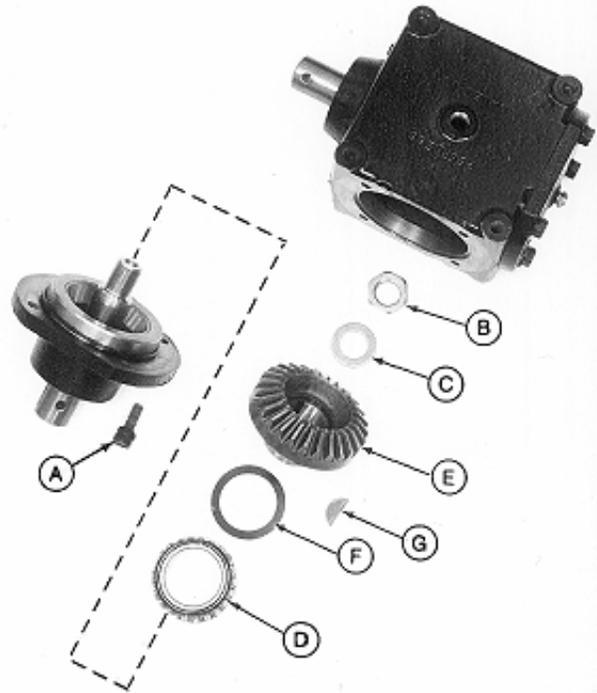
**IMPORTANT: DO NOT overtighten lock nut (B). Overtightening can damage bearing cone (D).**

27. Install washer (C) and lock nut (B). Tighten lock nut until there is zero endplay in input shaft.

28. Install input shaft assembly into gear case.

29. Install four cap screws (A) and tighten to 30 N-m (22 lb-ft).

- A—Cap Screw (4 used)
- B—Lock Nut
- C—Washer
- D—Bearing Cone
- E—Bevel Gear
- F—Shim (as required)
- G—Key



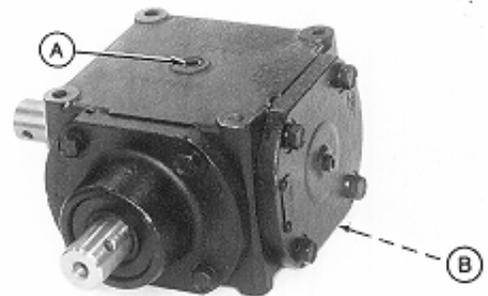
Input Shaft Side

MX,15908015,27 -19-13MAR95

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30. AFTER installing gear case on mower deck, fill gear case to proper level with John Deere API GL-5 Gear Oil.

31. Install plugs (A and B).

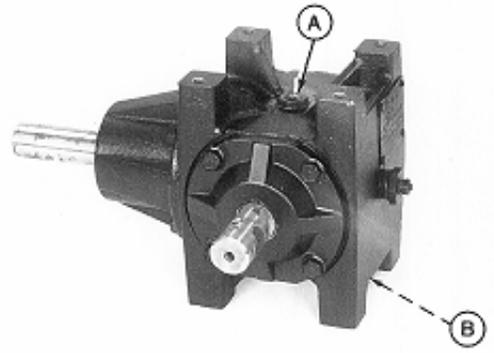


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## DISASSEMBLE AND INSPECT MOWER GEAR CASE—260 ROTARY MOWER

1. Remove drain plugs (A and B) and drain oil from gear case.



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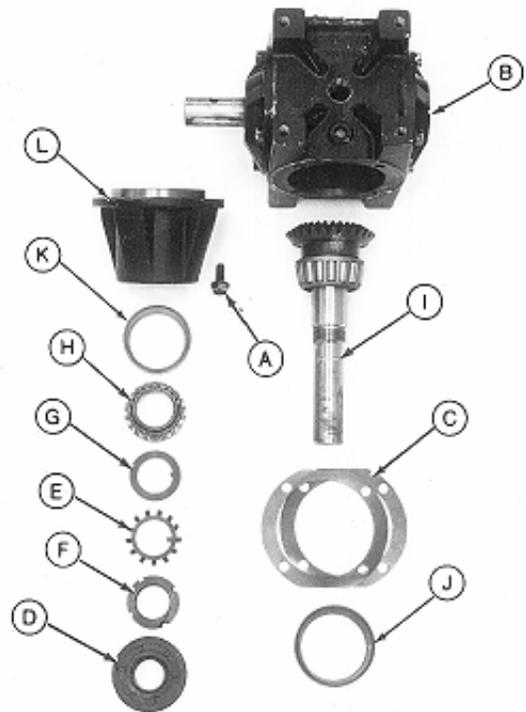
M77323 -UN-24FEB95

2. Remove four cap screws (A).
3. Remove output shaft assembly and housing from gear case (B).
4. Remove shims (C).
5. Punch a hole in seal (D) and pry out of housing (L).
6. Bend out exterior locking tab on toothed washer (E) from lock nut (F).
7. Turn lock nut (F) counterclockwise using a hammer and punch. Remove lock nut.
8. Bend interior locking tab on toothed washer (E) away from groove in shaft (I). Remove toothed washer.
9. Remove tabbed washer (G) and bearing cone (H).
10. Remove output shaft assembly (I) from housing (L).

*NOTE: Bearing cups are press-fit in housing. Remove bearing cups only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

11. Inspect bearing cups (K and J) for wear or damage. Replace if necessary.
12. Remove bearing cups using a brass drift or punch and hammer.



Output Shaft Side



- A—Cap Screw (4 used)
- B—Gear Case
- C—Shims (as required)
- D—Seal
- E—Toothed Washer
- F—Lock Nut
- G—Tabbed Washer
- H—Bearing Cone
- I—Output Shaft Assembly
- J—Bearing Cup
- K—Bearing Cup
- L—Housing

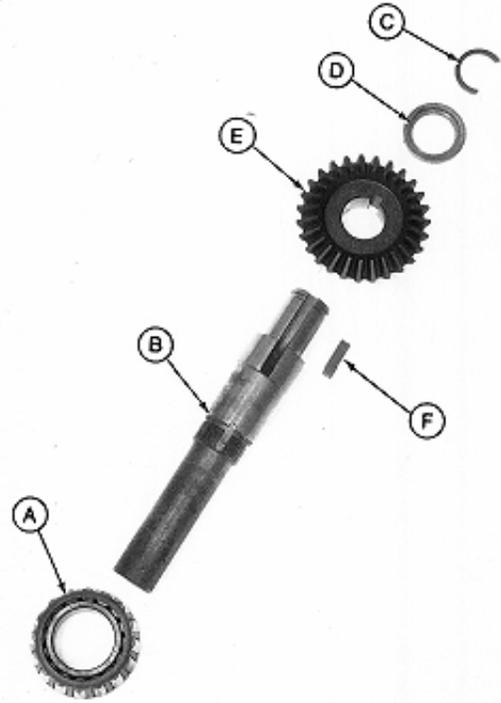
MX,15908015,30 -19-22FEB95

13. Remove bearing cone (A) from shaft (B) using a knife-edge puller and a press.

14. Remove c-ring (C), locking collar (D), bevel gear (E) and key (F).

15. Inspect all parts for wear or damage. Replace as necessary.

- A—Bearing Cone
- B—Output Shaft
- C—C-Ring
- D—Locking Collar
- E—Bevel Gear
- F—Key



Output Shaft Assembly

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16. Remove four cap screws (A).
17. Remove input shaft assembly (B) from gear case (C).
18. Remove four cap screws (D), end cap (E) and shims (F).
19. Remove vent plug (H) and adapter (I).

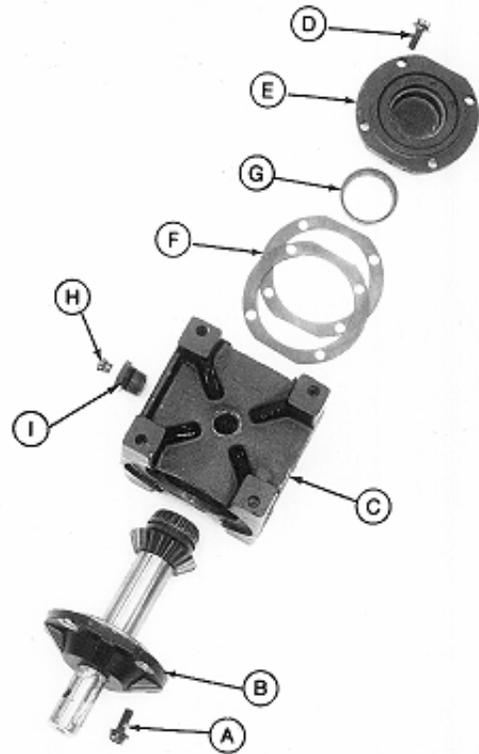
*NOTE: Bearing cup is press-fit in end cap. Remove bearing cup only if replacement is necessary.*

*Bearing cones and cups are matched and must be replaced as complete assemblies.*

20. Inspect bearing cup (G) for wear or damage. Replace if necessary.

21. Remove bearing cup (G) using a slide hammer and a three-jaw puller.

- A—Cap Screw (4 used)
- B—Input Shaft Assembly
- C—Gear Case
- D—Cap Screw (4 used)
- E—End Cap
- F—Shims (as required)
- G—Bearing Cup
- H—Vent Plug
- I—Adapter



Input Shaft Side

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MX,15908015,32 -19-22FEB95

22. Remove input shaft assembly from cap (A).

23. Remove shims (B).

24. Remove seal (C) using a punch and hammer.

*NOTE: Bearing cup is press-fit in cap. Remove bearing cup only if replacement is necessary.*

*Bearing cups and cones are matched and must be replaced as complete assemblies.*

25. Inspect bearing cup (D) for wear or damage. Replace if necessary.

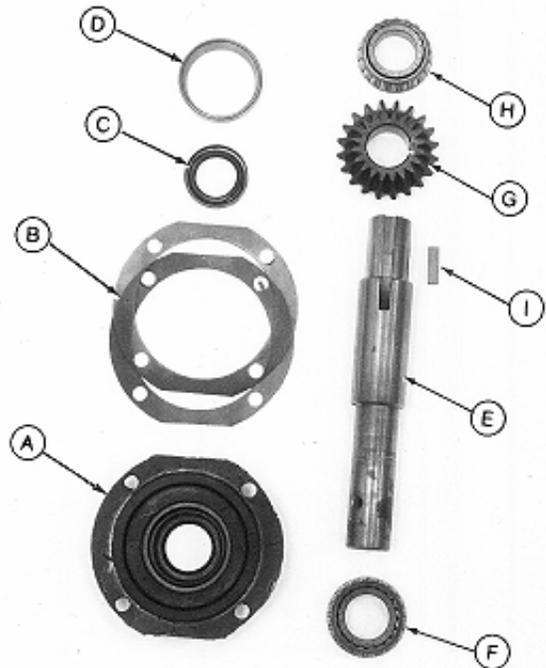
26. Remove bearing cup using a brass drift or punch and hammer.

27. Press shaft (E) from bearing cone (F).

28. Press shaft (E) from bevel gear (G) and bearing cone (H).

29. Remove key (I).

30. Inspect all parts for wear or damage. Replace as necessary.



Input Shaft Assembly

- A—Cap
- B—Shims (as required)
- C—Seal
- D—Bearing Cup
- E—Input Shaft
- F—Bearing Cone
- G—Bevel Gear
- H—Bearing Cone
- I—Key

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## ASSEMBLE MOWER GEAR CASE—260 ROTARY MOWER

**IMPORTANT: Always use new seals. Damaged or used seals will leak.**

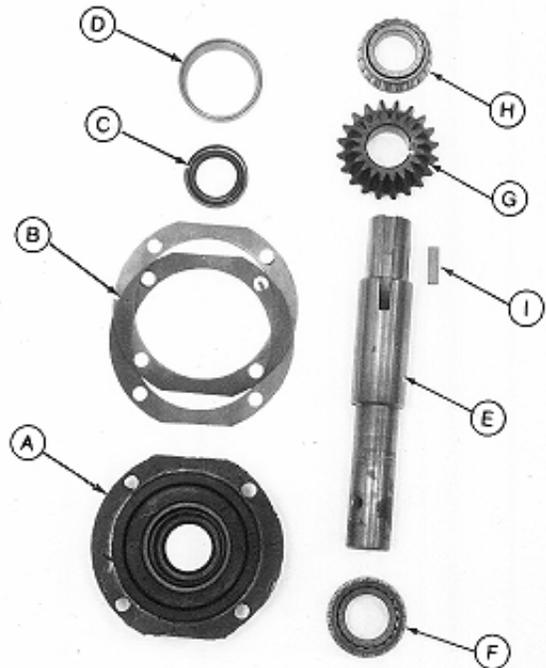
*NOTE: Apply clean gear case oil on all internal parts during assembly.*

1. Install key (I) into input shaft (E).
2. Press bevel gear (G), tapered end first, onto shaft (E) until started.
3. Press bearing cone (H) on shaft with small O.D. facing away from bevel gear (G). Install both bearing cone and bevel gear until bearing bottoms against shaft.
4. Press bearing cone (F) onto other end of input shaft (E) with small O.D. facing away from bevel gear.

**IMPORTANT: Do not press seal in until seated or bottomed out. Seal will become damaged and will leak.**

5. Press new seal (C) into cap (A) until top of seal is flush with first recess inside cap.
  6. Apply multipurpose grease to lip of seal.
  7. Install new bearing cup (D), if removed, using a driver set.
- IMPORTANT: Tape end of input shaft to prevent seal damage during shaft installation.**

8. Apply tape around end of input shaft.
9. Assemble input shaft assembly and cap (A). Remove tape.
10. Install shims (B) on cap (A).



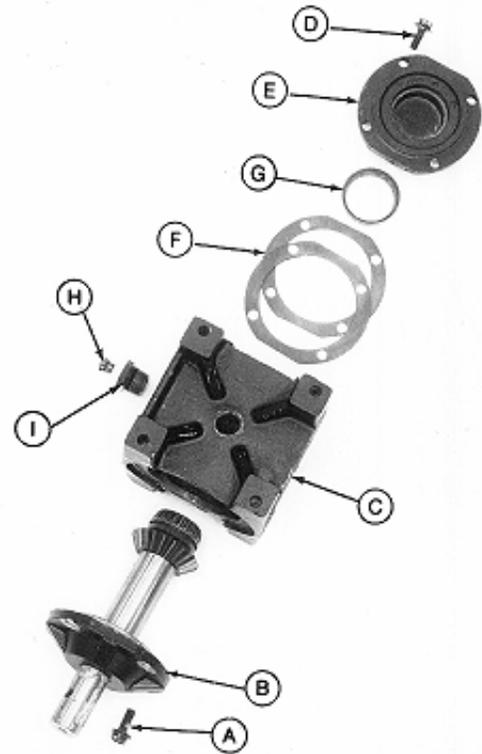
*Input Shaft Assembly*

- A—Cap
- B—Shims (as required)
- C—Seal
- D—Bearing Cup
- E—Input Shaft
- F—Bearing Cone
- G—Bevel Gear
- H—Bearing Cone
- I—Key

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11. Install new bearing cup (G), if removed, into end cap (E) using a driver set.
12. Install shims (F) onto end cap (E).
13. Clean mating surfaces of cap, shims and gear case using Clean and Cure Primer. Apply a bead of Form-In-Place Gasket, or an equivalent, between inside edge of top shim and flange on end cap (E).
14. Install end cap and four cap screws (D) onto gear case (C). Tighten cap screws to 30 N·m (22 lb-ft).
15. Install input shaft assembly (B) into gear case (C).
16. Install four cap screws (A) and tighten to 30 N·m (22 lb-ft).
17. Check input shaft endplay. Endplay should be within 0.025—0.076 mm (0.001—0.003 in.). If necessary, remove four cap screws (D) and end cap (E) and add or remove shims (F) as needed.
18. Remove input shaft assembly (B).
19. Clean mating surfaces of cap, shims and gear case using Clean and Cure Primer. Apply a bead of Form-In-Place Gasket, or an equivalent, between inside edge of top shim and flange on cap.
20. Install input shaft assembly and four cap screws (D). Tighten cap screws to 30 N·m (22 lb-ft).
21. Install adapter (I) and vent plug (H).



Input Shaft Side

- A—Cap Screw (4 used)
- B—Input Shaft Assembly
- C—Gear Case
- D—Cap Screw (4 used)
- E—End Cap
- F—Shims (as required)
- G—Bearing Cup
- H—Vent Plug
- I—Adapter

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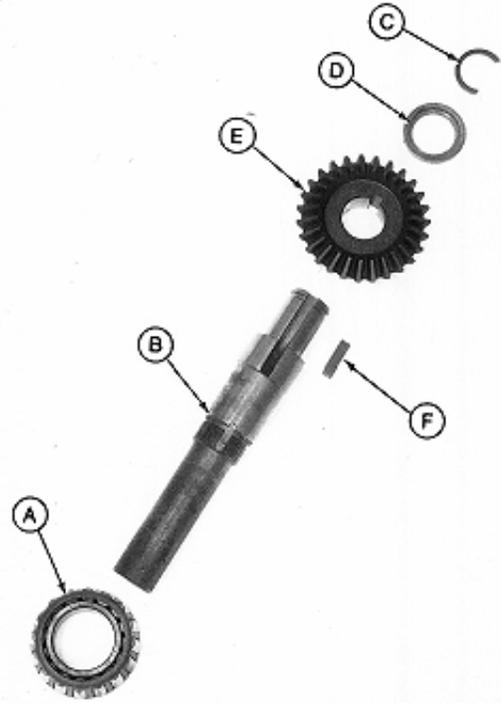
MX,15908015,35 -19-29MAR95

22. Install key (F) and bevel gear (E) on shaft (B). Install bevel gear with shoulder end toward threaded end of shaft.

23. Install locking collar (D) with groove facing away from bevel gear. Install c-ring (C).

24. Press bearing cone (A) on shaft with small O.D. facing away from bevel gear (E). Install bearing until it bottoms locking collar (D) against c-ring (C).

- A—Bearing Cone
- B—Output Shaft
- C—C-Ring
- D—Locking Collar
- E—Bevel Gear
- F—Key



Output Shaft Assembly

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25. Install new bearing cups (K and J), if removed, into housing (L) using a driver set.

26. Install output shaft assembly (I) into housing (L).

27. Slide bearing cone (H) on shaft with small O.D. facing toward housing (L).

28. Install tabbed washer (G) and toothed washer (E). Press internal tab on toothed washer (E) into slot on shaft using a screwdriver.

29. Install lock nut (F). Tighten lock nut, using a punch and hammer, until there is zero endplay in output shaft. Bend up one tab from toothed washer (E), that is in alignment with a slot in lock nut (F), to secure nut in place.

**IMPORTANT: Tape end of output shaft to prevent seal damage during shaft installation.**

30. Apply tape around end of output shaft.

31. Apply multipurpose grease to lip of seal.

32. Press new seal (D) into housing (L) until seal is flush with top of housing. Remove tape.

33. Install shims (C) on housing (L).

34. Install output shaft assembly and housing into gear case (B).

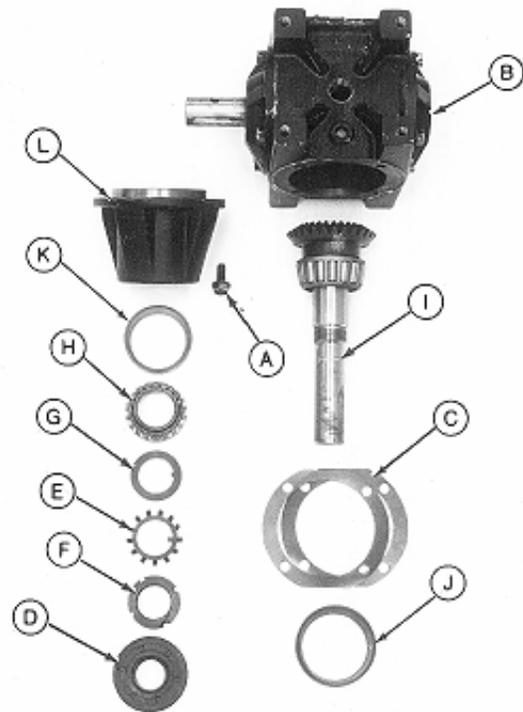
35. Install four cap screws (A) and tighten to 30 N-m (22 lb-ft).

36. Hold input shaft securely and check output shaft backlash. Backlash should be within 0.076—0.130 mm (0.003—0.005 in.). If necessary, remove four cap screws (A) and housing and output shaft assembly and add or remove shims (C) as needed.

37. Again, remove four cap screws (A) and housing and output shaft assembly.

38. Clean mating surfaces of housing, shims and gear case using Clean and Cure Primer. Apply a bead of Form-In-Place Gasket, or an equivalent, between inside edge of top shim and flange on housing (L).

39. Install housing and output shaft assembly into gear case. Install four cap screws (A) and tighten to 30 N-m (22 lb-ft).



Output Shaft Side

- A—Cap Screw (4 used)
- B—Gear Case
- C—Shims (as required)
- D—Seal
- E—Toothed Washer
- F—Lock Nut
- G—Tabbed Washer
- H—Bearing Cone
- I—Output Shaft Assembly
- J—Bearing Cup
- K—Bearing Cup
- L—Housing

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40. AFTER installing gear case on mower deck, fill gear case to proper level with John Deere API GL-5 Gear Oil.

41. Install plugs (A and B).



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# Section 220

# ENGINE, FUEL AND AIR SYSTEM CHECKOUT AND DIAGNOSIS

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Engine Oil Pressure Check . . . . .	220-05-2
Engine Performance Check . . . . .	220-05-2
Operator Complaint Not Identified . . . . .	220-05-3

### **Group 10—Diagnosis, Tests and Adjustments**

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Troubleshooting Guide . . . . .	220-10-1
Ignition Spark Test . . . . .	220-10-6
Throttle Cable Adjustment . . . . .	220-10-6
Choke Cable Adjustment . . . . .	220-10-7
Idle Mixture and Speed Adjustment . . . . .	220-10-7
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Fuel Transfer Pump Test . . . . .	220-10-10
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Timing Adjustment (B43E, B43G and B48G) . . . . .	220-10-11
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Oil Pressure Regulating Valve Check . . . . .	220-10-13
Throttle Lever Adjustment . . . . .	220-10-13

220



# Group 05 Engine, Fuel and Air System Checkout

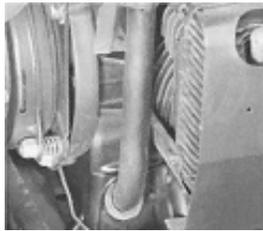
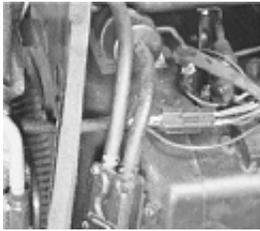
## BEFORE YOU START

Always begin with this group to identify a failure in the engine, fuel or air system. The step-by-step procedures will provide you with a quick check of the system. No special tools are required to perform these checks. If a failure is indicated, you will be referred to a more detailed check, adjustment, or test.

This procedure is designed as a quick check of the system. While performing the check, concentrate only on the check you are performing and disregard signals from unrelated components.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the check.

MX,159022005,1 -19-27APR95

<p><b>ENGINE OIL AND LEAK CHECK</b></p>	<p>Check engine oil level, condition and viscosity.</p>	 <p>Inspect for external oil leakage from oil base gasket, drain plug, oil filter (if equipped), seals and oil fill tube.</p>	<p><b>OK:</b> GO TO ' <b>NOT OK:</b> Repair or replace, then GO TO ' <b>MX,159022005,2 -19-05MAY95</b></p>
<p><b>FUEL LEAK CHECK</b></p>		<p>Inspect for external fuel leakage from fuel tank, fuel pump, fuel filter, fuel lines and fittings.</p>	<p><b>OK:</b> GO TO Æ <b>NOT OK:</b> Repair or replace, then GO TO Æ <b>MX,159022005,3 -19-27APR95</b></p>
<p><b>THROTTLE LEVER CHECK</b></p>		<p>Move throttle lever from low idle position to high idle position.</p> <p><i>LOOK:</i> Throttle lever must contact stops in the dash at low and high idle positions.</p> <p><i>FEEL:</i> Throttle lever must move smoothly from low to high idle position.</p>	<p><b>OK:</b> GO TO Å <b>NOT OK:</b> GO TO Æ, GROUP 10. <b>MX,159022005,4 -19-27APR95</b></p>

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*Engine, Fuel and Air System Checkout/Engine Performance Check*

<p><b>Å ENGINE START CHECK</b></p>	<p>Operator on seat.</p> <p>Put hydrostatic control lever in N/STOP position.</p> <p>Put PTO lever in OFF position.</p> <p>Pull choke knob all the way out.</p> <p>Depress brake pedal(s).</p>	 <p>M55029 -UN-09DEC89</p> <p>Turn key switch to START position.</p> <p>Starter must crank engine. Engine must start.</p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> GO TO ; , GROUP 10.</p> <p align="right">MX,159022005,5 -19-16MAY95</p>
<p><b>Ö CHOKE LEVER CHECK</b></p>	 <p>M55031 -UN-09DEC89</p>	<p>Run engine at half throttle.</p> <p>Quickly pull choke knob all the way out, then push in.</p> <p><i>LISTEN: Engine must falter, then resume speed.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> GO TO Å, GROUP 10.</p> <p align="right">MX,159022005,6 -19-05MAY95</p>
<p><b>0 ENGINE OIL PRESSURE CHECK</b></p>	 <p>M55030 -UN-09DEC89</p>	<p>Run engine at full throttle.</p> <p><i>LOOK: Oil pressure lamp must go OFF.</i></p> <p>Remove air cleaner cover.</p> <p><i>LOOK: Air filter must not be oil soaked.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>OIL PRESSURE LAMP STAYS ON:</b> Test oil pressure sender in Section 240. If sender is OK and lamp is still on, then GO TO 1#, GROUP 10.</p> <p align="right">MX,159022005,7 -19-27APR95</p>
<p><b>0 ENGINE PERFORMANCE CHECK</b></p>	<p><b>N CAUTION:</b> Engine exhaust fumes can cause sickness or death. If running an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.</p> <p>If you do not have an exhaust pipe extension, open the doors and get outside air into the area.</p> <p align="right">MX,159022005,8 -19-05MAY95</p>		

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Engine, Fuel and Air System Checkout/Operator Complaint Not Identified

<p><b>7a Engine Under No-Load</b></p>	 <p>M55061 -UN-09DEC89</p> <p>Start engine.</p> <p>Move throttle lever from slow idle to fast idle.</p> <p><i>LISTEN: Engine must accelerate smoothly, without hesitation.</i></p> <p><i>LOOK: Exhaust must be clear.</i></p> <p><i>LISTEN: Governor must hold engine at a constant rpm and not surge.</i></p> <p><i>LISTEN: Engine must not make any abnormal sounds or backfire.</i></p>	<p><b>OK:</b> GO TO 7b</p> <p><b>NOT OK:</b> GO TO ; , GROUP 10.</p> <p>MX,159022005,9 -19-27APR95</p>
<p><b>7b Engine Under Load</b></p>	 <p>M55019 -UN-09DEC89</p> <p>Start engine and run at half throttle.</p> <p>Engage PTO lever with implement attached.</p> <p>Move throttle lever to fast idle position.</p> <p>Cycle attached implement, if possible, to load engine.</p> <p><i>LISTEN: Governor must increase and decrease engine rpm to match load condition.</i></p> <p><i>LOOK: Exhaust must be clear.</i></p> <p><i>LISTEN: Engine must not make any abnormal sounds or backfire.</i></p>	<p><b>OK:</b> System Normal.</p> <p><b>NOT OK:</b> GO TO ; , GROUP 10.</p> <p>MX,159022005,10-19-27APR95</p>
<p><b>Ú OPERATOR COMPLAINT NOT IDENTIFIED</b></p>	<p>If you completed the checkout procedure and did not isolate a malfunction, the problem may be intermittent.</p> <p>Try to duplicate the conditions of the malfunction identified by the operator.</p> <p>Repeat system checkout in this group.</p>	<p>IF A MALFUNCTION IS NOT IDENTIFIED AFTER REPEATING SYSTEM CHECKOUT PROCEDURE, FACTORY ASSISTANCE IS AVAILABLE THROUGH THE DEALER TECHNICAL ASSISTANCE CENTER (DTAC).</p> <p>MX,159022005,11-19-27APR95</p>

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## ABOUT THIS GROUP

Always perform the system checkout procedures in Group 05 BEFORE making any tests or adjustments in this group. The step-by-step procedures in this group provide you with the detailed diagnostic information you will need to isolate a malfunction. Basic diagnostic equipment is used.

It is assumed that you are familiar with the machine and its engine, fuel and air system components.

Engine rpm and temperature are critical in most engine tests. Be sure to follow test specifications carefully.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the test.

Upon completing a test or adjustment, check to see whether the problem is corrected by performing the checkout procedures in Group 05.

MX,159022010,1 -19-27APR95

## ; TROUBLESHOOTING GUIDE

If engine does not operate properly, select the appropriate symptom from the list below. (If engine does not crank, see Section 240.)

- ENGINE WILL NOT START OR STARTS HARD: GO TO A
- ENGINE BACKFIRES: GO TO B
- ENGINE MISSES: GO TO C
- ENGINE SURGES OR STALLS FREQUENTLY: GO TO D
- ENGINE DOES NOT DEVELOP FULL POWER: GO TO E
- ENGINE RUNS ERRATICALLY: GO TO F
- ENGINE OVERHEATS: GO TO G
- ABNORMAL ENGINE NOISE: GO TO H
- LOW OIL PRESSURE: GO TO I
- ENGINE SMOKES EXCESSIVELY AND USES TOO MUCH OIL: GO TO J
- ENGINE SMOKES EXCESSIVELY AND USES TOO MUCH FUEL: GO TO K

MX,159022010,2 -19-27APR95

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## A ENGINE WILL NOT START OR STARTS HARD

- Test spark plugs: GO TO 1
- Test fuel filter: GO TO 2
- Adjust choke cable: GO TO 3
- Adjust throttle cable: GO TO 4
- Adjust idle mixture screw: GO TO 5
- Test fuel transfer pump: GO TO 6
- Check for sheared flywheel key—P218G (316 and 318) and P220G (420): See Engine CTM2.
- Adjust timing—B43E (316), B43G (318) and B48G (420): GO TO 1!
- Check ignition system: See Section 240.
- Test compression pressure: GO TO 1@
- Test crankcase vacuum: GO TO 10
- Inspect crankcase breather: See Engine CTM2.
- Check and adjust valve clearance: See Engine CTM2.

MX,159022010,3 -19-05MAY95

## B ENGINE BACKFIRES

- Adjust idle mixture screw: GO TO 5
- Check for sheared flywheel key—P218G (316 and 318) and P220G (420): See Engine CTM2.
- Adjust timing—B43E (B43E), B43G (318) and B48G (420): GO TO 1!
- Check ignition system: See Section 240.
- Check for sticking valves: See Engine CTM2.
- Check and adjust valve clearance: See Engine CTM2.

MX,159022010,4 -19-27APR95

## C ENGINE MISSES

- Test spark plugs: GO TO 1
- Test fuel filter: GO TO 1
- Adjust choke cable: GO TO 1
- Adjust carburetor: GO TO 1
- Adjust timing—B43E (316), B43G (318) and B48G (420): GO TO 1!
- Check ignition system: See Section 240.
- Check and adjust valve clearance: See Engine CTM2.

MX,159022010,5 -19-05MAY95

## D ENGINE SURGES OR STALLS FREQUENTLY

- Adjust choke cable: GO TO 1
- Adjust dashpot—B43E (316), B43G (318) and B48G (420): GO TO 1
- Adjust governor linkage: GO TO 1
- Adjust carburetor: GO TO 1
- Test fuel filter: GO TO 1
- Test fuel transfer pump: GO TO 1
- Adjust timing—B43E (316), B43G (318) and B48G (420): GO TO 1!
- Check ignition system: See Section 240.
- Test crankcase vacuum: GO TO 1
- Inspect crankcase breather: See Engine CTM2.
- Test compression pressure: GO TO 1@
- Check and adjust valve clearance: See Engine CTM2.

MX,159022010,6 -19-05MAY95

220  
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## **E ENGINE DOES NOT DEVELOP FULL POWER**

- Adjust throttle cable: GO TO Æ
- Adjust choke cable: GO TO Å
- Adjust governor linkage: GO TO Ò
- Adjust carburetor: GO TO Ö
- Test spark plugs: GO TO ´
- Check muffler for restriction or plugged condition.
- Test fuel filter: GO TO Ú
- Test fuel transfer pump: GO TO Û
- Adjust timing—B43E (316), B43G (318) and B48G (420): GO TO 1!
- Check ignition system: See Section 240.
- Test compression pressure: GO TO 1@
- Test crankcase vacuum: GO TO 1Ô
- Inspect crankcase breather: See Engine CTM2.
- Check and adjust valve clearance: See Engine CTM2.

MX,159022010,7 -19-05MAY95

## **F ENGINE RUNS ERRATICALLY**

- Check for loose electrical connections: See Section 240.
- Test spark plugs: GO TO ´
- Adjust carburetor: GO TO Ö
- Adjust dashpot—B43E (316), B43G (318) and B48G (420): GO TO Ò
- Adjust governor linkage: GO TO Ò
- Adjust timing—B43E (316), B43G (318) and B48G (420): GO TO 1!
- Test fuel filter: GO TO Ú
- Test fuel transfer pump: GO TO Û
- Check ignition system: See Section 240.
- Test crankcase vacuum: GO TO 1Ô
- Inspect crankcase breather: See engine CTM2.
- Check and adjust valve clearance: See Engine CTM2.
- Check carburetor for plugged passages: See Engine CTM2.

MX,159022010,8 -19-08MAY95

## **G ENGINE OVERHEATS**

- Check muffler for restriction or plugged condition.
- Adjust carburetor: GO TO 0
- Adjust governor linkage: TO TO 0
- Check engine oil pressure: GO TO 1#
- Check oil pump suction screen for plugged condition: See Engine CTM2.
- Check oil pump for wear or damage: See Engine CTM2.
- Check oil passages: See Engine CTM2.
- Check internal bearing clearance: See Engine CTM2.
- Check for carbon build-up in combustion chamber: See Engine CTM2.

MX,159022010,9 -19-03MAY95

## **H ABNORMAL ENGINE NOISE**

- Check for loose flywheel: See Engine CTM2.
- Check and adjust valve clearance: See Engine CTM2.
- Check for carbon build-up in combustion chamber: See Engine CTM2.
- Inspect engine for worn cylinder walls, loose or worn connecting rods, excessive main bearing endplay, and excessive crankshaft or camshaft endplay: See Engine CTM2.

MX,159022010,10-19-27APR95

## **I LOW OIL PRESSURE**

- Test oil indicator light and sender: See Section 240.
- Check engine oil pressure: GO TO 1#
- Check oil pump suction screen for plugged condition: See Engine CTM2.
- Check oil pump for wear or damage: See Engine CTM2.
- Check oil passages: See Engine CTM2.
- Check for excessive main bearing clearance and connecting rod bearing clearance: See Engine CTM2.

MX,159022010,11-19-03MAY95

**J ENGINE SMOKES EXCESSIVELY AND USES TOO MUCH OIL**

- Test crankcase vacuum: GO TO 10
- Inspect crankcase breather: See Engine CTM2.
- Test compression pressure: GO TO 1@
- Check valve stem seals (if equipped): See Engine CTM2.
- Check for correct engine oil dipstick being used.
- Check for proper installation of oil passage plug: See Engine CTM2.

MX,159022010,12-19-05MAY95

**K ENGINE SMOKES EXCESSIVELY AND USES TOO MUCH FUEL**

- Adjust choke cable: GO TO A
- Adjust carburetor: GO TO O
- Check carburetor float adjustment: See Engine CTM2.

MX,159022010,13-19-05MAY95

<p><b>IGNITION SPARK TEST</b></p>		<p>Connect spark plug wire to JDM-74-5 Ignition Test Plug or D-05351ST Spark Tester.</p> <p>Crank engine and watch for spark.</p> <p><i>LOOK: Ignition Test Plug or Tester must spark.</i></p>	<p>SPARK "BLUE" HOT: OK, Continue with test.</p> <p>NO SPARK OR "YELLOW" WEAK SPARK: GO TO SECTION 240.</p>
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M37088 -UN-29AUG88

	<p>Remove spark plug.</p> <p>Inspect spark plug for wet or fouled condition or damage.</p> <p>Check spark plug gap. Spark plug gap should be 0.64 mm (0.025 in.)</p> <p>Repeat spark test with original plug.</p>	<p>NO SPARK: Replace plug.</p>
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M37430 -UN-25JAN90

MX,159022010,14-19-05MAY95

<p><b>THROTTLE CABLE ADJUSTMENT</b></p>	 <p>Move throttle lever to fast idle position.</p>	 <p>Loosen clamp.</p> <p>Hold throttle control lever against fast idle stop (A). Tighten clamp.</p>
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M55061 -UN-09DEC89

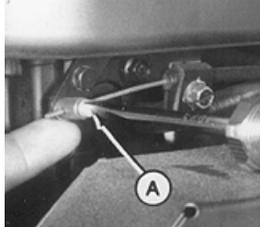
M37408 -UN-25JAN90

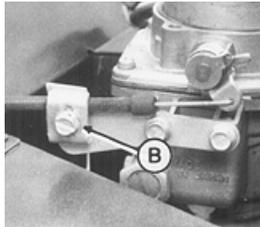
MX,159022010,15-19-03MAY95

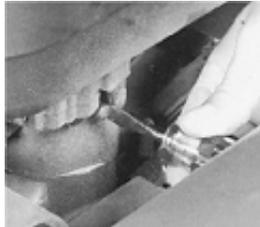
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Diagnosis, Tests and Adjustments/Idle Mixture and Speed Adjustment

<p><b>Ä CHOKE CABLE ADJUSTMENT</b></p>	<p>Remove air filter.</p> <p>MX,159022010,16-19-03MAY95</p>
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<p><b>4a Early Models</b></p>	<p>Pull choke knob out and then push knob in.</p> <p><i>LOOK: Choke plate must be completely closed, then completely open.</i></p>	 <p>M37084 -UN-28APR95</p>	<p>If necessary, loosen screw (A) and push choke knob all the way in.</p> <p>Pull on choke lever to completely open choke plate. Tighten screw (A).</p> <p>Check for completely open and completely closed positions.</p> <p>MX,159022010,17-19-08MAY95</p>
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<p><b>4b Later Models</b></p>	<p>Pull choke knob out and then push knob in.</p> <p><i>LOOK: Choke plate must be completely closed, then completely open.</i></p>	 <p>M7708 -UN-28APR95</p>	<p>If necessary, loosen screw (B) and push choke knob all the way in.</p> <p>Push choke cable to completely open choke plate. Tighten screw (B).</p> <p>Check for completely open and completely closed positions.</p> <p>MX,159022010,18-19-08MAY95</p>
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<p><b>Ö IDLE MIXTURE AND SPEED ADJUSTMENT</b></p> <p><b>IMPORTANT: Forcing the idle mixture screw tight will damage the needle and seat.</b></p> <p><i>NOTE: On later P218G (316 and 318) and P220G (420) engines; A "limiter cap" is installed over the idle mixture screw. The screw should only need to be adjusted within these limits. If screw is being replaced, pry off "cap" and remove screw. Turn the new idle mixture screw clockwise until lightly seated, then counterclockwise 1-1/4 turns. Install "cap" with tab up and centered between stops on carburetor.</i></p>	 <p>M37083 -UN-29AUG88</p>	<p>Turn idle mixture screw clockwise until lightly seated, then counterclockwise 1-1/4 turns.</p> <p>Start and run engine to bring it to NORMAL OPERATING TEMPERATURE. Move throttle lever to slow idle position.</p> <p>Continued on next page</p>
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220  
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Diagnosis, Tests and Adjustments/Idle Mixture and Speed Adjustment



M37098 -UN-29AUG88

**CAUTION: ENGINE WILL BE HOT. BE CAREFUL NOT TO BURN HANDS.**

Turn low speed stop screw (A) counterclockwise until throttle stop screw controls engine speed.

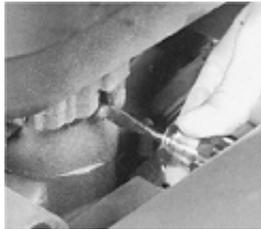


M37099 -UN-29AUG88

*NOTE: Check engine speeds using JDM71 Vibration Tachometer.*

Put Tachometer (A) on air cleaner. Set Tachometer to read 1250 rpm.

Turn throttle stop screw until engine speed is 1250 rpm.



M37083 -UN-29AUG88

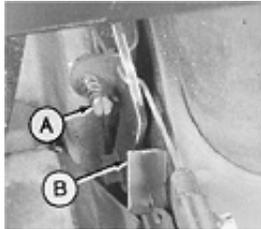
Turn idle mixture screw in until engine speed drops, then out until engine speed increases and begins to drop again.

Adjust idle mixture screw for highest engine speed between drops, then turn screw out an additional 1/8 turn.



M37100 -UN-29AUG88

Watch Tachometer and turn throttle stop screw until engine speed is 1250 rpm.



M37101 -UN-29AUG88

Turn low speed stop screw (A) until engine speed is 1350 rpm.

Move throttle lever to fast idle position. Bend high speed stop (B) in or out until engine speed is 3450 rpm. Check low idle rpm again and adjust if necessary.

MX,159022010,19-19-03MAY95

0 GOVERNOR LINKAGE ADJUSTMENT



M37441 -UN-25JAN90

*NOTE: "B-Series" Engine Shown.*

Disconnect throttle rod (A) from governor arm (B).

Push throttle rod and governor arm toward carburetor until they stop. Be sure dashpot spring (if equipped) is completely compressed.

Install throttle rod into closest governor arm hole. If between holes, install in next hole away from carburetor.



M37442 -UN-25JAN90

Check governor spring sensitivity.

On side pull governors, (shown), the governor spring should be in the third hole from governor arm pivot.

On front pull governors, the governor spring should be in the second hole from governor arm pivot.

If necessary, move governor spring one hole away from governor arm pivot to decrease sensitivity.

**AFTER ADJUSTMENT:**  
GO TO 0 and adjust carburetor.

MX,159022010,20-19-05MAY95

0 DASHPOT ADJUSTMENT (B43E, B43G and B48G)

Inspect dashpot for wear or damage. Dashpot plunger must move in and out freely.



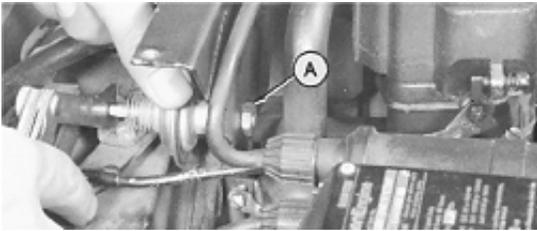
M37443 -UN-25JAN90

Push and hold governor arm away from carburetor until throttle stop (A) hits throttle stop screw (B).

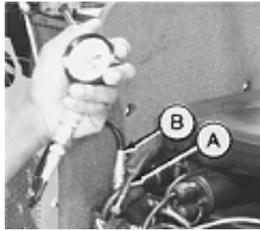
Measure dashpot-to-governor arm bracket clearance. Dashpot clearance should be  $1.3 \pm 0.2$  mm ( $0.050 \pm 0.010$  in.).

Continued on next page

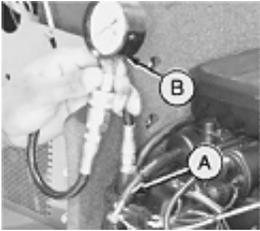
Diagnosis, Tests and Adjustments/Fuel Transfer Pump Test

 <p>M37457 -UN-25JAN90</p>	<p><b>IMPORTANT: DO NOT hold dashpot using a pliers. Dashpot can be damaged.</b></p> <p>If adjustment is necessary, loosen lock nut (A). Turn dashpot until clearance is obtained. Hold dashpot while tightening lock nut.</p>	<p><b>AFTER ADJUSTMENT:</b> GO TO 0 and adjust governor linkage.</p> <p>MX,159022010,21-19-27APR95</p>
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<p><b>Ü FUEL FILTER TEST</b></p>	 <p>M37079 -UN-29AUG88</p>	<p>Disconnect fuel filter outlet hose. Hold fuel filter in a graduated container.</p> <p>Crank engine for 30 seconds and record amount of fuel.</p> <p>Minimum fuel flow is 120 mL/30 seconds (4 oz/30 seconds).</p> <p>MX,159022010,22-19-03MAY95</p>
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<p><b>Ü FUEL TRANSFER PUMP TEST</b></p>	<p>Start and run engine at slow idle for five minutes to fill carburetor with fuel.</p> <p>Stop the engine.</p>	 <p>M55110 -UN-09DEC89</p> <p>Disconnect and plug fuel pump inlet hose (A). Connect vacuum gauge (B) to fuel pump inlet.</p> <p>Start and run engine at slow idle for 15 seconds, then record vacuum reading.</p>
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<p>Run engine at fast idle for 15 seconds, then record vacuum reading.</p> <p>Minimum vacuum at slow and fast idle is 9 kPa (2.6 in. mercury).</p>	<p>Stop the engine.</p> <p>Remove vacuum gauge.</p> <p>Connect fuel pump inlet hose.</p>	
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 <p>M55111 -UN-09DEC89</p>	<p>Disconnect and plug fuel pump outlet hose (A).</p> <p>Connect JDG356 Pressure Test Kit (B) to fuel pump outlet.</p> <p>Start and run engine at slow idle for 15 seconds, then record pressure reading.</p> <p>Run engine at fast idle for 15 seconds, then record pressure reading.</p> <p>Minimum pressure at slow and fast idle is 12 kPa (1.7 psi).</p> <p>MX,159022010,23-19-03MAY95</p>
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<p><b>10 CRANKCASE VACUUM TEST</b></p>	<p>Remove dipstick. <span style="float: right;">Start engine and run at fast idle.</span></p> <p>Put plug (A) in dipstick hole.</p> <p><b>IMPORTANT: Do not hook up rest of Test Kit until engine is running or fluid in Manometer will be sucked into crankcase during cranking mode.</b></p>	
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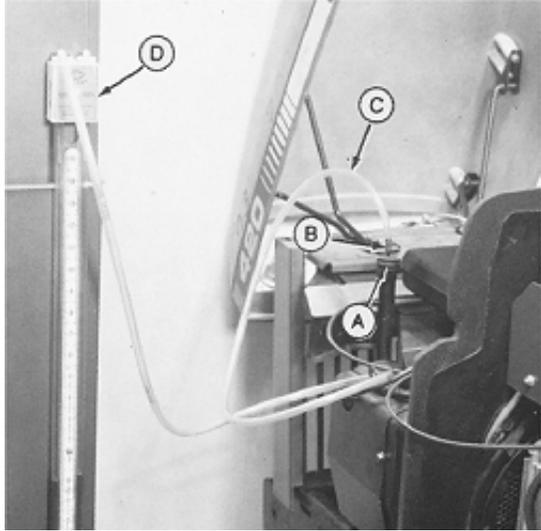
Make test connections from JT05697 U-Tube Manometer Kit.

Record crankcase vacuum reading.

**SPECIFICATIONS**

Minimum Crankcase Vacuum:  
 B43E (Early 316),  
 B43G (Early 318) and  
 B48G (Early 420) . . . . . 25 cm (10 in.) water  
 P218G (Later 316 and 318) and  
 P220G (Later 420) . . . . . 33 cm (13 in.) water

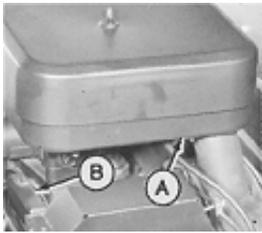
Remove Manometer line from plug before shutting off engine.



A—AHT8741-F66 Plug  
 B—JT05703 Double Barb Fitting  
 C—JT05699 Clear Line  
 D—JT05698 U-Tube Manometer

M49221    -UN-20DEC89    MX,159022010,24-19-28APR95

**1! TIMING ADJUSTMENT (B43E, B43G and B48G)**



M37092    -UN-29AUG88



M37095    -UN-28APR95

Remove air cleaner base (A) and ignition point cover (B).

Rotate crankshaft clockwise (facing flywheel) until points are completely open.

Turn adjusting screw (C) until ignition points are at widest gap.

Inspect ignition points for oxidation; stuck, burnt, or pitted condition.

Check point gap using a feeler gauge. Gap must according to specifications. If necessary, turn adjusting screw (C) until gap is correct.

**SPECIFICATIONS**

B43E and B43G . . . . .	0.41 mm (0.016 in.)
B48G	
Spec A and B . . . . .	0.51 mm (0.020 in.)
Spec C . . . . .	0.41 mm (0.016 in.)

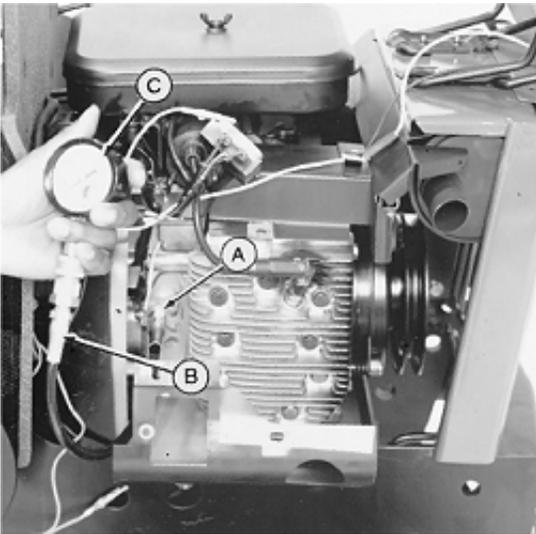
MX,159022010,25-19-16MAY95

Diagnosis, Tests and Adjustments/Engine Oil Pressure Test

<p><b>1@ COMPRESSION PRESSURE TEST</b></p>	<p>Start and run engine approximately five minutes at fast idle, to bring it to normal operating temperature.</p> <p>Stop engine.</p>	 <p>M55108 -UN-09DEC89</p>	<p>Disconnect and ground spark plug wires away from spark plug holes. Remove spark plugs.</p> <p>Install JDM59 Compression Gauge.</p> <p>Make sure choke plate is in wide open position.</p> <p>Move throttle lever to fast idle position. Crank engine and record pressure reading.</p> <p><b>SPECIFICATIONS</b></p> <p>Minimum Pressure:</p> <p>B43E (Early 316),          B43G (Early 318) and          B48G (Early 420) . . . . . 690 kPa (100 psi)          P218G (Later 316 and 318) and          P220G (Later 420) . . . . . 517 kPa (75 psi)          Maximum Difference Between          Cylinders . . . . . 69 kPa (10 psi)</p>
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 <p>M55109 -UN-09DEC89</p>	<p>Remove Compression Gauge.</p> <p>Put clean engine oil on piston rings through spark plug holes.</p> <p>Repeat compression pressure test.</p>	<p>If pressure increases significantly, check rings, piston, and cylinder bore for broken rings, scoring, wear or damage.</p> <p>If pressure does not increase significantly, check for leaking valves, valve seats, or cylinder head gasket.</p> <p style="text-align: right;">MX,159022010,26-19-05MAY95</p>
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<p><b>1# ENGINE OIL PRESSURE TEST</b></p>	<p>Remove right engine side panel.</p> <p>Remove voltage regulator.</p> <p>Remove engine shroud upper mounting bolts.</p> <p>Bend engine shroud away from engine for access to oil pressure</p>	<p>switch.</p> <p><b>IMPORTANT: The voltage regulator must be grounded to prevent damage to it when engine is run.</b></p> <p>Attach a ground wire from regulator to any frame location.</p> <p style="text-align: right;">MX,159022010,27-19-27APR95</p>
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 <p>M55134 -UN-20DEC89</p> <p><b>A—JT05490 3/8-24 M ORB X 7/16-20 M 37° Fitting</b>  <b>B—JT03017 Hose Assembly</b>  <b>C—JT03092 or JT05472 0—400 kPa (0—60 psi) Gauge</b></p>	<p>Start and run engine for five minutes at fast idle, to warm oil to normal operating temperature.</p> <p>Stop engine.</p> <p>Remove oil pressure switch and make test connections as shown.</p> <p>Run engine at test specification and record readings.</p> <p><b>SPECIFICATIONS</b></p> <table border="0"> <tr> <td>Engine Speed</td> <td>Oil Pressure</td> </tr> <tr> <td>Slow Idle . . . . .</td> <td>69—103 kPa (10—15 psi)</td> </tr> <tr> <td>Fast Idle . . . . .</td> <td>124—152 kPa (18—22 psi)</td> </tr> </table>	Engine Speed	Oil Pressure	Slow Idle . . . . .	69—103 kPa (10—15 psi)	Fast Idle . . . . .	124—152 kPa (18—22 psi)
Engine Speed	Oil Pressure						
Slow Idle . . . . .	69—103 kPa (10—15 psi)						
Fast Idle . . . . .	124—152 kPa (18—22 psi)						

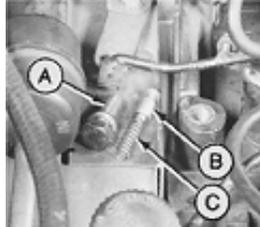
220  
10  
12

**NOT OK: GO TO 1\$**

MX,159022010,30-19-05MAY95

**1\$ OIL PRESSURE REGULATING VALVE CHECK**

Remove air cleaner base.  
Move air cleaner bracket until oil pressure regulating valve cap screw can be removed.



M37435 -UN-31JAN90

Measure cap screw (A) thread length.

Remove oil pressure regulating valve (B). Inspect spring (C) for weak or broken coils. Inspect valve and valve seat for stuck condition, metal particles, wear or damage.

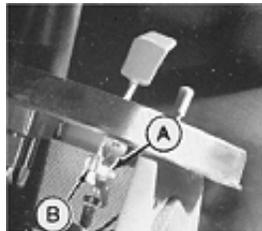
**SPECIFICATIONS**

Cap Screw Thread Length . . . . . 22 mm (0.875 in.)  
Spring Free Length . . . . . 25 mm (1 in.)  
Spring Test Length  
at 12 N (2.6 lbs force) . . . . . 13 mm (0.500 in.)

**NOT OK: Replace parts as necessary.**

MX,159022010,28-19-05MAY95

**1% THROTTLE LEVER ADJUSTMENT**



M49159 -UN-20DEC89

Tighten or loosen nut (A) until throttle lever moves from slow to fast idle with a slight drag. Replace friction washers (B) if necessary. Throttle lever must hold in all positions.

MX,159022010,31-19-05MAY95

220  
10  
13

220  
10  
14

# Section 240

# ELECTRICAL CHECKOUT, OPERATION AND DIAGNOSIS

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## BEFORE YOU START

Always begin with this group to identify a failure in the electrical system. The step-by-step procedures will provide you with a quick check of the system. No special tools are required to perform these checks. If a failure is indicated, you will be referred to a more detailed check, adjustment, or test located in Groups 20 and 25.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the check.

This procedure is designed as a quick check of the system. Concentrate only on the check being performed and disregard signals from unrelated components. If unfamiliar with the operation or

location of system components, refer to Group 15 in this section.

*NOTE: For clarity in this section, machines before the serial number listed below will be referred to as "Early Models". Machines including and after serial numbers listed below will be referred to as "Later Models".*

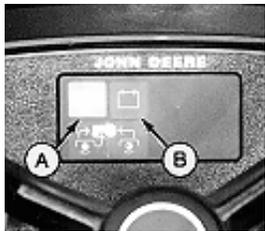
316 (S.N. 596121— )

318 (S.N. 600305— )

420 (S.N. 595881— )

*Later model machines have a brake switch added to the neutral start circuit, which is activated by the brake pedal(s).*

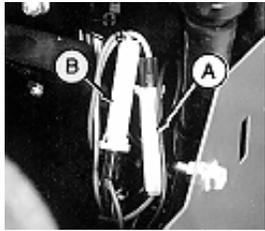
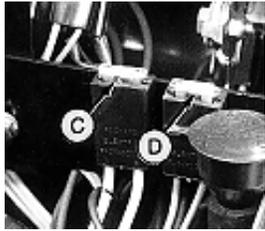
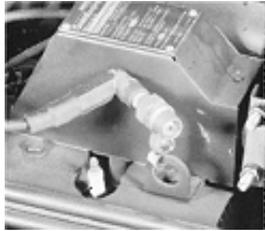
MX,159024005,1 -19-16MAY95

<p><b>DASH LAMP CIRCUIT CHECK</b></p> <p><i>NOTE: The following checks apply to the battery discharge and oil pressure lamps only. To check the PTO lamps, GO TO A</i></p>	<p>PTO switch OFF.</p> <p>Turn key switch to RUN position.</p>	<div style="text-align: center;">  <p style="font-size: small; margin-top: 5px;">M55028      -UN-13APR95</p> </div> <p><i>LOOK: Battery discharge light (B) must come ON once, then go OFF.</i></p> <p><i>NOTE: If battery voltage is low, lamp may stay ON.</i></p> <p><i>LOOK: Oil pressure lamp (A) must be ON.</i></p>	<p><b>OK:</b> GO TO ' '</p> <p><b>NOT OK:</b> GO TO 1a</p>
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MX,159024005,2 -19-16MAY95

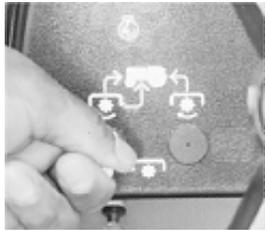
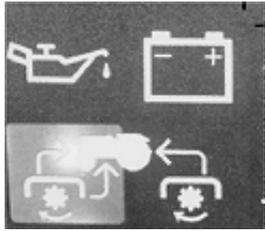
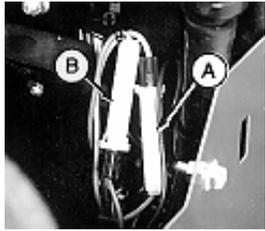
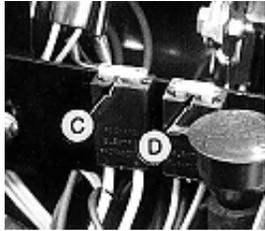
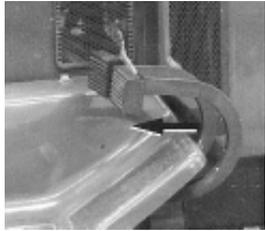
240  
05  
1

*Electrical System Checkout/ignition Circuit (Spark) Check*

<p><b>1a DASH LAMPS DO NOT OPERATE</b></p>	<p>Key switch OFF.</p> <p><i>NOTE:</i>  A—20-Amp Fuse  B—2-Amp Fuse  C—20-Amp Fuse  D—3-Amp Fuse</p>	 <p>M55140 -UN-13APR95</p>  <p>M77926 -UN-12APR95</p> <p>For machines:  316 (S.N. —475000)  318 (S.N. —475000)  420 (S.N. —595880),  disconnect fuse holders and check 20-amp fuse (A) and 2-amp fuse (B).</p> <p>For machines:  316 (S.N. 475001— )  318 (S.N. 475001— )  420 (S.N. 595881— ),  remove and check 20-amp fuse (C) and 3-amp fuse (D).</p>	<p>FUSE OK: GO TO ; , Group 20.</p> <p>FUSES BLOWN: Replace fuse, then repeat ;</p> <p>FUSES BLOW AFTER REPLACING: GO TO ; , Group 20.</p> <p align="right">MX,159024005,3 -19-16MAY95</p>
<p><b>' STARTING CIRCUIT CHECK</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p>	 <p>M55029 -UN-09DEC89</p> <p>Later Models; Depress brake pedal(s).</p> <p>Turn key switch to START position.</p> <p><i>LISTEN: Starter must crank engine. Engine must start and run (use choke as needed).</i></p>	<p><b>OK:</b> GO TO <b>Å</b></p> <p><b>ENGINE CRANKS BUT DOESN'T START:</b> GO TO <b>Æ</b></p> <p><b>ENGINE DOESN'T CRANK:</b> Check fuses, then GO TO ' , Group 20.</p> <p><b>ENGINE STARTS, BUT MISFIRES:</b>  For Machines (S.N. —420000);  GO TO 3j  For Machines (S.N. 420001— );  GO TO 3k</p> <p align="right">MX,159024005,4 -19-17MAY95</p>
<p><b>Æ IGNITION CIRCUIT (SPARK) CHECK</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Later Models; Engage park brake.</p> <p>Remove both engine side panels.</p>	 <p>M37088 -UN-29AUG88</p> <p>Disconnect spark plug wires from spark plugs and connect one to a spark tester. Other plug wire must be grounded to the engine.</p> <p>Crank engine.</p> <p><i>LOOK: Tester must indicate a strong, blue spark.</i></p> <p>Repeat test on other spark plug.</p>	<p><b>SPARK:</b> GO TO Section 220, Group 10 to check spark plug gap.</p> <p><b>NO SPARK:</b> GO TO <b>Æ</b>, Group 20.</p> <p align="right">MX,159024005,5 -19-17MAY95</p>

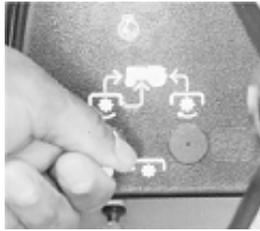
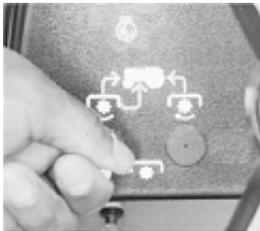
240  
05  
2

*Electrical System Checkout/Brake Neutral Start Check*

<p><b>Å PTO CLUTCH AND LAMP CHECK</b></p>	<p>Sit on seat. PTO switch OFF. Turn key switch to RUN position.</p>	 <p>M55019 -UN-09DEC89</p>  <p>M36492 -UN-29JAN90</p> <p>Move PTO switch to ON position. <i>LISTEN: Clutch must "click" ON.</i> <i>LOOK: PTO lamp must come ON.</i></p>	<p><b>OK: GO TO Ö</b> <b>NOT OK: GO TO 4a</b></p> <p align="right">MX,159024005,6 -19-16MAY95</p>
<p><b>4a PTO DOES NOT OPERATE PROPERLY</b></p>	<p>Key switch OFF. <i>NOTE:</i> A—20-Amp Fuse B—2-Amp Fuse C—20-Amp Fuse D—3-Amp Fuse</p>	 <p>M55140 -UN-13APR95</p>  <p>M77926 -UN-12APR95</p> <p>For machines: 316 (S.N. —475000) 318 (S.N. —475000) 420 (S.N. —595880), disconnect fuse holders to check 20-amp fuse (A) and 2-amp fuse (B).  For machines: 316 (S.N. 475001— ) 318 (S.N. 475001— ) 420 (S.N. 595881— ), remove and check 20-amp fuse (C) and 3-amp fuse (D).</p>	<p><b>FUSES OK: GO TO Å, Group 20.</b> <b>FUSES BLOWN: Replace fuse, then repeat Å</b> <b>FUSES BLOW AFTER REPLACING: GO TO ; , Group 20.</b></p> <p align="right">MX,159024005,7 -19-16MAY95</p>
<p><b>Ö BRAKE NEUTRAL START CHECK— FOR MACHINES: 316 (SN 596121— ) 318 (SN 600305— ) 420 (SN 595881— )</b></p>	<p>PTO switch OFF. Hydrostatic lever in N/STOP position.</p>	 <p>M77933 -UN-17JAN95</p> <p>Brake pedal(s) completely released. Turn key switch to START position. <i>LISTEN: Engine must NOT crank.</i></p>	<p><b>OK: GO TO Ö</b> <b>NOT OK: GO TO Ö, Group 20.</b></p> <p align="right">MX,159024005,8 -19-16MAY95</p>

240  
05  
3

Electrical System Checkout/Seat Switch Check for PTO

<p><b>0 TRANSMISSION NEUTRAL START CHECK</b></p>	 <p>M55018 -UN-09DEC89</p>	<p>PTO switch OFF.</p> <p>Later Models; Depress brake pedal(s).</p> <p>Pull hydrostatic lever away from N/STOP switch slot.</p> <p>Turn key switch to START position.</p> <p><i>LISTEN: Engine must NOT crank.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> GO TO 0, Group 20.</p>
<p><b>0 PTO NEUTRAL START CHECK</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Later Models; Depress brake pedal(s).</p>	 <p>M55019 -UN-09DEC89</p> <p>Move PTO switch to ON position.</p> <p>Turn key switch to START position.</p> <p><i>LISTEN: Engine must NOT crank.</i></p>	<p><b>OK:</b> GO TO U</p> <p><b>NOT OK:</b> GO TO 0, Group 20.</p>
<p><b>U SEAT SWITCH CHECK FOR PTO</b></p>	 <p>M55019 -UN-09DEC89</p>	<p>Sit on seat.</p> <p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Later Models; Depress brake pedal(s).</p> <p>Start engine and operate at half throttle.</p> <p>Move PTO switch to ON position.</p> <p>Raise off seat for 2—3 seconds.</p> <p><i>LOOK/LISTEN: PTO lamp must go OFF. PTO clutch must disengage.</i></p>	<p>Turn PTO switch OFF, then ON to engage PTO.</p> <p>Raise off seat and quickly sit back down before one second elapses.</p> <p><i>LOOK/LISTEN: PTO lamp and PTO clutch must stay ON.</i></p> <p><b>OK:</b> GO TO U</p> <p><b>NOT OK:</b> GO TO U, Group 20.</p>

240  
05  
4

*Electrical System Checkout/Lighting Check*

<p><b>Û SEAT SWITCH CHECK FOR IGNITION</b></p>	 <p>M55018 -UN-09DEC89</p>	<p>PTO switch OFF.</p> <p>Sit on seat.</p> <p>Later Models; Depress brake pedal(s).</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Start engine and operate at low idle.</p> <p>Move hydrostatic lever to SLOW FORWARD position.</p> <p>Raise off seat for 2—3 seconds.</p> <p><i>LISTEN: Engine must stop.</i></p> <p>Restart engine. Drive machine in SLOW FORWARD.</p> <p>Raise off seat and quickly sit back down before one second elapses.</p> <p><i>LISTEN: Engine may falter momentarily, but must stay running.</i></p>	<p><b>OK: GO TO 10</b></p> <p><b>NOT OK: GO TO Û, Group 20.</b></p> <p align="right">MX,159024005,12-19-16MAY95</p>
<p><b>10 HOUR METER CHECK</b></p>	<p>Sit on seat.</p>	 <p>M77927 -UN-17JAN95</p> <p>Turn key switch to RUN position.</p> <p><i>LOOK: Hour meter must operate.</i></p>	<p><b>OK: GO TO 1!</b></p> <p><b>NOT OK: GO TO 10, Group 20.</b></p> <p align="right">MX,159024005,13-19-16MAY95</p>
<p><b>1! LIGHTING CHECK</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M55080 -UN-09DEC89</p> <p>Pull light switch to ON position.</p> <p><i>LOOK: All lights must be ON.</i></p>	<p><b>OK: GO TO 1@</b></p> <p><b>NOT OK: GO TO 1!, Group 20.</b></p> <p align="right">MX,159024005,14-19-16MAY95</p>

240  
05  
5

*Electrical System Checkout/Operator Complaint Not Identified*

<p><b>1@ OPERATOR COMPLAINT NOT IDENTIFIED</b></p>	<p>If you completed the checkout procedure and did not isolate a malfunction, the problem may be intermittent.</p> <p>Try to duplicate the conditions of the malfunction identified by the operator.</p> <p>Verify system grounds and battery condition. (See steps A and B in Group 20.)</p>	<p>PERFORM BATTERY TESTS AND GROUND TESTS AS INSTRUCTED IN GROUP 20 AND REPEAT THE CHECKOUT PROCEDURE IN THIS GROUP.</p> <p>IF A MALFUNCTION IS NOT IDENTIFIED AFTER REPEATING SYSTEM CHECKOUT PROCEDURE, FACTORY ASSISTANCE IS AVAILABLE THROUGH THE DEALER TECHNICAL ASSISTANCE CENTER (DTAC).</p> <p>MX,159024005,15-19-16MAY95</p>
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240  
05  
6

240  
10  
1

### 316, 318 AND 420 ELECTRICAL SCHEMATIC—SINGLE PTO

A1—TDC Module	M2—Starter Motor:	X5—Rear PTO Harness 3-Pin Connector	X17—Headlight Harness Connector
A2—Ignition Module (S.N. 420001— )	316 (S.N. —362983)	X6—Rear PTO Switch 2-Pin Connector	1-Pin (S.N. —475000)
B1—Engine Oil Pressure Switch	318 (S.N. —364137)	X7—Rear PTO Switch 3-Pin Connector	X18—Tail Light Harness Connector
C1—Condenser (S.N. 420001— )	420 (S.N. —360009)	X8—Brake Switch 2-Pin Connector:	1-Pin (S.N. —475000)
E1—Spark Plug	N1—Voltage Regulator/Rectifier	316 (S.N. 596121— )	2-Pin (S.N. 475001— )
E2—Spark Plug	P1—Front PTO Indicator	318 (S.N. 600305— )	X19—Engine Oil Pressure Switch 1-Pin Connector
E3—Ignition (Breaker) Points (S.N. —420000)	P3—Hour Meter	420 (S.N. 595881— )	X20—Hour Meter 1-Pin Connector
E4—Left Headlight	P4—Battery Discharge Indicator	X9—Transmission Neutral Switch 1-Pin Connector	X21—Hour Meter 1-Pin Connector (Ground)
E5—Middle Headlight	P5—Engine Oil Pressure Indicator	X10—Transmission Neutral Switch 1-Pin Connector	X22—TDC Module 2-Pin Connector
E6—Right Headlight	S1—Key Switch	X11—Seat Switch 2-Pin Connector	X23—TDC Module 8-Pin Connector
E7—Left Tail Light	S2—Front PTO Switch	X12—Engine Harness 3-Pin Connector	X24—Rear PTO Clutch 1-Pin Connector (Ground)
E8—Right Tail Light	S4—Brake Switch:	X13—Voltage Regulator/Rectifier 1-Pin Connector (VDC Output)	X25—Rear PTO Lamp 1-Pin Connector (Ground)
F1—20-Amp Fuse	316 (S.N. 596121— )	X14—Voltage Regulator/Rectifier 1-Pin Connector (Stator)	X26—Front PTO Clutch 2-Pin Connector
F2—2-Amp Fuse:	318 (S.N. 600305— )	X15—Voltage Regulator/Rectifier 1-Pin Connector (Stator)	X27—Single Point Ground 1-Pin Connector:
316 (S.N. —475000)	420 (S.N. 595881— )		316 (S.N. 596121— )
318 (S.N. —475000)	S5—Transmission Neutral Switch		318 (S.N. 600305— )
420 (S.N. —595880)	S6—Seat Switch		420 (S.N. 595881— )
3-Amp Fuse:	S7—Headlight Switch		Y1—Front PTO Clutch
316 (S.N. 475001— )	T1—Ignition Coil		
318 (S.N. 475001— )	W1—Engine Ground (S.N. 475001— )		
420 (S.N. 595881— )	X1—Key Switch 5-Pin Connector		
F3—25-Amp Circuit Breaker	X2—Key Switch 1-Pin Connector		
G1—Battery	X3—Front PTO Switch 2-Pin Connector		
G2—Stator Alternator	X4—Front PTO Switch 3-Pin Connector		
K1—Starter Solenoid:			
316 (S.N. —362983)			
318 (S.N. —364137)			
420 (S.N. —360009)			
M1—Starter Motor:			
316 (S.N. 362984— )			
318 (S.N. 364138— )			
420 (S.N. 360010— )			

Legend For Electrical Schematic

**NOTE:**

Wire colors are the same for all machines. Wire numbers indicated on schematic are for machines (S.N. 475001— ).

1. For 316 (S.N. —596120), 318 (S.N. —600304) and 420 (S.N. —595880) machines, brake switch (S4) is not used. Purple wire “710” connects transmission neutral switch directly to terminal “S2” of key switch.

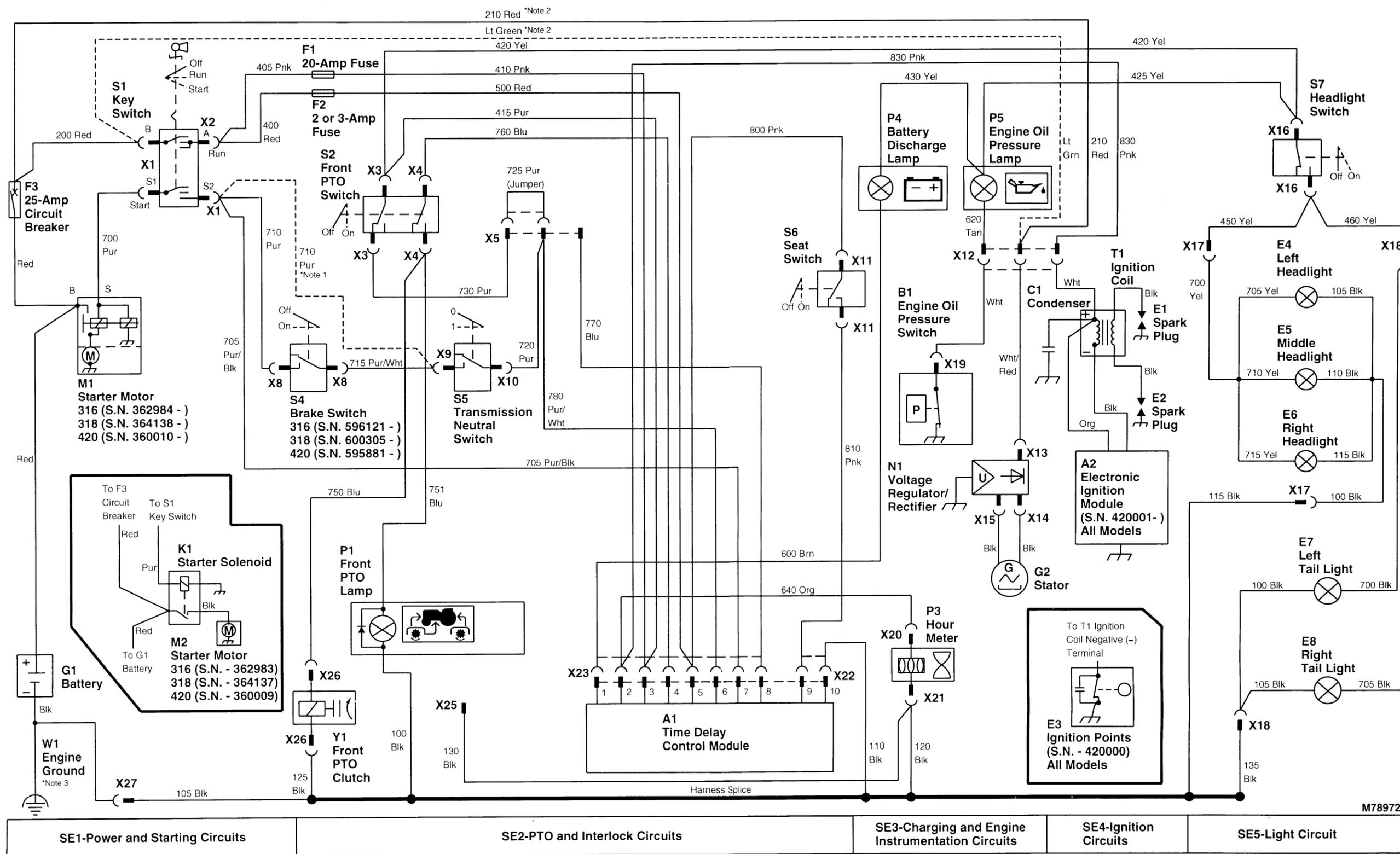
2. For machines (S.N. —475000), a light green wire is used instead of the red “210” wire used on later machines. The green wire connects to terminal “B” of key switch (S1), not to circuit breaker (F3) as does the red “210” wire.

**NOTE:**

3. The electrical schematic shows ground circuits for machines (S.N. 475001— ). For these machines, all component grounds terminate (spliced) inside the main harness with one wire connecting to a single ground point at the engine.

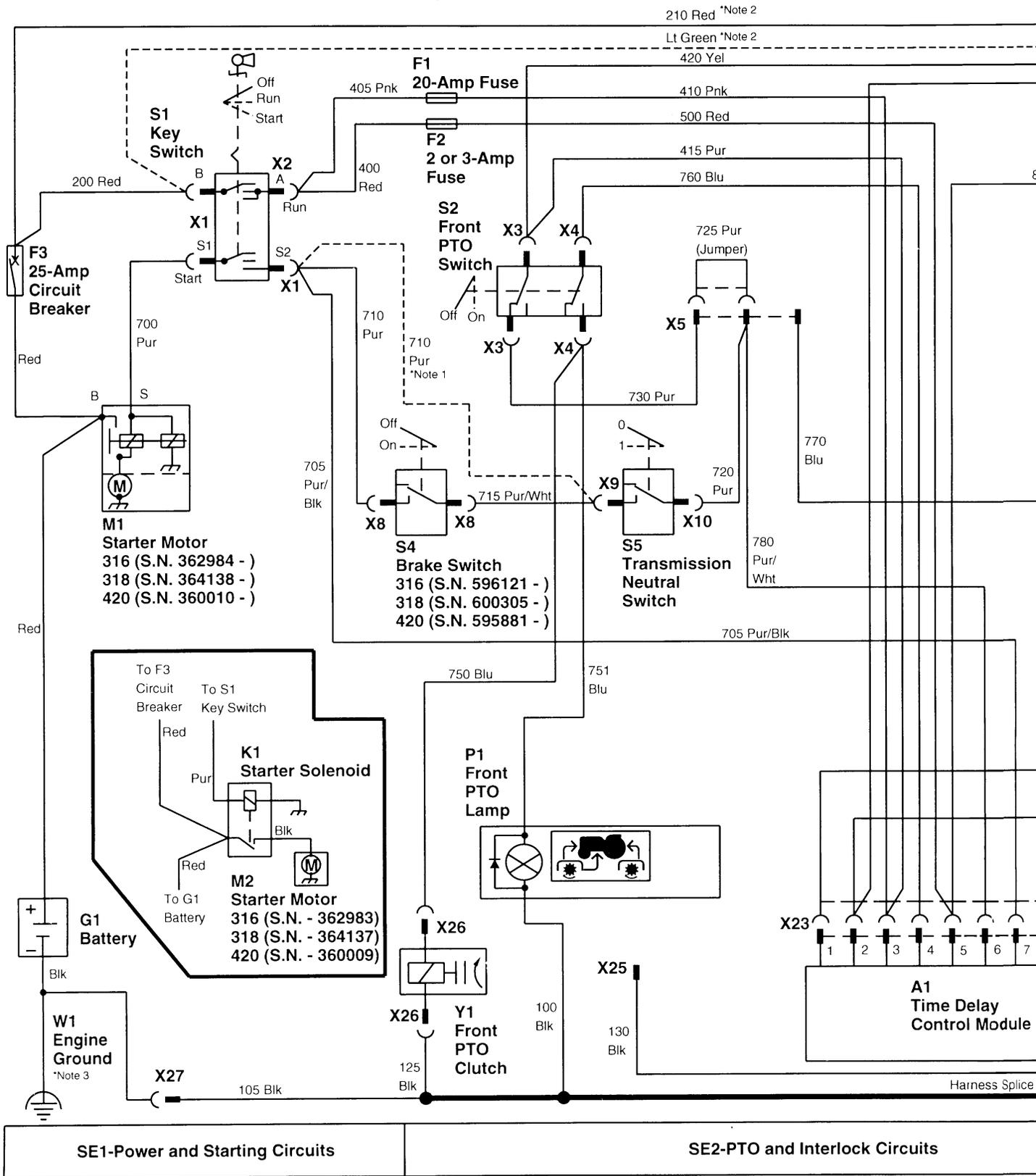
For machines (S.N. —475000), the (blk) ground wires for the PTO lamps, hour meter, and TDC module (2-pin connector) terminate at the right pedestal panel. Exterior components, such as the PTO clutches and head and tail lights use the tractor frame for ground.

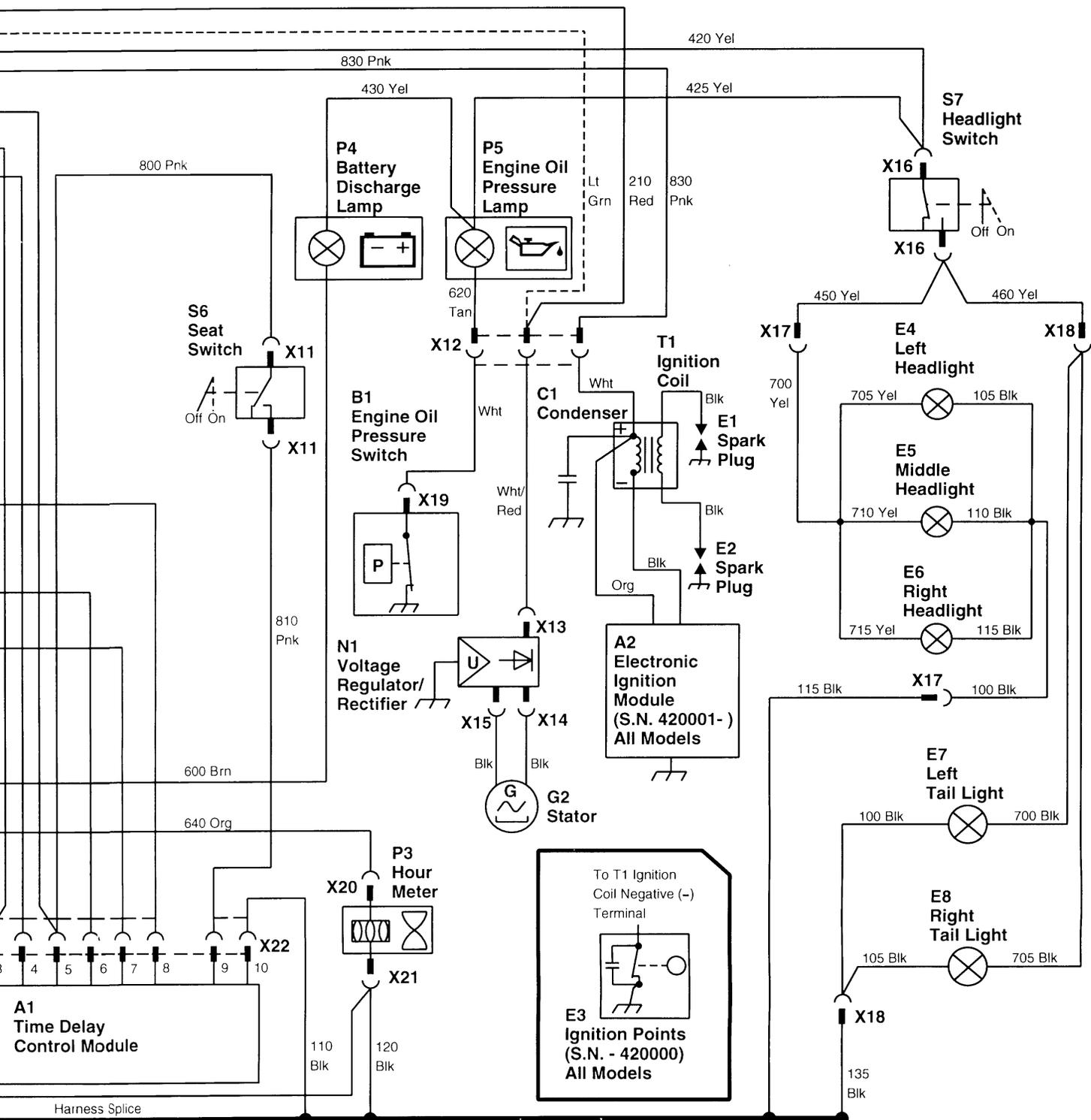
316, 318, AND 420 ELECTRICAL SCHEMATIC — SINGLE PTO



M78972

316, 318, AND 420 ELECTRICAL SCHEMATIC — SINGLE PTO

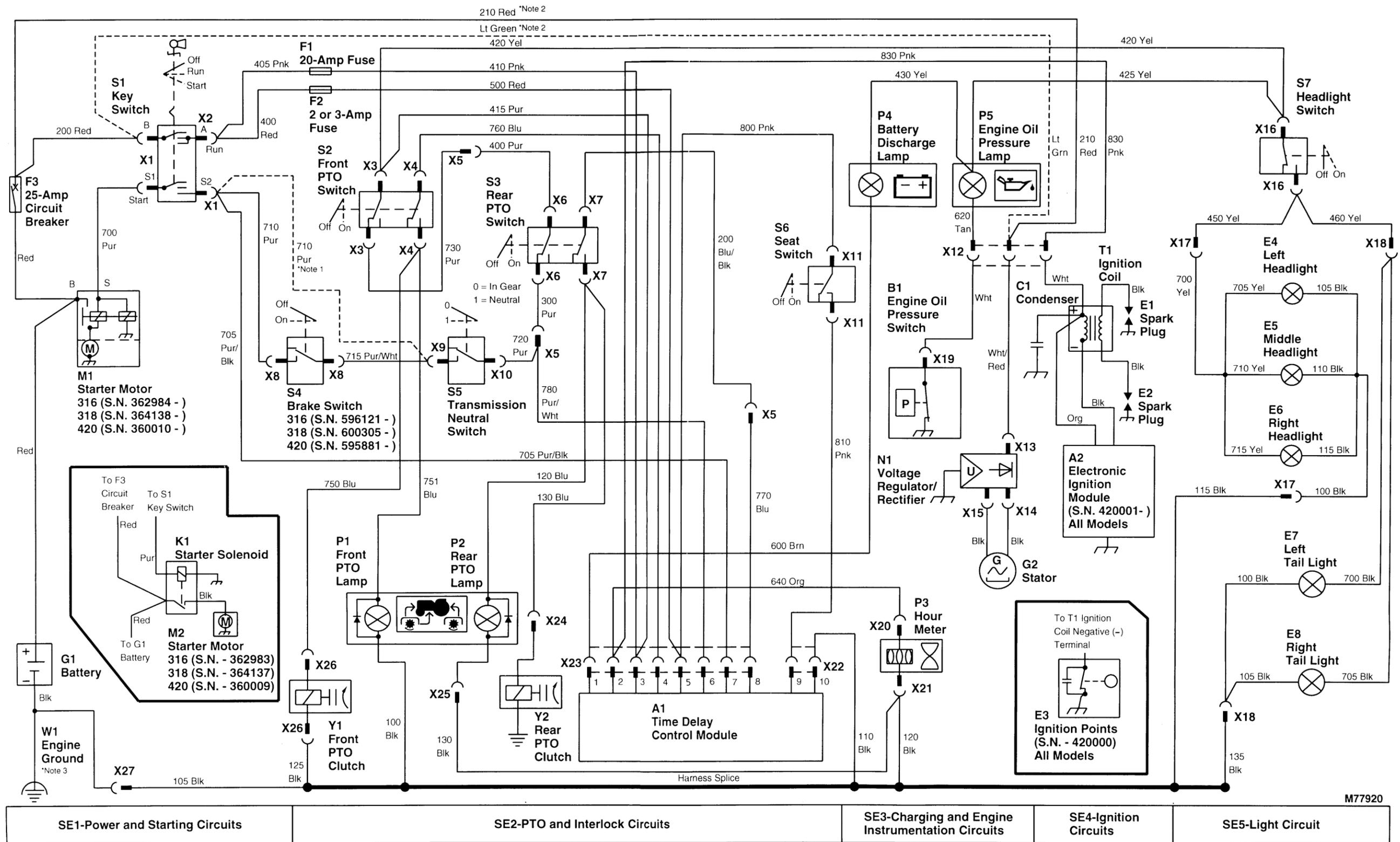




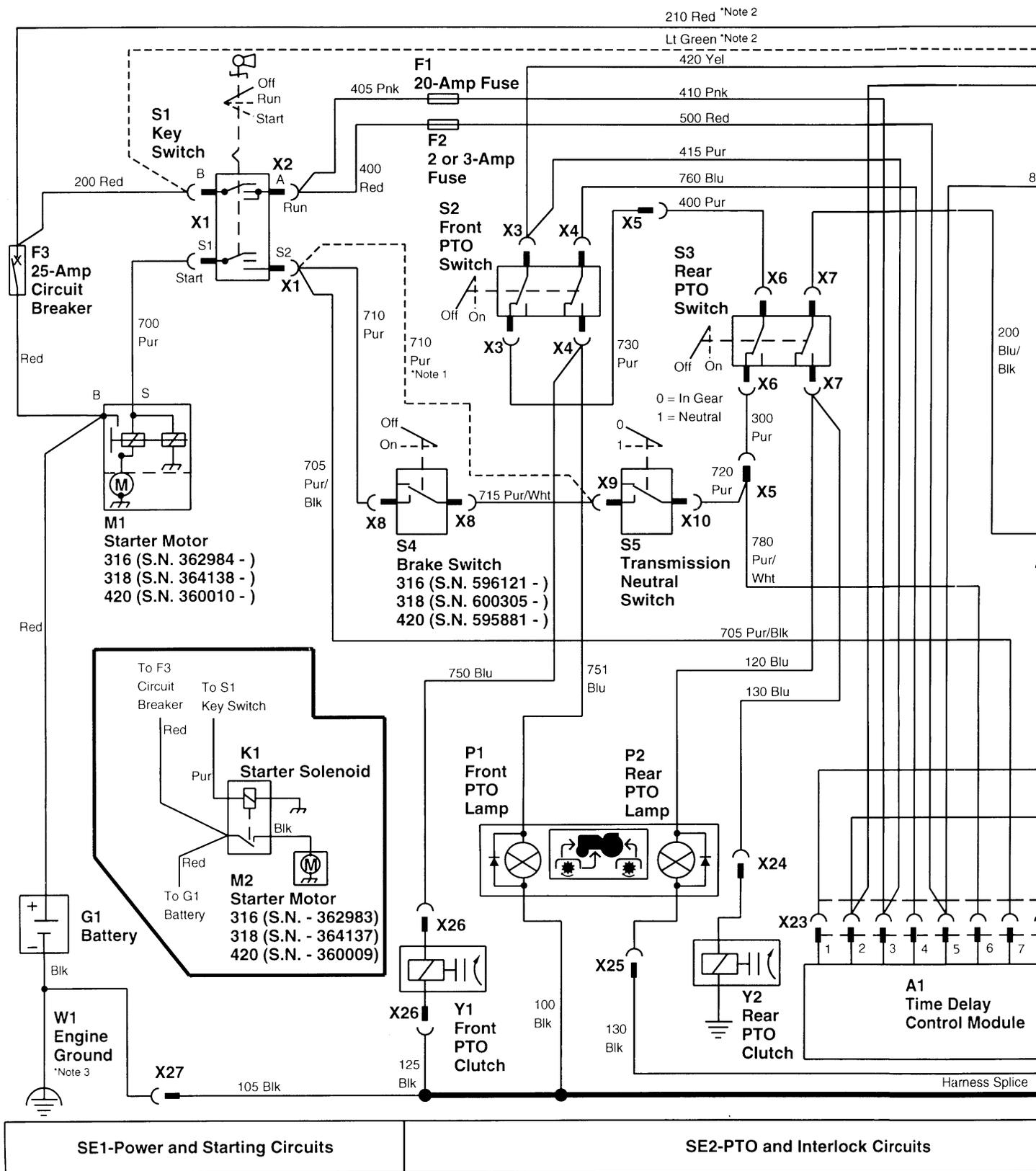
M78972

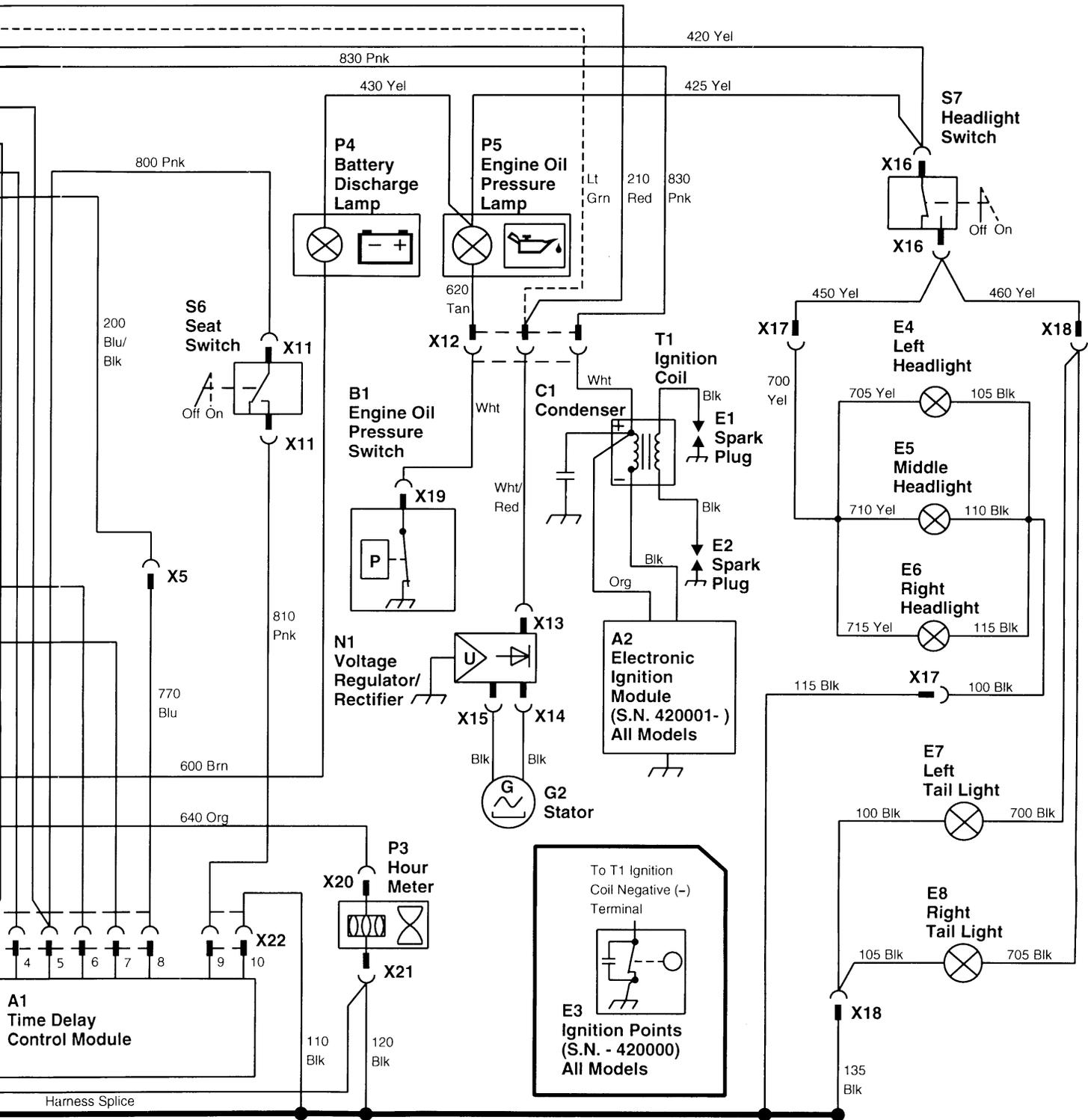
Circuits	SE3-Charging and Engine Instrumentation Circuits	SE4-Ignition Circuits	SE5-Light Circuit
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316, 318, AND 420 ELECTRICAL SCHEMATIC — DUAL PTO



# 316, 318, AND 420 ELECTRICAL SCHEMATIC — DUAL PTO





M77920

Circuits	SE3-Charging and Engine Instrumentation Circuits	SE4-Ignition Circuits	SE5-Light Circuit
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### 316, 318 AND 420 ELECTRICAL SCHEMATIC—DUAL PTO

A1—TDC Module	M2—Starter Motor:	X4—Front PTO Switch 3-Pin Connector	X17—Headlight Harness Connector
A2—Ignition Module (S.N. 420001— )	316 (S.N. —362983)	X5—Rear PTO Harness 3-Pin Connector	1-Pin (S.N. —475000)
B1—Engine Oil Pressure Switch	318 (S.N. —364137)	X6—Rear PTO Switch 2-Pin Connector	X18—Tail Light Harness Connector
C1—Condenser (S.N. 420001— )	420 (S.N. —360009)	X7—Rear PTO Switch 3-Pin Connector	1-Pin (S.N. —475000)
E1—Spark Plug	N1—Voltage Regulator/Rectifier	X8—Brake Switch 2-Pin Connector:	2-Pin (S.N. 475001— )
E2—Spark Plug	P1—Front PTO Indicator	316 (S.N. 596121— )	X19—Engine Oil Pressure Switch 1-Pin Connector
E3—Ignition (Breaker) Points (S.N. —420000)	P2—Rear PTO Indicator (Optional)	318 (S.N. 600305— )	X20—Hour Meter 1-Pin Connector
E4—Left Headlight	P3—Hour Meter	420 (S.N. 595881— )	X21—Hour Meter 1-Pin Connector (Ground)
E5—Middle Headlight	P4—Battery Discharge Indicator	X9—Transmission Neutral Switch 1-Pin Connector	X22—TDC Module 2-Pin Connector
E6—Right Headlight	P5—Engine Oil Pressure Indicator	X10—Transmission Neutral Switch 1-Pin Connector	X23—TDC Module 8-Pin Connector
E7—Left Tail Light	S1—Key Switch	X11—Seat Switch 2-Pin Connector	X24—Rear PTO Clutch 1-Pin Connector (Ground)
E8—Right Tail Light	S2—Front PTO Switch	X12—Engine Harness 3-Pin Connector	X25—Rear PTO Lamp 1-Pin Connector (Ground)
F1—20-Amp Fuse	S3—Rear PTO Switch (Optional)	X13—Voltage Regulator/Rectifier 1-Pin Connector (VDC Output)	X26—Front PTO Clutch 2-Pin Connector
F2—2-Amp Fuse:	S4—Brake Switch:	X14—Voltage Regulator/Rectifier 1-Pin Connector (Stator)	X27—Single Point Ground 1-Pin Connector:
316 (S.N. —475000)	316 (S.N. 596121— )	X15—Voltage Regulator/Rectifier 1-Pin Connector (Stator)	316 (S.N. 596121— )
318 (S.N. —475000)	318 (S.N. 600305— )	X16—Headlight Switch 2-Pin Connector	318 (S.N. 600305— )
420 (S.N. —595880)	420 (S.N. 595881— )		420 (S.N. 595881— )
3-Amp Fuse:	S5—Transmission Neutral Switch		Y1—Front PTO Clutch
316 (S.N. 475001— )	S6—Seat Switch		Y2—Rear PTO Clutch (Optional)
318 (S.N. 475001— )	S7—Headlight Switch		
420 (S.N. 595881— )	T1—Ignition Coil		
F3—25-Amp Circuit Breaker	W1—Engine Ground (S.N. 475001— )		
G1—Battery	X1—Key Switch 5-Pin Connector		
G2—Stator Alternator	X2—Key Switch 1-Pin Connector		
K1—Starter Solenoid:	X3—Front PTO Switch 2-Pin Connector		
316 (S.N. —362983)			
318 (S.N. —364137)			
420 (S.N. —360009)			
M1—Starter Motor:			
316 (S.N. 362984— )			
318 (S.N. 364138— )			
420 (S.N. 360010— )			

Legend For Electrical Schematic

NOTE:

Wire colors are the same for all machines. Wire numbers indicated on schematic are for machines (S.N. 475001— ).

1. For 316 (S.N. —596120), 318 (S.N. —600304) and 420 (S.N. —595880) machines, brake switch (S4) is not used. Purple wire "710" connects transmission neutral switch directly to terminal "S2" of key switch.

2. For machines (S.N. —475000), a light green wire is used instead of the red "210" wire used on later machines. The green wire connects to terminal "B" of key switch (S1), not to circuit breaker (F3) as does the red "210" wire.

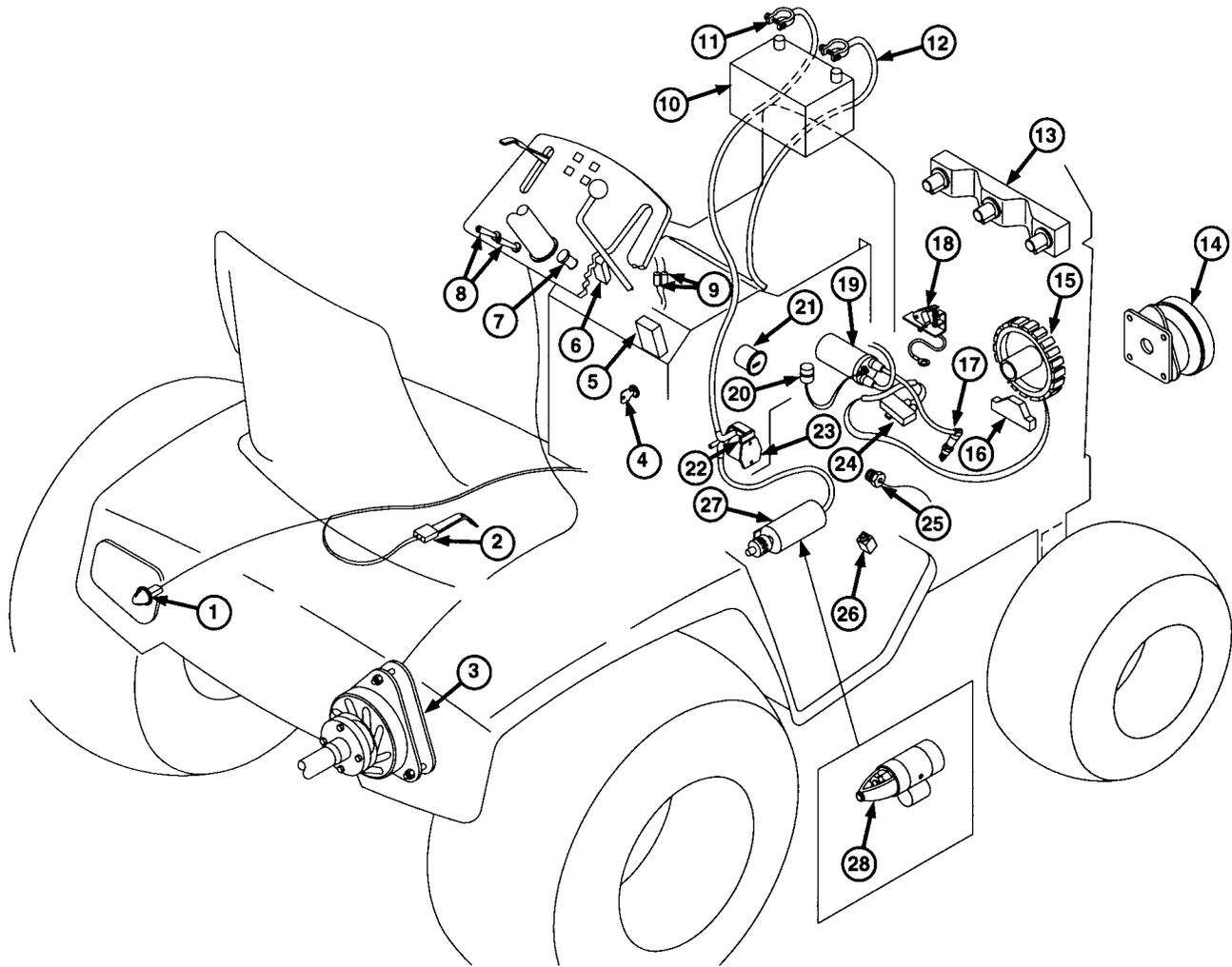
NOTE:

3. The electrical schematic shows ground circuits for machines (S.N. 475001— ). For these machines, all component grounds terminate (spliced) inside the main harness with one wire connecting to a single ground point at the engine.

For machines (S.N. —475000), the (blk) ground wires for the PTO lamps, hour meter, and TDC module (2-pin connector) terminate at the right pedestal panel. Exterior components, such as the PTO clutches and head and tail lights use the tractor frame for ground.

240  
10  
6

## ELECTRICAL COMPONENT LOCATION



- 1—Tail Light (2 used)
- 2—Seat Switch
- 3—Rear Electric PTO Clutch (Optional)
- 4—Key Switch
- 5—TDC Module
- 6—Transmission Neutral Start Switch
- 7—Light Switch
- 8—PTO Switches
- 9—2-Amp and 20-Amp Fuse: (See Note)  
316 (S.N. —475000)  
318 (S.N. —475000)  
420 (S.N. —595880)

- 10—Battery
- 11—Positive (+) Battery Cable
- 12—Negative (—) Battery Cable
- 13—Headlights
- 14—Front Electric PTO Clutch
- 15—Stator Alternator
- 16—Ignition Module (S.N. 420001— )
- 17—Spark Plug (2 used)
- 18—Ignition (Breaker) Points (S.N. —420000)

- 19—Ignition Coil
- 20—Condenser
- 21—Hour Meter
- 22—Circuit Breaker
- 23—Starter Solenoid:  
316 (S.N. —362983)  
318 (S.N. —364137)  
420 (S.N. —360009)
- 24—Regulator/Rectifier
- 25—Engine Oil Pressure Switch
- 26—Brake Switch:  
316 (S.N. 596121— )  
318 (S.N. 600305— )  
420 (S.N. 595881— )

- 27—Starter Motor:  
316 (S.N. —362983)  
318 (S.N. —364137)  
420 (S.N. —360009)
- 28—Starter Motor:  
316 (S.N. 362984— )  
318 (S.N. 364138— )  
420 (S.N. 360010— )

NOTE: For machines 316, 318 (S.N. 475001— ) and 420 (S.N. 595881— ), 3-amp and 20-amp blade type fuses replace the 2-amp

and 20-amp tubular type fuses shown. The blade type fuses are located in the same area as early version.

M31718 -JUN-19/JAN95

240  
15  
1

## STARTING CIRCUIT OPERATION

The function of the starting circuit is to crank the engine by energizing starter motor (M1). PTO switches (S2 and S3), transmission neutral switch (S5), and brake switch (S4) are used as interlock safety switches within the starter circuit. For the starter motor to energize, the following conditions must be met:

- Front and rear PTO switches in OFF position.
- Hydrostatic Control Lever in N/STOP position.
- Brake pedal depressed.
- Key Switch in "START" position.

*NOTE: Depressing the brake pedal required only on later models:*

316 (S.N. 596121— )  
 318 (S.N. 600305— )  
 420 (S.N. 595881— )

*For all other machines, depressing the brake pedal is not necessary for starter operation.*

PTO switches (S2 and S3) are used in the starting circuit to prevent the engine from cranking while the PTO is engaged. Each PTO switch contains two sets of contacts; one for the PTO circuit (lower contact) and the other (upper contact) as a safety interlock for the starting circuit. When the PTO switch is in the ON position (PTO engaged), the PTO switch interlock contacts are open. When the PTO switch is in the OFF position (PTO disengaged), the PTO interlock contacts are closed, allowing current to flow to transmission neutral switch (S5).

The transmission neutral switch is used in the starting circuit to prevent the engine from cranking when the transmission is in gear. When the hydrostatic control lever is in the forward or reverse position, the transmission neutral switch contacts are open. Moving the hydrostatic control lever to the N/STOP position closes the contacts, allowing current to flow to brake switch (S4).

*NOTE: Brake switch equipped on machines: 316 (S.N. 596121— ), 318 (S.N. 600305— ), and 420 (S.N. 595881— ) only. For all other machines, current flows from the transmission switch, directly to terminal "S2" on key switch (S1).*

The brake switch will prevent the engine from cranking unless the brake pedal is depressed or park

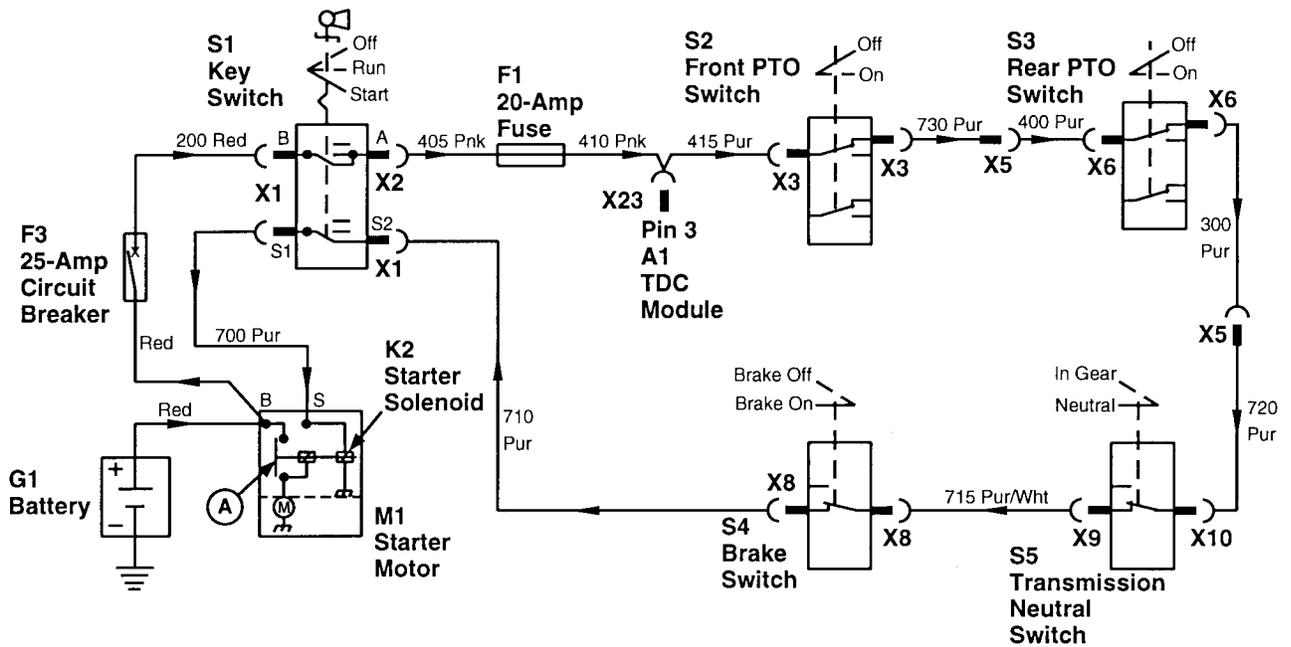
brake is engaged. Depressing the brake pedal closes the brake switch contacts, allowing current to flow to terminal "S2" on key switch (S1).

The key switch initiates current flow through the starting circuit with the use of two sets of contacts. Both contacts are open when the switch is in the OFF position. When the key switch is turned to the START position, both contacts close. If all the interlock switch contacts in the start circuit are closed, current from the battery positive terminal flows through the 25 amp circuit breaker (F3) to terminal "B" on the key switch. Current flows across the closed contacts, out terminal "A" to the 20 amp fuse (F1). From fuse (F1), current flows through the PTO, transmission, and brake (if equipped) switches and flows back to terminal "S2" of the key switch. The current flows across the key switch contacts, then out terminal "S1" to starter solenoid (K2), energizing the solenoid.

*NOTE: For machines 316 (S.N. —362983), 318 (S.N. —364137) and 420 (S.N. —360009), a Bendix drive starter motor is used. These starter motors use a remote mounted starter solenoid relay.*

Starter solenoid (K2) contains two coil windings called the pull-in and hold-in windings. Current flowing through these coils produce a strong magnetic field which pulls a plunger inward and closes solenoid main contacts (A). Because the starter is a shift type (solenoid mounted on starter), the plunger also moves the starter drive gear outward to mesh with the flywheel ring gear.

When the solenoid contacts close, high current from the battery flows across the solenoid contacts to starter motor (M1), causing it to turn. Because the pull-in windings are grounded through the starter, current will flow through the pull-in windings only as long as the solenoid main contacts are open. When the solenoid contacts close, both ends of the pull-in windings have the same voltage. This causes the current to stop flowing through the pull-in windings. Because the hold-in windings are grounded directly to the chassis, current continues to flow through the hold-in windings. This keeps the solenoid energized (main contacts closed; starter drive engaged) until the key switch is turned to the RUN or OFF position.



- |                                 |   |                                     |   |
|---------------------------------|---|-------------------------------------|---|
| A—Starter Solenoid Main Contact | S4—Brake Switch:<br>316 (S.N. 596121— ) | X3—Front PTO Switch 2-Pin Connector | X9—Transmission Neutral Switch 1-Pin Connector  |
| F1—20 Amp Fuse                  | 318 (S.N. 600305— )                     | X5—Rear PTO Harness 3-Pin Connector | X10—Transmission Neutral Switch 1-Pin Connector |
| F3—25 Amp Circuit Breaker       | 420 (S.N. 595881— )                     | X6—Rear PTO Switch 2-Pin Connector  | X23—TDC Module 8-Pin Connector                  |
| G1—Battery                      | S5—Transmission Neutral Switch          | X8—Brake Switch 2-Pin Connector:    |   |
| K2—Starter Solenoid             | X1—Key Switch 5-Pin Connector           | 316 (S.N. 596121— )                 |   |
| M1—Starter Motor                | X2—Key Switch 1-Pin Connector           | 318 (S.N. 600305— )                 |   |
| S1—Key Switch                   |   | 420 (S.N. 595881— )                 |   |
| S2—Front PTO Switch             |   |                                     |   |
| S3—Rear PTO Switch (Optional)   |   |                                     |   |

Starting Circuit Operation

MX,159024020,2 -19-16MAY95

MT7921 -19-04MAR95

## IGNITION CIRCUIT OPERATION

The function of the ignition circuit is to produce spark across the gap of spark plugs (E1 and E2). The circuit is a battery ignition type that fires both spark plugs simultaneously, thus eliminating the need for a distributor. The ignition circuit automatically stops the engine anytime the operator rises off the seat for more than one second when tractor is in gear or if PTO is engaged.

### OPERATOR ON SEAT—MACHINE IN GEAR AND/OR PTO ENGAGED:

When the key switch (S1) is turned to the RUN or START position, current flows from the positive terminal of battery (G1), through circuit breaker (F3), across key switch contacts at terminals "B" and "A", to fuses (F1 and F2). From fuse (F2), current flows across the contacts of seat switch (S6), through time delay IC (E), to switch transistor (D) located inside the TDC module. As long as current from the IC flows to the transistor, the transistor is "switched on". In this state, the transistor completes the path to ground for TDC ignition relay coil (B). The ground path allows current to flow from fuse (F1), through the relay coil to ground. This energizes the relay coil which closes relay contacts (A).

Current from fuse (F1) then flows across ignition relay contacts (A), out the TDC module to ignition coil (T1). The current flows through the coil primary windings, then through ignition module (A2) to ground.

Current flowing through the primary windings produces a magnetic field around the primary and secondary windings.

*NOTE: For machines (S.N. —420000), ignition points (E3) are used. The ignition points are actuated by a pushrod that rides on a camshaft lobe.*

The ignition module receives a signal from a trigger ring containing permanent magnets (the ring rotates with the engine crankshaft). This signal causes the ignition module to "break" the circuit, momentarily stopping current flow through the primary windings, and cause the magnetic field to collapse across the secondary windings. The collapsing magnetic field induces high voltage in the secondary windings of the ignition coil. The induced voltage flows from one end of the secondary windings, through the two spark plugs (jumping the plug gaps), then back to the opposite end of the secondary windings. The engine

block completes the circuit between the two spark plugs.

When the operator rises from the seat, the seat switch contacts open, causing current to stop flowing to the time delay IC. If the operator does not return to the seat within approximately one second, the time delay IC stops current flow to transistor (D). The transistor will "switch off", causing current through relay coil (B) to stop flowing and de-energize the coil. With the coil no longer energized, relay contacts (A) will open. Current stops flowing to the ignition coil, thus stopping the engine.

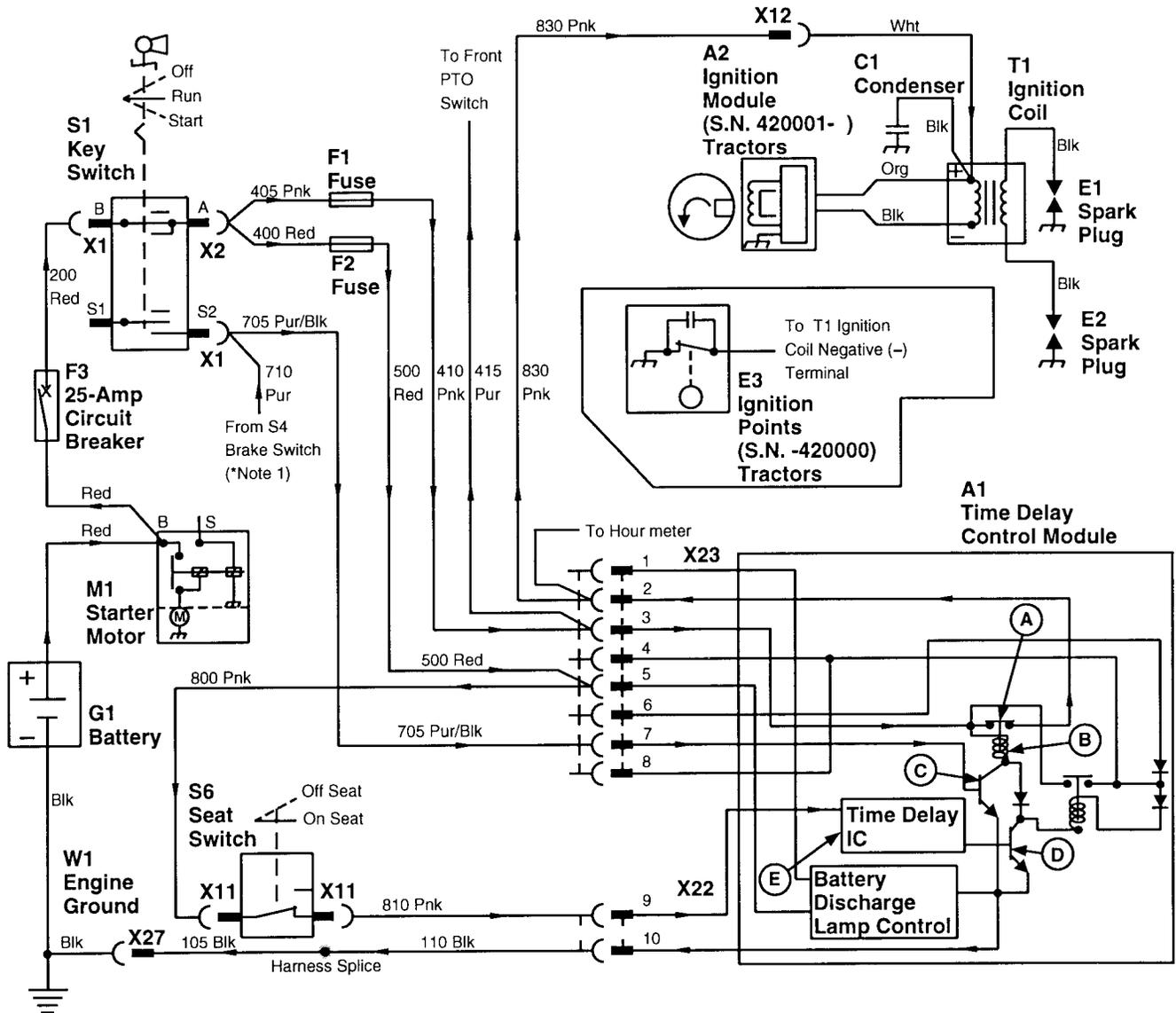
*NOTE: Driving the machine over rough terrain can cause the seat switch contacts to momentarily open and close. When this happens, the time delay IC allows the engine to operate without interruption.*

If the operator returns to the seat within approximately one second, current flow is re-established to the time delay IC before it has a chance to "time out" and stop current flow to the transistor. Current flow is NOT interrupted to the ignition coil and the engine is allowed to continue operating.

### OPERATOR OFF SEAT—MACHINE IN NEUTRAL AND PTO DISENGAGED:

When operator is off the seat, current to the ignition coil can still be maintained through the neutral start (interlock) circuit. For current to flow through the interlock circuit, the key switch must be turned to the RUN or START position, the hydrostatic control lever in the STOP position, the PTO switch(es) in the OFF position (PTO disengaged), and park brake engaged (later models only).

With these conditions met, current flows from terminal "A" of the key switch to fuse (F1). From fuse (F1), current flows through the interlock contacts of the PTO switch(es), transmission neutral switch, and brake switch to terminal "S1" on the key switch. From terminal "S1", current flows to transistor (C) located in the TDC module. As long as current from the interlock circuit flows to transistor (C), the transistor is "switched on". In this state, the transistor provides an alternate path to ground for relay coil (B). The energized relay closes the relay contacts, allowing current to flow to the ignition coil.



- |                                    |  |
|------------------------------------|--|
| A—TDC Ignition Relay Contacts      | C1—Condenser (S.N. 420001— )                               |
| B—TDC Ignition Relay Coil          | E1—Spark Plug  |
| C—Switch Transistor                | E2—Spark Plug  |
| D—Time Delay Switch Transistor     | E3—Ignition Points (S.N. —420000)                          |
| E—Time Delay IC (Internal Circuit) | F1—20 Amp Fuse   |
| A1—Time Delay Control (TDC) Module | F2—2 Amp Fuse (Early Machines) 3 Amp Fuse (Later Machines) |
| A2—Ignition Module (S.N. 420001— ) | F3—25 Amp Circuit Breaker                                  |

- |                                 |  |
|---------------------------------|--|
| G1—Battery                      | X12—Engine Harness 3-Pin Connector       |
| M1—Starter Motor                | X22—TDC Module 2-Pin Connector           |
| S1—Key Switch                   | X23—TDC Module 8-Pin Connector           |
| S6—Seat Switch                  | X27—Single Point Ground 1-Pin Connector: |
| T1—Ignition Coil                | 316 (S.N. 596121— )                      |
| W1—Engine Ground                | 318 (S.N. 600305— )                      |
| X1—Key Switch 5-Pin Connector   | 420 (S.N. 595881— )                      |
| X2—Key Switch 1-Pin Connector   |  |
| X11—Seat Switch 2-Pin Connector |  |

NOTE: 1. For machines 316 (S.N. —596120), 318 (S.N. —600304) and 420 (S.N. —595880), brake switch (S4) is not used. Interlock current flow to transistor (C) comes from transmission neutral start switch (S5).

NOTE: 2. The illustration shows ground circuit for machines (S.N. 475001— ). For machines (S.N. —475000), the blk wire from the TDC module 2-pin connector terminates (grounds) at the right pedestal panel.

MX.159024020,4 -19-16MAY95

## PTO CIRCUIT OPERATION

The function of the PTO circuit is to energize the PTO clutch(es) and turn on the PTO lamp(s). Also, the PTO circuit automatically disengages the PTO clutch(es) anytime the operator rises off the seat for more than one second.

To engage the PTO clutch(es), the following conditions must be met:

- Operator on seat.
- Key Switch at RUN position.
- PTO switches initially at OFF position, then moved to ON position.

When the operator is on the seat and key switch (S1) is turned to the RUN or START position, current flows from the positive terminal of battery (G1), through circuit breaker (F3), to key switch terminal "B". The current flows across the switch contacts to key switch terminal "A". From terminal "A", current flows to fuses (F1 and F2). From fuse (F2), current flows across the closed contacts of seat switch (S6) to pin "9" of TDC module connector (X22).

Inside the TDC module, current flows to time delay IC (A), then to switch transistor (B). As long as current from the IC flows to the transistor, the transistor is "switched on". In this state, the transistor completes the path to ground for PTO relay coil (G).

*NOTE: Front PTO switch (S2) and optional rear PTO switch (S3) have two sets of contacts each. One set is used to actuate the clutches and the other set is used in the interlock circuit (see Starting Circuit Theory of Operation in this group).*

*If machine is not equipped with rear PTO, a jumper wire at 3-pin connector (X5) is used in place of the rear PTO switch.*

With the PTO switch(es) in the OFF position, current will flow from fuse (F1) to connector (X3) on the front PTO switch. Current flows across the switch contacts, then to 3-pin connector (X5). If equipped with optional rear PTO, current will flow from connector (X5) to connector (X6) on the rear PTO switch. Current flows across the switch contacts and back out to connector (X5). From connector (X5), current flows to the TDC module, through pin "6" of connector (X23). Inside the TDC module, current flows through diodes (E and F), then through the PTO relay coil and transistor (B) to ground. The interlock circuit current energizes the

PTO relay coil, which closes relay contacts (D). Once the contacts are closed, current flows directly from fuse (F1), across the relay contacts to the relay coil. This current keeps the relay energized (latched) as long as transistor (B) provides a path to ground. Once the coil is latched, current from the interlock circuit is no longer needed to keep the relay energized.

When the front PTO switch is moved to the ON position, current flowing across the relay contacts will also flow to connector (X4) on the front PTO switch, through pin "4" of connector (X23). Current flows across the switch contacts to front PTO clutch (Y1), engaging the clutch. Current also flows to front PTO lamp (P1), turning the lamp on.

*NOTE: Operation of optional rear PTO is same as front PTO, except power for rear PTO comes from TDC module through pin "8" of connector (X23).*

When the operator rises from the seat, the seat switch contacts open, causing current to stop flowing to the time delay IC. If the operator does not return to the seat within approximately one second, the time delay IC stops current flow to transistor (B). The transistor will "switch off", causing current through the PTO relay coil to stop flowing and de-energize the coil. At this point the PTO relay contacts will open, stopping current flow to the PTO clutch(es) and lamp(s), thus disengaging the PTO clutch(es) and turning the lamp(s) off.

*NOTE: Driving the machine over rough terrain can cause the seat switch contacts to momentarily open and close. If this happens, the time delay IC allows the PTO(s) to operate without interruption.*

If the operator returns to the seat within approximately one second, current flow is re-established to the time delay IC before it has a chance to "time out" and stop current flow to the transistor. Current flow is NOT interrupted, allowing the PTO(s) to continue operating.

*NOTE: Illustration shows component ground for machines (S.N. 475001— ). For machines (S.N. —475000), the component ground point is located at right side of pedestal panel.*



## CHARGING CIRCUIT OPERATION

The function of the charging circuit is to keep the battery properly charged by supplying approximately 13.6—14.7 VDC to the battery while the engine is operating.

The charging system is a permanent magnet and stator type. The magnets are located in the flywheel, which rotates around the stationary stator (G2) windings. Current output is controlled by voltage regulator/rectifier (N1), mounted separately from the stator. Battery discharge lamp (P4) warns the operator when battery discharge lamp control (A) senses low battery voltage. The battery discharge lamp and lamp control DO NOT monitor current output from the stator.

As the flywheel turns, the permanent magnets induce alternating current (AC) in the stator windings. The alternating current flows to the voltage regulator/rectifier. The rectifier portion of the voltage regulator/rectifier converts the alternating current to direct current (DC). The regulator portion stabilizes the direct current and increases or decreases current flow as required by the battery.

Battery discharge lamp control (A) senses battery voltage present at fuse (F2). If the lamp control senses low voltage (less than 12.3 volts), it will provide a path to ground for battery discharge lamp (P4). Since battery voltage is always available at the discharge lamp when the key switch is in the RUN or START position, the ground path provided by the lamp control will allow battery current from fuse (F1) to flow through the battery discharge lamp to ground, lighting the discharge lamp. The lamp will stay on until battery voltage increases to 12.7 volts. At this point, the battery discharge lamp control will break the path to ground, turning the battery discharge lamp off.

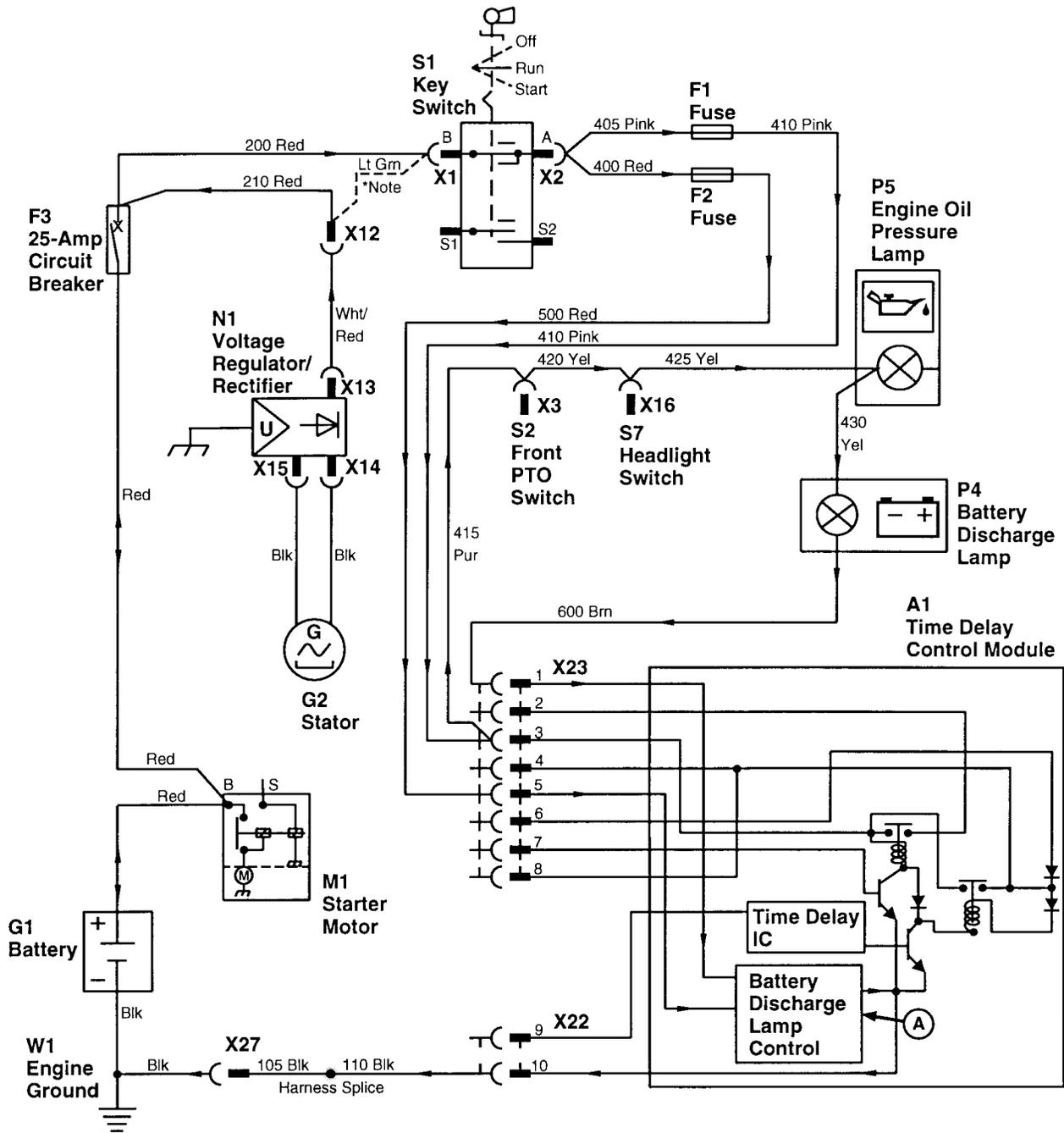
Fuses (F1 and F2) protect the battery discharge lamp and lamp control circuit from excessive current.

*NOTE: (\*) For machines (S.N. —475000), a light green wire is used instead of the 210 red wire used on later machines. The green wire connects to terminal "B" of key switch (S1), instead of connecting to circuit breaker (F3).*

*NOTE: 1. The illustration shows ground circuit for machines (S.N. 475001— ).*

*For machines (S.N. —475000), the blk wire from the TDC module 2-pin connector terminates (grounds) at the right side of the pedestal panel.*

MX,159024020,7 -19-16MAY95

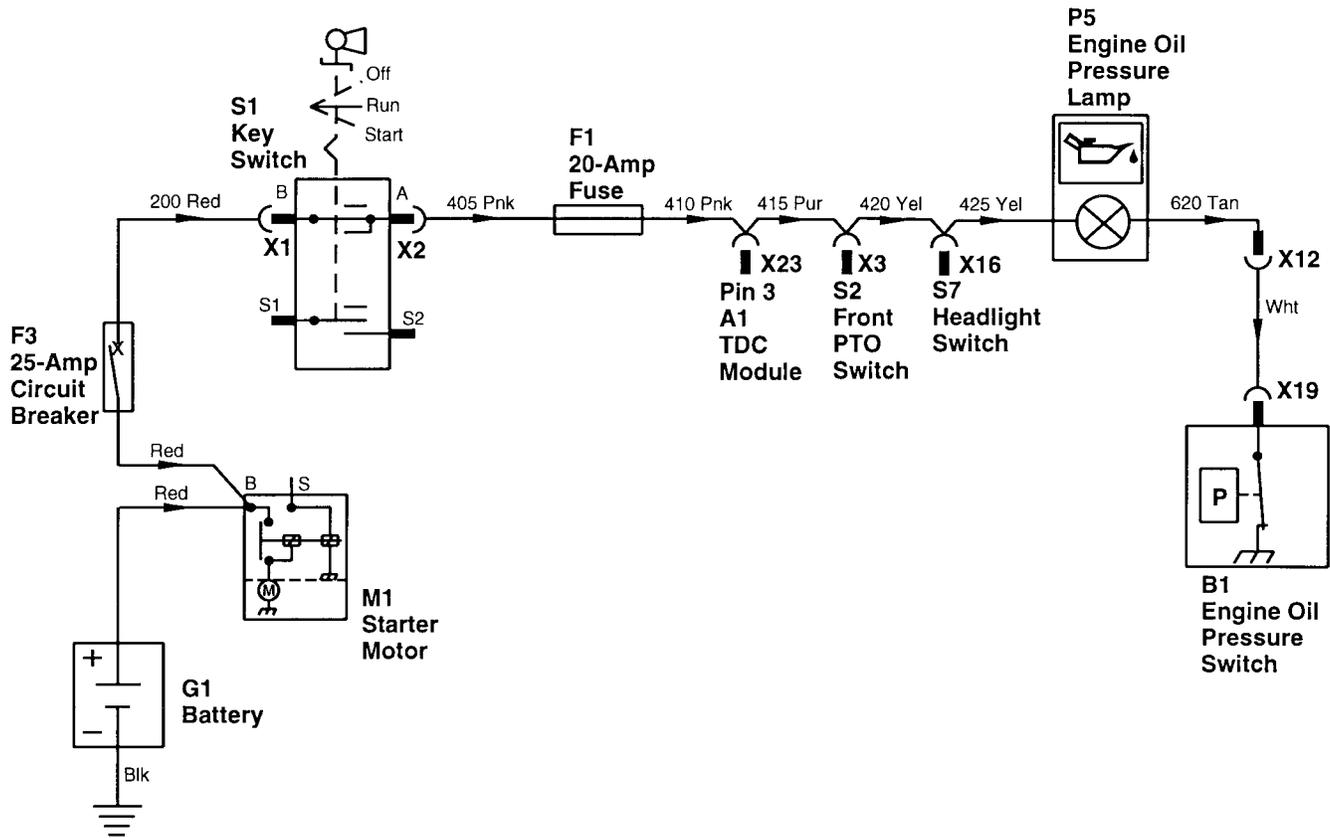


- |                                    |                                |                                     |                                |
|------------------------------------|--------------------------------|-------------------------------------|--------------------------------|
| A—Battery Discharge Lamp Control   | F3—25 Amp Circuit Breaker      | S1—Key Switch                       | X16—Headlight Switch Connector |
| A1—Time Delay Control (TDC) Module | G1—Battery                     | W1—Engine Ground (See Note)         | X22—TDC Module 2-Pin Connector |
| F1—20 Amp Fuse                     | G2—Stator                      | X1—Key Switch 5-Pin Connector       | X23—TDC Module 8-Pin Connector |
| F2—2 Amp Fuse (Early Machines)     | M1—Starter Motor               | X2—Key Switch 1-Pin Connector       |                                |
| F3—3 Amp Fuse (Later Machines)     | N1—Voltage Regulator/Rectifier | X3—Front PTO Switch 2-Pin Connector |                                |
| P4—Battery Discharge Lamp          | P5—Engine Oil Pressure Lamp    |                                     |                                |

Charging Circuit Operation

MX.159024020,8 -19-16MAY95

## OIL PRESSURE LAMP CIRCUIT OPERATION



B1—Engine Oil Pressure Switch  
 F1—20 Amp Fuse  
 F3—25 Amp Circuit Breaker  
 G1—Battery

M1—Starter Motor  
 P5—Engine Oil Pressure Lamp  
 S1—Key Switch  
 X1—Key Switch 5-Pin Connector

X2—Key Switch 1-Pin Connector  
 X3—Front PTO Switch 2-Pin Connector

X16—Headlight Switch 2-Pin Connector  
 X23—TDC Module 8-Pin Connector

The purpose of the oil pressure lamp circuit is to warn the operator when engine oil pressure is too low for safe operation of the engine.

Oil pressure switch (B1) is a normally-closed switch. When there is no oil pressure, such as when the engine is not operating, the switch contacts are closed. The closed contacts of the oil pressure switch provide a path to ground for oil pressure lamp (P5).

When the key switch is turned to the RUN or START position, current from the battery flows through circuit breaker (F3), key switch (S1), and 20 amp fuse (F1). From the fuse, current flows through oil pressure lamp (P5), oil pressure switch (B1), then to ground, lighting the oil pressure lamp. The lamp will stay lit until either the key switch is turned to the OFF position or engine oil pressure increases to the point where the pressure switch contacts open, such as during normal engine operation.

Fuse (F1) protects the oil pressure lamp circuit from excessive current.

240  
15  
10

-19-04/MAR95  
M77925

## ABOUT THIS GROUP

Always perform the system checkout procedures in Group 05 BEFORE doing any tests in this group. The step-by-step procedures in this group provide you with the detailed diagnostic information you will need to isolate a malfunction. Always start with the first step and follow the sequence from left to right. Read each step completely before performing the test.

Basic diagnostic equipment is used. It is assumed that you are familiar with the machine and its electrical components.

**IMPORTANT:** Before doing any testing, verify the system ground circuits and test the battery. All ground connections must be clean and tight and the battery fully charged.

Upon completing a test or adjustment, check to see whether the problem is corrected by performing the checkout procedure for that step in Group 05.

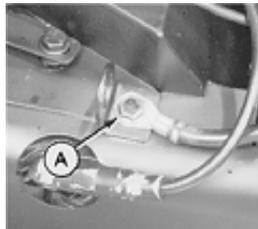
MX,159024025,1 -19-16MAY95

### A VERIFY SYSTEM GROUNDS

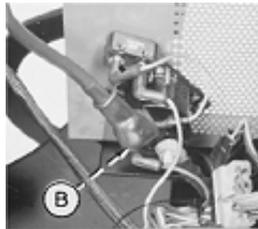
*NOTE:* For machines (S.N. —475000), the ground wires for the PTO lamps, hour meter, and TDC module (2-pin connector) terminate at the right pedestal panel. Exterior components, such as the PTO clutches and head and tail lights use the tractor frame for ground.

For machines (S.N. 475001— ), all component grounds terminate (spliced) inside the main harness with one wire connecting to a single ground point located where the battery negative (—) cable connects to the engine block.

Key switch OFF.



M55069 -UN-09DEC89



M55070 -UN-09DEC89

*NOTE:* Machines (S.N. —475000) shown.

Verify the system grounds using a continuity tester or ohmmeter. Check for good continuity between battery negative (—) terminal and the following:

Battery ground (A) connection to engine.

Harness ground (B) connection to right pedestal panel; (S.N. —475000) only.

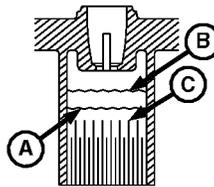
**NOT OK:** Clean and tighten ground connections as necessary.

**OK:** GO TO B

MX,159024025,2 -19-16MAY95

### B BATTERY TESTS

*NOTE:* If problem is with starting circuit, perform all battery tests. If problem is with other components, perform battery tests only if starter does not crank engine satisfactorily.



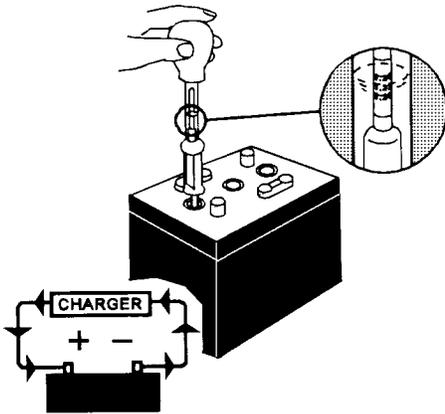
M78970 -UN-09MAY95

Check electrolyte level in each cell of battery. If low, add the proper amount of electrolyte or DISTILLED water.

Continued on next page

240  
20  
1

Electrical System Diagnosis/Battery Tests



Check specific gravity of each cell with a hydrometer.

**SPECIFIC GRAVITY**

ALL CELLS LESS THAN 1.175: GO TO –@

ALL CELLS MORE THAN 1.225 WITH LESS THAN 50 (0.050) GRAVITY POINT VARIATION: GO TO –#

ALL CELLS LESS THAN 1.225 WITH LESS THAN 50 (0.050) GRAVITY POINT VARIATION: GO TO –!

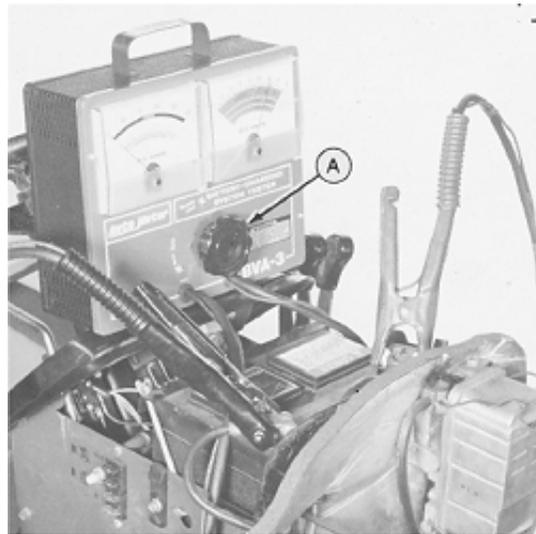
CELLS VARY MORE THAN 50 POINTS: Replace Battery.

M78971 -UN-09MAY95

MX,159024025,3 -19-16MAY95

–! **Test Battery Voltage**

*NOTE: Battery need not be disconnected from machine.*



M36655 -UN-25JAN90

**IMPORTANT: Before connecting JT05685 Tester to battery, make sure load knob (A) is turned fully counterclockwise.**

Check battery voltage with voltmeter or JT05685 Battery Tester.

12.4 VOLTS OR MORE: GO TO –%

LESS THAN 12.4 VOLTS: GO TO –@

MX,159024025,4 -19-16MAY95

*Electrical System Diagnosis/Battery Tests*

<p>—@ <b>Charge Battery</b></p>	<p>Connect a variable-rate type charger to battery. Start charger at a slow rate. Increase charge rate one setting at a time. Check ammeter (on charger) after 1 minute at each setting. Try to maintain a 10 amp charge rate. Use boost setting as necessary.</p> <p>The maximum charging time at boost setting is 10 minutes. Allow an additional 5 minutes for each 10°F below 70°F.</p>	<p>BATTERY DID NOT REQUIRE WATER AT STEP B AND IS ACCEPTING A 10-AMP CHARGE: GO TO —\$</p> <p>BATTERY REQUIRED WATER AT STEP B OR ALL CELLS WERE BELOW 1.175, BUT BATTERY IS ACCEPTING A 10-AMP CHARGE: GO TO —#</p> <p>BATTERY DOES NOT ACCEPT A 10-AMP CHARGE AFTER 10 MINUTES AT BOOST SETTING: Replace Battery.</p>
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MX,159024025,5 -19-16MAY95

<p>—# <b>Increase Charge Rate</b></p>	<p>Set charger at 15—25 amps.</p>	<p><b>IMPORTANT:</b> Decrease charge rate if battery gases or bubbles excessively or becomes too warm to hold.</p>	<p>Check specific gravity after 30 minutes.</p>	<p>VARIATION BETWEEN CELLS IS MORE THAN 50 SPECIFIC GRAVITY POINTS (0.050): Replace Battery.</p> <p>VARIATION BETWEEN CELLS IS LESS THAN 50 SPECIFIC GRAVITY POINTS (0.050): GO TO —\$</p>
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MX,159024025,7 -19-16MAY95

<p>—\$ <b>Continue Charging Battery</b></p>	<p><b>IMPORTANT:</b> Decrease charge rate if battery gases or bubbles too much or if battery gets too warm to hold.</p> <p>Continue charging battery until specific gravity is 1.230—1.265 points.</p>	<p>BATTERY WAS DISCHARGED AT A SLOW RATE OR DISCHARGE RATE IS UNKNOWN: Charge battery at 10—15 amps for 6—12 hours. (Maintenance free battery may require 12—24 hours.)</p> <p>THEN GO TO —%</p> <p>BATTERY WAS DISCHARGED AT A FAST RATE: Charge battery at 20—25 amps. Battery may require 2—4 hours charging time. (Maintenance free battery may need 4—8 hours.)</p> <p>THEN GO TO —%</p>
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MX,159024025,8 -19-16MAY95

Electrical System Diagnosis/Dash Lamp Circuit Tests

—% Load Test Battery



M36665 -UN-29AUG88

Connect JT05685 Tester to battery.

Follow instructions on back of meter for testing battery.

REPLACE BATTERY AS NEEDED.

MX,159024025,9 -19-16MAY95

**DASH LAMP CIRCUIT TESTS**

Listed at right are symptoms that may occur in a malfunctioning dash lamp circuit. Locate the symptom that applies, then proceed to the appropriate test.

**LAMP CIRCUIT SYMPTOMS:**

- Fuses Blow When Any Of The Lamp Circuits Are Energized. Check For Shorts In The Power Circuit: GO TO 0, Group 25.
- No Lamps Come ON: GO TO 1a

- Oil Pressure Lamp Does Not Come On: GO TO 1i
- Oil Pressure Lamp On All The Time: GO TO 1l
- Battery Discharge Lamp Does Not Come On: GO TO 1m
- Battery Discharge Lamp On All The Time: GO TO 1p

MX,159024025,10-19-16MAY95

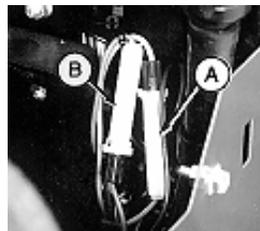
**1a Power Circuit Test at 20-Amp Fuse**

Check 20-amp fuse.

Turn key switch to RUN position.

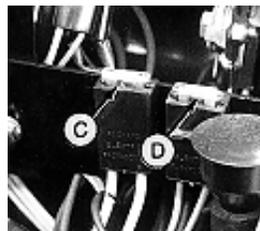
**NOTE:**

- A—20-Amp Fuse
- B—2-Amp Fuse
- C—20-Amp Fuse
- D—3-Amp Fuse



M55140 -UN-13APR95

For machines:  
316 (S.N. —475000)  
318 (S.N. —475000)  
420 (S.N. —595880),  
check for voltage at both ends of 20-amp, in-line fuse (A).



M77926 -UN-12APR95

For machines:  
316 (S.N. 475001— )  
318 (S.N. 475001— )  
420 (S.N. 595881— ),  
check for voltage at both contacts of 20-amp fuse (C).

**VOLTAGE ONE SIDE:**  
Check fuse contacts.

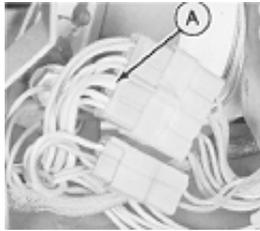
**VOLTAGE BOTH SIDES:** GO TO 1b

**NO VOLTAGE:** GO TO 1e

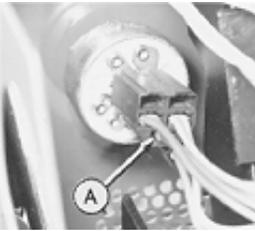
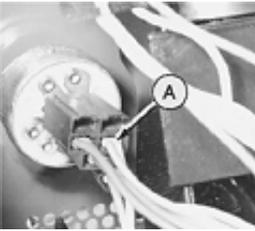
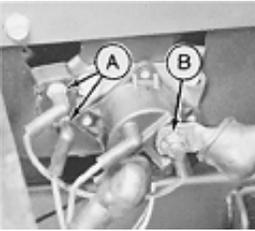
MX,159024025,11-19-16MAY95

240  
20  
4

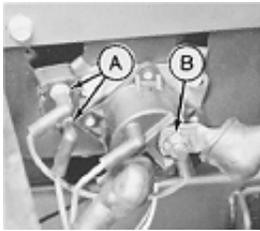
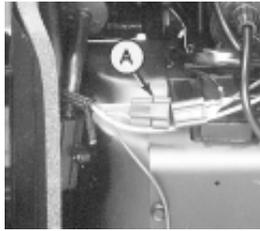
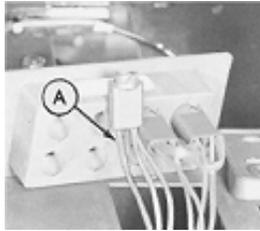
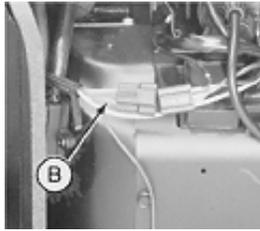
*Electrical System Diagnosis/Dash Lamp Circuit Tests*

<p><b>1b 20-Amp Power Circuit Test at TDC Module</b></p>	<p>Remove battery base to access TDC 8-pin connector.</p> <p>Set battery on air cleaner cover, then reroute battery negative (—) cable so it can be connected to battery.</p>	 <p>M37160 -UN-25JAN90</p>	<p>Turn key switch to RUN position.</p> <p>Check for voltage at terminal with pink and purple wires (A) at TDC 8-pin connector.</p>	<p>VOLTAGE: GO TO 1c</p> <p>NO VOLTAGE: Pink wire between 20-amp fuse and TDC 8-pin connector is open. Repair or replace as necessary, then GO TO ; , Group 05.</p> <p align="right">MX,159024025,12-19-16MAY95</p>
<p><b>1c 20-Amp Power Circuit Test at PTO Switch</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M55146 -UN-11DEC99</p>	<p>Check for voltage at switch terminal with yellow and purple wires (A).</p>	<p>VOLTAGE: GO TO 1d</p> <p>NO VOLTAGE: Purple wire running between TDC 8-pin connector and PTO switch is open. Repair or replace wire as necessary, then GO TO ; , Group 05.</p> <p align="right">MX,159024025,13-19-16MAY95</p>
<p><b>1d 20-Amp Power Circuit Test at Light Switch</b></p>	<p>For machines, 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) remove left pedestal side panel.</p>	 <p>M77928 -UN-17JAN95</p>	<p>Turn key switch to RUN position.</p> <p>Check for voltage at terminal (A) at light switch.</p>	<p>VOLTAGE: GO TO 1k</p> <p>NO VOLTAGE: Yellow wire between PTO switch and light switch is open. Repair or replace as necessary, then GO TO ; , Group 05.</p> <p align="right">MX,159024025,14-19-16MAY95</p>

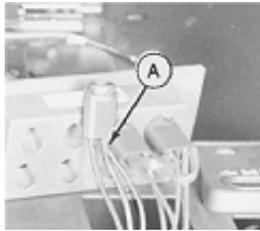
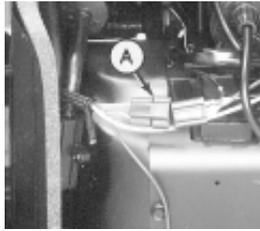
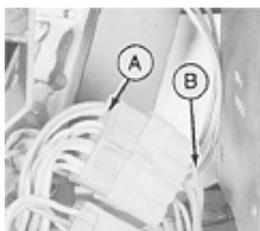
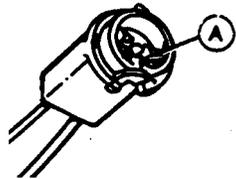
Electrical System Diagnosis/Dash Lamp Circuit Tests

<p><b>1e Power Circuit Test at Key Switch—Fuse Side</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M55141 -UN-09DEC89</p>	<p>Check for voltage at key switch terminal "A", where red and pink wires (A) connect to key switch.</p>	<p><b>VOLTAGE:</b> For 20-amp power circuit, pink wire between fuse and key switch is open.</p> <p>For 2-amp or 3-amp power circuit, red wire between fuse and key switch is open.</p> <p>Repair or replace wire as necessary, then GO TO ; and A, Group 05.</p> <p><b>NO VOLTAGE: GO TO 1f</b></p> <p>MX,159024025,15-19-16MAY95</p>
<p><b>1f Power Circuit Test at Key Switch—Battery Side</b></p>	<p>Key switch OFF.</p>	 <p>M55142 -UN-09DEC89</p>	<p>Check for voltage at key switch terminal "B" where red wire (A) from circuit breaker terminates.</p>	<p><b>VOLTAGE:</b> Replace key switch.</p> <p><b>NO VOLTAGE: GO TO 1g</b></p> <p>MX,159024025,16-19-16MAY95</p>
<p><b>1g Main Power Circuit Test at Circuit Breaker</b></p>	<p>Check 20-amp fuse.</p> <p>If fuse is OK, remove battery base to access circuit breaker.</p> <p>Set battery on air cleaner cover, then reroute negative (—) cable to connect battery.</p>	 <p>M37158 -UN-25JAN90</p>	<p><i>NOTE: Early Models: 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) have starter solenoid mounted next to circuit breaker, as shown.</i></p> <p><i>On Later Models; Starter solenoid is on starter.</i></p> <p>Check for voltage at both terminals (A) of circuit breaker.</p>	<p><b>VOLTAGE AT ONLY ONE TERMINAL:</b> Replace breaker.</p> <p><b>VOLTAGE AT BOTH TERMINALS:</b> Red wire between key switch and circuit breaker is open. Repair or replace as necessary, then GO TO ; , Group 05.</p> <p><b>NO VOLTAGE AT EITHER TERMINAL:</b> For early machines, GO TO 1h.</p> <p>For later machines, replace red wire to battery.</p> <p>MX,159024025,17-19-16MAY95</p>

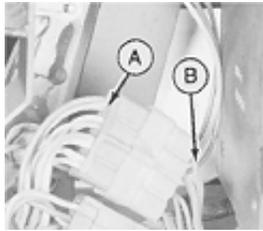
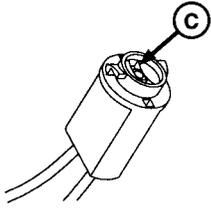
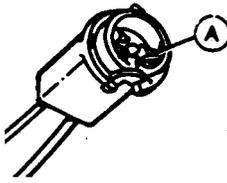
Electrical System Diagnosis/Dash Lamp Circuit Tests

<p><b>1h Main Power Circuit Test at Starter Solenoid—For Early Models:</b>  <b>316 (SN —362983)</b>  <b>318 (SN —364137)</b>  <b>420 (SN —360009)</b></p> <p><i>NOTE: On Later Models; Starter solenoid is on starter.</i></p>	 <p>M37158 -UN-25JAN90</p>	<p>Check for voltage at battery cable terminal (B) at starter solenoid.</p>	<p><b>VOLTAGE AT SOLENOID:</b> Replace wire to breaker.</p> <p><b>NO VOLTAGE:</b> Replace battery cable.</p> <p>Make repairs as necessary, then GO TO ; , Group 05.</p> <p>MX,159024025,18-19-16MAY95</p>
<p><b>1i Engine Oil Pressure Lamp Test</b></p>	<p>Check 20-amp fuse.</p> <p>If lamp stays on at all times, GO TO 1l</p> <p>Open hood.</p> <p>Disconnect 3-pin connector at left front side of engine.</p>	 <p>M55081 -UN-17JAN95</p> <p>Turn key switch to RUN position.</p> <p>Connect jumper wire from tan wire of connector (A) to ground.</p> <p><i>LOOK: Lamp should come ON.</i></p>	<p><b>LAMP ON:</b> Wire between 3-pin connector and oil pressure switch is open or switch is faulty. Repair or replace as necessary, then GO TO ; , Group 05.</p> <p><b>LAMP NOT ON:</b> GO TO 1j</p> <p>MX,159024025,19-19-16MAY95</p>
<p><b>1j Engine Oil Pressure Lamp Ground Circuit Test</b></p>	<p>Key switch OFF.</p> <p>Disconnect 3-pin engine connector.</p>	 <p>M37300 -UN-25JAN90</p>  <p>M55082 -UN-09DEC89</p> <p>Remove and check bulb.</p> <p>Check for continuity between tan wire (A) of bulb socket and tan wire (B) of engine harness connector.</p>	<p><b>CONTINUITY:</b> Connect engine harness, then GO TO 1k</p> <p><b>NO CONTINUITY:</b> Repair or replace tan wire from engine harness to bulb socket then GO TO ; , Group 05.</p> <p>MX,159024025,20-19-16MAY95</p>

*Electrical System Diagnosis/Dash Lamp Circuit Tests*

<p><b>1k Engine Oil Pressure Lamp Power Circuit Test.</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M37299 -UN-25JAN90</p>	<p>Remove oil pressure lamp socket from panel. Remove bulb.</p> <p>Check for voltage at terminal with double yellow wires (A).</p>	<p>NO VOLTAGE: GO TO 1a</p> <p>MX,159024025,21-19-16MAY95</p>
<p><b>1l Engine Oil Pressure Lamp Short Circuit Test</b></p>	<p>Turn key switch OFF.</p>	 <p>M55081 -UN-17JAN95</p>	<p>Disconnect engine harness connector.</p> <p>Check for continuity between tan wire at connector (A) and engine ground.</p>	<p>CONTINUITY: Tan wire is shorted to ground. Repair or replace wire.</p> <p>NO CONTINUITY: Check engine oil pressure. See Section 220.</p> <p>MX,159024025,22-19-16MAY95</p>
<p><b>1m Battery Discharge Lamp Test</b></p>	<p>Check 20-amp fuse.</p> <p>If discharge lamp stays on at all times, GO TO 1p</p>	 <p>M37163 -UN-25JAN90</p>	<p>Connect a jumper wire from brown wire (B) of TDC connector to ground.</p> <p>Turn key switch to RUN position.</p> <p><i>LOOK: Indicator lamp ON.</i></p>	<p>LAMP ON: GO TO 1q</p> <p>LAMP NOT ON: Jump from brown wire (A) to ground. If lamp comes on, repair connector. Lamp still not on, GO TO 1n</p> <p>MX,159024025,23-19-16MAY95</p>
<p><b>1n Battery Discharge Lamp Power Circuit Test</b></p>	<p>Remove battery discharge lamp socket from dash panel.</p> <p>Check bulb.</p> <p>Turn key switch to RUN position.</p>	 <p>M36635 -UN-24APR89</p>	<p>Check for voltage at terminal with yellow wire (A).</p>	<p>NO VOLTAGE: GO TO 1k</p> <p>VOLTAGE: GO TO 1o</p> <p>MX,159024025,24-19-16MAY95</p>

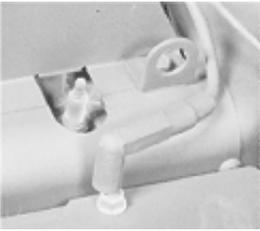
Electrical System Diagnosis/Dash Lamp Circuit Tests

<p><b>1o Battery Discharge Lamp Ground Circuit Test</b></p>	<p>Key switch OFF.</p>	 <p>M37163 -UN-25JAN90</p>  <p>M77932 -UN-19JAN95</p>	<p>Check for continuity of brown wire (A) between TDC 8-pin connector and bulb socket (C) of the battery discharge lamp socket.</p> <p>NO CONTINUITY: Repair or replace brown wire between lamp socket and TDC 8-pin connector.</p> <p>CONTINUITY: Check for continuity between (A and B) at TDC 8-pin connector.</p>	<p>CONTINUITY: GO TO 1q</p> <p>NO CONTINUITY: Repair connector as necessary.</p>
<p><b>1p Battery Discharge Lamp Short Circuit Test</b></p>	<p>Key switch OFF.</p> <p>Disconnect discharge lamp socket from dash panel.</p> <p>Remove bulb from socket.</p> <p>Disconnect TDC module 8-pin connector.</p>	 <p>M36635 -UN-24APR89</p>	<p>Check for continuity of brown wire between bulb socket contact (A) and ground.</p>	<p>CONTINUITY: Brown wire is shorted to ground. Repair or replace.</p> <p>NO CONTINUITY: GO TO 1q</p>
<p><b>1q TDC Module Test for Discharge Lamp</b></p> <p><i>NOTE: For this test, battery voltage must be 12.3 or less.</i></p>	<p>Check battery voltage using JT05685 Battery Tester or a volt meter.</p> <p>If more than 12.3-volts, use the following procedure to discharge the battery.</p>	 <p>M37179 -UN-25JAN90</p>	<p>Disconnect and ground both spark plug leads.</p> <p>Crank engine for 10—15 seconds.</p> <p>Check battery voltage to be sure it is less than 12.3-volts.</p>	<p>Turn key switch to RUN position.</p> <p><i>LOOK: Discharge lamp ON, indicating low battery voltage.</i></p>
 <p>M37358 -UN-25JAN90</p>	<p>Connect both spark plug wires to spark plugs.</p>	<p>Operate tractor at full throttle until battery voltage is at least 13.5 volts.</p> <p><i>LOOK: Discharge lamp OFF.</i></p>	<p>If battery does not reach 13.5 volts after several minutes operating time, test charging circuit.</p> <p>GO TO Å, Group 25.</p>	<p>LAMP OFF: Circuit OK</p> <p>LAMP ON: Replace TDC module, then GO TO ; , Group 05.</p>

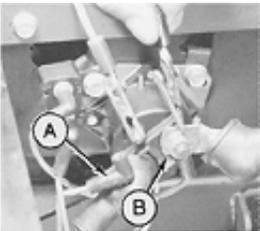
Electrical System Diagnosis/Starting Circuit Tests

<p><b>' STARTING CIRCUIT TESTS</b></p> <p>Listed at right are symptoms that may occur in a malfunctioning starting circuit. Locate the symptom that applies, then proceed to the appropriate test.</p>	<p><b>IMPORTANT: Test battery and verify grounds before testing starting circuit. (See steps A and B at the beginning of this group.)</b></p>	<p><b>STARTING CIRCUIT SYMPTOMS:</b></p> <p>—Starter Operates, But Doesn't Crank Engine: REPAIR STARTER (See CTM2.)</p> <p>—Solenoid Doesn't Click, Starter Doesn't Operate: For Machines: 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) GO TO 2a For Machines: 316 (S.N. 362984— ) 318 (S.N. 364138— ) 420 (S.N. 360010— ) GO TO 2c</p>	<p>For Machines: 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) GO TO 2b For Machines: 316 (S.N. 362984— ) 318 (S.N. 364138— ) 420 (S.N. 360010— ) GO TO 2d</p> <p>—Starter Cranks Engine Slowly Or Erratically: GO TO A, Group 25.</p>
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MX,159024025,29-19-16MAY95

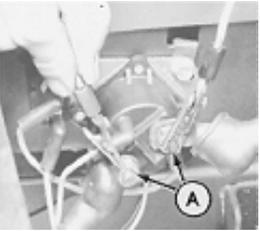
<p><b>2a Starter Test—For Machines:</b> 316 (SN —362983) 318 (SN —364137) 420 (SN —360009)</p>	<p>Remove battery base to access solenoid.</p> <p>Set battery on air cleaner base, then reroute negative (—) battery cable to connect.</p>	<p>PTO switch OFF, Starter Doesn't Operate: Key switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Park brake engaged.</p>		<p>Disconnect spark plug wires from spark plugs and ground to engine block.</p>
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M37179 -UN-25JAN90

	<p>Disconnect small purple wire (A) from solenoid. Connect one end of a jumper wire to the exposed terminal, then briefly touch other end of jumper to battery cable terminal (B).</p> <p><i>LISTEN: Starter must operate.</i></p>	<p><b>STARTER OPERATES:</b> GO TO 2e</p> <p><b>STARTER DOESN'T OPERATE:</b> GO TO 2b</p>
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M37165 -UN-25JAN90

MX,159024025,30-19-16MAY95

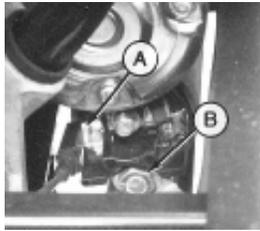
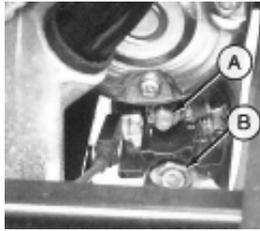
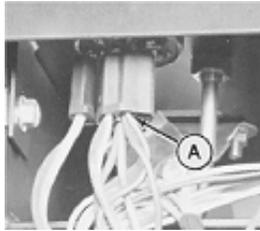
<p><b>2b Starter Solenoid Test—For Machines:</b> 316 (SN —362983) 318 (SN —364137) 420 (SN —360009)</p>	<p>PTO switch OFF.</p> <p>Key switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Park brake engaged.</p> <p>Spark plug wires disconnected and grounded.</p>		<p>Briefly jump between the two large terminals (A), located on the starter solenoid.</p> <p><i>LISTEN: Starter must operate.</i></p> <p><b>STARTER OPERATES:</b> Replace solenoid, then GO TO ' group 05.</p> <p><b>STARTER DOESN'T OPERATE:</b> Check battery and starter wiring connections, then GO TO A, Group 25.</p>
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M37166 -UN-25JAN90

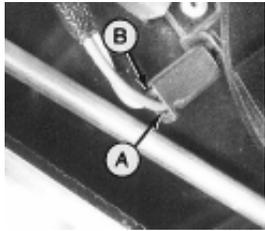
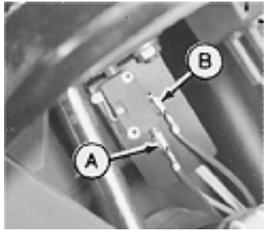
MX,159024025,31-19-16MAY95

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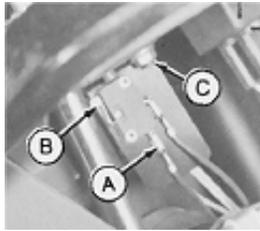
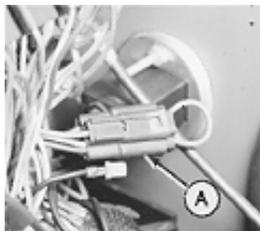
Electrical System Diagnosis/Starting Circuit Tests

<p><b>2c Starter Test— For Machines: 316 (SN 362984— ) 318 (SN 364138— ) 420 (SN 360010— )</b></p>	<p>PTO switch OFF. Key switch OFF. Hydrostatic lever in N/STOP position. Park brake engaged. Disconnect spark plug wires from spark plugs and ground to engine block.</p>	 <p>M77929 -UN-17JAN95</p>	<p>Connect one end of a jumper wire to terminal (A) on the starter solenoid, then briefly touch other end of jumper to battery cable terminal (B). <i>LISTEN: Starter must operate.</i></p>	<p><b>STARTER OPERATES:</b> GO TO 2e <b>STARTER DOESN'T OPERATE:</b> GO TO 2d</p>
<p><b>2d Starter Solenoid Test—For Machines: 316 (SN 362984— ) 318 (SN 364138— ) 420 (SN 360010— )</b></p>	<p>PTO switch OFF. Key switch OFF. Hydrostatic lever in N/STOP position. Park brake engaged. Spark plug wires disconnected and grounded.</p>	 <p>M77930 -UN-17JAN95</p>	<p>Briefly jump between starter terminal (A) and battery cable terminal (B), located on the starter solenoid, <i>LISTEN: Starter must operate.</i></p>	<p><b>STARTER OPERATES:</b> Replace solenoid, then GO TO ' , Group 05. <b>STARTER DOESN'T OPERATE:</b> Check battery and starter wiring connections, then GO TO Æ, Group 25.</p>
<p><b>2e Starter Circuit Test at Key Switch</b></p>	<p>PTO switch OFF. Hydrostatic lever in N/STOP position. <i>NOTE: Engaged park brake required on machines: 316 (S.N. 596121— ) 318 (S.N. 600305— ) 420 (S.N. 595881— )</i> Engage park brake.</p>	 <p>M37167 -UN-25JAN90</p>	<p>Turn key switch to RUN position. Check for voltage at terminal (A) on back of key switch (purple and purple/black wires).</p>	<p><b>VOLTAGE:</b> Replace key switch, then GO TO ' , Group 05. <b>NO VOLTAGE:</b> Early machines, GO TO 2g Later machines, GO TO 2f</p>

*Electrical System Diagnosis/Starting Circuit Tests*

<p><b>2f Starter Circuit Test at Brake Switch—For Machines:</b>  <b>316 (SN 596121— )</b>  <b>318 (SN 600305— )</b>  <b>420 (SN 595881— )</b></p>	<p>PTO switch OFF.                      Hydrostatic lever in N/STOP position.                      Park brake engaged.                      Turn key switch to RUN position.</p>	 <p>M77931 -UN-17JAN95</p> <p>Check for voltage at purple wire terminal (A).                      If there is voltage at (A), purple wire between key switch and brake switch is open.                      If no voltage at (A), check for voltage at purple/white wire terminal (B).</p>	<p>VOLTAGE: Replace switch, then GO TO ' , Group 05.                      NO VOLTAGE: GO TO 2g</p> <p align="right">MX,159024025,35-19-16MAY95</p>
<p><b>2g Starter Circuit Test at Transmission Neutral Start Switch</b></p>	 <p>M36623 -UN-25JAN90</p>	<p>PTO switch OFF.                      Hydrostatic lever in N/STOP position.                      Turn key switch to RUN position.                      Check for voltage at terminal (A).                      For machines: 316 (S.N. —596120) 318 (S.N. —600304) 420 (S.N. —595880), voltage at (A) indicates the purple wire between key switch and trans. neutral switch is open.                      For machines: 316 (S.N. 596121— ) 318 (S.N. 600305— ) 420 (S.N. 595881— ), voltage at (A) indicates purple/white wire between brake switch and trans. neutral switch is open.                      If no voltage at (A), check for voltage at terminal (B).</p>	<p>VOLTAGE: GO TO 2h                      NO VOLTAGE: GO TO 2i</p> <p align="right">MX,159024025,36-19-16MAY95</p>

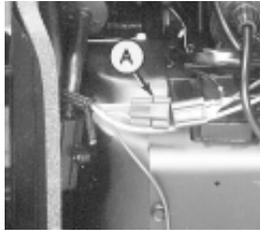
Electrical System Diagnosis/Starting Circuit Tests

<p><b>2h Starter Circuit Test at Transmission Neutral Start Switch—Continued</b></p>	<p>PTO switch OFF.</p> <p>Move hydrostatic lever to FORWARD position.</p> <p>Turn key switch to RUN position.</p>	 <p>M36647 -UN-25JAN90</p>	<p>Push switch arm (B) fully in and check for voltage at terminal with purple/white wire (A).</p>	<p><b>NO VOLTAGE:</b> Replace switch, then GO TO ' , Group 05.</p> <p><b>VOLTAGE:</b> With hydrostatic lever at N/STOP position, loosen adjusting nut (C) and slide switch toward hydrostatic lever until switch contacts just close, then tighten nut.</p> <p><b>DO NOT</b> adjust switch to the point where arm (B) is tight against switch body. This could cause damage to the switch during machine operation.</p> <p><b>AFTER REPLACING OR ADJUSTING SWITCH,</b> GO TO ' , Group 05.</p> <p>MX,159024025,37-19-16MAY95</p>
<p><b>2i Starter Circuit Test at Jumper Connector—Single PTO</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p>Turn key switch to RUN position.</p>	 <p>M36624 -UN-25JAN90</p>	<p>Check for voltage at purple jumper wire of connector (A).</p>	<p><b>VOLTAGE ONE TERMINAL:</b> Repair jumper connector.</p> <p><b>VOLTAGE BOTH TERMINALS:</b> Purple wire between connector and transmission switch is open. Repair or replace wire if necessary, then GO TO ' , Group 05.</p> <p><b>NO VOLTAGE EITHER TERMINAL:</b> GO TO 2j</p> <p>MX,159024025,38-19-16MAY95</p>

Electrical System Diagnosis/Ignition Circuit Tests

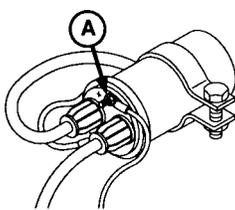
<p>2j <b>Starter Circuit Test at PTO Switch</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M55146 -UN-11DEC89</p>	<p>Check for voltage at terminal (A) with yellow and purple wires, then at terminal with single purple wire.</p>	<p>VOLTAGE ONE TERMINAL: Replace switch.</p> <p>VOLTAGE BOTH TERMINALS: Purple wire between jumper connector and PTO switch is open.</p> <p>NO VOLTAGE: GO TO 1e</p> <p>Repair or replace wire, then GO TO ' , Group 05.</p> <p>MX,159024025,39-19-16MAY95</p>
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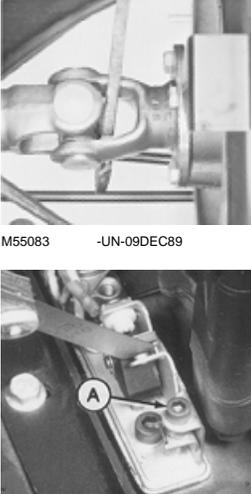
<p>Æ <b>IGNITION CIRCUIT TESTS</b></p>	<p>Listed at right are symptoms that may occur in a malfunctioning ignition circuit. Locate the symptom that applies, then proceed to the appropriate test.</p>	<p>IGNITION CIRCUIT SYMPTOMS:</p> <ul style="list-style-type: none"> <li>—Starter Cranks Engine Satisfactorily, But Engine Doesn't Start: GO TO 3a</li> <li>—Engine Stops With Operator On Seat When:             <ul style="list-style-type: none"> <li>PTO Switch Is Turned On,</li> <li>Or</li> <li>Hydrostatic Lever Is Moved To Forward Or Reverse Position,</li> <li>Or</li> <li>Brake Pedal Is Released (Later Machines Only).</li> </ul>             GO TO 4e           </li> <li>—Engine Starts, But Misfires:             <ul style="list-style-type: none"> <li>For Machines (S.N. —420000);</li> <li>GO TO 3j</li> </ul> </li> </ul>	<p>For Machines (S.N. 420001— ); GO TO 3k</p> <p>MX,159024025,40-19-16MAY95</p>
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<p>3a <b>Ignition Circuit Test—All Machines</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p><i>NOTE: Engaged park brake required on machines:</i>            316 (S.N. 596121— )            318 (S.N. 600305— )            420 (S.N. 595881— )</p> <p>Engage park brake.</p>	 <p>M55081 -UN-17JAN95</p>	<p>Remove right-hand engine side panel.</p> <p>Disconnect engine 3-pin connector.</p> <p>Turn key switch to RUN position.</p> <p>Check for voltage at pink wire terminal of connector (A).</p>	<p>VOLTAGE:</p> <p>For Machines (S.N. —420000); GO TO 3b</p> <p>For Machines (S.N. 420001— ); GO TO 3f</p> <p>NO VOLTAGE: GO TO 3I</p> <p>MX,159024025,41-19-16MAY95</p>
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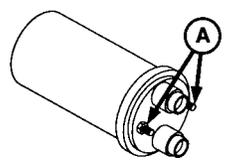
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*Electrical System Diagnosis/Ignition Circuit Tests*

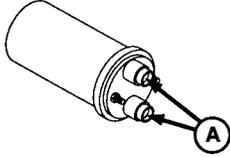
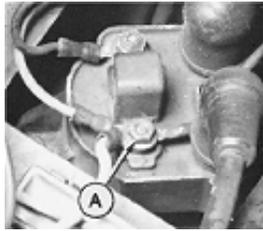
<p><b>3b Ignition Circuit Test—For Machines (S.N. —420000)</b></p>	<p>Disconnect spark plug wires and remove spark plugs.</p> <p>Connect a spark tester to each of the spark plug wires.</p>	 <p>M77904 -UN-19JAN95</p>	<p>Connect a jumper wire from positive (+) battery terminal to positive (+) coil terminal (A). Crank engine and check for spark.</p>	<p>SPARK: Wire between ignition coil positive (+) terminal and 3-pin engine connector is open or 3-pin engine connector is faulty.</p> <p>NO SPARK: GO TO 3c</p> <p>MX,159024025,42-19-16MAY95</p>
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<p><b>3c Ignition Points: Inspection and Adjustment—For Machines (S.N. —420000)</b></p>	<p>Disconnect negative (—) battery cable.</p> <p>Remove ignition points cover.</p> <p>Inspect points for burning, pitting or other damage.</p> <p>If points are damaged, replace them as instructed in CTM2.</p>	 <p>M65083 -UN-09DEC89</p> <p>M78973 -UN-16MAY95</p>	<p>Turn engine by rotating U-joint until ignition points are at widest gap.</p> <p>Check point gap using a feeler gauge.</p> <p>Turn adjusting screw (A) until gap is set to specifications.</p> <p align="center"><b>IGNITION POINT GAP SPECIFICATIONS</b></p> <p>B43E and B43G . . . . . 0.41 mm (0.016 in.)</p> <p>B48G</p> <p>Spec A and B . . . . . 0.51 mm (0.020 in.)</p> <p>Spec C . . . . . 0.41 mm (0.016 in.)</p>	<p>AFTER REPAIR OR ADJUSTMENT: GO TO <math>\bar{E}</math>, Group 05.</p> <p>IF STILL NO SPARK: GO TO 3d</p> <p>MX,159024025,43-19-16MAY95</p>
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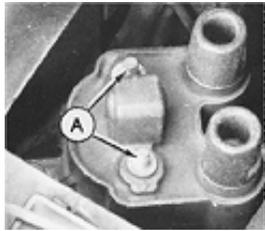
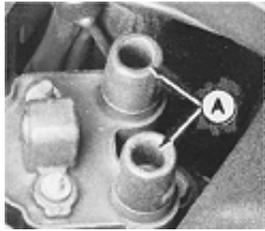
				<p>AFTER REPAIR OR ADJUSTMENT: GO TO <math>\bar{E}</math>, Group 05.</p> <p>IF STILL NO SPARK: GO TO 3d</p> <p>MX,159024025,43-19-16MAY95</p>
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<p><b>3d Ignition Coil Test: Primary Windings—For Machines (S.N. —420000)</b></p>	<p>Key switch OFF.</p> <p>Disconnect all wires from ignition coil.</p>	 <p>M77939 -UN-19JAN95</p>	<p>Using a ohmmeter, measure resistance of primary windings across terminals (A).</p> <p>Resistance should be 3.9—4.7 ohms when temperature of coil is approximately 20°C (68°F).</p>	<p>RESISTANCE OK: GO TO 3e</p> <p>RESISTANCE NOT OK: Replace coil.</p> <p>MX,159024025,45-19-16MAY95</p>
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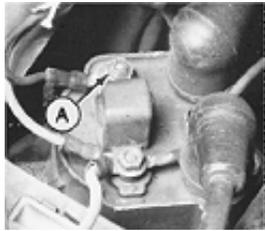
Electrical System Diagnosis/Ignition Circuit Tests

<p>3e Ignition Coil Test: Secondary Windings—For Machines (S.N. —420000)</p>	<p>Key switch OFF. Disconnect all wires from ignition coil.</p>	 <p>M77938 -UN-19JAN95</p> <p>Using a ohmmeter, measure resistance of secondary windings at spark plug wire terminals (A). Resistance should be 12.6—15.4 K-ohms when temperature of coil is approximately 20°C (68°F).</p>	<p>RESISTANCE NOT OK: Replace coil, then GO TO Æ, Group 05.</p> <p>MX,159024025,46-19-16MAY95</p>
<p>3f Ignition Circuit Test—For Machines (S.N. 420001— )</p>	<p>Disconnect spark plug wires and remove spark plugs. Connect a spark tester to each of the spark plug wires.</p>	 <p>M45243 -UN-12JAN90</p> <p><b>IMPORTANT: Do not touch the negative coil terminal with the jumper wire. Battery voltage applied to the negative coil terminal will damage the ignition control module.</b></p> <p>NOTE: Terminal (A) is smaller in diameter of the two posts.</p> <p>Connect a jumper wire from positive (+) battery terminal to positive (+) coil terminal (A). Crank engine and check for spark.</p>	<p>SPARK: White wire to 3-pin engine connector is open or 3-pin engine connector is faulty. Repair or replace as necessary, then GO TO Æ, Group 05.</p> <p>NO SPARK: GO TO 3g</p> <p>MX,159024025,47-19-16MAY95</p>

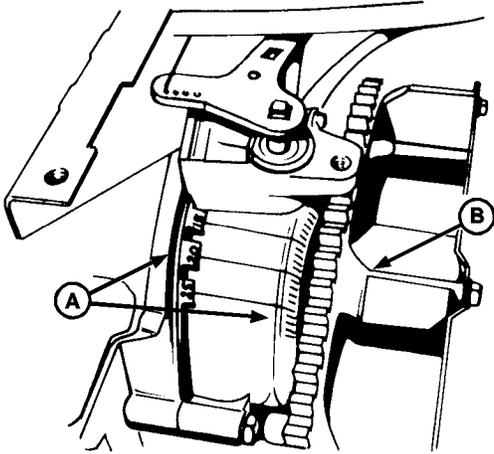
*Electrical System Diagnosis/Ignition Circuit Tests*

<p><b>3g Ignition Coil Test: Primary Windings— For Machines (S.N. 420001— )</b></p>	<p>Key switch OFF. Disconnect all wires from ignition coil.</p>	 <p>M45244 -UN-12JAN90</p> <p>Using a ohmmeter, measure resistance of primary windings across terminals (A). Resistance should be 3.7—4.6 ohms when temperature of coil is approximately 20°C (68°F).</p>	<p>RESISTANCE OK: GO TO 3h RESISTANCE NOT OK: Replace coil, then GO TO Æ, Group 05.</p> <p align="right">MX,159024025,48-19-16MAY95</p>
<p><b>3h Ignition Coil Test: Secondary Windings— For Machines (S.N. 420001— )</b></p>	<p>Key switch OFF. Disconnect all wires from ignition coil.</p>	 <p>M45245 -UN-21JAN90</p> <p>Using a ohmmeter, measure resistance of secondary windings across spark plug wire terminals (A). Resistance should be 34.02—41.6 K-ohms when temperature of coil is approximately 20°C (68°F).</p>	<p>RESISTANCE OK: GO TO 3i RESISTANCE NOT OK: Replace coil.</p> <p align="right">MX,159024025,49-19-16MAY95</p>

Electrical System Diagnosis/Ignition Circuit Tests

<p><b>3i</b> Ignition Control Module Test—For Machines (S.N. 420001— )</p>	<p>Connect coil wires. Ground spark plug wires.</p>	 <p>M45246 -UN-12JAN90</p> <p><i>NOTE: Terminal (A) is larger in diameter of the two posts.</i></p> <p>Measure ignition module voltage. Connect voltmeter red lead to negative (—) coil terminal (A) and black lead to engine ground.</p> <p>Turn key switch to RUN position.</p> <p>Turn flywheel slowly by hand. Voltage should fluctuate back and forth between battery voltage and 1—1.5 volts.</p>	<p>VOLTAGE DOES NOT SWITCH: Replace ignition control module.</p> <p><b>IMPORTANT: Always replace ignition module and trigger ring as a set.</b></p> <p>Make sure an insulator is installed between the ignition module and gear cover.</p> <p>Also, replace the condenser whenever the ignition module is replaced.</p> <p>MX,159024025,50-19-16MAY95</p>
<p><b>3j</b> Ignition Timing Check—For Machines (S.N. —420000)</p>	<p><i>NOTE: The engine timing is preset at the factory, however, a slight timing change can be made by adjusting the ignition points.</i></p>	 <p>M37179 -UN-25JAN90</p> <p><b>CAUTION: Failure to disconnect and ground spark plug wires before turning flywheel by hand may cause the engine to start, resulting in injury.</b></p> <p>Disconnect and ground spark plug wires. Remove spark plugs.</p>	<p><b>Continued on next page</b></p>

Electrical System Diagnosis/Ignition Circuit Tests



M78974 -UN-16MAY95

Remove blower housing to access gearcase cover timing marks (A) and flywheel timing mark (B).

Connect one lead of an ohmmeter or continuity tester to the primary windings negative (—) terminal of the ignition coil.

Connect the other tester lead to engine ground or negative (—) terminal of battery.

Slowly turn flywheel clockwise until meter or tester shows no continuity.

Turn flywheel 360 degrees until meter or tester again shows no continuity. At this point the ignition points just open, which is when ignition occurs.

Check which of the gear case timing marks (A) is directly across from flywheel timing mark (B). See chart for timing specification of particular engine used.

If timing is early (advanced), the ignition point gap is too wide. If the timing is late (retarded), the point gap is too narrow. Adjust ignition points as necessary, GO TO 3c.

*NOTE: The ignition point gap of: 0.41 mm (0.016 in.) equals 16° BTC 0.51 mm (0.020 in.) equals 20° BTC*

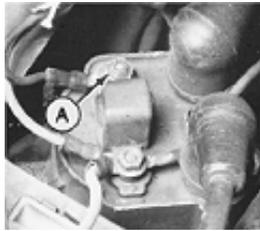
The "Spec" letter is the last letter of the engine model number.

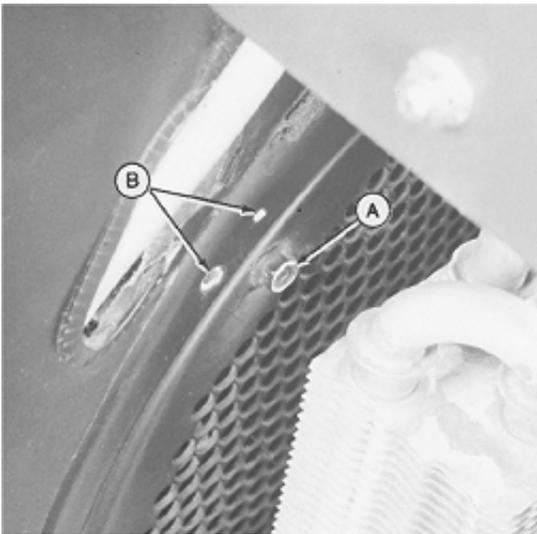
**TIMING SPECIFICATION**

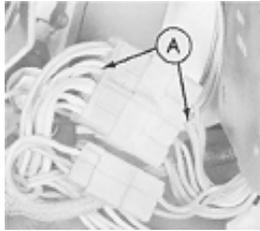
Engine Model	Timing In Degrees
B43E and B43G . . . . .	16° BTC
B48G	
Spec A and B . . . . .	20° BTC
Spec C . . . . .	16° BTC

MX,15902402551A-19-16MAY95

Electrical System Diagnosis/Ignition Circuit Tests

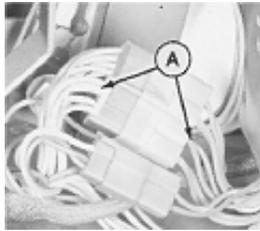
<p><b>3k Ignition Timing Check— For Machines (S.N. 420001— )</b></p>	<p><i>NOTE: Ignition timing is not adjustable. If a misfire condition exists, the flywheel key may be partially sheared. This can be verified by checking the ignition timing.</i></p>	 <p>M45246 -UN-12JAN90</p>	<p><b>CAUTION: FAILURE TO REMOVE SPARK PLUGS BEFORE TURNING FLYWHEEL BY HAND MAY CAUSE ENGINE TO START RESULTING IN INJURY.</b></p> <p>Disconnect and ground spark plug wires. Remove spark plugs.</p> <p><i>NOTE: Terminal (A) is larger in diameter of the two posts.</i></p> <p>Connect a voltmeter or continuity test lamp between negative (—) coil terminal (A) and ground.</p>
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 <p>M45247 -UN-12JAN90</p>	<p>Slowly turn the flywheel clockwise by hand until the voltmeter reading changes from 1 volt to approximately 12 volts, or the test lamp goes out.</p> <p>For correct timing, one of the flywheel screen screws (A) should be between the marks (B) on the blower housing. The marks are at the 11 o'clock position.</p> <p>To recheck timing, the flywheel must be turned another complete revolution. Moving the flywheel back and forth across the timing marks will not activate the electronic ignition control.</p>	<p><b>TIMING NOT CORRECT:</b> Check flywheel key for sheared condition, or if ignition control module and magnetic trigger ring are properly positioned.</p> <p>MX,159024025,51-19-16MAY95</p>
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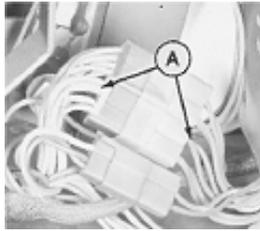
<p><b>3l Ignition Voltage Test at TDC Module</b></p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in N/STOP position.</p> <p><i>NOTE: Engaged park brake required on machines:</i>          316 (S.N. 596121— )          318 (S.N. 600305— )          420 (S.N. 595881— )</p> <p>Engage park brake.</p> <p>Turn key switch to RUN position.</p>	 <p>M37172 -UN-25JAN90</p>	<p>At both sides of TDC 8-pin connectors, check for voltage at terminal with pink and orange wires and terminal with single pink wire (A).</p> <p><b>VOLTAGE BOTH TERMINALS:</b> Pink wire from TDC connector to engine connector is open. Repair or replace wire as necessary, then GO TO Æ, Group 05.</p> <p><b>VOLTAGE ONE TERMINAL:</b> Repair connector.</p> <p><b>NO VOLTAGE:</b> GO TO 3m</p> <p>MX,159024025,53-19-16MAY95</p>
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Electrical System Diagnosis/PTO Clutch and Lamp Tests

<p><b>3m Main Power Test for TDC Module</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M37173 -UN-25JAN90</p>	<p>At both sides of TDC 8-pin connector, check for voltage at terminal with pink and purple wires and terminal with single purple wire (A).</p>	<p>VOLTAGE: Verify good ground at TDC 2-pin connector, then GO TO 3n</p> <p>VOLTAGE AT ONE TERMINAL: Repair connector, then GO TO Æ, Group 05.</p> <p>NO VOLTAGE: GO TO 1a</p>
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MX,159024025,54-19-16MAY95

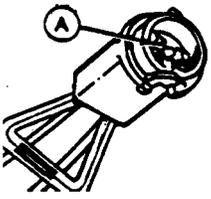
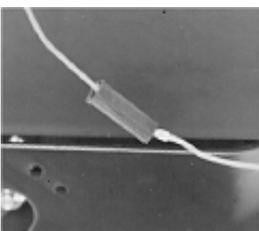
<p><b>3n Starter (Interlock) Circuit Voltage Test at TDC Module</b></p>	<p>PTO switch OFF. Hydrostatic lever in N/STOP position.</p> <p><i>NOTE: Engaged park brake required on machines:</i> 316 (S.N. 596121— ) 318 (S.N. 600305— ) 420 (S.N. 595881— )</p> <p>Engage park brake.</p> <p>Turn key switch to RUN position.</p>	 <p>M37173 -UN-25JAN90</p>	<p>Check for voltage at purple/black leads (A) at TDC 8-pin connector.</p>	<p>VOLTAGE BOTH LEADS: Verify ground at 2-pin connector. If OK; replace TDC module.</p> <p>VOLTAGE ONE LEAD: Repair connector.</p> <p>NO VOLTAGE: Purple/black wire to key switch is open or there is an opening in the starter interlock circuit. GO TO 2e</p>
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MX,159024025,55-19-16MAY95

<p><b>Å PTO CLUTCH AND LAMP TEST</b></p> <p>Listed at right are symptoms that may occur if the PTO clutch circuit malfunctions. Locate the symptom that applies, then proceed to the appropriate test.</p>	<p><b>PTO CLUTCH CIRCUIT SYMPTOMS:</b></p> <ul style="list-style-type: none"> <li>—PTO Lamp Does Not Come On, But Clutch Engages: GO TO 4a</li> <li>—PTO Lamp Burns Out Frequently: GO TO 4b</li> <li>—PTO Lamp Comes On, But Clutch Doesn't Engage: GO TO 4c</li> <li>—PTO Lamp Does Not Come On And Clutch Doesn't Engage: GO TO 4e</li> <li>—PTO Does Not Disengage When Operator Raises From The</li> </ul>	<p>Seat For Approximately 1 Second Or More: GO TO 4f</p> <ul style="list-style-type: none"> <li>—PTO Clutch Slips: GO TO Ö, Group 25.</li> </ul>
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MX,159024025,56-19-16MAY95

Electrical System Diagnosis/PTO Clutch and Lamp Tests

<p><b>4a PTO Lamp Test</b></p>	<p>Remove battery base to access instrument panel.</p> <p>Disconnect PTO lamp socket.</p> <p>Remove and check bulb.</p>	 <p>M36643 -UN-29AUG88</p>	<p>If bulb is good, check for continuity between black wire at contact (A) and ground.</p>	<p>CONTINUITY: Replace blue wire between PTO switch and bulb socket. Repair or replace wire as necessary, then GO TO <math>\bar{A}</math>, Group 05.</p> <p>NO CONTINUITY: Repair or replace ground wire as necessary, then GO TO <math>\bar{A}</math>, Group 05.</p>
<p><b>4b PTO Lamp Diode Test</b></p>	<p><i>NOTE: Diodes are designed to allow current flow in one direction only.</i></p> <p>Remove battery base to access instrument panel.</p> <p>Remove PTO lamp socket.</p> <p>Remove bulb.</p>	<p>Check diode with ohmmeter or continuity tester. If using a digital meter, use diode check position on meter.</p>	<p>Check for continuity across terminals of bulb socket. Reverse leads and check again.</p> <p><i>LOOK: There should be continuity in one direction only.</i></p>	<p>CONTINUITY ONE DIRECTION ONLY: Circuit probably has an intermittent short. Check all connections and grounds, then GO TO <math>\bar{O}</math>, Group 25.</p> <p>CONTINUITY BOTH DIRECTIONS OR NO CONTINUITY: Replace diode.</p>
<p><b>4c PTO Voltage Test at Clutch Connector</b></p>	<p>Remove right-hand engine side panel.</p> <p>Install jumper wire across seat switch connector or have someone sit on seat.</p> <p>Turn key switch to RUN position.</p> <p>Move PTO switch to ON position.</p>	 <p>M55084 -UN-09DEC89</p>	<p><i>NOTE: Machines (S.N. —475000) shown. Later machines use a 2-pin connector.</i></p> <p>Check for voltage at blue lead of PTO clutch connector.</p>	<p>VOLTAGE: GO TO 4d</p> <p>NO VOLTAGE: GO TO 4e</p>

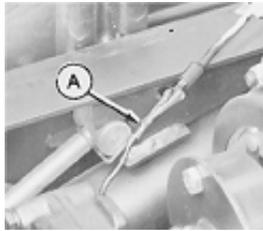
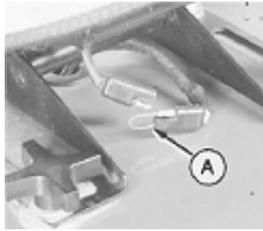
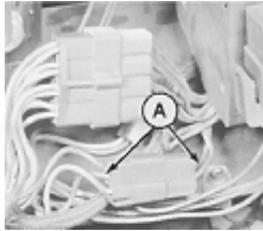
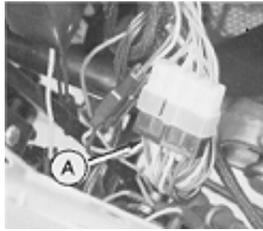
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MX,159024025,58-19-16MAY95

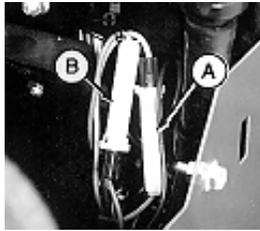
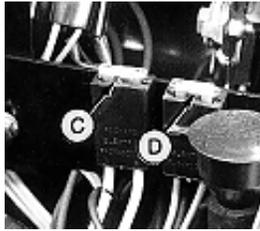
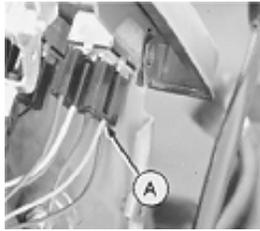
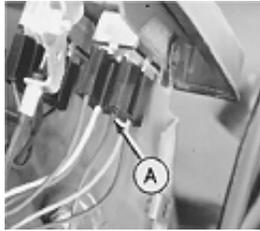
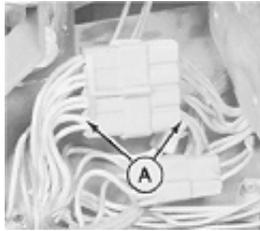
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*Electrical System Diagnosis/PTO Clutch and Lamp Tests*

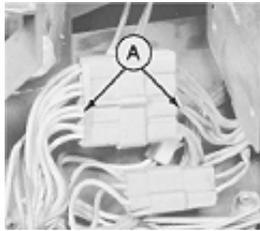
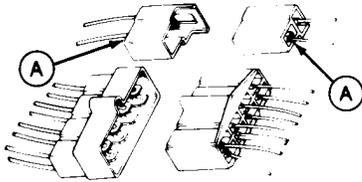
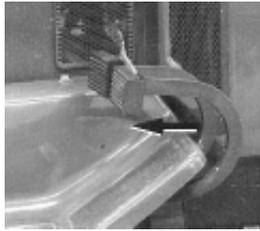
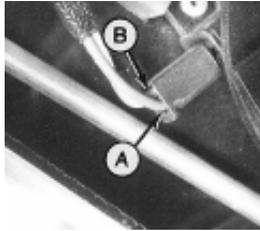
<p><b>4d PTO Clutch Test</b></p>	<p>Separate PTO clutch connector at right-hand side of engine.</p> <p><i>NOTE: Machines (S.N. —475000) shown. Later machines use a 2-pin connector.</i></p>	 <p>M36626 -UN-25JAN90</p>	<p>Connect a jumper wire to battery positive (+) terminal and jump to dark blue clutch lead (A).</p> <p>For machines (S.N. 475001— ), also connect a jumper wire from the black PTO clutch lead to ground.</p> <p><i>LISTEN: Clutch should "click" when engaged.</i></p>	<p><b>CLUTCH ENGAGES:</b> For machines (S.N. 475001— ), check continuity between ground and the black wire contact at main harness side of PTO clutch connector. If no continuity, repair or replace harness ground wire, then GO TO Å, Group 05.</p> <p><b>CLUTCH DOES NOT ENGAGE:</b> Check for good ground. If ground OK, repair clutch: GO TO Section 40.</p> <p align="right">MX,159024025,60-19-16MAY95</p>
<p><b>4e Seat Switch Circuit Test for PTO or Ignition Circuits.</b></p>	<p><i>NOTE: Jumper wire (A) not required for this test.</i></p> <p>Disconnect seat switch connector.</p>	 <p>M36627 -UN-25JAN90</p>	<p>Turn key switch to the RUN position.</p> <p>Check for voltage at harness side of connector.</p>	<p><b>VOLTAGE:</b> GO TO 4f</p> <p><b>NO VOLTAGE:</b> GO TO 4h</p> <p align="right">MX,159024025,61-19-16MAY95</p>
<p><b>4f Seat Switch Test</b></p>	<p>Key switch OFF.</p> <p>Disconnect seat switch connector.</p>	<p>Connect ohmmeter or continuity tester across switch side of connector.</p> <p>There should NOT be continuity.</p>	<p>Press down on center of seat.</p> <p>There should be continuity.</p> <p>Connect switch after testing.</p>	<p><b>SEAT SWITCH OK:</b> GO TO 4g</p> <p><b>SEAT SWITCH NOT OK:</b> Replace switch, then GO TO Ũ and Ū, Group 05.</p> <p align="right">MX,159024025,62-19-16MAY95</p>
<p><b>4g Seat Switch Circuit Test at TDC 2-Pin Connector</b></p>	<p>Install jumper wire across seat switch connector or have someone sit on seat.</p>	 <p>M37289 -UN-25JAN90</p>	<p>Turn key switch to RUN position.</p> <p>Check for voltage at pink wire at TDC 2-pin connector (A).</p>	<p><b>VOLTAGE:</b> Circuit OK, GO TO 4j</p> <p><b>NO VOLTAGE:</b> Replace pink wire between seat switch and TDC 2-pin connector.</p> <p align="right">MX,159024025,63-19-16MAY95</p>
<p><b>4h 2-Amp or 3-Amp Power Circuit Test at TDC 8-Pin Connector</b></p>	<p><i>NOTE: For machines: 316 (S.N. 475001— ) 318 (S.N. 475001— ) 420 (S.N. 595881— ), a 3-amp fuse is used.</i></p> <p>Turn key switch to RUN position.</p>	 <p>M55133 -UN-11DEC89</p>	<p>Check for voltage at red and pink leads (A) at TDC 8-pin connector.</p>	<p><b>VOLTAGE:</b> Replace pink wire between seat switch and TDC 8-pin connector.</p> <p><b>NO VOLTAGE:</b> GO TO 4i</p> <p align="right">MX,159024025,64-19-16MAY95</p>

*Electrical System Diagnosis/PTO Clutch and Lamp Tests*

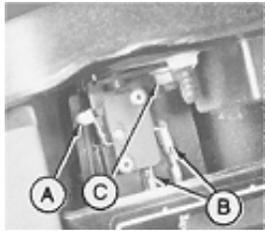
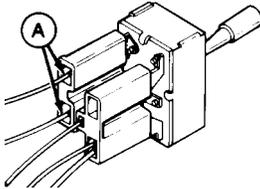
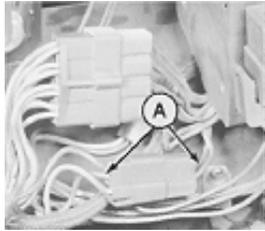
<p><b>4i Power Circuit Voltage Test at 2-Amp or 3-Amp Fuse</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M55140 -UN-13APR95</p>  <p>M77926 -UN-12APR95</p>	<p>For machines: 316 (S.N. —475000) 318 (S.N. —475000) 420 (S.N. —595880), check for voltage at both ends of 2-amp, in-line fuse (B).</p> <p>For machines: 316 (S.N. 475001— ) 318 (S.N. 475001— ) 420 (S.N. 595881— ), check for voltage at both contacts of 3-amp fuse (D).</p>	<p>VOLTAGE BOTH SIDES: Replace red wire to TDC 8-pin connector.</p> <p>VOLTAGE ONE SIDE: Check fuse contacts.</p> <p>NO VOLTAGE: GO TO 1e</p> <p align="right">MX,159024025,65-19-16MAY95</p>
<p><b>4j PTO circuit Test at PTO Switch</b></p>	<p>Key switch OFF. PTO switch OFF.</p> <p>Install jumper wire across seat switch connector.</p>	 <p>M55144 -UN-09DEC89</p>	<p>Turn key switch to RUN position.</p> <p>Move PTO switch to ON position.</p> <p>Check for voltage at double blue leads (A) at PTO switch.</p>	<p>VOLTAGE: Replace blue wire to PTO clutch connector.</p> <p>NO VOLTAGE: GO TO 4k</p> <p align="right">MX,159024025,66-19-16MAY95</p>
<p><b>4k PTO Circuit Test at PTO Switch—Continued</b></p>	<p>Jumper wire across seat switch connector.</p> <p>Key switch at RUN position.</p> <p>PTO switch ON.</p>	 <p>M55145 -UN-09DEC89</p>	<p>Check for voltage at single blue lead (A) on PTO switch.</p>	<p>VOLTAGE: Replace PTO switch.</p> <p>NO VOLTAGE: GO TO 4l</p> <p align="right">MX,159024025,67-19-16MAY95</p>
<p><b>4l PTO Circuit Test at TDC Module</b></p>	<p>Jumper wire across seat switch connector.</p> <p>Key switch at RUN position.</p> <p>PTO switch ON.</p>	 <p>M37181 -UN-25JAN90</p>	<p>Check for voltage at single blue wires (A) at TDC 8-pin connector.</p>	<p>VOLTAGE ONE LEAD: Repair connector.</p> <p>VOLTAGE BOTH LEADS: Replace blue wire from 8-pin connector to PTO switch.</p> <p>NO VOLTAGE: GO TO 4m</p> <p align="right">MX,159024025,68-19-16MAY95</p>

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Electrical System Diagnosis/Brake Neutral Start Safety Switch Test

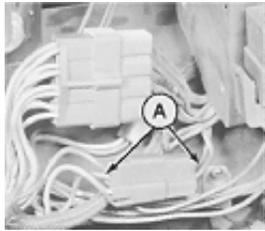
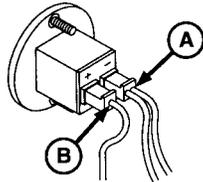
<p>4m <b>20-Amp Power Circuit Test at TDC Module</b></p>	<p>Turn key switch to RUN position.</p>	 <p>M37290 -UN-25JAN90</p>	<p>Check for voltage at pink and purple leads and single purple lead (A) at TDC 8-pin connector.</p>	<p>VOLTAGE ONE LEAD: Repair connector.</p> <p>VOLTAGE BOTH LEADS: GO TO 4n</p> <p>NO VOLTAGE: GO TO 1f</p> <p>MX,159024025,69-19-16MAY95</p>
<p>4n <b>TDC Ground Check at 2-Pin Connector</b></p>	 <p>M36649 -UN-28APR95</p>	<p>Turn key switch to OFF position.</p> <p>Verify good ground at TDC 2-pin connector (A).</p>	<p>GOOD GROUND: Replace TDC Module.</p> <p>NO OR POOR GROUND: Clean connections and restore good ground, then GO TO A, Group 05.</p>	<p>MX,159024025,70-19-16MAY95</p>
<p>0 <b>BRAKE NEUTRAL START SAFETY SWITCH TEST—</b>  <b>For Machines:</b>          316 (SN 596121— )          318 (SN 600305— )          420 (SN 595881— )</p>	<p>PTO switch OFF.</p> <p>Hydrostatic lever in STOP position.</p>	 <p>M77933 -UN-17JAN95</p>  <p>M77931 -UN-17JAN95</p>	<p>Release brake pedal completely.</p> <p>Turn key switch to RUN position.</p> <p>Check for voltage at purple lead (A).</p>	<p>VOLTAGE: Check for proper switch engagement. IF OK; replace switch, then GO TO 0, Group 05.</p> <p><i>NOTE: Brake switch engagement can be adjusted by slightly bending the engagement pad that's welded on the brake linkage shaft. Check for proper brake adjustment before bending the tab. (See Section 60, Group 10.)</i></p> <p>MX,159024025,71-19-16MAY95</p>

Electrical System Diagnosis/Seat Switch Test For PTO Time Delay

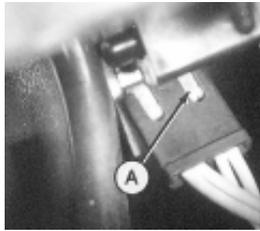
<p>0 TRANSMISSION NEUTRAL START SAFETY SWITCH TEST</p>	<p>Key switch OFF. Put hydrostatic lever in REVERSE position.</p>	 <p>M45195 -UN-08JAN90</p> <p>With switch arm (A) fully released, check for continuity across terminals (B). CONTINUITY: Replace and adjust switch. NO CONTINUITY: Push switch arm (A) fully in. Check for continuity across terminals (B) again.</p>	<p>NO CONTINUITY: Replace and adjust switch. CONTINUITY: Adjust switch if necessary. <b>IMPORTANT: After tightening nut (C), make sure hydro lever does not push switch arm (A) against switch body, otherwise, damage to switch could occur.</b> Put hydrostatic lever in N/STOP position, loosen adjusting nut (C) and slide switch toward hydrostatic lever until switch "clicks" (contacts just close), then tighten nut. AFTER REPLACING AND/OR ADJUSTING SWITCH: GO TO ' and 0, Group 05.</p>
<p>0 PTO NEUTRAL START SAFETY SWITCH TEST</p>	<p>Turn key switch to RUN position. Move PTO switch to ON position.</p>	 <p>M36648 -UN-17JAN95</p> <p>Check for voltage at both purple leads (A) at PTO switch.</p>	<p>VOLTAGE AT BOTH LEADS: Replace switch, then GO TO 0, Group 05.</p>
<p>U SEAT SWITCH TEST FOR PTO TIME DELAY</p>	<p>Key switch OFF.</p>	 <p>M37289 -UN-25JAN90</p> <p>Check the black leads (A) of the TDC 2-pin connector for good ground.</p>	<p>GOOD GROUND: Replace TDC module, then GO TO ; , Group 05. POOR GROUND: Clean and tighten all ground connections as needed, then GO TO U, Group 05.</p>

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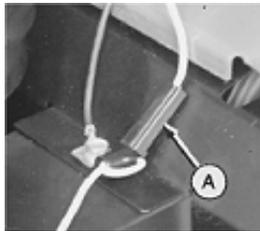
Electrical System Diagnosis/Hour Meter Circuit Test

<p>Ü SEAT SWITCH TEST FOR IGNITION TIME DELAY</p>	<p>Key switch OFF.</p>	 <p>M37289 -UN-25JAN90</p> <p>Check the black leads (A) of the TDC 2-pin connector for good ground.</p>	<p>GOOD GROUND: Replace TDC module, then GO TO ; , Group 05.</p> <p>POOR GROUND: Clean and tighten all ground connections then GO TO Ü, Group 05.</p> <p>MX,159024025,75-19-16MAY95</p>
<p>10 HOUR METER CIRCUIT TEST</p>	<p>Check fuses.</p> <p>Put jumper wire across seat switch terminals.</p> <p>Key switch OFF.</p>	 <p>M77934 -UN-19JAN95</p> <p>Check for continuity between terminal with two black wires (A) and ground.</p> <p>Turn key switch to RUN position.</p> <p>Check for voltage at terminal with orange wire (B).</p>	<p>CONTINUITY AND VOLTAGE OK: Replace hour meter.</p> <p>NO CONTINUITY: Black wire from hour meter to ground is open.</p> <p>NO VOLTAGE: Check if orange wire to TDC 8-pin connector is open. If ok, GO TO 3k</p> <p>MX,159024025,76-19-16MAY95</p>

*Electrical System Diagnosis/Lighting Test*

<p><b>1! LIGHTING TEST</b></p>	<p>Check bulbs and 20-amp fuse.</p> <p><i>NOTE: If lights come on when key switch is in the RUN position, but light switch is in OFF position, replace light switch.</i></p> <p>Turn key switch to RUN position.</p> <p><i>NOTE: If either head or tail lamp comes on when light switch is pulled to the ON position, light switch is OK: GO TO 1: a.</i></p> <p>Pull light switch to ON position.</p>	 <p>M77928 -UN-17JAN95</p>	<p>Check for voltage at connector terminal (A).</p> <p>NO VOLTAGE: GO TO 1c</p> <p>VOLTAGE: Check for voltage at other switch terminal.</p>	<p>NO VOLTAGE: Replace light switch.</p> <p>VOLTAGE: GO TO 1: a</p>
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MX,159024025,77-19-16MAY95

<p><b>1: a Voltage Test for Head or Tail Lamps</b></p>	<p>Turn key switch to RUN position.</p> <p>Pull light switch On.</p>	 <p>M55063 -UN-09DEC89</p>	<p><i>NOTE: Machines (S.N. —475000) shown.</i></p> <p><i>For machines (S.N. 475001— ), a 2-pin connector is used.</i></p> <p>Disconnect head light connector (A) or tail light connector and check for voltage.</p>	<p>VOLTAGE: Check for shorts, open wires, or poor grounds in wiring to head and tail lamps.</p> <p>NO VOLTAGE: Yellow wire from light switch to connector is open. Repair or replace.</p>
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MX,159024025,78-19-16MAY95

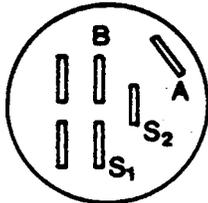
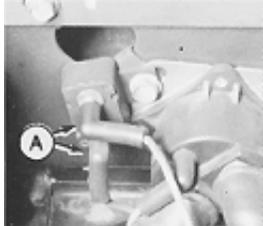
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28

# Electrical System Component Tests and Adjustments

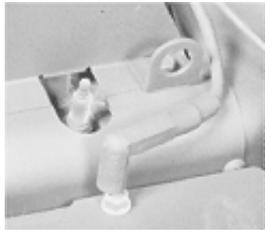
## BEFORE YOU START

Always perform the system checkout procedures in Group 05 and the System Diagnosis in Group 20 BEFORE making any tests in this group. These procedures include any special tooling required to identify a failure. Make the repair and perform the System Checkout in Group 05 to be certain all failures are solved.

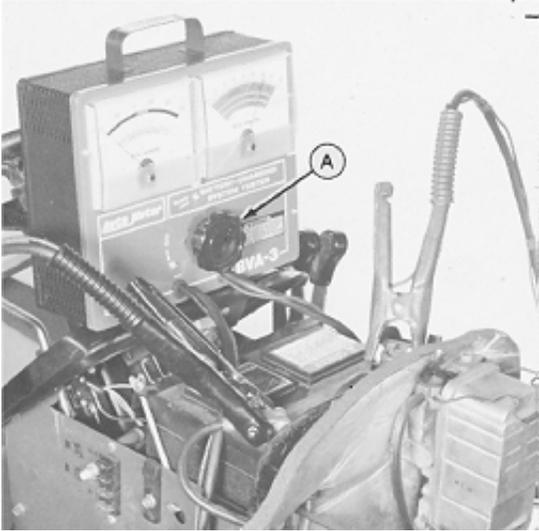
MX,159024030,1 -19-16MAY95

<p><b>KEY SWITCH TEST</b></p>	<p>Remove key switch from machine. Test terminals for continuity using a continuity tester or ohmmeter.</p>	 <p>M37207 -UN-29AUG88</p>	<table border="0"> <thead> <tr> <th>Key Position</th> <th>Continuity</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>NONE</td> </tr> <tr> <td>RUN</td> <td>B + A</td> </tr> <tr> <td>START</td> <td>B + A, S<sup>1</sup> + S<sup>2</sup></td> </tr> </tbody> </table>	Key Position	Continuity	OFF	NONE	RUN	B + A	START	B + A, S <sup>1</sup> + S <sup>2</sup>	<p>CONTINUITY: Key switch OK.</p> <p>NO CONTINUITY: Replace key switch.</p> <p>MX,159024030,2 -19-16MAY95</p>
Key Position	Continuity											
OFF	NONE											
RUN	B + A											
START	B + A, S <sup>1</sup> + S <sup>2</sup>											
<p><b>CIRCUIT BREAKER TEST</b></p>	 <p>M37397 -UN-25JAN90</p>	<p><i>NOTE: Machines:</i>            316 (S.N. —362983)            318 (S.N. —364137)            420 (S.N. —360009)  <i>shown.</i></p> <p>Disconnect wires (A) from circuit breaker.</p>	<p>Connect ohmmeter across the circuit breaker terminals.</p>	<p>ZERO RESISTANCE: Circuit breaker OK.</p> <p>RESISTANCE: Replace circuit breaker.</p> <p>MX,159024030,3 -19-16MAY95</p>								

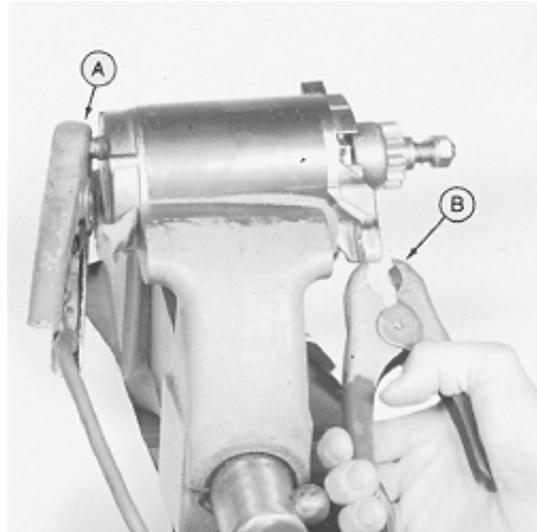
Electrical System Component Tests and Adjustments/Starter Tests

<p><b>Æ STARTER DRAW TEST</b></p>	<p>Before performing starter draw test, test battery. (See Battery Tests B in Group 20 of this section.)</p>	<p>Disconnect and ground spark plug wires.</p> 	
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M37179 -UN-25JAN90

 <p>M36655 -UN-25JAN90</p>	<p><b>IMPORTANT: Before making any test connections, turn load knob (A) on meter fully counterclockwise.</b></p> <p>Connect JT05685 Battery Tester to machine battery. Red lead to positive (+) terminal, black lead to negative (—) terminal.</p> <p>Crank engine with starter and read voltage on meter while cranking.</p> <p>Use a photo tachometer such as JT05719 to check engine rpm while cranking. Engine should crank at approximately 300 rpm.</p> <p>With key switch at OFF position, adjust load knob (A) until battery voltage reads the same as when cranking.</p> <p>Read amperage on meter. Amperage should read 250 amps or less.</p> <p>Immediately after test, turn load knob (A) fully counterclockwise.</p>	<p>250 AMPS OR LESS AT 300 RPM: Starter OK.</p> <p>250 AMPS OR LESS BUT RPM IS LESS THAN 300: For Machines: 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) GO TO 3b</p> <p>For Machines: 316 (S.N. 362984— ) 318 (S.N. 364138— ) 420 (S.N. 360010— ) GO TO 3e</p> <p>MORE THAN 250 AMPS: For Machines: 316 (S.N. —362983) 318 (S.N. —364137) 420 (S.N. —360009) GO TO 3a</p> <p>For Machines: 316 (S.N. 362984— ) 318 (S.N. 364138— ) 420 (S.N. 360010— ) GO TO 3d</p> <p>MX,159024030,4 -19-16MAY95</p>
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**3a Bendix Starter—  
No Load Running  
Test**



M37208 -UN-25JAN90

Disconnect battery ground cable.

Remove starter and mount in a vise.

Connect jumper cables from starter to machine battery or battery of similar capacity.

Connect positive clamp to starter positive (+) terminal (A).

Connect negative (—) battery cable (B) to starter body.

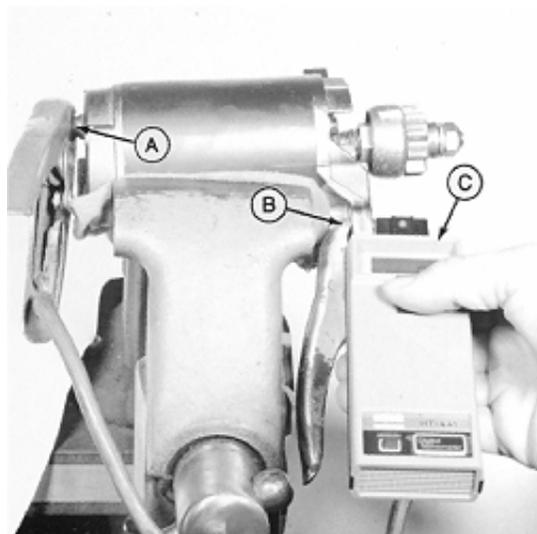
Starter should run.

**STARTER DOESN'T RUN:** Repair starter. (See CTM2.)

**STARTER RUNS:** GO TO 3b

MX,159024030,6 -19-16MAY95

**3b Bendix Starter—  
No Load RPM  
Test**



M37203 -UN-25JAN90

Mount starter in a vise and connect to a battery as instructed in 3a

With starter running, check no load rpm with a tachometer such as JT05719. (Follow manufacturer instructions with the tachometer.)

No load rpm should be about 5900.

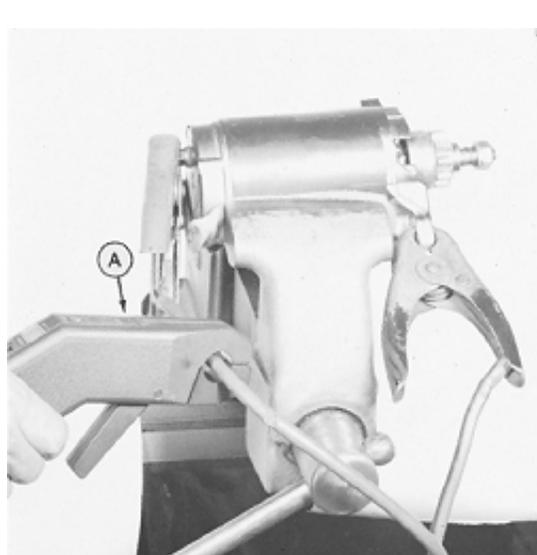
**RPM NO LESS THAN 5900:** GO TO 3C

**RPM BELOW 5900:** Make sure battery is of proper rating size and fully charged. If not, repeat test as needed with proper size battery that's fully charged.

If battery is OK, repair or replace starter. (See CTM2.)

MX,159024030,7 -19-16MAY95

**3C Bendix Starter—  
No Load Amp  
Draw Test**



M37204 -UN-25JAN90

Mount starter in a vise and connect to a battery as instructed in step 3a

With starter running, check amperage with JT05712 Current Gun (A).

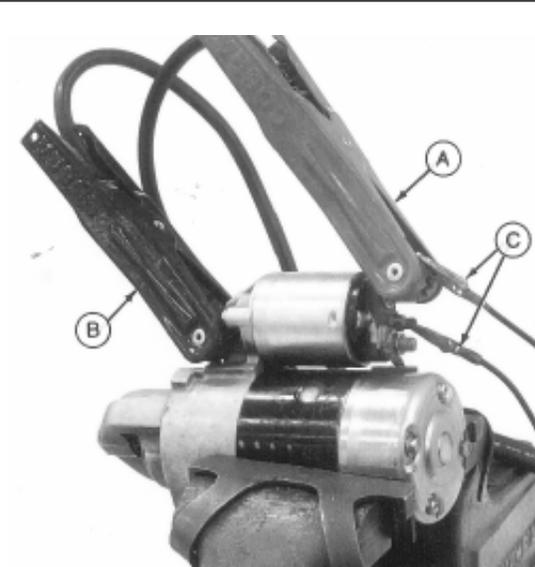
Starter should draw 30 amps or less at 5900 rpm.

**AMPERAGE 30 OR LESS:** Starter OK. Malfunction is in wiring on machine. Check all connections and grounds.

**AMPERAGE MORE THAN 30:** Repair or replace starter. (See CTM2.)

MX,159024030,8 -19-16MAY95

**3d Solenoid Shift Starter—No Load Running Test**



M77935 -UN-17JAN95

Disconnect battery ground cable.

Remove starter and mount in a vise.

Use jumper cables to connect starter to machine battery or battery of similar capacity.

Connect positive clamp (A) to positive (+) battery cable terminal on starter solenoid.

Connect negative (—) battery cable (B) to starter body.

Connect jumper wire (C) to the solenoid coil terminal and to positive cable clamp as shown.

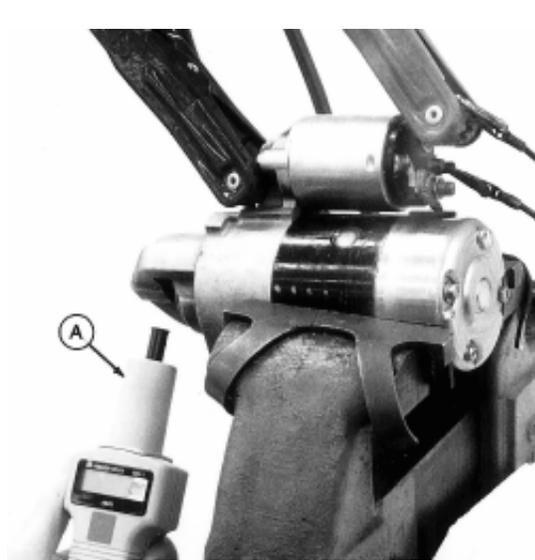
Starter should engage and run.

**STARTER DOESN'T RUN:** Repair starter. (See CTM2.)

**STARTER ENGAGES AND RUNS:** GO TO 3e

MX,159024030,9 -19-16MAY95

**3e Solenoid Shift Starter—No Load RPM Test**



M77936 -UN-18JAN95

Mount starter in a vise and connect to a battery as instructed in 3d

With starter running, check no load rpm with a tachometer such as JT05719. (Follow manufacturer instructions with the tachometer.)

No load rpm should be about 7000.

**RPM NO LESS THAN 7000:** GO TO 3f

**RPM BELOW 7000:** Make sure battery is of proper rating size and fully charged. If not, repeat test as needed with proper size battery that's fully charged.

If battery is OK, repair or replace starter. (See CTM2.)

MX,159024030,10-19-16MAY95

**3f Solenoid Shift Starter—No Load Amp Draw Test**



M77937 -UN-17JAN95

Mount starter in a vise and connect to a battery as instructed in step 3d

With starter running, check amperage with JT05712 Current Gun (A).

Starter should draw 53 amps or less at 7000 rpm.

AMPERAGE 53 OR LESS: Starter OK. Malfunction is in wiring on machine. Check all connections and grounds.

AMPERAGE MORE THAN 53: Repair or replace starter. (See CTM2.)

MX,159024030,11-19-16MAY95

**Ä ALTERNATOR TEST FOR REGULATED CURRENT OUTPUT**

**IMPORTANT: Poor connections and grounds contribute to a large portion of the problems associated with the charging system. Verify that all system connections and grounds are good before replacing any parts. Make sure battery cable connections are clean and tight.**



M37205 -UN-25JAN90

Disconnect and ground spark plug wires.

Discharge battery by cranking engine for 10—15 seconds.

*NOTE: Be sure selector switch on current gun is set for DC current and current direction arrow on gun is pointing in the correct direction.*

Connect JT05712 Current Gun (A) over white wire with red stripe, connected to B+ terminal on regulator.

Connect a voltmeter to battery positive (+) and negative (—) terminals.

Connect spark plug wires to spark plugs.

*NOTE: The maximum current (unregulated) output for the 316-P218G engine and all 318 and 420 engines is 20 amps.*

*The maximum current (unregulated) output of the 316-B43E engine is 15 amps.*

Start engine and run at full throttle. Observe meters. Ammeter should start at a high output until the battery voltage comes up to 13.8—14.7.

After voltage reaches 13.8—14.7, the amp output should start to decrease.

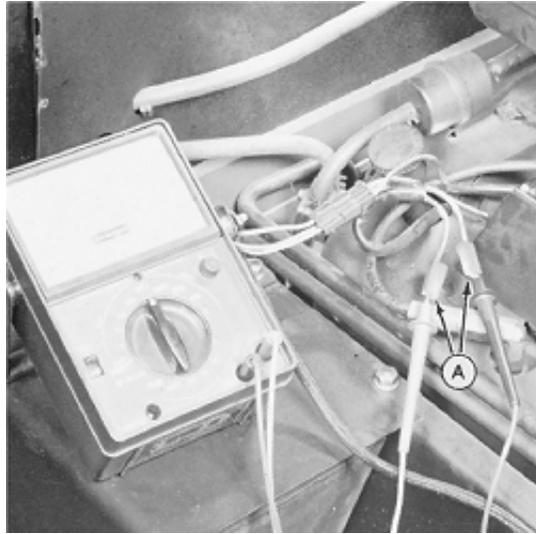
AMP OUTPUT DOES NOT DECREASE, BATTERY VOLTAGE GOES ABOVE 15: Replace regulator.

AMP OUTPUT IS HIGH BUT BATTERY VOLTAGE DOES NOT INCREASE: Battery is bad or connections or grounds are bad.

AMP OUTPUT IS LOW BUT BATTERY VOLTAGE EVENTUALLY INCREASES: GO TO 4a

MX,159024030,12-19-16MAY95

**4a Alternator Test For Unregulated Output**



M37209 -UN-25JAN90

*NOTE: The specifications listed in the table below are the approximate maximum VAC output of unregulated stators used on the "P" series and "B" series engines.*

Disconnect stator leads (A) from regulator.

Start engine and run at full throttle (approx. 3450 rpm).

Connect voltmeter to stator leads (A). Compare reading with specification (listed in chart) of engine being tested.

*NOTE: If stator AC voltage is at least twice the specified battery DC voltage, stator is probably okay. Perform resistance and continuity tests if stator is still suspect.*

*The "Spec" letter is the last letter of the engine model number.*

<b>"P" SERIES ENGINE (P218G and P220G)</b>	<b>VAC OUTPUT</b>
Spec "A" .....	28—41 VAC
Spec "B" and "C" .....	28—57 VAC
<b>"B" SERIES ENGINE</b>	<b>VAC OUTPUT</b>
B43E .....	28—40 VAC
B43G and B48G .....	28—31 VAC

*NOTE: A stator shorted to ground may produce VAC output that's within specification, but produce below specified VDC when stator is connected to regulator.*

Key switch OFF.  
Stator leads disconnected from regulator.

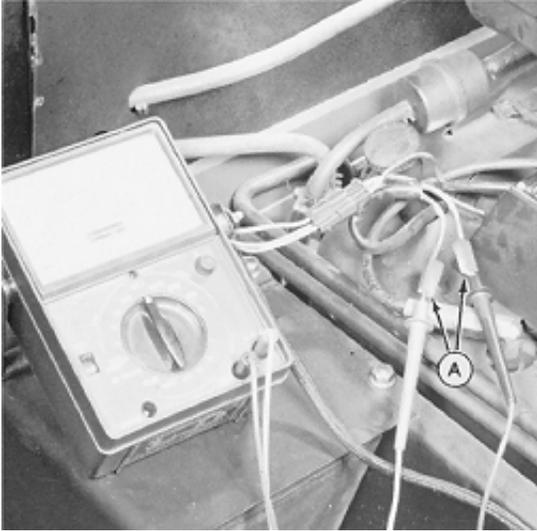
Check each stator lead for continuity to ground.

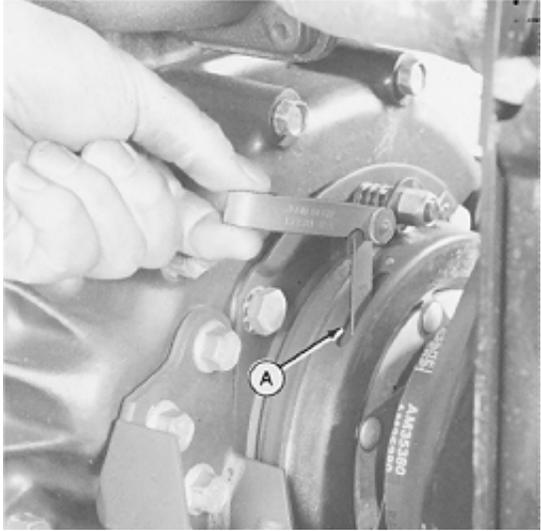
CONTINUITY TO GROUND: Replace stator.  
NO CONTINUITY TO GROUND: GO TO 4b

MX,159024030,14-19-17MAY95

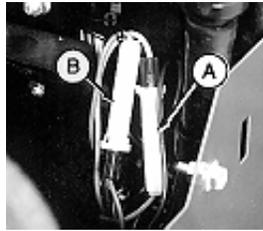
Electrical System Component Tests and Adjustments/PTO Clutch Adjustment Check

<p><b>4b Stator Resistance Test</b></p>	<p>Key switch OFF.</p>	<p>Stator leads disconnected from regulator.</p>	<p><i>NOTE: Because of the small amount of resistance in the stator windings, use a digital multimeter or an analog meter with a high sensitivity rating to measure resistance of stator windings. If an analog meter is to be used, make sure it is at the lowest scale setting and is zeroed.</i></p>
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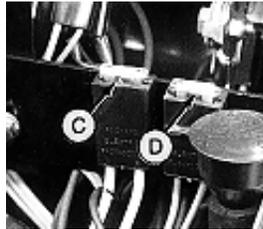
 <p>M37209 -UN-25JAN90</p>	<p>Connect ohmmeter to stator leads (A). Compare reading with specification (listed in chart) of engine being tested.</p> <p><i>NOTE: The "Spec" letter is the last letter of the engine model number.</i></p> <table border="0"> <tr> <td><b>"P" SERIES ENGINE (P218G and P220G)</b></td> <td><b>RESISTANCE (ohms)</b></td> </tr> <tr> <td>Spec "A" . . . . .</td> <td>0.06—0.10</td> </tr> <tr> <td>Spec "B" and "C" . . . . .</td> <td>0.10—0.19</td> </tr> <tr> <td><b>"B" SERIES ENGINE</b></td> <td><b>RESISTANCE (ohms)</b></td> </tr> <tr> <td>B43E . . . . .</td> <td>0.10—0.20</td> </tr> <tr> <td>B43G and B48G . . . . .</td> <td>0.30—0.50</td> </tr> </table>	<b>"P" SERIES ENGINE (P218G and P220G)</b>	<b>RESISTANCE (ohms)</b>	Spec "A" . . . . .	0.06—0.10	Spec "B" and "C" . . . . .	0.10—0.19	<b>"B" SERIES ENGINE</b>	<b>RESISTANCE (ohms)</b>	B43E . . . . .	0.10—0.20	B43G and B48G . . . . .	0.30—0.50	<p><b>RESISTANCE NOT OK:</b> Replace stator.</p> <p><b>RESISTANCE OK:</b> Verify all connections are good. Clean or replace connections as necessary.</p> <p>MX,159024030,16-19-16MAY95</p>
<b>"P" SERIES ENGINE (P218G and P220G)</b>	<b>RESISTANCE (ohms)</b>													
Spec "A" . . . . .	0.06—0.10													
Spec "B" and "C" . . . . .	0.10—0.19													
<b>"B" SERIES ENGINE</b>	<b>RESISTANCE (ohms)</b>													
B43E . . . . .	0.10—0.20													
B43G and B48G . . . . .	0.30—0.50													

<p><b>Ö PTO CLUTCH ADJUSTMENT CHECK</b></p>	 <p>M36659 -UN-25JAN90</p>	<p>Key switch OFF.</p> <p>Check armature-to-rotor clearance using a feeler gauge.</p> <p>Insert feeler gauge through slot (A) in brake plate.</p> <p>Clearance should be 0.46 mm (0.018 in.)</p> <p><i>NOTE: There are three slots around the clutch for checking clearance. Check clearance at all slots.</i></p>	<p><b>CLEARANCE OK:</b> Repair or replace clutch assembly. (See Section 40.)</p> <p><b>CLEARANCE NOT OK:</b> Adjust clearance as instructed in Section 40.</p> <p>MX,159024030,17-19-16MAY95</p>
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**0 SYSTEM SHORT CIRCUIT TESTS FOR 20-AMP FUSE**



M55140 -UN-13APR95



M77926 -UN-12APR95

*NOTE: For machines:*  
 316 (S.N. —475000)  
 318 (S.N. —475000)  
 420 (S.N. —595880),  
 A—20-Amp Fuse  
 B—2-Amp Fuse

*NOTE: For machines:*  
 316 (S.N. 475001— )  
 318 (S.N. 475001— )  
 420 (S.N. 595881— ),  
 C—20-Amp Fuse  
 D—3-Amp Fuse

THE 20-AMP FUSE PROVIDES CURRENT TO:

- Neutral Start (Interlock) Circuit
- Lighting Circuit
- Ignition/Hour Meter Circuit
- PTO Circuit

• If the 20-amp fuse blows each time the key switch is turned to the RUN position, there is probably a short in the 20-amp fuse power circuit, neutral start circuit or ignition/hour meter circuit. Isolate the short by using the following method:

1. With the PTO switch in the ON position, turn key switch to RUN position.

**FUSE DOESN'T BLOW:** Go to Step 2.

**FUSE BLOWS:** Short is in the 20-amp fuse power circuit.

2. Put PTO switch at OFF position, hydro lever in N/STOP and engage park brake (later models). Disconnect TDC 8-pin connector,

then turn key switch to RUN position.

**FUSE BLOWS:** Short is in the neutral start circuit.

**FUSE DOESN'T BLOW:** Short is in TDC module or

ignition/hour meter circuit.

• If the fuse blows after pulling the light switch to the ON position with key switch in RUN position, then a short is probably in yellow wires between the light switch and lights.

• If the fuse blows only after the key switch is turned to START position, a short is probably in the purple wire between key switch and starter solenoid.

• If the fuse blows after PTO switch is moved to ON position, the short is either at the PTO clutch or blue wires running between the PTO switch, clutch and lamp. The short is NOT in or before the TDC module.

**MOST LIKELY AREAS TO CHECK FOR SHORTS:**

Wires routed through panels or between frame and deck.

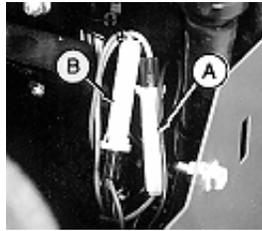
Wires routed near exhaust manifold or muffler

Wires routed near the drive shaft.

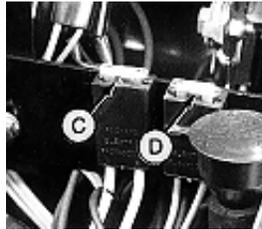
MX,159024030,18-19-16MAY95

Electrical System Component Tests and Adjustments/System Short Circuit Tests

0 SYSTEM SHORT CIRCUIT TESTS FOR 2-AMP OR 3-AMP FUSE



M55140 -UN-13APR95



M77926 -UN-12APR95

NOTE: For machines:  
316 (S.N. —475000)  
318 (S.N. —475000)  
420 (S.N. —595880),  
A—20-Amp Fuse  
B—2-Amp Fuse

NOTE: For machines:  
316 (S.N. 475001— )  
318 (S.N. 475001— )  
420 (S.N. 595881— ),  
C—20-Amp Fuse  
D—3-Amp Fuse

THE 2 OR 3-AMP FUSE PROVIDES CURRENT TO:

—Time Delay Control (Seat Switch) Circuit

—Battery Discharge Control Circuit

• If the 2 or 3-amp fuse blows each time the key switch is turned to the RUN position, a short is probably in the 2 or 3-amp fuse power circuit or inside the TDC module. Check red wire running between fuse and TDC 8-pin connector and pink wire running between TDC 8-pin connector and seat switch.

• If sitting on the seat blows this fuse when the key switch is at the RUN position, there is probably a short in the pink wire running between the seat switch and TDC 2-pin connector or a short may be inside the TDC module.

MOST LIKELY AREAS TO CHECK FOR SHORTS:

Wires routed through panels or between frame and deck.

Wires routed near exhaust manifold or muffler

Wires routed near the drive shaft.

MX,159024030,19-19-16MAY95

240  
25  
10

# Section 250

# POWER TRAIN CHECKOUT, OPERATION AND DIAGNOSIS

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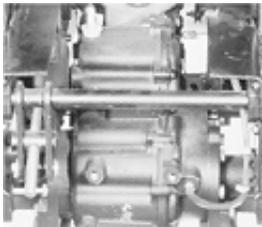
## BEFORE YOU START

Always begin with this group to identify a failure in the power train. The step-by-step procedures will provide you with a quick check of the system. No tools are required to perform these checks. If a failure is indicated, you will be referred to a more detailed check, adjustment, or test.

This procedure is designed as a quick check of the system. While performing the check, concentrate only on the check you are performing and disregard signals from unrelated components.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the check.

MX,159025005,1 -19-20APR95

<p><b>TRANSMISSION OIL LEAK CHECK</b></p>	 <p>M36695 -UN-25JAN90</p>	<p>Check transmission oil level and oil condition.</p> <p>Inspect for external transmission oil leakage from transmission filter, drain plug, lines, fittings, charge pump gasket, charge pump shaft seal and differential gasket.</p>	<p><b>OK:</b> GO TO ' </p> <p><b>NOT OK:</b> Repair or replace then GO TO ' </p> <p style="text-align: right;">MX,159025005,2 -19-20APR95</p>
<p><b>HYDROSTATIC LEVER FRICTION CHECK</b></p>	<p>Start and run engine at fast idle.</p>	 <p>M36669 -UN-25JAN90</p> <p>Move hydrostatic lever to slow forward position.</p> <p><i>LOOK: Hydrostatic lever must move freely and not move after released.</i></p>	<p><b>OK:</b> GO TO Æ</p> <p><b>NOT OK:</b> GO TO Ü, GROUP 15.</p> <p style="text-align: right;">MX,159025005,3 -19-20APR95</p>
<p><b>TRANSMISSION NEUTRAL CHECK</b></p>	 <p>M36668 -UN-25JAN90</p>	<p>Move hydrostatic lever to N/STOP position.</p> <p>Start and run engine at half throttle.</p> <p><i>LOOK: Machine must not creep in neutral.</i></p>	<p><b>OK:</b> GO TO Å</p> <p><b>NOT OK:</b> GO TO GROUP 15: Early Machines: 1! Later Machines: 1@</p> <p style="text-align: right;">MX,159025005,4 -19-16MAY95</p>

*Power Train Checkout/Speed Reduction Check*

<p><b>Ä NEUTRAL RETURN CHECK</b></p>	<p>318 and 420; Lock pedals together.</p>	 <p>M36667 -UN-25JAN90</p>  <p>M36668 -UN-25JAN90</p> <p>Move hydrostatic lever to full forward or reverse position.</p> <p>Depress brake pedal(s).</p> <p><i>LOOK: Hydrostatic lever must move to "STOP" position from forward or reverse.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> GO TO 10, GROUP 15.</p> <p align="right">MX,159025005,5 -19-20APR95</p>
<p><b>0 TRANSMISSION DRIVE CHECK</b></p>	<p>Start and run engine at fast idle. Operate machine under no load and then under load conditions.</p>	 <p>M36669 -UN-25JAN90</p> <p>Move hydrostatic lever from slow forward, to full forward, to full reverse.</p> <p><i>LOOK: Machine must move and increase speed, slow down, change direction and increase speed as lever is moved from full forward to full reverse.</i></p> <p><i>FEEL: Speed increase must be smooth. Transmission suction line must not be uncomfortable to touch.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> Check transmission oil level.</p> <p><b>OIL LEVEL OK:</b> GO TO ; , GROUP 15.</p> <p align="right">MX,159025005,6 -19-20APR95</p>
<p><b>0 SPEED REDUCTION CHECK (318 AND 420)</b></p>	<p>Start engine and run at half throttle.</p>	 <p>M36669 -UN-25JAN90</p>  <p>M36667 -UN-25JAN90</p> <p>Move hydrostatic lever to full forward position.</p> <p>Depress right brake pedal.</p> <p><i>LOOK: Hydrostatic lever must move to slow forward position. Right wheel must stop; left wheel must continue to turn.</i></p>	<p align="right">MX,159025005,7 -19-25APR95</p>

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Power Train Checkout/Operator Complaint Not Identified

<p>Move hydrostatic lever to full forward position.</p>	 <p>M36671 -UN-25JAN90</p>	<p>Depress left brake pedal.</p> <p><i>LOOK: Hydrostatic lever must move to slow forward position. Left wheel must stop; right wheel must continue to turn.</i></p>	<p><b>OK:</b> GO TO 0</p> <p><b>NOT OK:</b> GO TO Ü, GROUP 15.</p> <p>MX,159025005,8 -19-25APR95</p>
<p><b>0 TWO-SPEED AXLE LEVER CHECK (420)</b></p>	<p>Start and run engine at half throttle.</p>	 <p>M36672 -UN-25JAN90</p> <p>Move two-speed axle lever to slow speed position. Move hydrostatic lever to full forward position.</p> <p><i>LOOK: Observe ground speed.</i></p> <p>Move two-speed axle lever to fast speed position. Move hydrostatic lever to full forward position.</p> <p><i>LOOK: Ground speed must be approximately twice as fast.</i></p>	<p><b>OK:</b> GO TO Ü</p> <p><b>NOT OK:</b> GO TO 1#, GROUP 15.</p> <p>MX,159025005,9 -19-20APR95</p>
<p><b>Ü DIFFERENTIAL LOCK CHECK (420)</b></p>	<p>Start and run engine at fast idle.</p> <p>Move hydrostatic lever to slow forward position.</p>	 <p>M36673 -UN-25JAN90</p> <p>Turn steering wheel left or right.</p> <p>Depress differential lock and turn left or right.</p> <p><i>LOOK: With differential lock depressed, machine must try to go straight forward when steering wheel is turned or rear tire must show scuffing on the ground.</i></p>	<p><b>OK:</b> System Normal.</p> <p><b>NOT OK:</b> GO TO 1\$, GROUP 15.</p> <p>MX,159025005,10-19-20APR95</p>
<p><b>Ü OPERATOR COMPLAINT NOT IDENTIFIED</b></p>	<p>If you completed the checkout procedure and did not isolate a malfunction, the problem may be intermittent.</p> <p>Try to duplicate the conditions of the malfunction identified by the operator.</p>	<p>IF A MALFUNCTION IS NOT IDENTIFIED AFTER SYSTEM CHECKOUT PROCEDURE; FACTORY ASSISTANCE IS AVAILABLE THROUGH DEALER TECHNICAL ASSISTANCE CENTER (DTAC).</p>	<p>MX,159025005,11-19-20APR95</p>

*Power Train Checkout/Operator Complaint Not Identified*

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## HYDROSTATIC TRANSMISSION OPERATION

### Function:

Transfers power from the input (pump) shaft to the gear drive components of the transmission. It also provides infinitely variable speed and torque within a range in forward and reverse directions.

Also supplies pressurized oil to the hydraulic lift and steering systems.

### Theory of Operation:

The transmission consists of a variable displacement, axial piston pump (B) connected in a closed loop to a fixed displacement, axial piston motor (I). A charge pump (C) and valve system is used to charge and lubricate the transmission.

The charge pump is a gerotor-type, fixed displacement pump. It continually pumps oil throughout the entire hydrostatic/hydraulic system whenever the engine is running.

As the input (pump) shaft (A) is turned by the engine drive shaft, the pump rotating group consisting of the variable hydrostatic pump and charge pump also turn. The charge pump draws pressure-free oil from the reservoir (F) through the filter (D) and pressurizes it to approximately 620—1240 kPa (90—180 psi). The charge oil pressure is enough to unseat the forward and/or reverse check valve (E and M), supplying charge pressure oil to pump (B).

The transmission also supplies pressurized oil to the lift and hydraulic steering systems. If pressure in this line becomes excessive, the implement relief valve (N) will open allowing the oil to flow into the reservoir.

### NEUTRAL:

With the transmission in the neutral position, springs in the pump cylinder bores force the pump pistons against the variable position swashplate, which is parallel to the pump body. With the swashplate parallel to the pump body, the pistons do not reciprocate in the cylinder block, they merely rotate, no oil is being drawn in or discharged from the pump. The pump is in a zero displacement position and the machine remains stationary.

### FORWARD:

As the swashplate control arm is moved to the forward position, the variable position swashplate is moved from the neutral position to a forward angle position. Springs inside the cylinder bores force the pistons against the swashplate. As the pump rotates

the pistons follow the contour of the swashplate they move outward, drawing oil into their bores. As the pistons continue to rotate, the swashplate angle forces the pistons back into the bores, forcing oil out of the bores through the valve plate.

High pressure oil from the pump forces the forward check valve (E) closed and supplies pressurized oil to the drive motor (I). The motor works in conjunction with a fixed position swashplate. Oil enters the piston bore through a port in the valve plate at a point where the piston is compressed in its bore.

As the oil fills the piston bore, the piston is forced out and follows the contour of the swashplate. This causes the motor to rotate. Oil pressure within these components is directly proportional to the load encountered. This is known as the high pressure side of the system.

As the motor continues to rotate, the piston is now compressed by the angle of the swashplate and oil is forced from the piston bore into the other port in the valve plate. This oil is directed back to the suction side of the pump. There is minimal oil pressure from the back to the motor and this is referred as the low pressure side of the system.

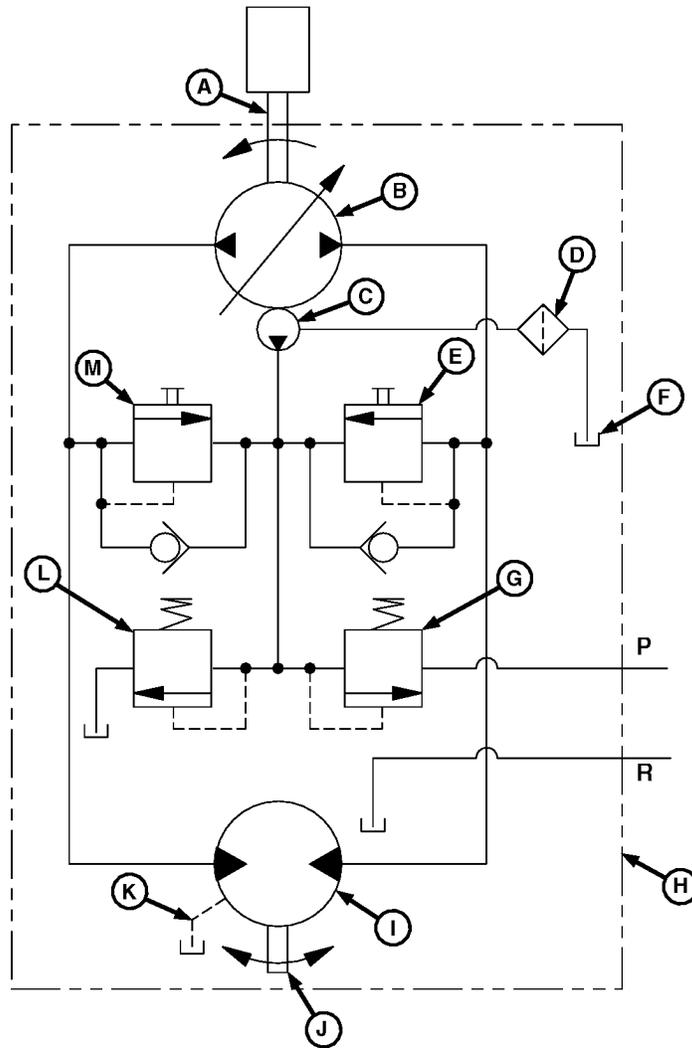
The reverse check (freewheel) valve (M) remains open to allow charge pressure oil to flow to the low pressure side of the system to make up for any oil lost due to internal lubrication/leakage.

### REVERSE:

The operation of the transmission in reverse is similar to forward operation, except that the reverse swashplate position causes the pressurized oil flow to be reversed. When oil flow is reversed, the reverse check (freewheel) valve (M) is forced closed supplying pressurized oil to the drive motor. The forward check valve (E) remains open to allow charge pressure oil to flow to the low pressure side of the system to make up for any oil lost due to internal lubrication/leakage.

### FREEWHEEL:

When the forward/reverse check (freewheel) valves are manually engaged, the valves are forced off their seats and allows oil to flow from both sides of the motor to the reservoir. Normally the motor would have excessive resistance to movement due to dynamic braking of the hydrostatic closed loop.



A—Input (Pump) Shaft  
 B—Variable Hydrostatic Pump  
 C—Charge Pump  
 D—Filter

E—Forward Check (Freewheel) Valve  
 F—Reservoir  
 G—Charge Relief Valve

H—Hydrostatic Transmission Housing  
 I—Hydrostatic Drive Motor  
 J—Output (Motor) Shaft

K—Transmission Case Drain  
 L—Implement Relief Valve  
 M—Reverse Check (Freewheel) Valve

M78856 -JUN-03APR95

MX.159025010.2 -19-20APR95



## ABOUT THIS GROUP

Always perform the system checkout procedures in Group 05 BEFORE making any tests or adjustments in this group. The step-by-step procedures in this group provide you with the detailed diagnostic information you will need to isolate a malfunction. Basic diagnostic equipment is used.

It is assumed that you are familiar with the machine and its power train components. If you need additional information, read the theory of operation in Group 10 or refer to the overall hydraulic schematics in Section 270, Group 10.

Engine rpm and temperature are critical in most hydraulic tests. Be sure to follow test specifications carefully.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the test.

Upon completing a test or adjustment, check to see whether the problem is corrected by performing the checkout procedures in Group 05.

MX,159025015,1 -19-20APR95

## ; TROUBLESHOOTING GUIDE

If machine does not operate properly, select the appropriate symptom from the list below.

- MACHINE MOVES IN ONE DIRECTION ONLY: GO TO A
- MACHINE WILL NOT MOVE IN EITHER DIRECTION: GO TO B
- MACHINE CREEPS IN ONE DIRECTION CONSISTENTLY: GO TO 1! OR 1@
- HYDRO CONTROL LEVER DOES NOT RETURN TO NEUTRAL WHEN BOTH BRAKES ARE APPLIED: GO TO 10
- TRANSMISSION OPERATION HAS ERRATIC OR LOW POWER OR SPEED WILL NOT INCREASE: GO TO C
- MACHINE WILL NOT REACH FULL SPEED: GO TO D
- TRANSMISSION OPERATES HOT: GO TO E
- MACHINE FREEWHEELS: GO TO F
- HYDRAULIC SYSTEM IS NOISY: GO TO G
- NO HYDRAULICS AFTER BEING SERVICED: GO TO H
- CHARGE PUMP SEAL REPEATEDLY FAILS: GO TO I

MX,159025015,2 -19-20APR95

## **A MACHINE MOVES IN ONE DIRECTION ONLY**

- Inspect transmission control linkage for wear or damage. See Section 50.
- 316 and 318; Test for debris in check valves: GO TO '
- Inspect check valves for damaged valve seat, seals or stuck check ball. See Section 50.
- Inspect internal transmission components for wear or damage. See Section 50.

MX,159025015,3 -19-20APR95

## **B MACHINE WILL NOT MOVE IN EITHER DIRECTION**

- Inspect transmission control linkage for wear or damage. See Section 50.
- Inspect transmission drive shaft and crankshaft pulley for loose cap screws or damage.
- Check for improper charge pump installation (180 degrees off). See Section 50.
- Test charge pump pressure: GO TO Æ
- Inspect check valves for damaged valve seat, seals or stuck check ball. See Section 50.
- Inspect internal rotating group for scoring and wear (slippers, pistons and cylinder block, valve plate and cylinder block). If internal damage is found, check for missing welch plug: GO TO Ò

MX,159025015,4 -19-20APR95

## **C TRANSMISSION OPERATION HAS ERRATIC OR LOW POWER OR SPEED WILL NOT INCREASE**

- Inspect brakes and brake linkage for wear or damage. See Section 60.
- Inspect transmission control linkage for wear or damage. See Section 50.
- Check for improper charge pump installation (180 degrees off). See Section 50.
- Test charge pump pressure: GO TO Æ
- Inspect check valves for damaged valve seat, seals or stuck check ball. See Section 50.
- Inspect internal rotating group for scoring and wear (slippers, pistons and cylinder block, valve plate and cylinder block). If internal damage is found, check for missing welch plug: GO TO Ò
- Check for dirt accumulation on transmission causing transmission oil to overheat: GO TO Ò
- Check for high draft loads causing transmission oil to overheat: GO TO Ò

MX,159025015,5 -19-20APR95

## D MACHINE WILL NOT REACH FULL SPEED

- Inspect transmission control linkage for wear or damage. See Section 50.
- Inspect transmission and differential mounting cap screws for loose condition.
- Check engine fast idle speed: See Section 220.
- Inspect check valves for damaged seat, seals or stuck check ball. See Section 50.
- Inspect internal rotating group for scoring and wear (slippers, pistons and cylinder block, valve plate and cylinder block). If internal damage is found check for missing welch plug: GO TO 0

MX,159025015,6 -19-20APR95

## E TRANSMISSION OPERATES HOT

- Check transmission temperature. GO TO 0
- Check all cooling components for plugged or restricted condition.
- 318 and 420; Test steering valve for neutral return: GO TO U
- Test charge pump pressure: GO TO A
- Inspect internal transmission components for wear or damage. See Section 50.
- Check for dirt accumulation on transmission causing transmission oil to overheat: GO TO 0
- Check for high draft loads causing transmission oil to overheat: GO TO 0

MX,159025015,7 -19-20APR95

## F MACHINE FREEWHEELS

- Inspect transmission control linkage for loose connections allowing swashplate movement under load. See Section 50.
- 316 and 318; Test for debris in check valves: GO TO '
- Inspect check valves for damaged valve seat, seals or stuck check ball. See Section 50.
- Test charge pump pressure: GO TO A
- Inspect internal rotating group for scoring and wear (slippers, pistons and cylinder block, valve plate and cylinder block). If internal damage is found check for missing welch plug: GO TO 0

MX,159025015,8 -19-20APR95

## **G HYDRAULIC SYSTEM IS NOISY**

- Check power steering valve, if equipped, or hydraulic control valve for overheating. If either valve is too hot to touch after 1/2 hour of operation, disassemble valve and repair internal leak. See Section 60 or 70.
- Adjust hydrostatic transmission linkage for positive neutral position: GO TO 10
- Check steel hydraulic lines for vibration. Especially the line that runs from the charge pump to the steering valve on later 318 and 420 models, or the line that runs from the charge pump to the SCV on early 318 and 420 models. Secure with clamps or replace with a rubber pressure hose rated at 8274 kPa (1200 psi).
- Adjust charge relief valve so that charge pressure is above 1379 kPa (200 psi). The increased charge pressure will not cause any problems and it may eliminate the noise, if it is caused by charge relief valve chattering: GO TO 3c
- Increase implement relief pressure to upper limit of specification: GO TO 4b

MX,159025015,9 -19-20APR95

## **H NO HYDRAULICS AFTER BEING SERVICED**

- Check for improper charge pump installation (180 degrees off). See Section 50.
- Check for proper installation of transmission output shaft bearing into aluminum case. If installed too shallow, the motor rotating group will not contact the valve plate. See Section 50.

MX,159025015,10-19-20APR95

## **I CHARGE PUMP SEAL REPEATEDLY FAILS**

- Inspect the seal surface on the shaft.
- Inspect seal for cuts which may be caused by installing seal over shaft without covering sharp splines.
- Check for a loose or worn U-Joint on the drive shaft.
- Inspect charge pump for wear or damage. Charge pressure may be getting into the seal area because of internal pump leakage. See Section 50.

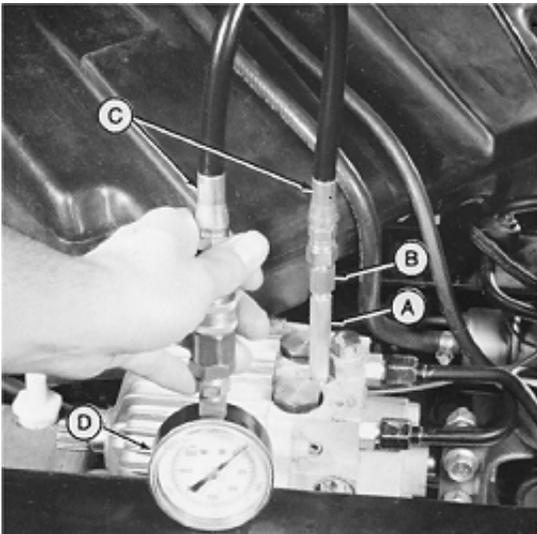
MX,159025015,11-19-20APR95

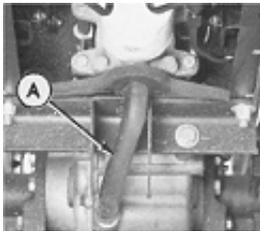
Diagnosis, Tests and Adjustments/Charge Pump

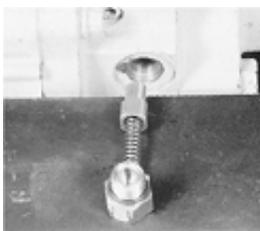
<p><b>CHECK VALVE DEBRIS CHECK</b></p>	<p>Engine OFF. Service park brake OFF.</p>	 <p>316 and 318; Engage Manual Push lever (A) and push machine forward to remove debris from check valves.</p> <p>Early 420; Remove fender deck. Remove and inspect check valves for debris. Repair or replace if necessary.</p> <p>Later 420; Remove fender deck. Manually depress check valve "buttons" and push machine forward to remove debris from check valves.</p>	<p>Repeat Transmission Drive Check in Group 05.</p>
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MX,159025015,12-19-21APR95

<p><b>Æ CHARGE PUMP PRESSURE TEST</b></p>	<p>Heat hydraulic oil to 43°C (110°F), See <math>\bar{O}</math> in this group.</p> <p><b>CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.</b></p> <p><i>NOTE: It is normal for charge pressure to increase as engine speed or implement pressure increases. Charge pressure up to 3448 kPa (500 psi) at fast idle is normal.</i></p>	<p>Continued on next page</p>
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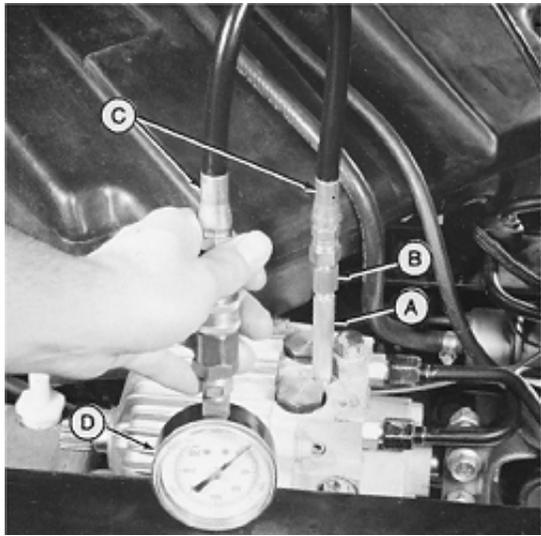
 <p>M36682 -UN-25JAN90</p>	<p><b>A</b>—JT03339 Connector  <b>B</b>—JT03107 Adapter  <b>C</b>—JT03017 Hose  <b>D</b>—JT03344 Gauge, 2000 kPa (300 psi)</p>	<p><b>IMPORTANT:</b>  Hydraulic control levers must remain in neutral position and engine must be run at slow idle.</p> <p>Pressure gauge will be damaged if a hydraulic function is actuated or test is run at fast idle.</p> <p>Make test connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit.</p> <p>Run engine at slow idle.</p> <p><i>LOOK: Record pressure reading.</i></p> <p>Charge pressure must be 620—1240 kPa (90—180 psi).</p>	<p><b>CHARGE PRESSURE OK:</b> Inspect check valves for wear or damage. See Section 50. Then repeat Æ</p> <p><b>CHARGE PRESSURE LOW:</b> REPLACE FILTER, THEN...REPEAT Æ</p> <p><b>CHARGE PRESSURE STILL LOW:</b> GO TO 3a</p> <p>MX,159025015,13-19-20APR95</p>
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<p><b>3a Charge Pump Suction Line Check</b></p>	 <p>M49217 -UN-20DEC89</p>	<p>Inspect suction line (A) for restriction, loose hose clamp, holes or damage that would cause air leakage.</p>	<p><b>SUCTION LINE OK:</b> GO TO 3b</p> <p><b>SUCTION LINE DAMAGED:</b> Repair or replace then bleed hydraulic system. See Section 270, Group 20.</p> <p>MX,159025015,14-19-20APR95</p>
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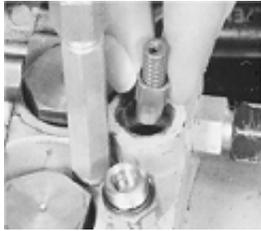
<p><b>3b Charge Relief Valve Check</b></p>	 <p>M36683 -UN-25JAN90</p>	<p>Remove charge relief valve and check for a broken spring or a stuck or damaged valve. Replace broken parts.</p>	<p><b>CHARGE RELIEF VALVE OR SPRING WORN:</b> GO TO 3c</p> <p><b>CHARGE RELIEF VALVE NOT DAMAGED:</b> GO TO Æ</p> <p>MX,159025015,15-19-20APR95</p>
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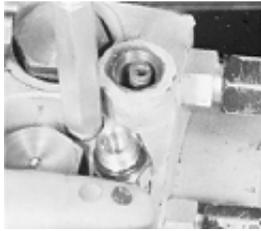
<p><b>3c Charge Relief Valve Adjustment</b></p>	 <p>M36684 -UN-25JAN90</p>	<p><i>NOTE: Only use shims to increase pressure when valve or spring are worn. Charge pressure will not increase by adding shims if another component is leaking.</i></p> <p>Add shims (A) in spring retainer to increase charge pressure to specification.</p> <p>Check charge pressure.</p>	<p><b>IF CHARGE PRESSURE IS STILL LOW:</b> GO TO Æ</p> <p>MX,159025015,16-19-20APR95</p>
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Diagnosis, Tests and Adjustments/Implement Relief Valve

<p><b>IMPLEMENT RELIEF VALVE PRESSURE TEST</b></p>	<p><b>CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.</b></p>		<p>A—JT03339 Connector B—JT03107 Adaptor C—JT03017 Hose D—JT03345 Gauge, 20,000 kPa (3000 psi)</p>
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<p>Make test connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit.</p> <p>Heat hydraulic oil to 43°C (110°F), see 0 in this group.</p> <p>Run engine at fast idle.</p> <p>Move and hold control valve lever in</p>	<p>full raise position.</p> <p><i>LOOK: Record pressure reading.</i></p> <p>Implement pressure must be 5861—6722 kPa (850—975 psi).</p>	<p>IMPLEMENT PRESSURE OK: GO TO 0</p> <p>IMPLEMENT PRESSURE LOW: GO TO 4a</p> <p>MX,159025015,17-19-21APR95</p>
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<p><b>4a Implement Relief Valve Check</b></p>	 <p>M36686 -UN-25JAN90</p> <p>Remove implement relief valve and check for a broken spring or a stuck or damaged valve.</p> <p><i>LOOK: Implement relief valve spring is a much heavier spring than the charge relief valve spring.</i></p>	<p>IMPLEMENT RELIEF VALVE NOT DAMAGED: GO TO 4b</p> <p>IMPLEMENT RELIEF VALVE DAMAGED: Replace damaged valve parts, then check implement pressure.</p> <p>IMPLEMENT PRESSURE STILL LOW: GO TO 4b</p> <p>MX,159025015,18-19-20APR95</p>
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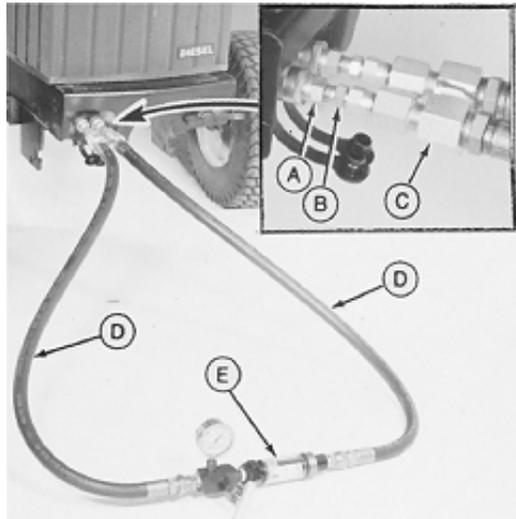
<p><b>4b Implement Relief Valve Adjustment</b></p>	 <p>M36687 -UN-25JAN90</p> <p><i>NOTE: Only use shims to increase pressure when valve or spring are worn. Implement pressure will not increase by adding shims if another component is leaking.</i></p> <p>Add shims in spring retainer to increase implement pressure to specification.</p> <p>Check implement pressure.</p>	<p>IF IMPLEMENT PRESSURE IS STILL LOW: GO TO 0</p> <p>MX,159025015,19-19-20APR95</p>
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**0 CHARGE PUMP FLOW TEST**

**CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.**

Make front outlet connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit and JT05469 Flowmeter Kit.

Heat hydraulic oil to 43°C (110°F), See 0 in this group.



A—JT03340 Quick Coupler  
 B—JT03343 Connector  
 C—JT03342 Coupler  
 D—JT05531 Hose  
 E—STD12 Flowmeter

M36688 -UN-25JAN90

Run machine at fast idle.

Move and hold outside hydraulic control lever in implement lower position. Turn load valve until pressure reaches 3450 kPa (500 psi).

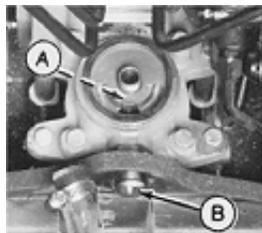
*LOOK: Pump flow must be a minimum of 11 L/min (3 gpm)*

**CHARGE PUMP FLOW OK:** Inspect transmission internal components for wear or damage. See Section 50.

**CHARGE PUMP FLOW NOT OK:** Inspect charge pump for sheared drive pin, wear or damage. Repair or replace, then test charge pump flow.

MX,159025015,20-19-20APR95

**0 WELCH PLUG LOCATION CHECK**



M49218 -UN-20DEC89

*NOTE: If welch plug is missing, unfiltered oil is flowing through the transmission possibly causing excessive wear of the rotating groups and charge pump.*

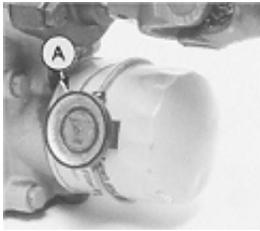
Remove transmission oil filter.

Check for welch plug at position (A). Put a piece of wire thru threaded fitting. It must hit welch plug and not come out kidney shaped port.

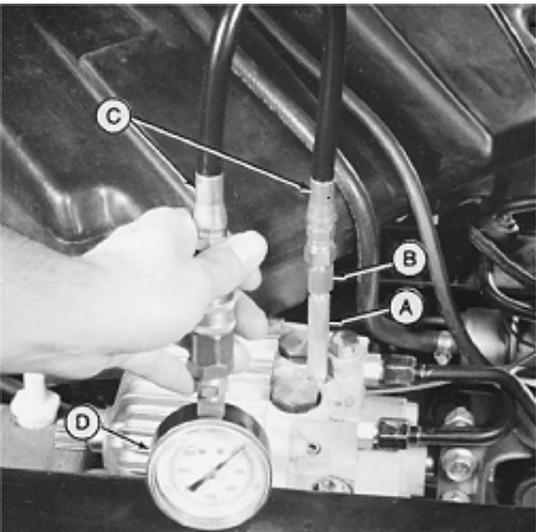
If welch plug is missing install a new one through suction hose fitting (B). Use LOCTITE thread sealant and stake into housing.

MX,159025015,21-19-20APR95

Diagnosis, Tests and Adjustments/Steering Valve Neutral Check (318 and 420)

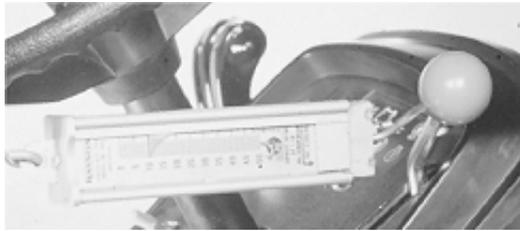
<p><b>0</b> HYDRAULIC OIL WARM-UP PROCEDURE</p>	 <p>Remove belly screen/pan. Install JDG282 Temperature Gauge (A) on transmission oil filter.</p> <p>M43008 -UN-18JAN90</p>	<p>Apply park brake. Start engine and run at full throttle.</p> <p>MX,159025020,22-19-20APR95</p>
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 <p>M43629 -UN-12JAN90</p>	<p>Move and hold control lever in implement "raise" position. Periodically cycle all hydraulic functions to distribute heated oil. <i>NOTE: 316 Shown</i></p>	<p>Heat oil to temperature specified in test. <i>NOTE: The hydrostatic transmission should not exceed 93°C (200°F) as a continuous operating temperature.</i></p> <p>MX,159025020,23-19-20APR95</p>
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<p><b>U</b> STEERING VALVE NEUTRAL CHECK (318 and 420)</p>	<p><b>CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.</b></p>	 <p>M36682 -UN-25JAN90</p>	<p>A—JT0339 Connector B—JT03107 Adaptor C—JT03017 Hose D—JT03345 Gauge, 20,000 kPa (3000 psi)</p>
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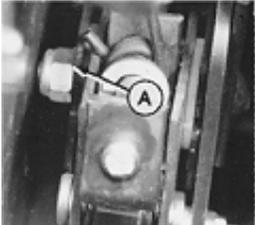
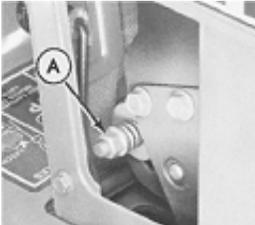
<p>Make test connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit. Heat hydraulic oil to 43°C (110°F) see 0 in this group. Run engine at slow idle. Move steering wheel to left and right turn position. <i>LOOK: When steering wheel is being turned pressure should increase. When steering wheel is stopped (neutral position) pressure must drop to approximately 620—1240 kPa (90—180 psi).</i> Repeat several times to ensure neutral position.</p>	<p><b>OK: STEERING VALVE RETURNS TO NEUTRAL.</b> <b>STEERING VALVE DOES NOT RETURN TO NEUTRAL: Remove and repair steering valve. See Section 60.</b></p> <p>MX,159025020,24-19-20APR95</p>
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Diagnosis, Tests and Adjustments/Neutral Return Linkage Adjustment (Early Models)

<p><b>Ü</b> <b>HYDROSTATIC LEVER FRICTION ADJUSTMENT</b></p>	<p>Early models; Remove left and right engine side panels, battery and battery base.</p> <p>Later models; Remove right-hand pedestal screen/panel.</p>		<p>Connect a scale to hydrostatic control lever.</p>
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M36674 -UN-25JAN90

MX,159025020,25-19-20APR95

 <p>M36675 -UN-25JAN90</p>  <p>M49215 -UN-20DEC89</p>	<p>Adjust friction disks by tightening or loosening lock nut (A) until 31—44.5 N (7—10 lb force) is required to move hydrostatic control lever.</p> <p><i>NOTE: Top photo shows Version One—All Models and Version Two—420.</i></p> <p><i>NOTE: Bottom photo shows Version Two—316 and 318 and Versions Three and Four—All Models.</i></p>
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MX,159025020,26-19-20APR95

<p><b>10</b> <b>NEUTRAL RETURN LINKAGE ADJUSTMENT</b></p>	<p>Hydrostatic lever friction must be adjusted previous to this adjustment: GO TO Ü</p>
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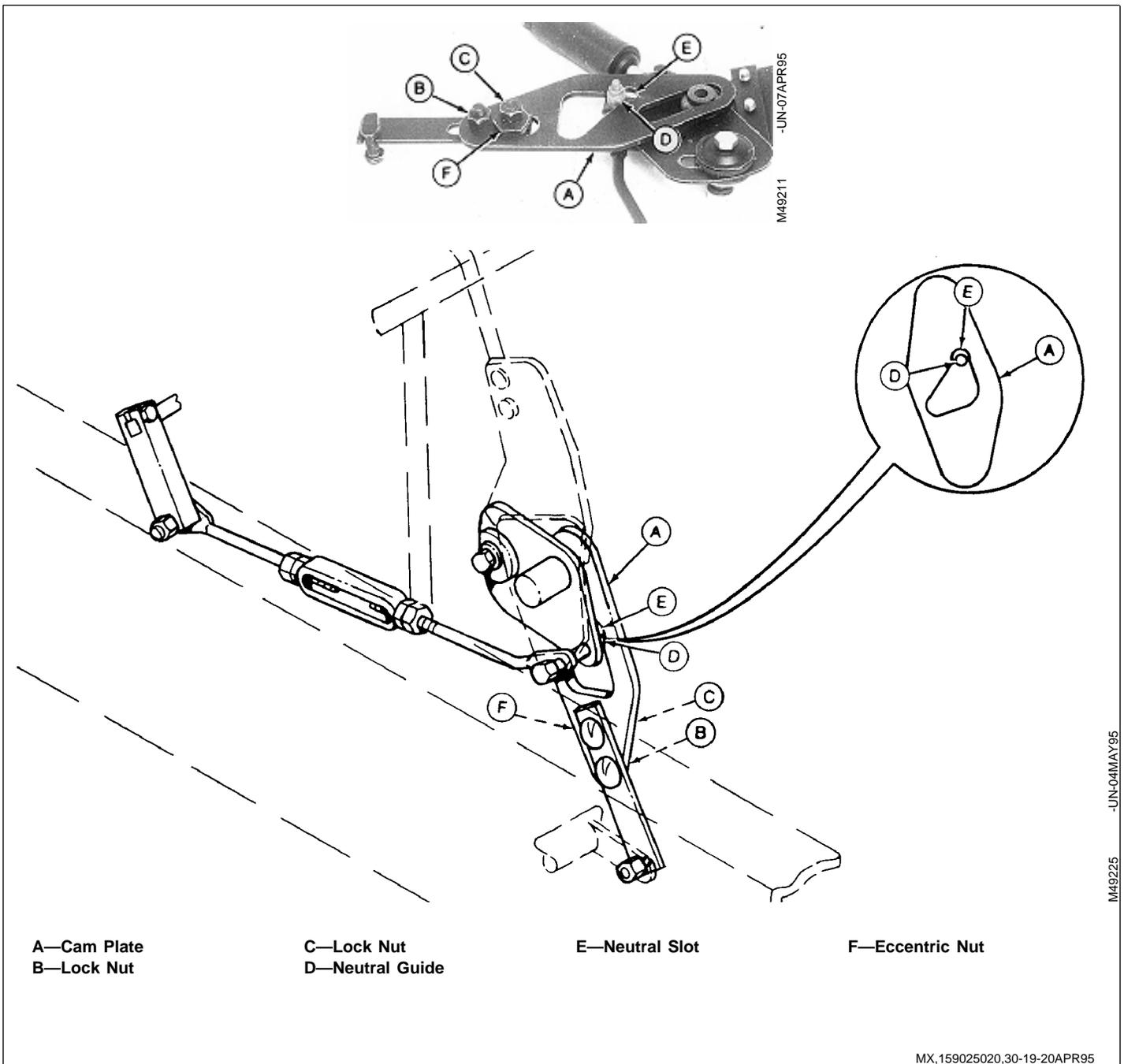
MX,159025020,27-19-20APR95

<p><b>1j a</b> <b>Version One—316 and Version Two—318 (Sliding Lever Linkage)</b></p> <p><i>NOTE: For Versions One—316 and 420, (J-Bolt Style Linkage): GO TO 1j b For later Versions of all models (Detented Neutral Style Linkage): GO TO 1@</i></p>	<p><i>Early 316 has a different hydrostatic control lever than shown. Adjustment procedure is the same.</i></p>	<p><b>IMPORTANT: This adjustment must be made with pedestal panels installed and hardware tightened.</b></p> <p>Remove belly screen from underneath machine.</p>	
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<p>On 318; Lock both brake pedals together.</p> <p>Apply and lock park brake.</p> <p>Adjust cam plate (A) position by loosening lock nuts (B and C) and moving cam plate until neutral guide (D) just enters neutral slot (E) in</p>	<p>cam plate. Be sure neutral guide does not hit top of cam plate neutral slot.</p> <p>Tighten lock nuts.</p>	<p>Check position of hydrostatic control lever. Lever must be in N/STOP notch of dash panel. If necessary, loosen lock nut (C) and turn eccentric nut (F) until lever is in N/STOP notch of dash panel. Tighten lock nut.</p>
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MX,159025020,28-19-16MAY95

250  
15  
10



A—Cam Plate  
B—Lock Nut

C—Lock Nut  
D—Neutral Guide

E—Neutral Slot

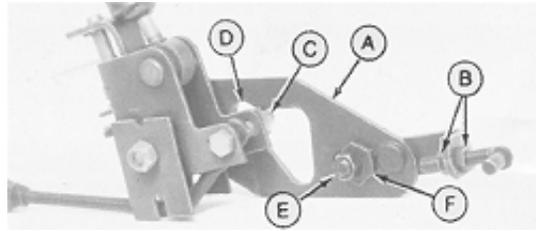
F—Eccentric Nut

MX,159025020,30-19-20APR95

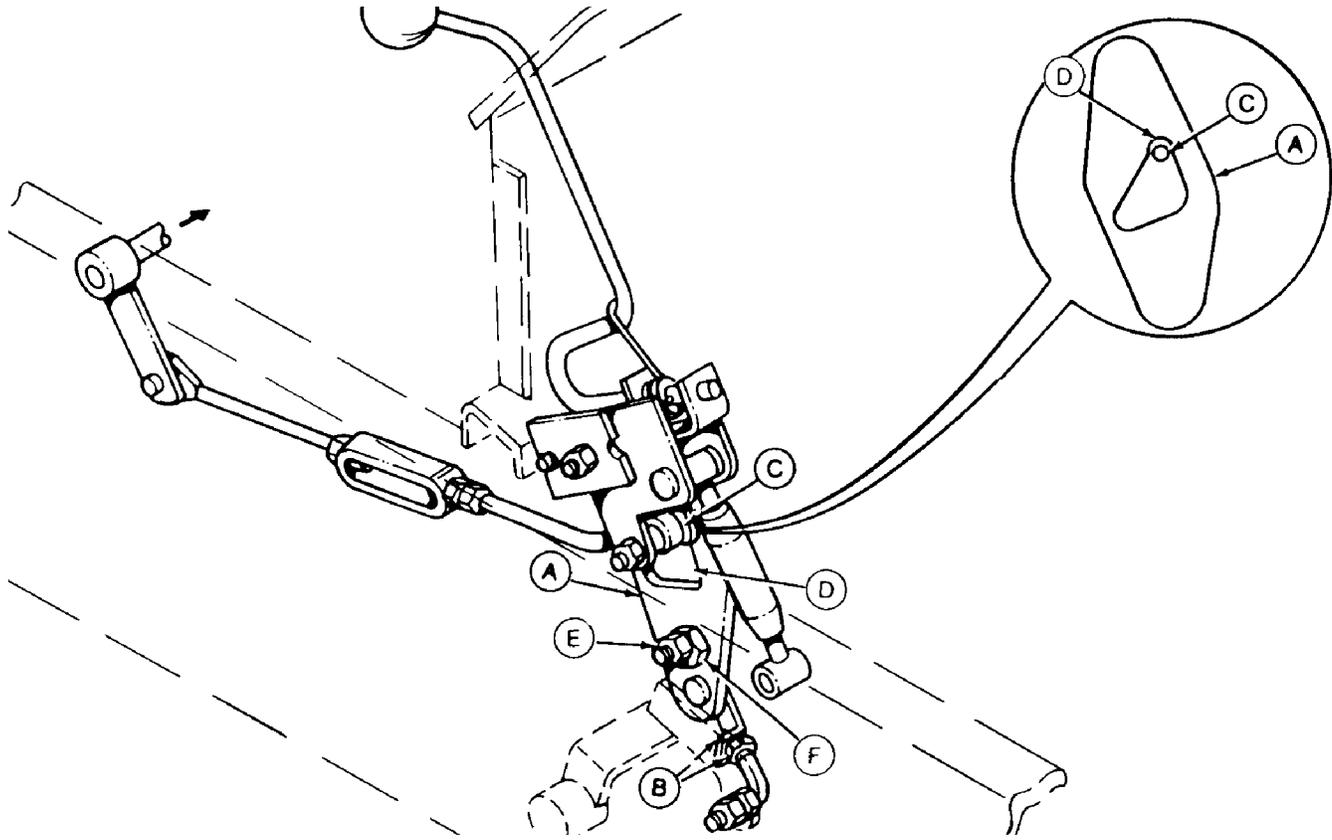
M49225  
-UN-04MAY95

*Diagnosis, Tests and Adjustments/Neutral Return Linkage Adjustment (Early Models)*

<p><b>1 j b Versions One—318 and 420 (J-Bolt Style Linkage)</b></p> <p><i>NOTE: For Version One—316 and Version Two—318 (Sliding Lever Linkage): GO TO 1 j a For later Versions of all models (Detented Neutral Style Linkage): GO TO 1@</i></p>	<p><i>On 318, the J-bolt attached to cam plate (A) with lock nuts (B), faces opposite direction shown. Adjustment procedure is the same.</i></p>	<p><b>IMPORTANT: This adjustment must be made with pedestal panels installed and hardware tightened.</b></p> <p>Remove belly screen/pan from underneath machine.</p>	
<p>Lock both brake pedals together.</p> <p>Apply and lock park brake.</p> <p>Adjust cam plate (A) position by tightening or loosening J-Bolt lock nuts (B) until neutral guide (C) just enters neutral slot (D) in cam plate. Be sure neutral guide does not hit</p>	<p>top of cam plate neutral slot.</p> <p>Tighten lock nuts.</p>	<p>Check position of hydrostatic control lever. Lever must be in N/STOP notch of dash panel. If necessary, loosen lock nut (E) and turn eccentric nut (F) until lever is in N/STOP notch of dash panel. Tighten lock nut.</p>	<p align="right">MX,159025020,31-19-16MAY95</p>



M49213 -UN-20DEC89



420 Shown

A—Cam Plate  
B—Lock Nuts

C—Neutral Guide  
D—Neutral Slot

E—Lock Nut

F—Eccentric Nut

MX,159025020,33-19-20APR95

M49226 -UN-04MAY95

**1!** NEUTRAL ADJUSTMENT (Version One—All Models and Version Two—318)

**IMPORTANT:** This adjustment must be made with pedestal panels installed and hardware tightened.

Remove fender deck.

Raise rear of machine and put jack stands under frame.



M36668 -UN-25JAN90

Move hydrostatic control lever to N/STOP position.

On 420; Move Two-speed axle lever to low speed position.

Continued on next page



M36677 -UN-25JAN90

**CAUTION: USE EXTREME CAUTION WHEN PERFORMING THIS ADJUSTMENT BECAUSE DRIVE WHEELS ARE FREE TO SPIN AND DRIVE SHAFT IS CLOSE TO TURNBUCKLE.**

Loosen lock nuts.

Start and run engine at fast idle. Turn turnbuckle (A) as required until the drive wheels stop turning.

Turn engine OFF.

**IMPORTANT: Tighten lock nuts to proper torque to prevent loss of neutral.**

Hold turnbuckle and tighten lock nuts to 33 N·m (24 lb-ft).

Start engine and check for tire movement. Readjust if necessary.

MX,159025020,34-19-16MAY95

**1@ NEUTRAL AND NEUTRAL RETURN LINKAGE ADJUSTMENT (Later Versions—All Models) (Detented Neutral Style Linkage)**

*NOTE: For Version One—316 and Version Two—318 (Sliding Lever Linkage): GO TO 1j a For Versions One—318 and 420 (J-Bolt Style Linkage): GO TO 1j b*

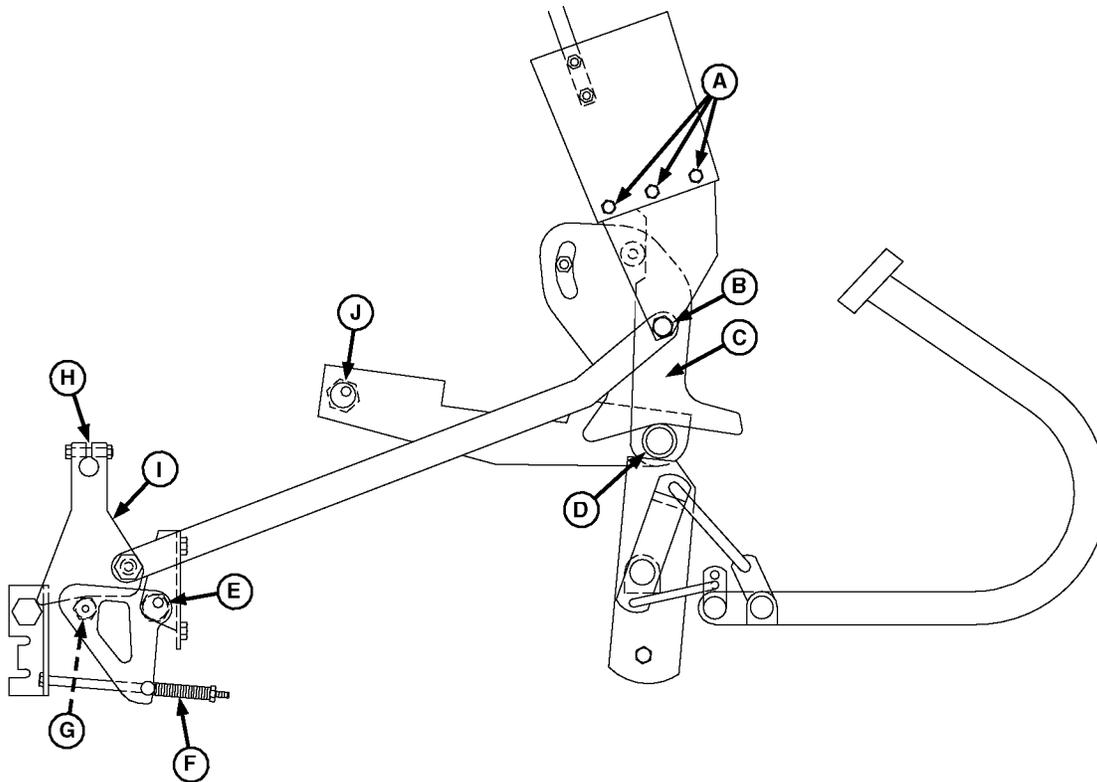
Remove right-hand pedestal screen, belly screen/pan and fender deck.

Move and secure fuel tank off to the left side of machine to gain access to linkage.

*NOTE: Early machines with this style of linkage will have the torsional dampener behind the pedestal. Later machines will have the dampener attached to the frame behind the swashplate on the hydrostatic transmission. The hydrostatic control link may be different also. Both versions are covered by this adjustment.*

Raise rear wheels off the ground. Put jack stands under frame.

MX,159025020,36-19-20APR95



M51871 -UN-26APR95

A—Bolts  
B—Bolt  
C—Cam Plate

D—Roller  
E—Eccentric  
F—Detent Spring

G—Roller  
H—Slot

I—Swashplate Control Arm  
J—Eccentric

Loosen bolts (A and B).

Place a screwdriver in slot (H) and move swashplate control arm (I) until roller (G) is centered in detent notch.

Adjust length of detent spring (F) to 50 mm (1.970 in.).

**CAUTION: BE AWARE OF SPINNING DRIVE SHAFT AND WHEELS WHEN PERFORMING THE NEXT ADJUSTMENT.**

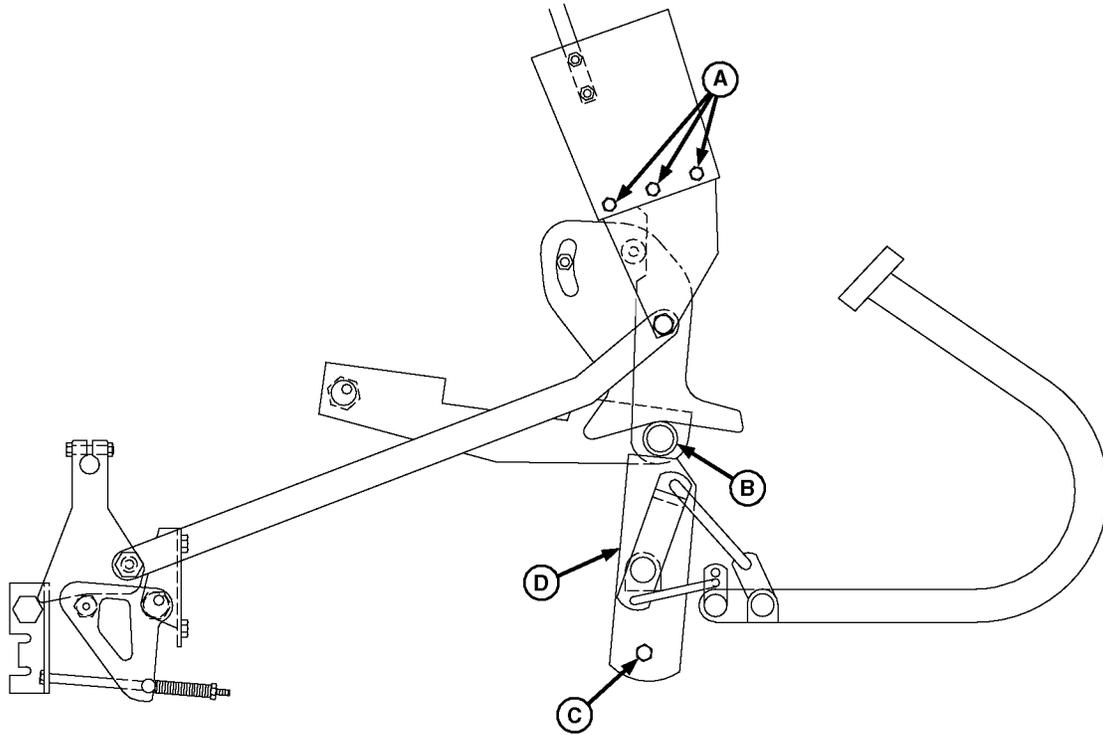
Start and run engine at fast idle.

Loosen bolt and adjust eccentric (E) until rear wheels stop turning, then tighten eccentric bolt.

Stop engine.

Loosen bolt and adjust eccentric (J) until bolt (B) is exactly centered in hole, while making sure roller (D) is centered in notch of cam plate (C).

Tighten bolt (B) and eccentric (J) bolt while holding eccentric in place.



M51872 -UN-26APR95

**A—Bolts**

**B—Roller**

**C—Bolt(s)**

**D—Plate**

Lock park brake.

Loosen bolt(s) (C). (One bolt on 316 and 318, two bolts on 420).

Slide plate (D) upward until it firmly contacts roller (B).

Tighten bolt(s) (C).

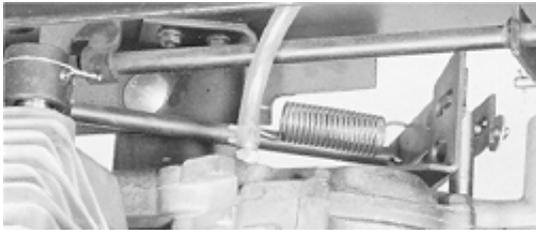
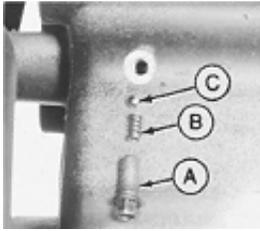
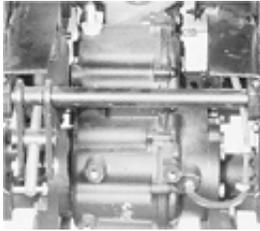
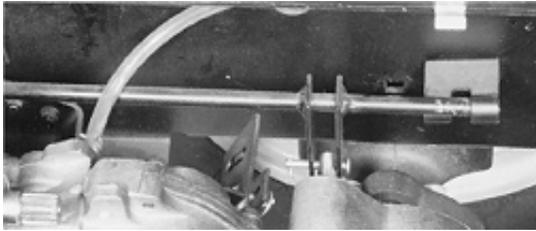
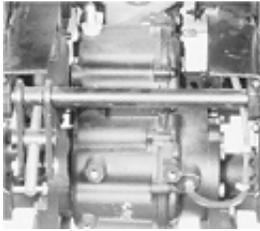
Place the hydrostatic shift lever in the N/STOP position in the quadrant.

Tighten bolts (A).

Unlock park brake.

Adjust hydrostatic shift lever friction: GO TO Ü

*Diagnosis, Tests and Adjustments/Differential Lock Linkage Check (420)*

<p><b>1# TWO-SPEED AXLE LEVER LINKAGE CHECK (420)</b></p>	 <p>M36693 -UN-25JAN90</p>	<p>Remove belly pan.</p> <p>Inspect two-speed axle lever linkage for missing pin, broken spring, wear or damage. Plate notch must engage slots easily.</p>	<p>LINKAGE OK: GO TO 1fa</p> <p>LINKAGE DAMAGED: Repair or replace as necessary.</p> <p>MX,159025020,39-19-20APR95</p>
<p><b>1fa Two-speed Axle Lever Detent Adjustment</b></p>	 <p>M36694 -UN-25JAN90</p>	<p>Remove fender deck and fuel tank.</p> <p>Remove detent screw (A), spring (B) and ball (C). Inspect parts for damage; replace as necessary. Install ball and spring.</p> <p>Apply thread lock and sealer (low strength) on detent screw threads. Install and tighten detent screw. If two-speed lever is hard to move, turn detent screw counterclockwise one turn.</p>	<p>DETENT OK: GO TO 1fb</p> <p>MX,159025020,40-19-20APR95</p>
<p><b>1fb Differential Inspection</b></p>	 <p>M36695 -UN-25JAN90</p>	<p>Remove and disassemble differential. (See procedures in Section 50.)</p> <p>Inspect shifter fork and two-speed gears for improper assembly, wear or damage.</p>	<p>MX,159025020,41-19-20APR95</p>
<p><b>1\$ DIFFERENTIAL LOCK LINKAGE CHECK (420)</b></p>	 <p>M36696 -UN-25JAN90</p>	<p>Remove belly pan.</p> <p>Inspect differential lock linkage for missing pin, bent rod, wear or damage. Differential lock shift rod must slide in and out easily.</p>	<p>LINKAGE OK: GO TO 1a</p> <p>MX,159025020,42-19-20APR95</p>
<p><b>1a Differential Inspection</b></p>	 <p>M36695 -UN-25JAN90</p>	<p>Remove and disassemble differential. (See procedures in Section 50.)</p> <p>Inspect shifter fork, shift collar, pins, shift rod, and springs for improper assembly, wear or damage.</p>	<p>MX,159025020,43-19-20APR95</p>



# Section 260 STEERING AND BRAKES CHECKOUT, OPERATION AND DIAGNOSIS

260

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# Group 05

## Steering And Brakes System Checkout

### BEFORE YOU START

Always begin with this group to identify a failure in the steering system. The step-by-step procedures will provide you with a quick check of the system. No special tools are required to perform these checks. If a failure is indicated you will be referred to a more detailed check, adjustment, or test.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the check.

This procedure is designed as a quick check of the system. While performing the check, concentrate only on the check you are performing and disregard signals from unrelated components.

*NOTE: The 316 has manual steering (gearbox).*

*The 318 and 420 have power steering (steering valve).*

MX,159026005,1 -19-24APR95

### ; STEERING SYSTEM OIL LEAK CHECK (318 AND 420)

MX,159026005,2 -19-24APR95

Check hydraulic oil level, condition and viscosity.



M49199 -UN-07APR95

Inspect for external hydraulic oil leakage from steering valve, cylinder, lines and fittings.

*NOTE: 318 Shown*

**OK:** GO TO '

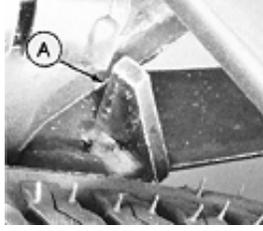
**NOT OK:** Repair or replace, then GO TO '

MX,159026005,12-19-24APR95

**HYDROSTATIC STEERING SYSTEM CHECK (318 AND 420)**

260  
05  
2

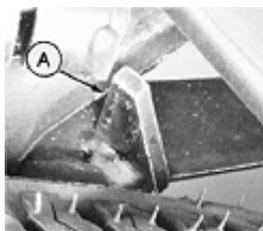
MX,159026005,3 -19-24APR95

<p><b>2a Power Steering Check</b></p>	<p>Start engine and run at full throttle.</p>	 <p>M49195 -UN-02FEB90</p> <p>Turn steering wheel full left, then full right.</p> <p><i>FEEL: Smooth, constant effort should be felt.</i></p> <p><i>LOOK: Wheels must stop turning when steering wheel is stopped.</i></p> <p><i>LOOK: Wheels must move full left and full right. Stops (A) must contact axle.</i></p>	<p><b>OK: CONTINUE WITH TEST</b></p> <p>WHEELS CONTINUE TURNING AFTER STEERING WHEEL IS STOPPED: GO TO I , GROUP 15.</p> <p>STOPS DO NOT CONTACT AXLE: GO TO G, GROUP 15.</p>
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MX,159026005,4 -19-24APR95

 <p>M55027 -UN-09DEC89</p>	<p>Count the number of revolutions of the steering wheel from a full right turn to a full left turn then, from a full left turn to a full right turn.</p> <p>Approximate revolutions from right turn to left . . . . . 3                  Approximate revolutions from left turn to right . . . . . 2-1/2</p>	<p><b>OK: GO TO 2b</b></p> <p>INCORRECT NUMBER OF STEERING WHEEL REVOLUTIONS: GO TO Æ, GROUP 15.</p>
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MX,159026005,5 -19-24APR95

<p><b>2b Manual Steering Check</b></p>	<p>Engine OFF.</p>	 <p>M49195 -UN-02FEB90</p> <p>Turn steering wheel full left, then full right.</p> <p><i>LOOK: Wheels must move full left and full right.</i></p> <p><i>LOOK: Stops (A) must contact axle.</i></p>	<p><b>OK: GO TO Æ</b></p> <p>WHEELS DO NOT MOVE FULL LEFT AND FULL RIGHT: Remove and inspect steering valve check valve. See Section 60.</p> <p>STOPS DO NOT CONTACT AXLE: GO TO G, GROUP 15.</p>
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MX,159026005,6 -19-24APR95

Steering And Brakes System Checkout/Turn Brake Check (318 and 420)

260  
05  
3

Æ SERVICE PARK BRAKE CHECK

MX,159026005,7 -19-24APR95

<p>3a Park Brake Lock Lever Check</p>	 <p>M49000 -UN-08JAN90</p>	<p>Depress brake pedal(s) and engage service park brake lock.</p> <p><i>LOOK: Service park brake must remain in park position.</i></p>	<p>Disengage service park brake.</p> <p>Move park brake knob up and down.</p> <p><i>FEEL: Slight spring pressure should be felt.</i></p>	<p><b>OK:</b> GO TO 3b</p> <p><b>NOT OK:</b> Adjust park brake linkage. See Section 60.</p> <p>MX,159026005,8 -19-24APR95</p>
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<p>3b Brake Pedal(s) Check</p>	 <p>M49001 -UN-08JAN90</p>	<p>Latch brake pedals together, if equipped. Depress brake pedal(s) and engage service park brake lock.</p> <p><i>NOTE: 318 Shown</i></p>	<p>Try to move hydrostat lever forward or reverse.</p> <p><i>FEEL: Lever must NOT move from N/STOP position.</i></p>	<p><b>OK:</b> GO TO Å</p> <p><b>NOT OK:</b> Adjust park brake linkage and shoes. See Section 60.</p> <p>MX,159026005,9 -19-16MAY95</p>
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Å TURN BRAKE CHECK (318 AND 420)

MX,159026005,10-19-05MAY95

<p>Drive machine forward at medium speed.</p>	 <p>M49002 -UN-08JAN90</p>	<p>Depress left, then right turn brake.</p> <p><i>LOOK: Left, then right wheel must stop and other must continue driving.</i></p>	<p><b>OK:</b> System normal.</p> <p><b>NOT OK:</b> Inspect and adjust brake shoes. See Section 60.</p> <p>MX,159026005,13-19-24APR95</p>
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**Ö OPERATOR COMPLAINT NOT IDENTIFIED**

260  
05  
4

MX,159026005,11-19-24APR95

If you completed the checkout procedure and did not isolate a malfunction, the problem may be intermittent.

Try to duplicate the condition of the malfunction identified by the operator.

Repeat system checkout in this group.

IF A MALFUNCTION IS NOT IDENTIFIED AFTER REPEATING SYSTEM CHECKOUT PROCEDURE, FACTORY ASSISTANCE IS AVAILABLE THROUGH THE DEALER TECHNICAL ASSISTANCE CENTER (DTAC).

MX,159026005,14-19-24APR95

## STEERING VALVE/SYSTEM OPERATION—FOUR-PORT VALVE

### Function:

Supply pressurized oil to the proper side of the steering cylinder to turn the wheels, when the engine is running.

### Theory of Operation:

*NOTE: Right-hand turn shown.*

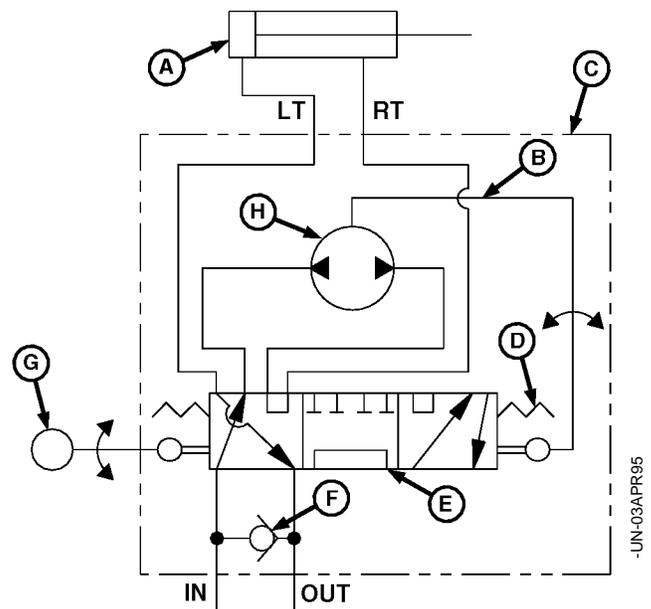
The “four-port” design steering valve is an open center type valve, consisting of a self-centering fluid control valve section (E) and a fluid metering section (H). These are hydraulically and mechanically interconnected inside the valve (C).

All external oil flow from the transmission is routed through the hydraulic control valve. Pressure oil is supplied to the steering valve after the auxiliary hydraulic system needs have been satisfied. This will reduce steering response when auxiliary hydraulic systems are active.

### NEUTRAL:

Whenever the steering wheel (G) is released, the centering springs (D) return the control valve section to the center (neutral) position. In this position, pressure oil entering the steering valve through the “IN” port is allowed to flow through the control valve section and out through the “OUT” port. When in neutral position, the control valve section prevents pressure oil from entering the fluid metering section (H).

For Power Turn, Manual Turn and Steering Cylinder Operation, see STEERING VALVE/SYSTEM OPERATION—FIVE-PORT VALVE in this group.



- A—Steering Cylinder
- B—Drive Link Assembly
- C—Steering Valve
- D—Centering Springs
- E—Control Valve Section
- F—Check Valve
- G—Steering Wheel
- H—Fluid Metering Section

MX,159026010,1 -19-24APR95

## STEERING VALVE/SYSTEM OPERATION—FIVE-PORT VALVE

### Function:

Supply pressurized oil to the proper side of the steering cylinder to turn the wheels, when the engine is running.

### Theory of Operation:

*NOTE: Right-hand turn shown.*

All external oil flow from the transmission is routed through the steering valve. The steering valve is an open center type valve. The "five-port" design provides "power beyond" to the auxiliary hydraulic systems only after satisfying steering valve needs.

The steering valve consists of a self-centering fluid control valve section (E) and a fluid metering section (H). These are hydraulically and mechanically interconnected inside the valve (C).

### NEUTRAL:

Whenever the steering wheel (G) is released, the centering springs (D) return the control valve section to the center (neutral) position. In this position, charge pressure oil entering the steering valve through port "IN" is allowed to flow through the control valve section and out through port "AUX". When in neutral position, the control valve prevents charge pressure oil from entering the fluid metering section.

### POWER TURN:

As the steering wheel is turned to the right, the control valve section is shifted by the drive link assembly (B). This shifting opens the steering cylinder ports "RT" and "LT". Oil flow to auxiliary hydraulic systems through port "AUX" is reduced giving the steering valve priority over the auxiliary system components.

Oil flows from port "IN" directly to the inlet of the control valve section. As the steering wheel is turned,

charge pressure oil is routed through the control valve section to the fluid metering section. Metered oil is routed to port "RT" on the steering cylinder. Return oil from the other end of the steering cylinder is routed back to port "LT", through the control valve and "OUT" port, returning to the transmission.

When the rotation of the steering wheel stops, the centering springs (D) move the control valve section back to the center (neutral) position, and will remain there until the steering wheel is moved again.

### MANUAL TURN:

If hydraulic pressure is lost, the machine can still be steered without hydraulic assistance. All components still function the same with the exception of the fluid metering section (H). The fluid metering section now acts as a pump, moving oil from one side of the metering section to the other as the steering wheel is turned.

When the rotation of the steering wheel stops, the centering springs move the valve back to the center (neutral) position, and will remain there until the steering wheel is moved again.

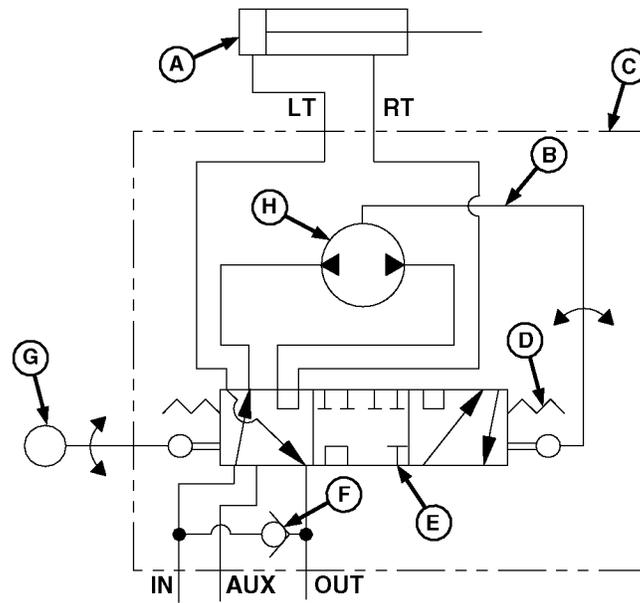
### STEERING CYLINDER OPERATION:

The steering cylinder is a double-acting design.

One end of the cylinder is attached to the frame which prevents the cylinder from moving. The rod end is attached to the steering arm/spindle.

As pressurized oil enters the cylinder, the piston and rod move, moving the steering arm, causing the machine to turn.

To turn in the other direction, pressurized oil is applied to the other port, moving the cylinder in the opposite direction.



A—Steering Cylinder  
B—Drive Link Assembly

C—Steering Valve  
D—Centering Springs

E—Control Valve Section  
F—Check Valve

G—Steering Wheel  
H—Fluid Metering Section

MX,159026010,3 -19-24APR95

260  
10  
3

M78855 -JUN-26APR95

260  
10  
4

## ABOUT THIS GROUP

The step-by-step procedures in this group provide you with the detailed diagnostic information you will need to perform a test. Basic diagnostic equipment is used.

It is assumed that you are familiar with the machine and its steering system components. If you need additional information, read the theory of operation in Group 10 or refer to the overall hydraulic schematics in Section 270, Group 10.

Engine rpm and temperature are critical in most hydraulic tests. Be sure to follow test specifications carefully.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the test.

Upon completing a test or adjustment, check to see whether the problem is corrected.

*NOTE: The 316 has manual steering (gearbox).*

*The 318 and 420 have power steering (steering valve).*

*Therefore, all solutions to the symptoms may not apply to your particular machine.*

MX,159026015,1 -19-24APR95

## ; TROUBLESHOOTING GUIDE

If the steering system does not operate properly, select the appropriate symptom from the list below.

After selecting the appropriate symptom, go to that step and perform the following checks, tests, or adjustments in the order shown to isolate and repair the malfunction.

- STEERING WANDER: GO TO A
- STEERING SHIMMY: GO TO B
- SLUGGISH STEERING RESPONSE: GO TO C
- LOST MOTION AT THE STEERING WHEEL: GO TO D
- HIGH STEERING EFFORT IN ONE DIRECTION: GO TO E
- HIGH STEERING EFFORT IN BOTH DIRECTIONS: GO TO F
- WHEELS DO NOT HIT STOP: GO TO G
- STEERING EFFORT IS ERRATIC: GO TO H
- WHEELS CONTINUE TURNING AFTER STEERING WHEEL IS STOPPED: GO TO I

MX,159026015,2 -19-24APR95

## A STEERING WANDER

- Check for correct tire size.
- Check front tires for incorrect or unequal pressure.
- Check for loose or worn steering linkage parts.
- Check for worn wheel bearing or spindle bushings.
- Check Toe-In adjustment: See Section 80.

MX,159026015,3 -19-24APR95

## B STEERING SHIMMY

- Check for improperly mounted tire or wheel.
- Check for loose or worn steering linkage parts.
- Check for worn wheel bearings or spindle bushings.
- Bleed hydraulic system: See Section 270, Group 20.
- Check Toe-In adjustment: See Section 80.

MX,159026015,4 -19-24APR95

## C SLUGGISH STEERING RESPONSE

- Bleed hydraulic system: See Section 270, Group 20.
- Check for bent or restricted return line, oil cooler (if equipped) oil filter or steering linkage.
- Check for restricted oil filter or charge pump suction line.
- Check for cylinder rod binding in cylinder barrel.
- Check implement relief pressure. See Section 250.
- Test for steering system leakage. GO TO Æ
- Adjust engine rpm: See Section 220.

MX,159026015,5 -19-30MAR95

## **D LOST MOTION AT STEERING WHEEL**

- Check for loose or worn steering linkage.
- Check for steering valve loose at mounting.
- Bleed hydraulic system: See Section 270, Group 20.

MX,159026015,6 -19-30MAR95

260  
15  
3

## **E HIGH STEERING EFFORT IN ONE DIRECTION**

- Check for binding of linkage or cylinder rod binding in cylinder barrel.
- Check for bent or restricted return line.
- Test for steering system leakage: GO TO Æ
- Inspect plate valve for sticking: See Section 60.

MX,159026015,7 -19-30MAR95

## **F HIGH STEERING EFFORT IN BOTH DIRECTIONS**

- Check for improperly mounted tires or wheels.
- Check for binding of steering linkage and cylinder.
- Check for bent or restricted return line, oil cooler (if equipped) or oil filter.
- Check implement relief pressure. See Section 250.
- Check for steering valve check ball missing, damaged, or in "IN" port: See Section 60.
- Adjust engine rpm: See Section 220.
- Check for dirt accumulation on transmission causing transmission to overheat: GO TO '
- Check for high draft load causing transmission to overheat: GO TO '

MX,159026015,8 -19-30MAR95

### G WHEELS DO NOT HIT STOP

- Check for bent steering linkage, cylinder or cylinder rod.

MX,159026015,9 -19-30MAR95

### H STEERING EFFORT IS ERRATIC

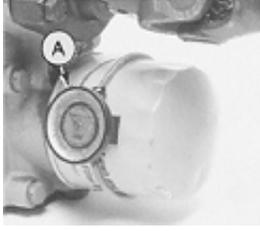
- Bleed hydraulic system: See Section 270, Group 20.
- Test for steering system leakage. GO TO Æ

MX,159026015,10-19-30MAR95

### I WHEELS CONTINUE TURNING AFTER STEERING WHEEL IS STOPPED

- Inspect valve plate for sticking: See Section 60.
- Inspect steering valve springs for wear or damage: See Section 60.

MX,159026015,11-19-30MAR95

<p><b>HYDRAULIC OIL WARM-UP PROCEDURE</b></p>	 <p>Remove belly screen/pan.</p> <p>Install JDG282 Temperature Gauge (A) on transmission oil filter.</p>	<p>Apply park brake.</p> <p>Start engine and run at full throttle.</p>
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M43008 -UN-18JAN90

MX,159026015,16-19-24APR95

	<p>Move and hold control lever in implement "raise" position.</p> <p>Periodically cycle all hydraulic functions to distribute heated oil.</p> <p><i>NOTE: 316 Shown</i></p>	<p>Heat oil to temperature specified in test.</p> <p><i>NOTE: The hydrostatic transmission should not exceed 93°C (200°F) as a continuous operating temperature.</i></p>
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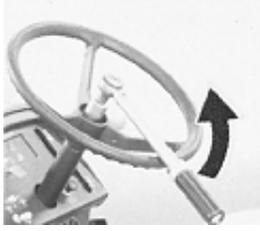
M43629 -UN-12JAN90

MX,159025020,23-19-20APR95

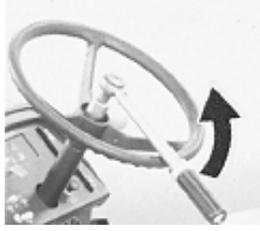
*Diagnosis, Tests and Adjustments/Steering Valve Leakage Test*

<p><b>Æ STEERING SYSTEM LEAKAGE TEST</b></p>	<p>Heat hydraulic oil to 43°C (110°F). See ' in this group.</p> <p>Start engine and run at slow idle.</p>	 <p>M49198 -UN-20DEC89</p>	<p>With wheels in a maximum right position, turn steering wheel with a constant torque of 6.8 N-m (60 lb-in.) for one minute.</p> <p><i>LOOK: Count the revolutions.</i></p> <p>RPM must not exceed 6.</p>
--	---	---	--

260  
15  
5

 <p>M49197 -UN-20DEC89</p>	<p>With wheels in a maximum left position, turn steering wheel with a constant torque of 6.8 N-m (60 lb-in.) for one minute.</p> <p><i>LOOK: Count the revolutions.</i></p> <p>Rpm must not exceed 6.</p>	<p><b>6 RPM OR LESS: STEERING SYSTEM OK.</b></p> <p><b>MORE THAN 6 RPM: GO TO Å</b></p> <p align="right">MX,159026015,13-19-27MAR95</p>
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<p><b>Å STEERING VALVE LEAKAGE TEST</b></p>	<p><b>CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.</b></p>	 <p>M49196 -UN-20DEC89</p>	<p>Remove cap nut on left front side of fender deck and raise fender deck to access hydraulic lines. (Fender deck is removed in photo only for clarity of procedure.)</p> <p>Disconnect hydraulic lines at fittings (A) and plug fittings (A) with JT03391 Plugs.</p> <p>Start engine and run at slow idle.</p>
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 <p>M49198 -UN-20DEC89</p>	<p>With wheels in a maximum right position, turn steering wheel with a constant torque of 6.8 N-m (60 lb-in.)</p> <p><i>LOOK: Count the revolutions.</i></p> <p>RPM must not exceed 6.</p>	 <p>M49197 -UN-20DEC89</p>	<p>With wheels in a maximum left position, turn steering wheel with a constant torque of 6.8 N-m (60 lb-in.)</p> <p><i>LOOK: Count the revolutions.</i></p> <p>RPM must not exceed 6.</p>
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**6 RPM OR LESS:  
STEERING VALVE OK:  
Replace steering cylinder.**

**MORE THAN 6 RPM:  
Remove and repair steering valve. (See Section 60.)**

MX,159026015,15-19-27MAR95

260  
15  
6

Section 270

# HYDRAULIC SYSTEM CHECKOUT, OPERATION AND DIAGNOSIS

## Contents

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270



## BEFORE YOU START

Always begin with this group to identify a failure in the hydraulic system. The step-by-step procedures will provide you with a quick check of the system. No special tools are required to perform these checks. If a failure is indicated, you will be referred to a more detailed check, adjustment, or test.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the check.

This procedure is designed as a quick check of the system. While performing the check, concentrate only on the check you are performing and disregard signals from unrelated components.

*NOTE: The 316 has manual steering (gearbox), single-spool control valve and rockshaft cylinder.*

*The 318 has power steering, steering cylinder, two-spool control valve, rockshaft cylinder and oil cooler.*

*The 420 has power steering, steering cylinder, three-spool control valve, rockshaft cylinder and oil cooler.*

*For further information, refer to the overall hydraulic schematics in Group 10.*

MX,159027005,1 -19-24APR95

<p><b>HYDRAULIC SYSTEM OIL LEAK CHECK</b></p>	<p>Check hydraulic oil level, condition and viscosity.</p>	 <p style="text-align: center;"><i>NOTE: 318 Shown</i></p>	<p>Inspect control valve, cylinders, lines, hoses and fittings for external hydraulic oil leakage.</p>	<p><b>OK:</b> GO TO ' '</p> <p><b>NOT OK:</b> Repair or replace, then GO TO ' '</p>
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M49199 -UN-07APR95

MX,159027005,2 -19-24APR95

Hydraulic System Checkout/Operator Complaint Not Identified

**HYDRAULIC CONTROL VALVE CHECK**

*NOTE: 316; Single lever controls rockshaft cylinder and right-hand front outlets.*

**318 Levers;**

- Inside lever controls right-hand front outlets “float” and optional rear outlets.
- Outside lever controls rockshaft cylinder and left-hand front outlets..

**420 Levers;**

- Inside lever controls right-hand front outlets “float”.
- Middle lever controls rockshaft cylinder.
- Outside lever controls left-hand front and optional rear outlets.



M36699 -UN-25JAN90

Run engine at full throttle.

Pull control valve lever rearward to raise implement. Release lever.

*LOOK: Implement must raise and hold position without dropping. Lever must return to neutral.*

*NOTE: 318 Shown*

270  
05  
2

*NOTE: With the exception of “float” position, all control valve levers should operate the same with an attachment correctly connected to that particular hydraulic system.*

- All control valve levers except “float” position:

Push control valve lever forward to lower implement. Release lever.

*LOOK: Implement must lower and hold position. Lever must return to neutral.*

Pull control valve lever rearward to raise implement. Release lever.

*LOOK: Implement must raise and hold position. Lever must return to neutral.*

- Control valve lever “float” position:

Push control valve lever forward to float position. Release lever.

*LOOK: Implement must lower to ground and lever must stay in float position.*

- All control valve levers:

Pull control valve lever rearward

and raise implement halfway.

Turn engine OFF.

Pull control valve rearward to raise implement.

*LOOK: Implement must not move down.*

**OK:** Procedure complete. System is normal.

**NOT OK:** GO TO ; in Group 20.

MX,159027005,3 -19-05MAY95

**Æ OPERATOR COMPLAINT NOT IDENTIFIED**

If you completed the checkout procedure and did not isolate a malfunction, the problem may be intermittent.

Try to duplicate the condition of the malfunction identified by the operator.

IF A MALFUNCTION IS NOT IDENTIFIED AFTER SYSTEM CHECKOUT PROCEDURE, FACTORY ASSISTANCE IS AVAILABLE THROUGH THE DEALER TECHNICAL ASSISTANCE CENTER (DTAC).

MX,159027005,4 -19-24APR95

**HYDRAULIC SYSTEM SCHEMATICS**

The hydraulic system schematics on the following pages can be folded out for use while diagnosing malfunctions or while repairing hydraulic components.

MX,159027010,1 -19-24APR95

270  
10  
1

HYDRAULIC CIRCUIT SYMBOLS

LINES

1		WORKING (MAIN) LINES
2		PILOT CONTROL LINES
3		DRAIN LINE
4		HYDRAULIC } FLOW PNEUMATIC } DIRECTION
5		CROSSING LINES
6		JOINING LINES
7		FLEXIBLE LINE

PUMPS

8		FIXED DISPLACEMENT
9		VARIABLE DISPLACEMENT

MOTORS

10		FIXED DISPLACEMENT
11		VARIABLE DISPLACEMENT

RESERVOIR

12		VENTED RESERVOIR
13		PRESSURIZED RESERVOIR
14		RESERVOIR RETURN - ABOVE FLUID LEVEL
15		RESERVOIR RETURN - BELOW FLUID LEVEL

VALVES

16		CHECK VALVE
17		MANUAL ON/OFF VALVE
19		PRESSURE RELIEF VALVE
20		PRESSURE REDUCTION VALVE
21		TWO POSITION, TWO CONNECTION VALVE
22		TWO POSITION, THREE CONNECTION VALVE
23		TWO POSITION, FOUR CONNECTION VALVE
24		THREE POSITION, FOUR CONNECTION VALVE
25		TWO POSITION, FOUR CONNECTION VALVE WITH TRANSMISSION
26		THREE POSITION, FOUR CONNECTION VALVE WITH INFINITE POSITIONING
27		ADJUSTABLE FLOW CONTROL VALVE (TEMPERATURE AND PRESSURE COMPENSATED)
18		FIXED } VARIABLE } ORIFICE

270  
10  
2

M81419AE -19-19NOV92

**VALVE OPERATORS**

<b>28</b>		SPRING
<b>29</b>		MANUAL
<b>30</b>		PUSH BUTTON
<b>31</b>		PUSH/PULL LEVER
<b>32</b>		PEDAL OR TREADLE
<b>33</b>		MECHANICAL
<b>34</b>		DETENTS
<b>35</b>		PRESSURE COMPENSATED
<b>36</b>		SOLENOID-SINGLE WINDING
<b>37</b>		REVERSING MOTOR
<b>38</b>		PILOT PRESSURE -REMOTE SUPPLY
<b>39</b>		PILOT PRESSURE -INTERNAL SUPPLY

**CYLINDERS**

<b>40</b>		SINGLE ACTING
<b>41</b>		DOUBLE ACTING, SINGLE ROD
<b>42</b>		DOUBLE ACTING, DOUBLE ROD
<b>43</b>		DOUBLE ACTING, ADJ. CUSHION, EXTEND ONLY
<b>44</b>		DOUBLE ACTING, DIFFERENTIAL PISTON

**MISCELLANEOUS**

<b>45</b>		COOLER
<b>46</b>		FILTER, STRAINER
<b>47</b>		HEATER
<b>48</b>		TEMPERATURE CONTROLLER
<b>49</b>		PRESSURE SWITCH
<b>50</b>		PRESSURE INDICATOR
<b>51</b>		TEMPERATURE INDICATOR
<b>52</b>		PRESSURE COMPENSATED VARIABLE COMPONENT (SYMBOL THRU COMPONENT)
<b>53</b>		VARIABLE COMPONENT (SYMBOL THRU COMPONENT)
<b>54</b>		PLUG, TEST PORT, PRESSURE SUPPLY TEST
<b>55</b>		GAS CHARGED ACCUMULATOR
<b>56</b>		SPRING LOADED ACCUMULATOR
<b>57</b>		ELECTRIC MOTOR
<b>58</b>		SHAFT ROTATION (ARROW ON NEAR SIDE OF SHAFT)
<b>59</b>		COMPONENT OUTLINE

270  
10  
3

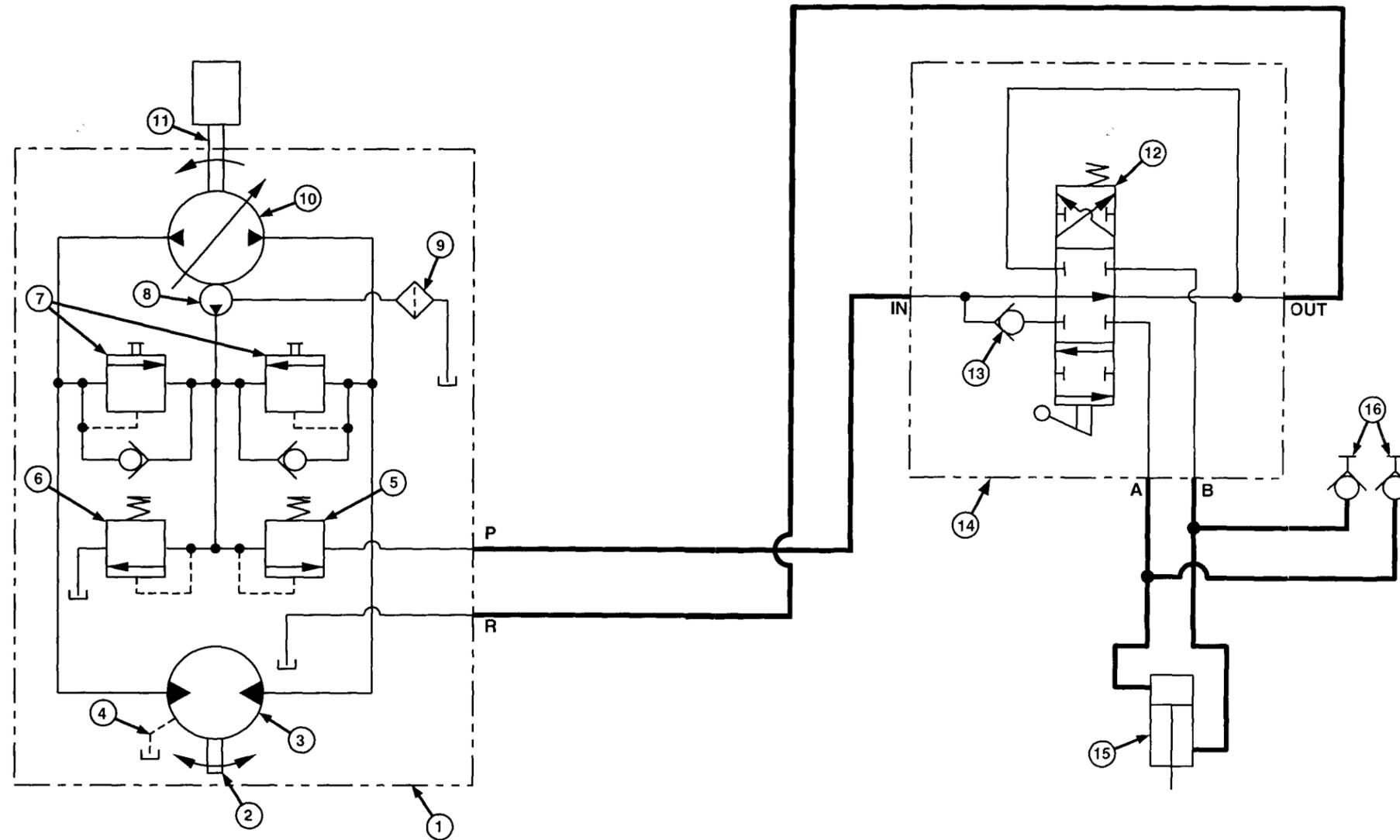
M81440AE -19-19NOV92

## LEGEND FOR HYDRAULIC SYSTEM SCHEMATIC—316

1—Hydrostatic Transmission	6—Implement Relief Valve	11—Input (Pump) Shaft	14—Hydraulic Control Valve
2—Output (Motor) Shaft	7—Check (Freewheel) Valves	12—Control Valve Spool (Three-Position)	15—Rockshaft Cylinder
3—Hydrostatic Drive Motor	8—Charge Pump	13—Check Valve	16—Right Front Hydraulic Outlets
4—Transmission Case Drain	9—Filter		
5—Charge Relief Valve	10—Variable Hydrostatic Pump		

270  
10  
4

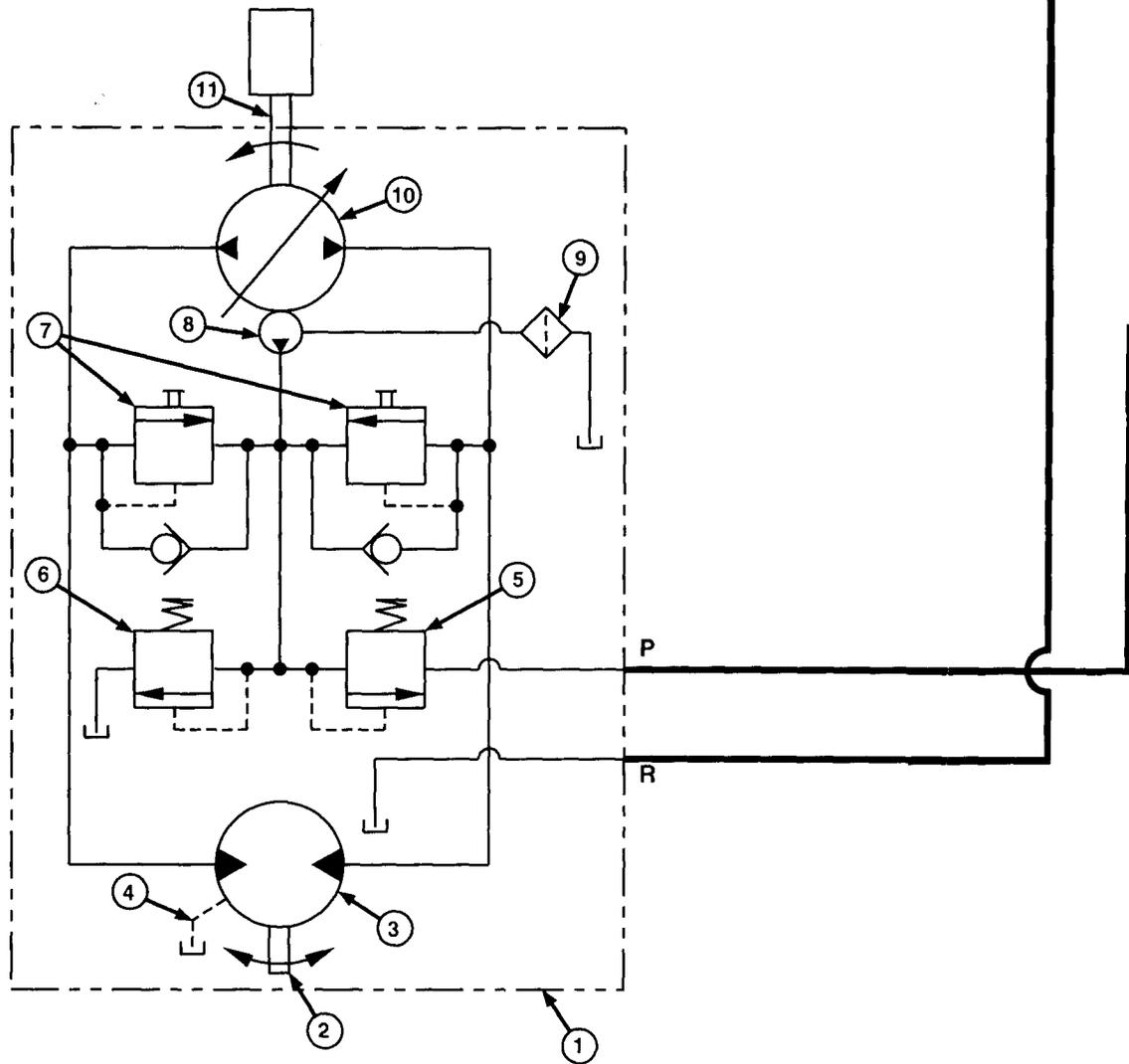
MX,159027010,2 -19-03MAY95



M78844

### HYDRAULIC SYSTEM SCHEMATIC — 316

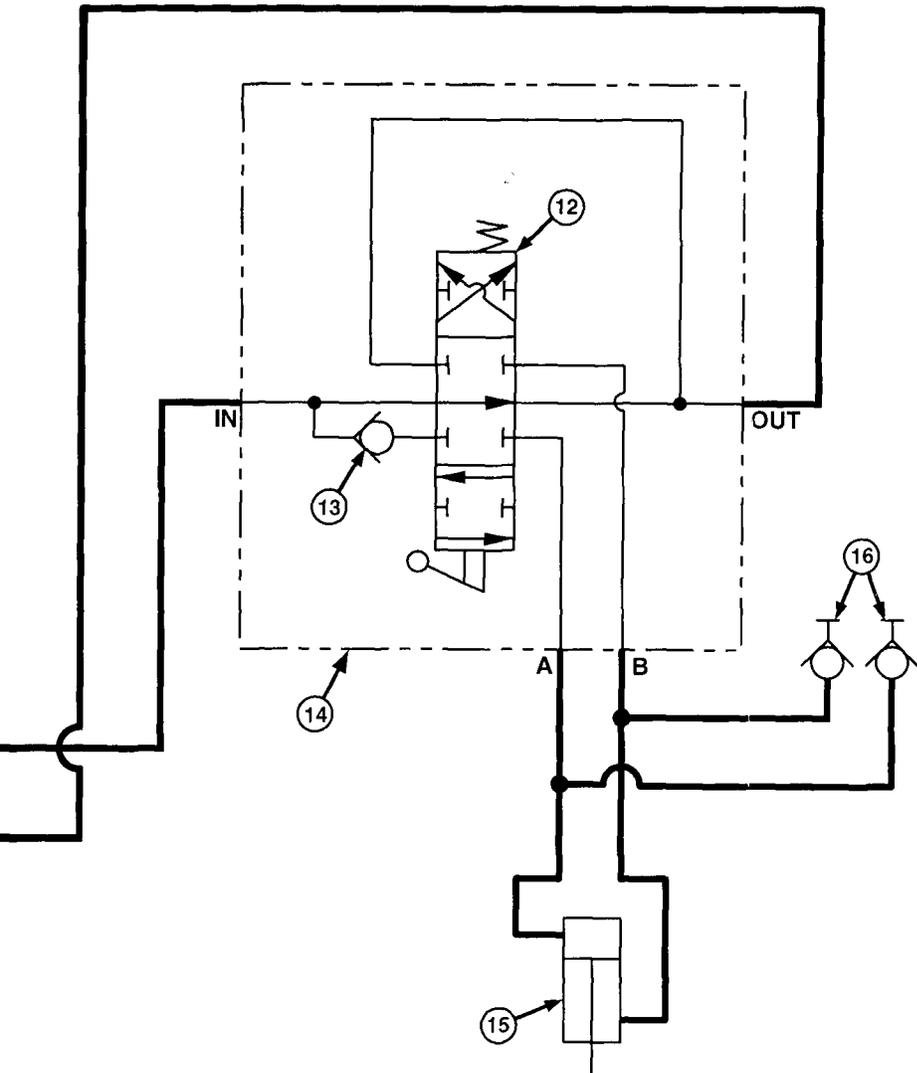
1060X660



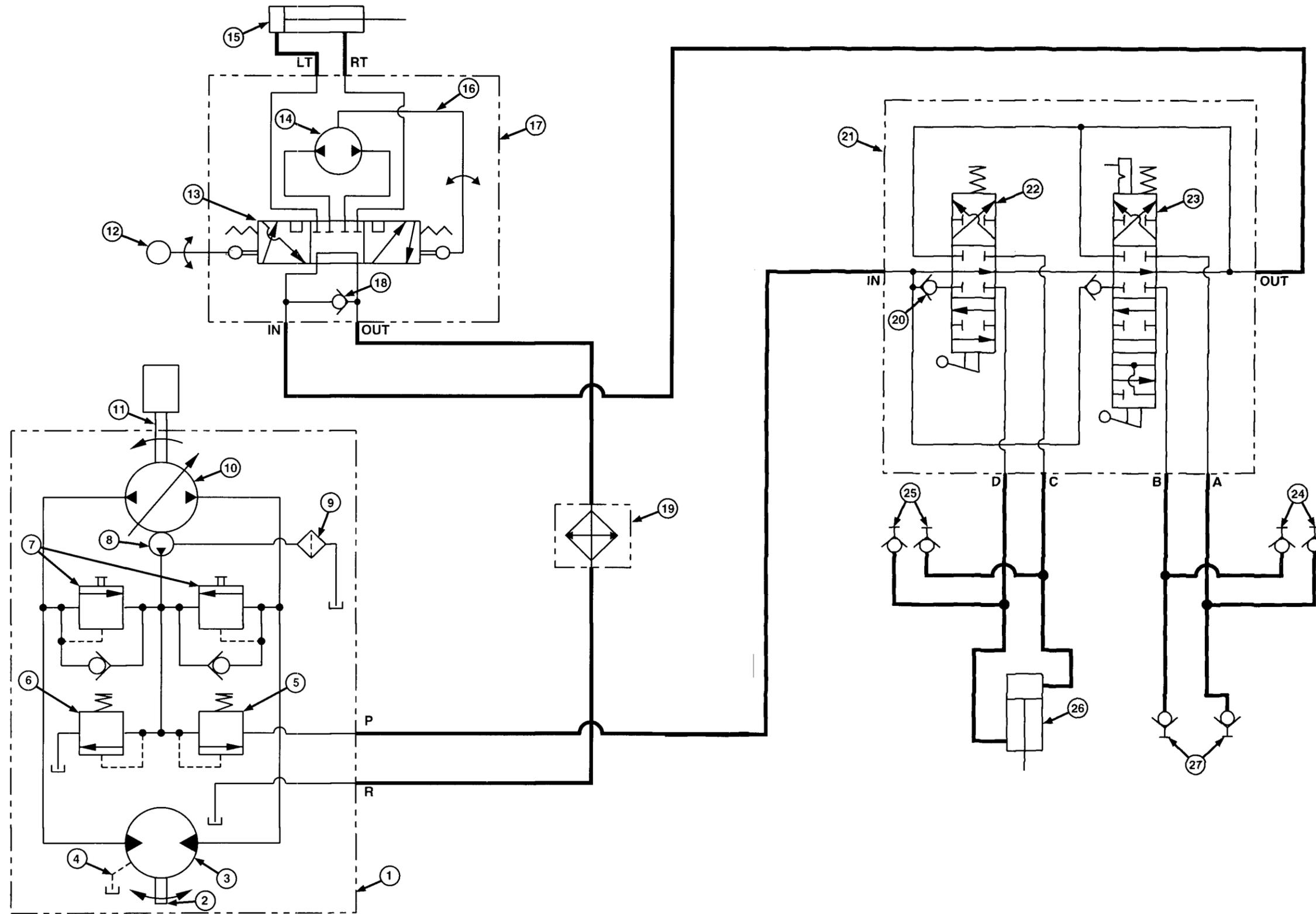
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# HYDRAULIC SYSTEM SCHEMA

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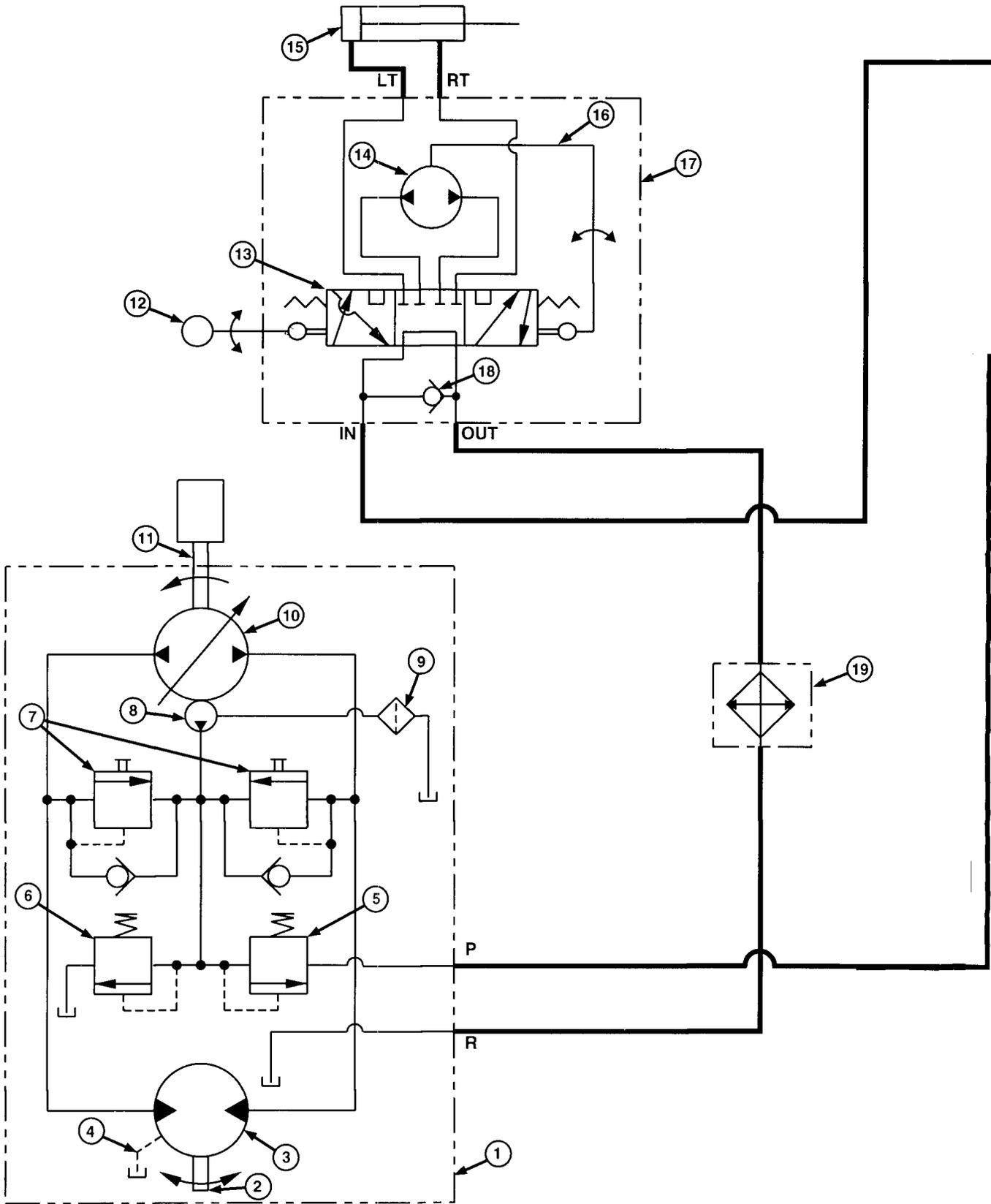
SCHEMATIC — 316



HYDRAULIC SYSTEM SCHEMATIC - EARLY 318

1060X660

M78845

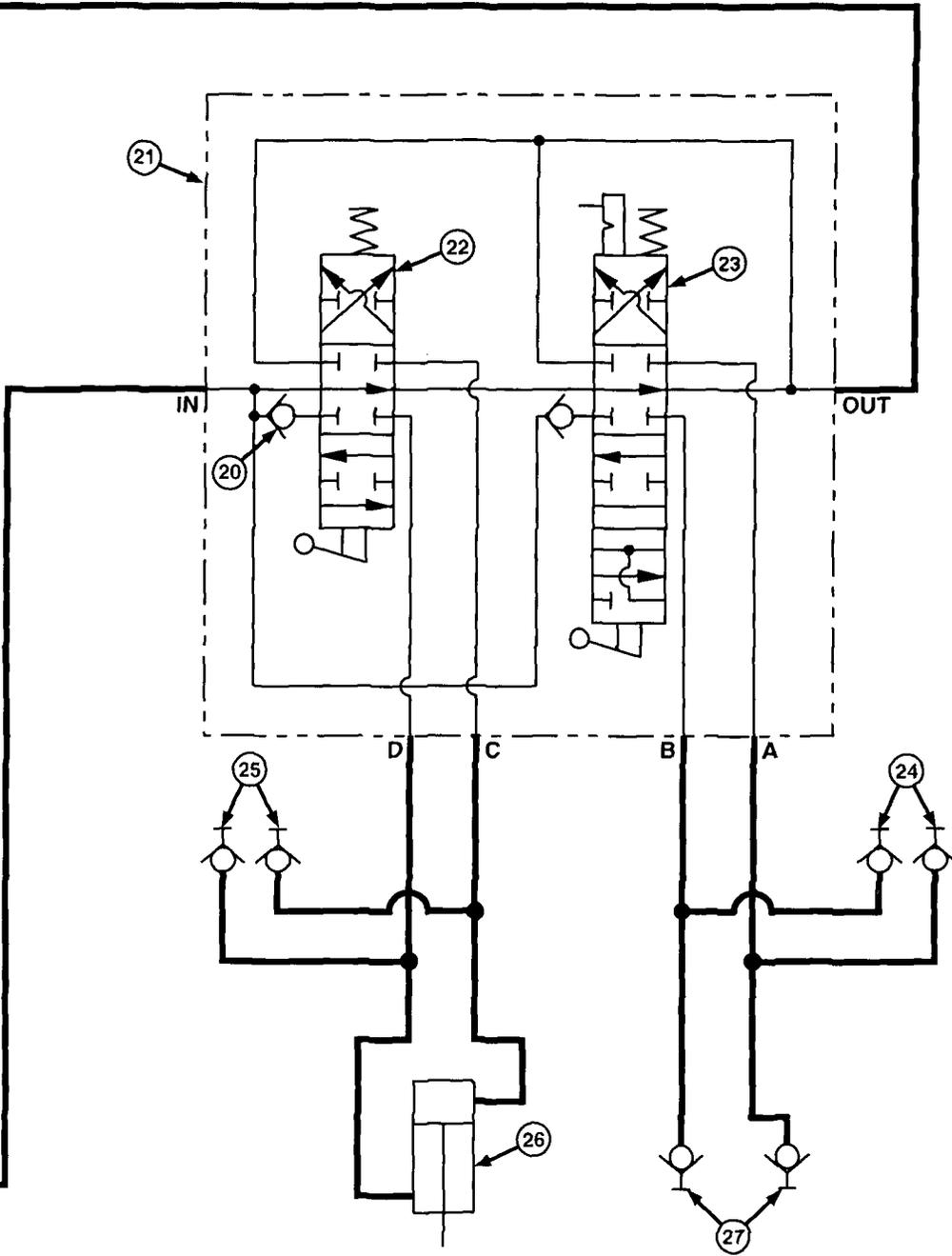


M78845

HYDRAULIC SYSTEM SCHEMATIC -

1060X660

TM1590



HEMATIC - EARLY 318

## LEGEND FOR HYDRAULIC SYSTEM SCHEMATIC—EARLY 318

1—Hydrostatic Transmission	10—Variable Hydrostatic Pump	17—Steering Valve (4-Port)	24—Front Hydraulic Outlets—Right Side
2—Output (Motor) Shaft	11—Input (Pump) Shaft	18—Check Valve	25—Front Hydraulic Outlets—Left Side
3—Hydrostatic Drive Motor	12—Steering Wheel	19—Oil Cooler	26—Rockshaft Cylinder
4—Transmission Case Drain	13—Control Valve Section	20—Check Valve (2 used)	27—Rear Hydraulic Outlets (Optional)
5—Charge Relief Valve	14—Fluid Metering Section	21—Hydraulic Control Valve	
6—Implement Relief Valve	15—Steering Cylinder	22—Control Valve Spool (Three-Position)	
7—Check (Freewheel) Valves	16—Drive Link Assembly	23—Control Valve Spool with “Float” (Four-Position)	
8—Charge Pump			
9—Filter			

MX,159027010,5 -19-03MAY95

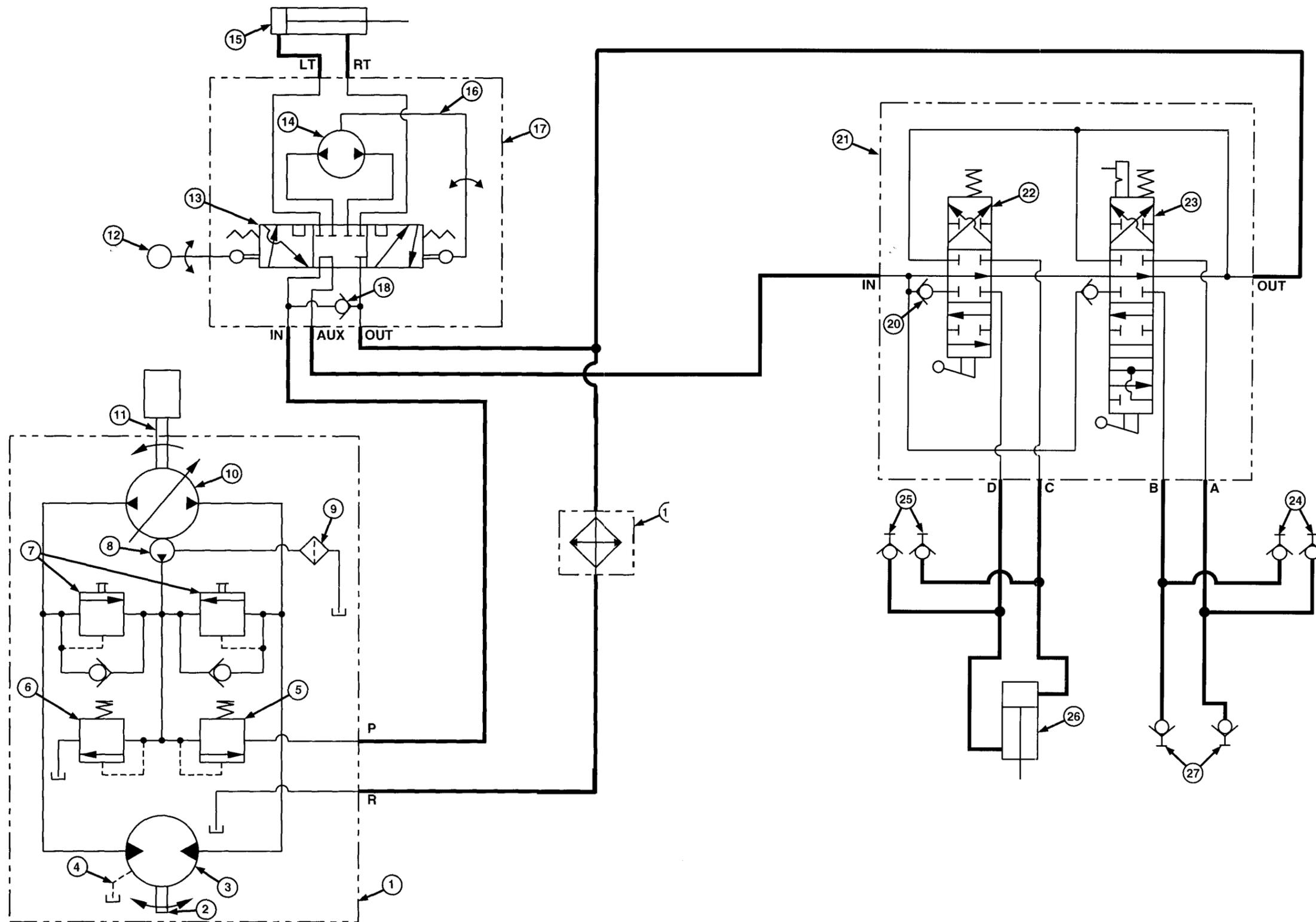
270  
10  
7

## LEGEND FOR HYDRAULIC SYSTEM SCHEMATIC—LATER 318

1—Hydrostatic Transmission	10—Variable Hydrostatic Pump	17—Steering Valve (5-Port)	24—Front Hydraulic Outlets—Right Side
2—Output (Motor) Shaft	11—Input (Pump) Shaft	18—Check Valve	25—Front Hydraulic Outlets—Left Side
3—Hydrostatic Drive Motor	12—Steering Wheel	19—Oil Cooler	26—Rockshaft Cylinder
4—Transmission Case Drain	13—Control Valve Section	20—Check Valve (2 used)	27—Rear Hydraulic Outlets (Optional)
5—Charge Relief Valve	14—Fluid Metering Section	21—Hydraulic Control Valve	
6—Implement Relief Valve	15—Steering Cylinder	22—Control Valve Spool (Three-Position)	
7—Check (Freewheel) Valves	16—Drive Link Assembly	23—Control Valve Spool with “Float” (Four-Position)	
8—Charge Pump			
9—Filter			

270  
10  
8

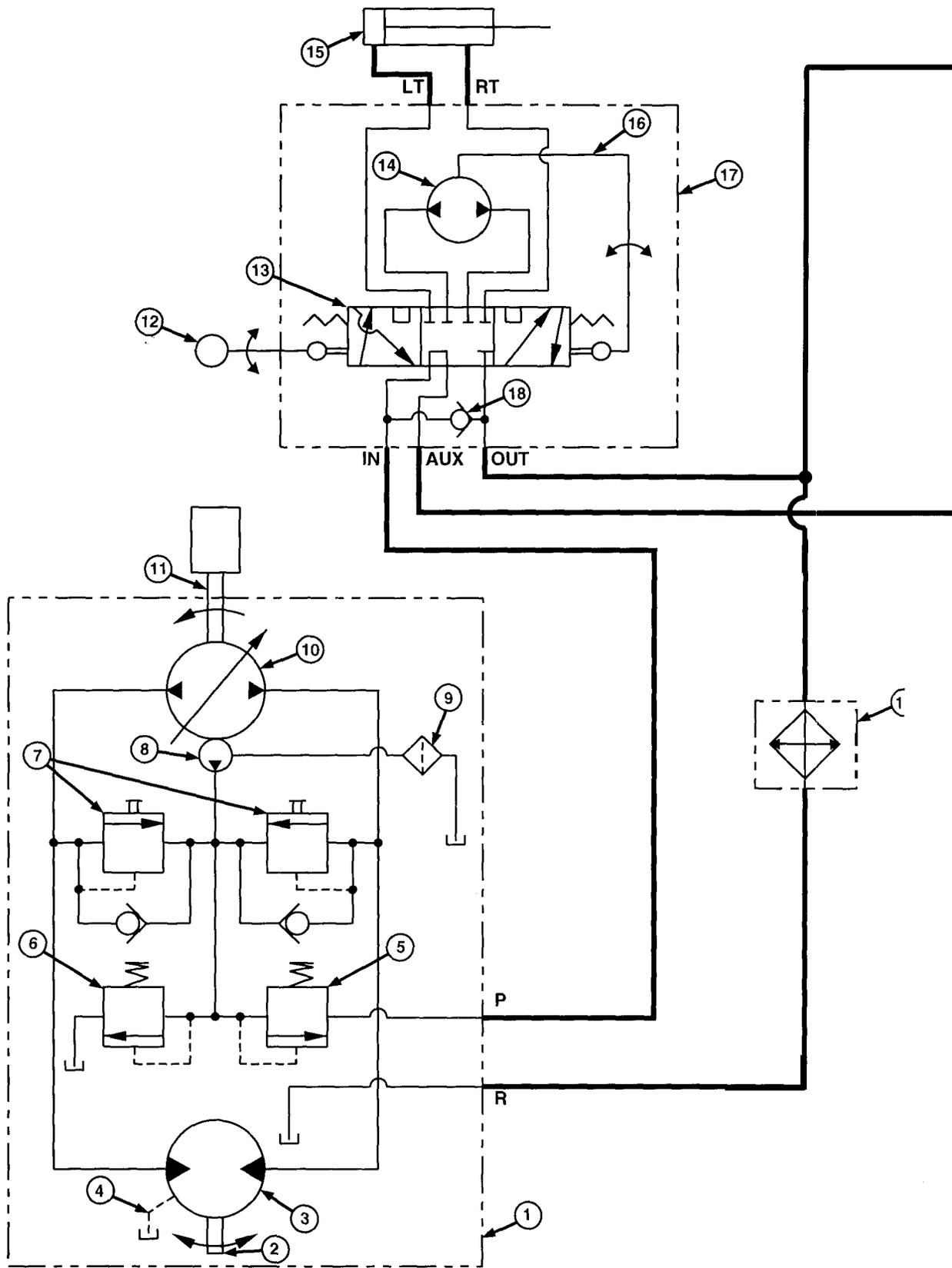
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HYDRAULIC SYSTEM SCHEMATIC — LATER 318

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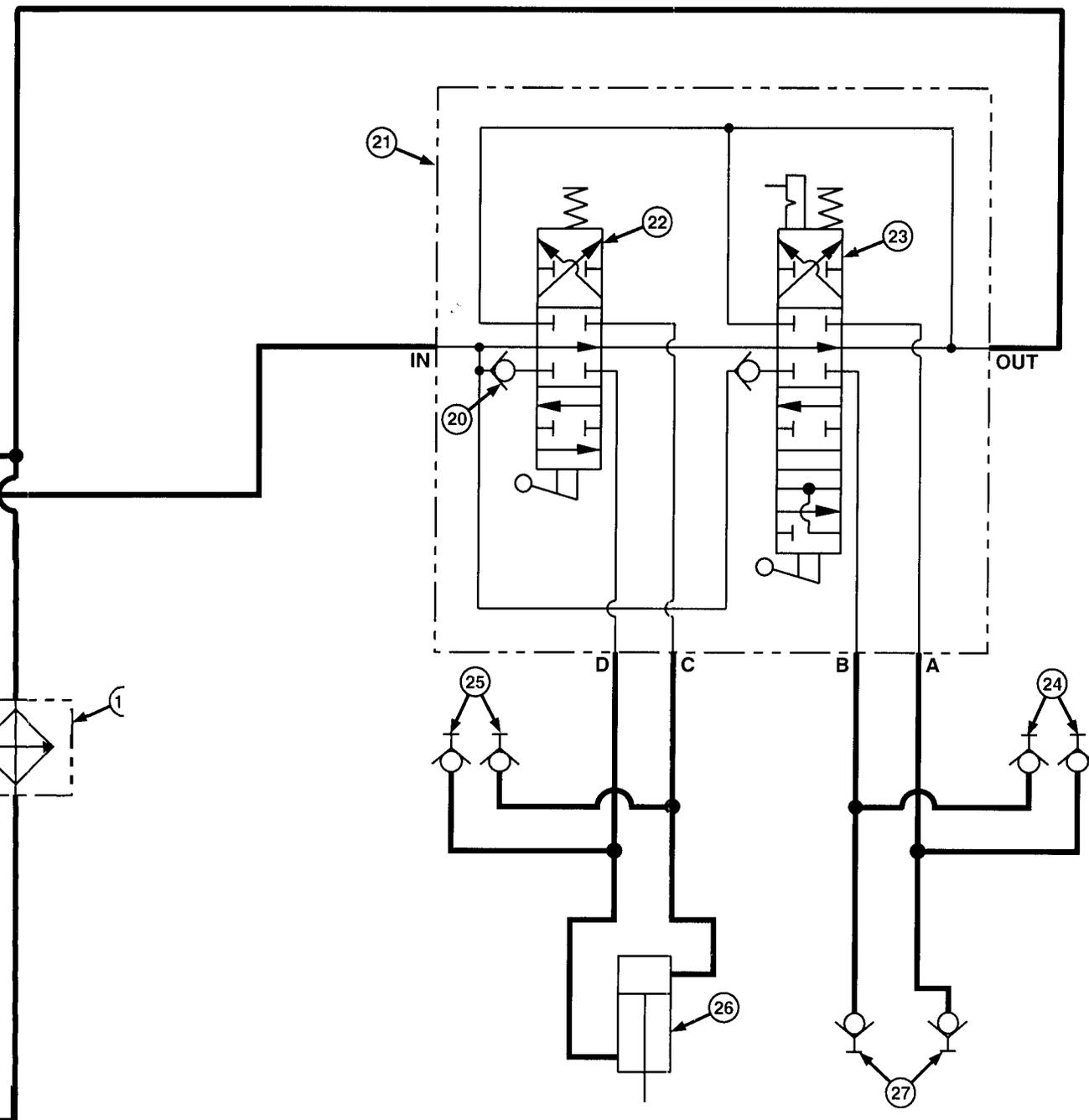


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### HYDRAULIC SYSTEM SCH

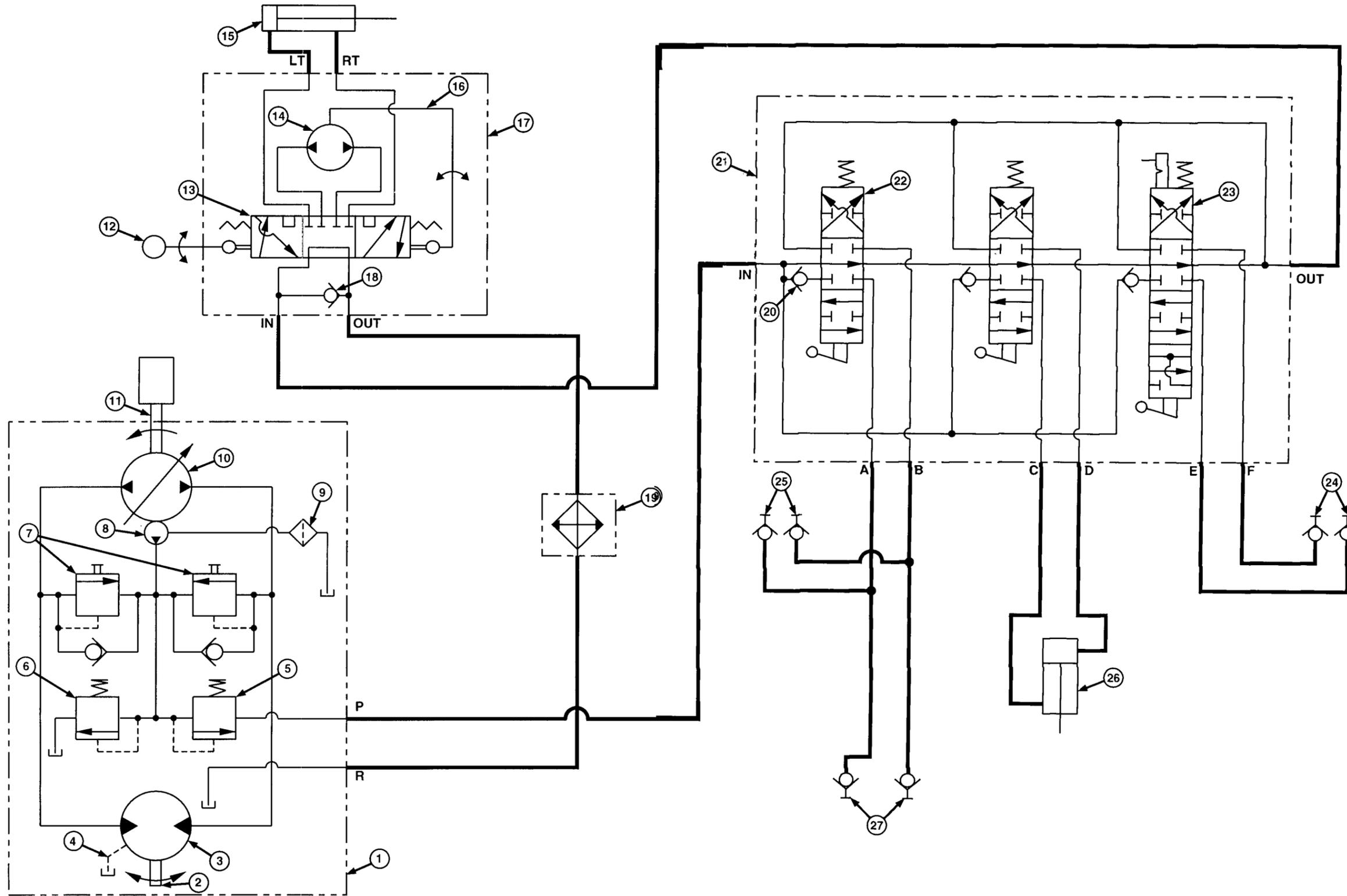
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MX.159027010.7 -19-03MAY95



SYSTEM SCHEMATIC — LATER 318

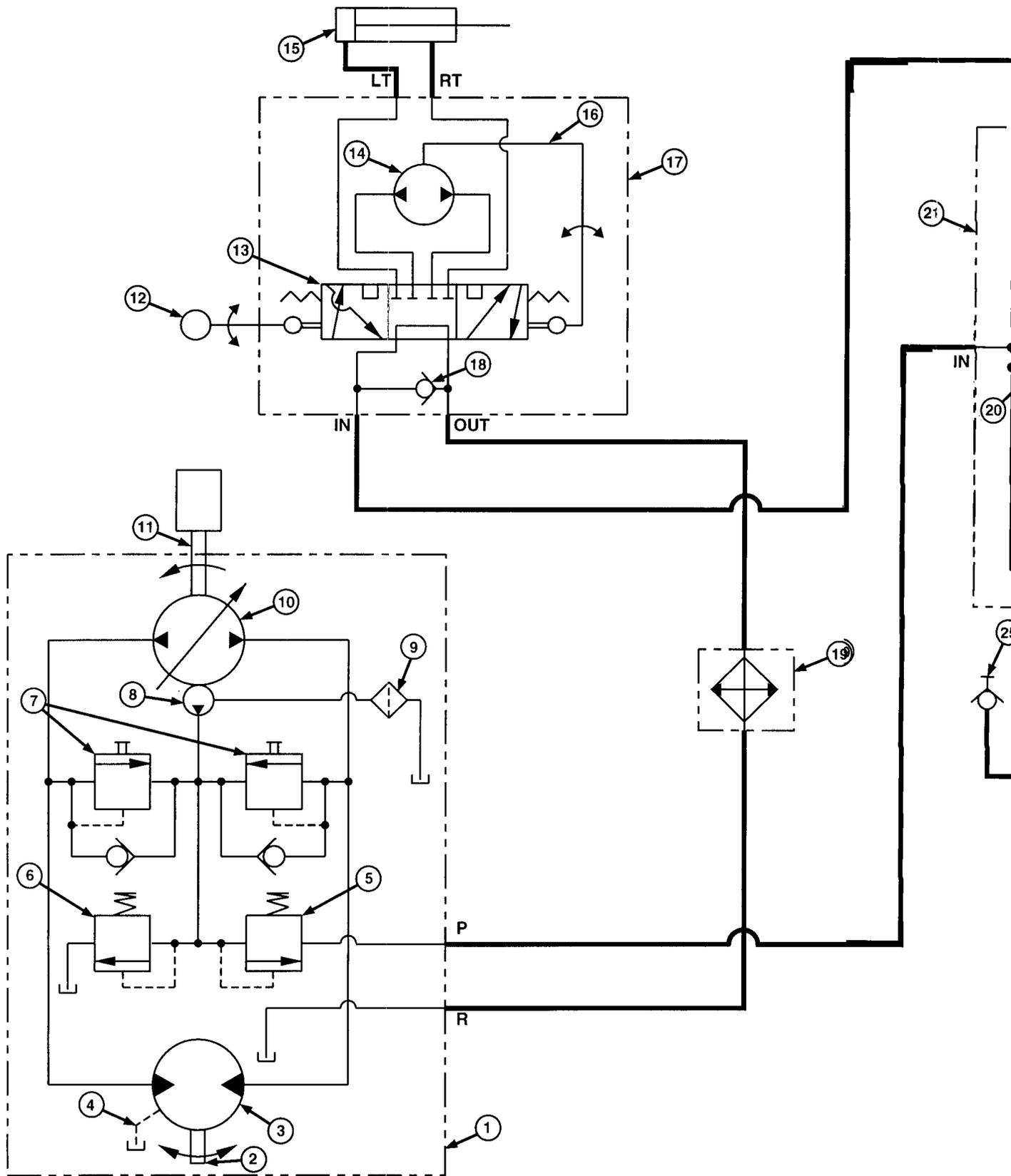
1060X660



HYDRAULIC SYSTEM SCHEMATIC — EARLY 420

1060X660

M78847

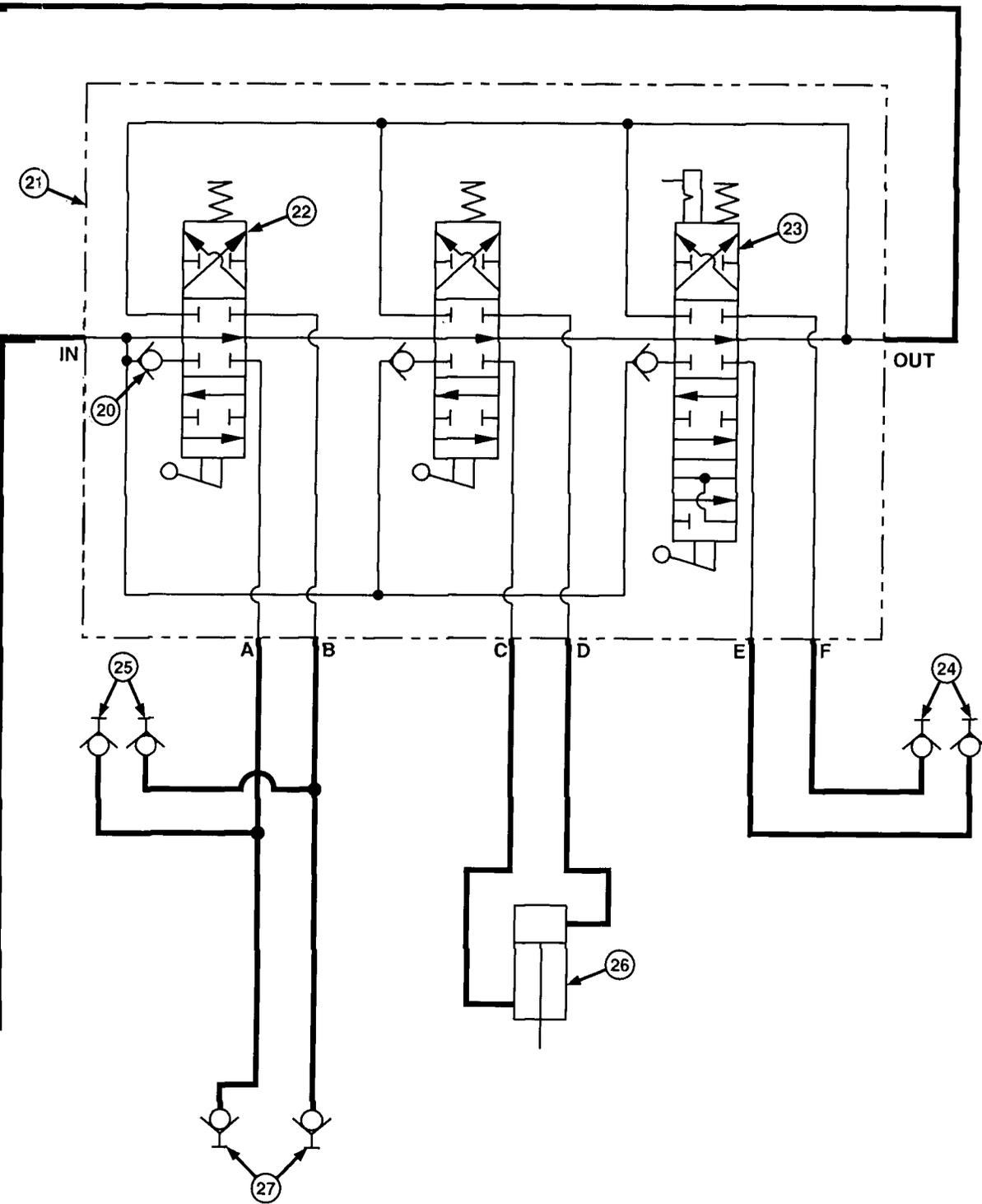


M78847

HYDRAULIC SYSTEM SCHEMATIC —

1060X660

TM1590



**HYDRAULIC - EARLY 420**

## LEGEND FOR HYDRAULIC SYSTEM SCHEMATIC—EARLY 420

1—Hydrostatic Transmission	10—Variable Hydrostatic Pump	17—Steering Valve (4-Port)	24—Front Hydraulic Outlets—Right Side
2—Output (Motor) Shaft	11—Input (Pump) Shaft	18—Check Valve	25—Front Hydraulic Outlets—Left Side
3—Hydrostatic Drive Motor	12—Steering Wheel	19—Oil Cooler	26—Rockshaft Cylinder
4—Transmission Case Drain	13—Control Valve Section	20—Check Valve (3 used)	27—Rear Hydraulic Outlets (Optional)
5—Charge Relief Valve	14—Fluid Metering Section	21—Hydraulic Control Valve	
6—Implement Relief Valve	15—Steering Cylinder	22—Control Valve Spool (Three-Position) (2 used)	
7—Check (Freewheel) Valves	16—Drive Link Assembly	23—Control Valve Spool with “Float” (Four-Position)	
8—Charge Pump			
9—Filter			

MX,159027010,9 -19-03MAY95

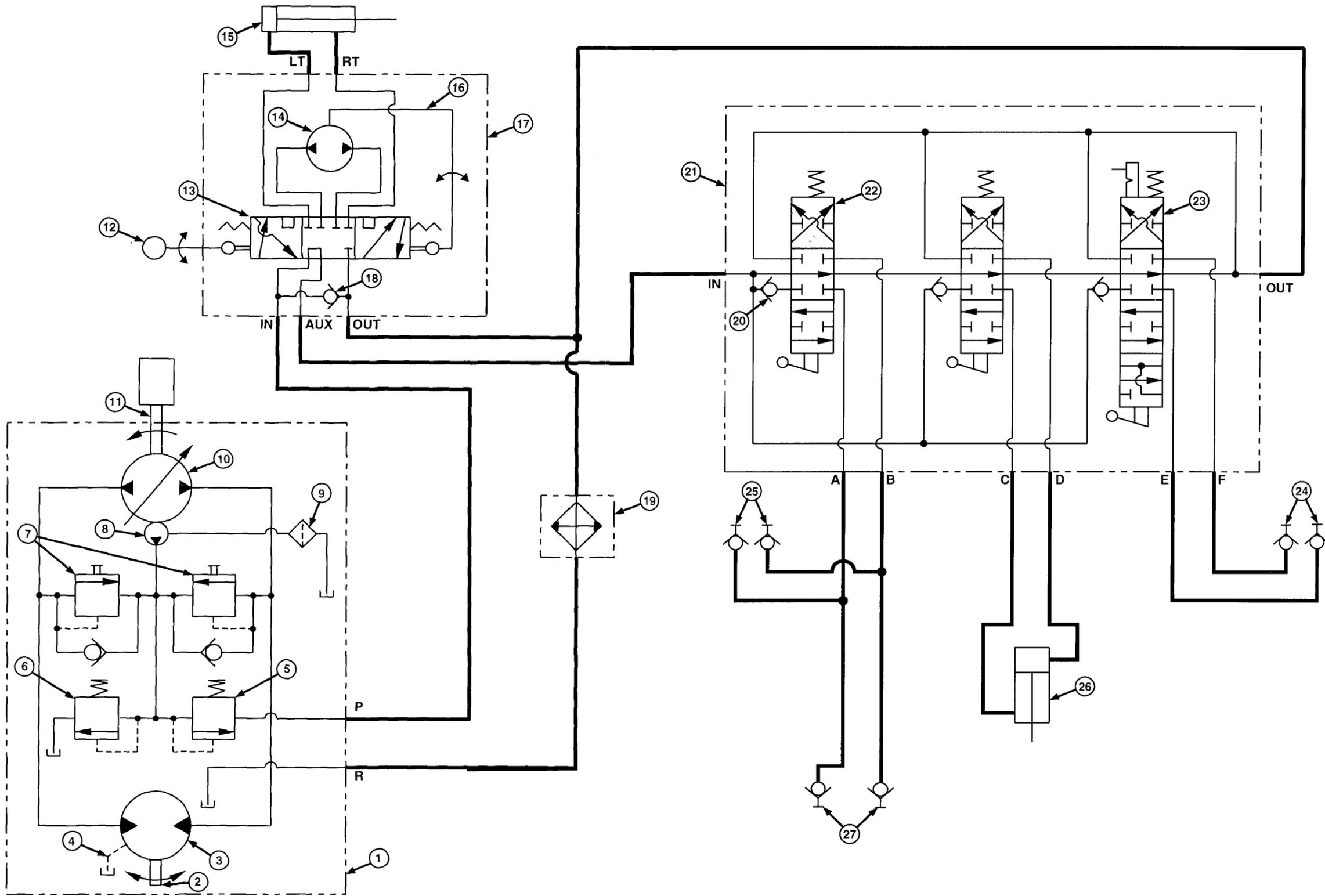
270  
10  
11

## LEGEND FOR HYDRAULIC SYSTEM SCHEMATIC—LATER 420

1—Hydrostatic Transmission	10—Variable Hydrostatic Pump	17—Steering Valve (5-Port)	24—Front Hydraulic Outlets—Right Side
2—Output (Motor) Shaft	11—Input (Pump) Shaft	18—Check Valve	25—Front Hydraulic Outlets—Left Side
3—Hydrostatic Drive Motor	12—Steering Wheel	19—Oil Cooler	26—Rockshaft Cylinder
4—Transmission Case Drain	13—Control Valve Section	20—Check Valve (3 used)	27—Rear Hydraulic Outlets (Optional)
5—Charge Relief Valve	14—Fluid Metering Section	21—Hydraulic Control Valve	
6—Implement Relief Valve	15—Steering Cylinder	22—Control Valve Spool (Three-Position) (2 used)	
7—Check (Freewheel) Valves	16—Drive Link Assembly	23—Control Valve Spool with “Float” (Four-Position)	
8—Charge Pump			
9—Filter			

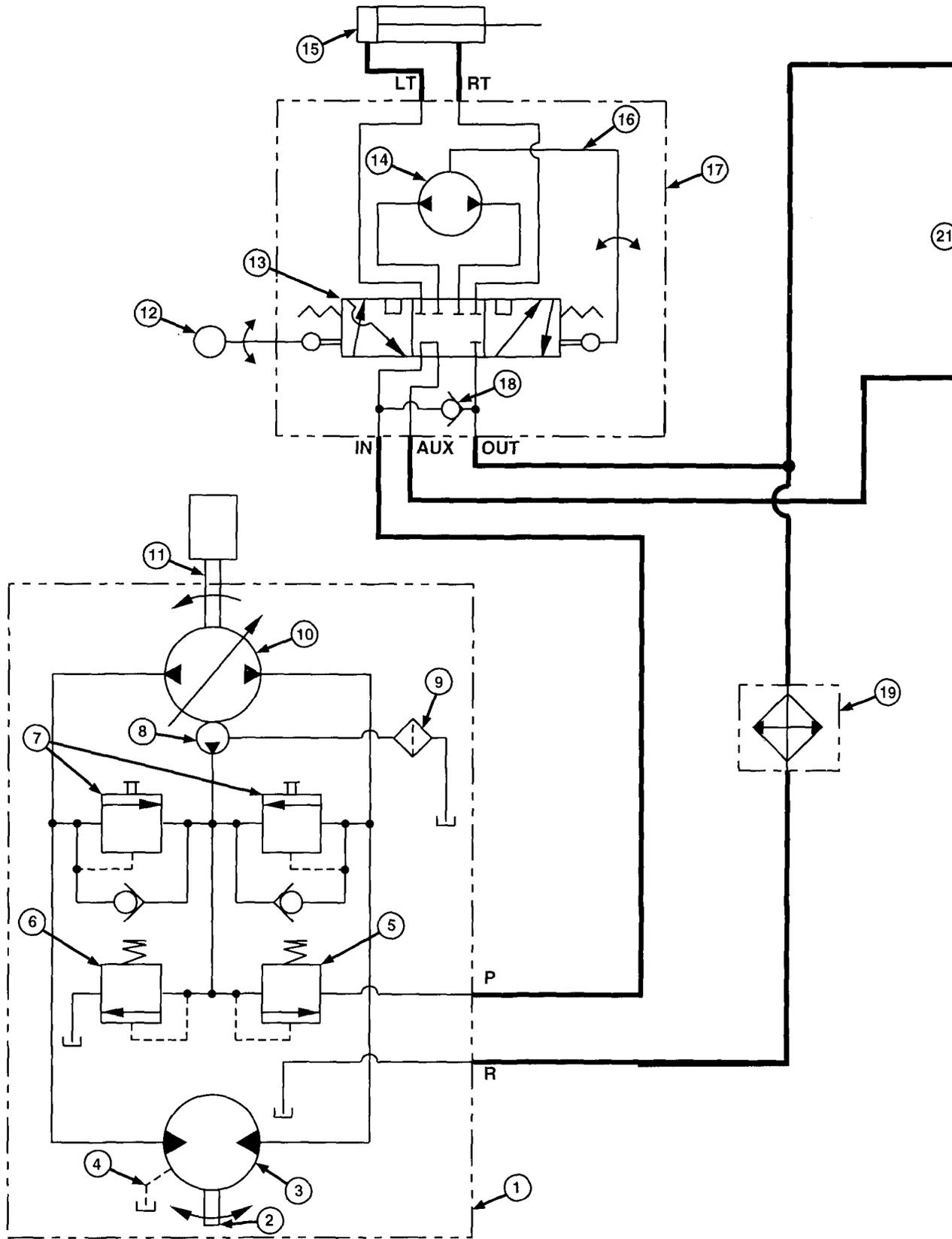
MX,159027010,10-19-03MAY95

270  
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12



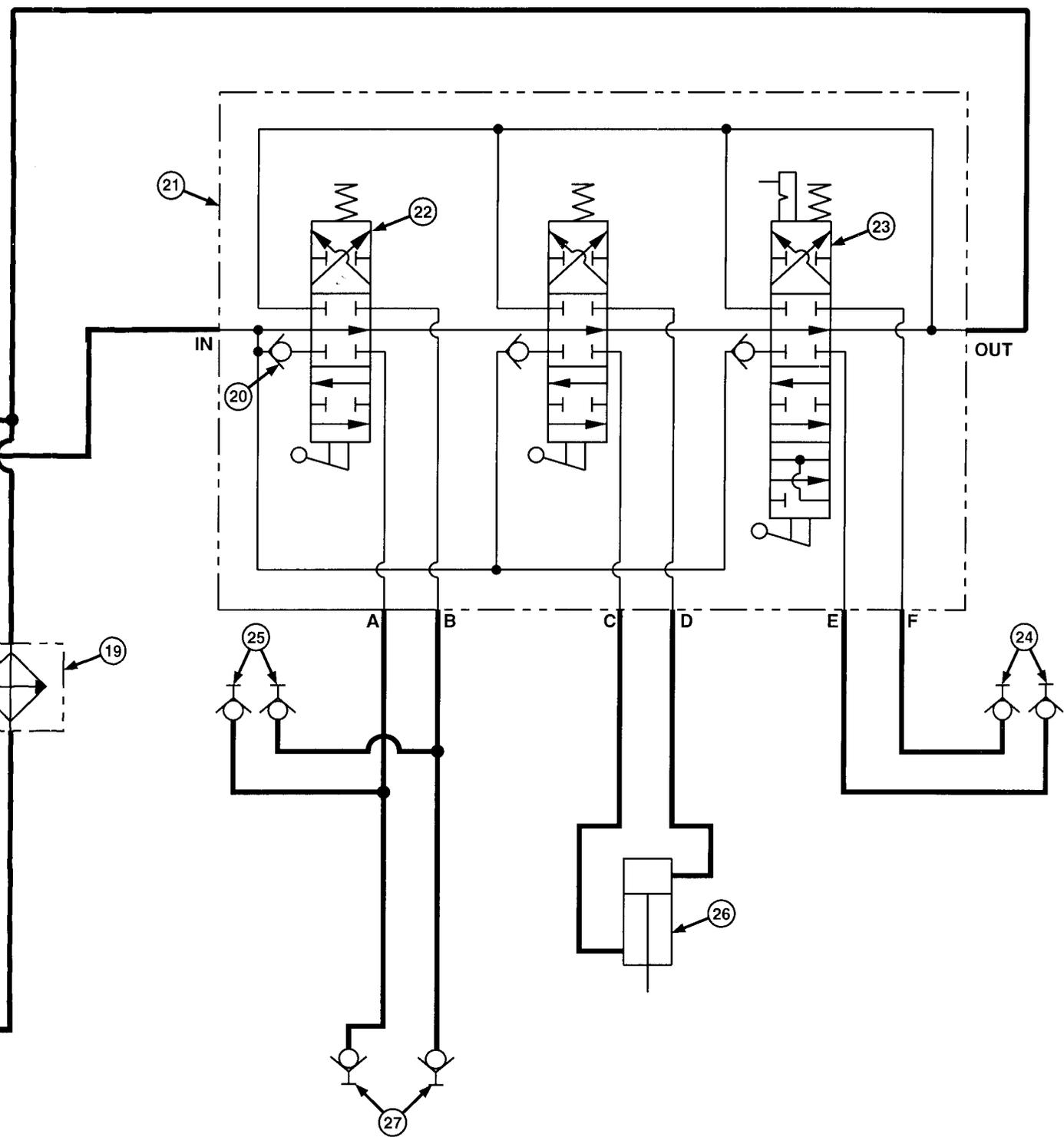
M78848

HYDRAULIC SYSTEM SCHEMATIC — LATER 420



M78848

HYDRAULIC SYSTEM SCH



SYSTEM SCHEMATIC — LATER 420

1060X650

270  
10  
14

## HYDRAULIC LIFT SYSTEM OPERATION—THREE-POSITION SPOOL

### Function:

To control the flow of pressurized oil to the rockshaft cylinder or implement.

### Theory of Operation:

*NOTE: Lower position shown.*

*On later 318 and 420 models, pressurized oil is routed through the steering valve before reaching the hydraulic control valve. This design provides "power beyond" to the auxiliary hydraulic systems only after satisfying steering valve needs. (See Section 260 for further information.)*

### LOWER:

As the handle is moved to the LOWER position, linkage connected to the actuator (F) causes the control valve spool (A) to change position. Pressurized oil entering the control valve inlet (H) forces the check valve (G) to open. Oil is then directed by the spool valve to the rockshaft cylinder (E) or hydraulic outlets (D).

Oil returning from the cylinder or implement is routed through the control valve spool and is returned to the transmission.

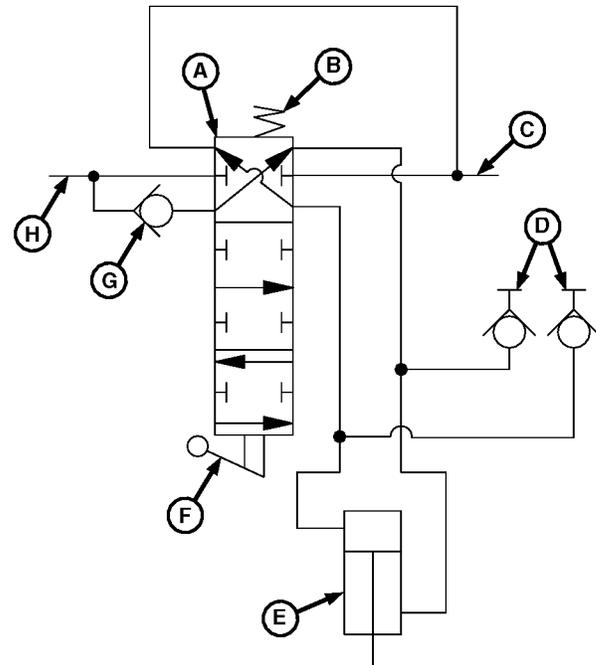
### RAISE:

Valve operation for RAISE is similar to LOWER, except that spool position reverses oil flow.

### NEUTRAL:

As the handle is released, the centering spring (B) returns the control valve spool (A) to the neutral position. Oil flow to/from the cylinder or implement is then blocked, holding the implement in either the raised or lowered position.

The valve spool position allows pressurized oil to flow through the valve to other valves in the system, or return to the transmission.



- A—Control Valve Spool
- B—Centering Spring
- C—Return Oil to Transmission
- D—Hydraulic Outlets
- E—Rockshaft Cylinder
- F—Actuator
- G—Check Valve
- H—Control Valve Inlet

M78849 -UN-03APR95

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## HYDRAULIC LIFT SYSTEM OPERATION—FOUR-POSITION SPOOL

### Function:

To control the flow of pressurized oil to the implement.

### Theory of Operation:

NOTE: Float position shown.

On later 318 and 420 models, pressurized oil is routed through the steering valve before reaching the hydraulic control valve. This design provides "power beyond" to the auxiliary hydraulic systems only after satisfying steering valve needs. (See Section 260 for further information.)

### RAISE:

As the handle is moved to the RAISE position, linkage connected to the actuator causes the control valve spool to change position. Pressurized oil entering the control valve inlet forces the check valve to open. Oil is then directed by the spool valve to the hydraulic outlets.

Oil returning from the implement is routed through the control valve spool and is returned to the transmission.

### LOWER:

Valve operation for LOWER is similar to RAISE, except that spool position reverses oil flow.

### NEUTRAL:

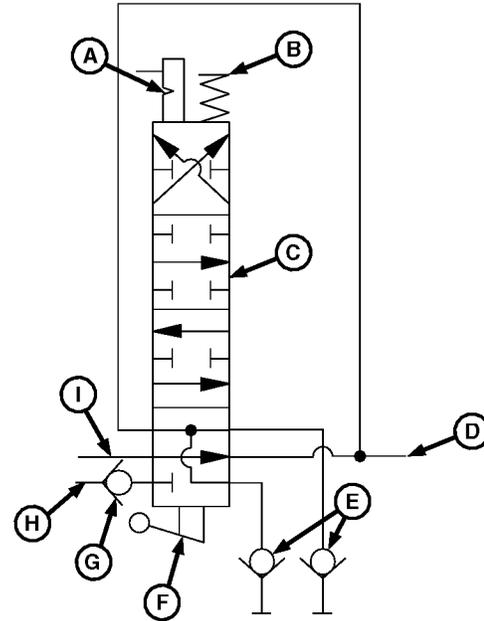
As the handle is released, the centering spring (B) returns the control valve spool (C) to the neutral position. Oil flow to/from the implement is then blocked, holding the implement in either the raised or lowered position.

The valve spool position allows pressurized oil to flow through the valve to other valves in the system, or return to the transmission.

### FLOAT:

As the handle is moved to the FLOAT position, linkage connected to the actuator (F) causes the control valve spool (C) to change position and engage the detent (A), locking the valve in position. In this position, both sides of the hydraulic outlets (E) are connected to the return line (D) to the transmission. This allows pressure to be released as the implement moves or "floats".

Valve spool position also allows pressurized oil entering from the valve stack inlet (I) to flow through the valve and return to the transmission.



- A—Detent
- B—Centering Spring
- C—Control Valve Spool
- D—Return Oil to Transmission
- E—Hydraulic Outlets
- F—Actuator
- G—Check Valve
- H—Control Valve Inlet
- I—Inlet from Valve Stack

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## **ABOUT THIS GROUP**

The step-by-step procedures in this group provide you with the detailed diagnostic information you will need to perform a test. Basic diagnostic equipment is used.

It is assumed that you are familiar with the machine and its hydraulic system components. If you need additional information, read the theory of operation in Group 15 or refer to the overall hydraulic schematics in Group 10.

Engine rpm and temperature are critical in most hydraulic tests. Be sure to follow test specifications carefully.

Always start with the first step and follow the sequence from left to right. Read each step completely before performing the test.

Upon completing a test or adjustment, check to see whether the problem is corrected.

*NOTE: The 316 has manual steering (gearbox), single-spool control valve and rockshaft cylinder.*

*The 318 has power steering, steering cylinder, two-spool control valve, rockshaft cylinder and oil cooler.*

*The 420 has power steering, steering cylinder, three-spool control valve, rockshaft cylinder and oil cooler.*

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## ; TROUBLESHOOTING GUIDE

If hydraulic system does not operate properly, select the appropriate symptom from the list below.

After selecting the appropriate symptom, go to that step and perform the following checks, tests, or adjustments in the order shown to isolate and repair malfunction.

- HYDRAULIC SYSTEM INOPERATIVE: GO TO A
- LOW OR SLOW HYDRAULIC POWER: GO TO B
- HYDRAULIC SYSTEM OPERATES ERRATICALLY: GO TO C
- LOAD DROPS WITH CONTROL VALVE IN NEUTRAL POSITION: GO TO D
- LOAD DROPS SLIGHTLY WHEN CONTROL VALVE IS SHIFTED TO RAISE POSITION: Check for damaged lift check in control valve. See Section 70.
- EXCESSIVE HYDRAULIC PUMP NOISE: GO TO E
- CONTROL VALVE STICKS OR HARD TO OPERATE: GO TO F
- FREQUENT FAILURE OF HYDRAULIC LINES AND O-RINGS: GO TO G
- HYDRAULIC OIL FOAMS: GO TO H
- HYDRAULIC OIL OVERHEATS: GO TO I
- 318 AND 420; ATTACHMENT OR HYDRAULIC LEVER DOES NOT STAY IN FLOAT POSITION: Inspect control valve detent assembly for wear or damage. See Section 70.

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## A HYDRAULIC SYSTEM INOPERATIVE

- Check for slipping or broken transmission drive shaft. See Section 50.
- Check for proper charge pump housing installation. See Section 50.
- Check hoses for proper attaching location.
- Check for dented or restricted lines.
- Test charge pump pressure. See Section 250.
- Check suction line for air leaks. See Section 250.
- Check for plugged oil filter.
- Test implement relief valve pressure. See Section 250.
- 318 and 420; Check for steering valve check ball missing, damaged, or in "IN" port. See Section 60.

MX,159027020,3 -19-24APR95

## **B LOW OR SLOW HYDRAULIC POWER**

- Check for dented or restricted lines.
- Check for proper engine speed. See Section 220.
- Test charge pump pressure. See Section 250.
- Check for plugged oil filter.
- Check suction line for air leaks. See Section 250.
- Test implement relief valve pressure. See Section 250.
- Test control valve for leakage. GO TO Å
- Inspect cylinder packings for excessive wear. GO TO Æ

MX,159027020,4 -19-24APR95

## **C HYDRAULIC SYSTEM OPERATES ERRATICALLY**

- Bleed hydraulic system. GO TO Ö
- Check for restricted lines.
- Test charge pump pressure. See Section 250.
- Check for plugged oil filter.
- Check suction line for air leaks. See Section 250.
- Check for dirt in implement relief valve. See Section 50.

MX,159027020,5 -19-24APR95

## **D LOAD DROPS WITH CONTROL VALVE IN NEUTRAL POSITION**

- Check lines from control valve to rockshaft cylinder for leakage.
- Check control valve for centering when released.
- Check implement relief valve for leakage. See Section 250.
- Test control valve for leakage. GO TO Å
- Check cylinder packings and O-rings for leakage. GO TO Æ

MX,159027020,6 -19-24APR95

## **E EXCESSIVE HYDRAULIC PUMP NOISE**

- Bleed hydraulic system. GO TO 0
- Check suction line for air leaks. See Section 250.
- Check for worn or damaged charge pump. See Section 50.

MX,159027020,7 -19-24APR95

## **F CONTROL VALVE STICKS OR HARD TO OPERATE**

- Check for binding control valve linkage.
- Inspect control valve for broken return spring, contaminated or scored valve bore, or bent valve spool. See Section 70.

MX,159027020,8 -19-24APR95

## **G FREQUENT FAILURE OF HYDRAULIC LINES AND O-RINGS**

- Check hydraulic oil for contamination.
- Check hydraulic connections for proper torque.
- Test implement relief valve pressure. See Section 250.

MX,159027020,9 -19-24APR95

## **H HYDRAULIC OIL FOAMS**

- Check hydraulic lines for kinks or dents.
- Check suction line for air leaks. See Section 250.

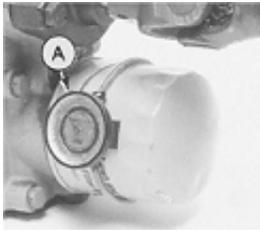
MX,159027020,10-19-24APR95

## **I HYDRAULIC OIL OVERHEATS**

- Operator holding control valve open too long causing implement relief valve to open.
- Check oil cooler fins (if equipped) and transmission fins for plugged condition.
- Check for restricted lines or plugged oil filter.
- Test implement relief valve pressure. See Section 250.
- Check for high air temperatures and high draft loads. GO TO '

MX,159027020,11-19-24APR95

Diagnosis, Tests and Adjustments/Rockshaft Cylinder Leakage Test

<p><b>HYDRAULIC OIL WARM-UP PROCEDURE</b></p>	 <p>Remove belly screen/pan.</p> <p>Install JDG282 Temperature Gauge (A) on transmission oil filter.</p>	<p>Apply park brake.</p> <p>Start engine and run at full throttle.</p>
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M43008 -UN-18JAN90

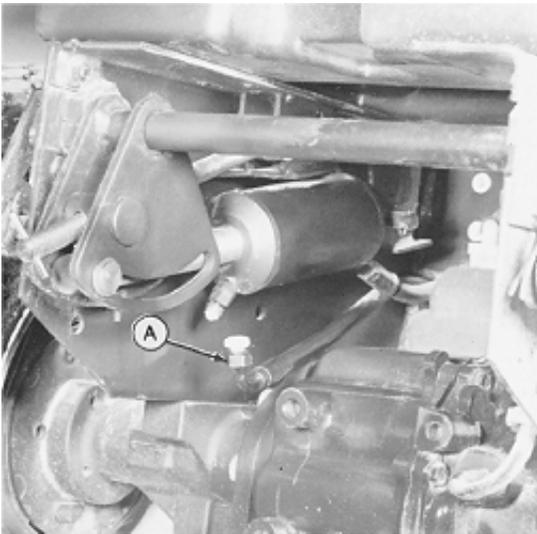
MX,159026015,16-19-24APR95

	<p>Move and hold control lever in implement "raise" position.</p> <p>Periodically cycle all hydraulic functions to distribute heated oil.</p> <p><i>NOTE: 316 Shown</i></p>	<p>Heat oil to temperature specified in test.</p> <p><i>NOTE: The hydrostatic transmission should not exceed 93°C (200°F) as a continuous operating temperature.</i></p>
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M43629 -UN-12JAN90

MX,159025020,23-19-20APR95

<p><b>ROCKSHAFT CYLINDER LEAKAGE TEST</b></p>	<p>Heat hydraulic oil to 43°C (110°F).</p> <p>With implement linkage in the raised position (cylinder extended), shut off engine.</p> <p><b>CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.</b></p>	
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	<p>Disconnect hose (A) from rod-end of cylinder. There might be some initial dripping of hydraulic oil from the cylinder and hose. This is not leakage.</p> <p>Put JT03393 steel Plug in disconnected hose.</p> <p>Start engine and run at full throttle.</p> <p>Hold control valve lever in the "lift" position.</p> <p>Observe cylinder, hydraulic oil should not continually leak out of the rod-end fitting.</p>	<p><b>IF HYDRAULIC OIL CONTINUALLY LEAKS OUT OF THE ROD-END FITTING, REPLACE CYLINDER.</b></p>
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M43631 -UN-12JAN90

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Diagnosis, Tests and Adjustments/Control Valve Leakage Test

**Ä CONTROL VALVE LEAKAGE TEST**

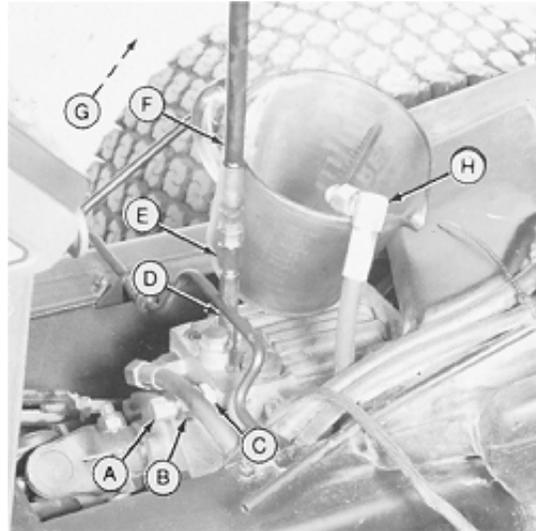
**CAUTION: TO AVOID INJURY FROM ESCAPING HYDRAULIC OIL UNDER PRESSURE, RELIEVE THE PRESSURE IN THE SYSTEM BY STOPPING THE ENGINE AND OPERATING ALL HYDRAULIC CONTROL VALVES.**

**IMPORTANT: To avoid putting full pump flow into container, DO NOT return control valve lever to "neutral" or "float" (if equipped) position with engine running. If equipped with power steering, DO NOT move steering wheel.**

MX,159027020,15-19-03MAY95

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**4a Model 316**



- A—JT05484 Cap
- B—JT03002 Adapter
- C—JT03036 Connector
- D—JT03339 Connector
- E—JT03107 Adapter
- F—JT03017 Hose
- G—JT03345 Gauge  
20,000 kPa (3,000 psi)(Not Shown)
- H—Return Line

M43632 -UN-12JAN90

MX,159027020,16-19-24APR95

Heat hydraulic oil to 43°C (110°F). See ' in this group.

Disconnect hydraulic hose (return line) (H). Put disconnected hose into a container.

Make test port connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit.

Hold control valve lever in "raise" position.

Start engine and run at fast idle for one minute.

Stop engine. Record amount of oil in container. Amount must be less than 15 mL/min (1/2 fl oz/min). Pressure must be 5860—6550 kPa (850—950 psi).

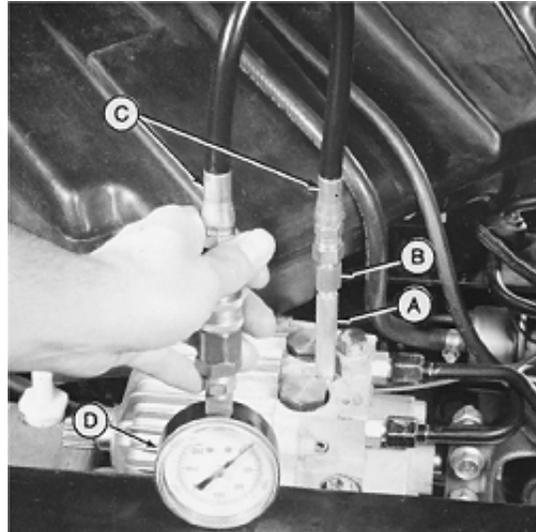
Repeat test for "lower" position.

**IF PRESSURE IS NOT WITHIN SPECIFICATIONS: GO TO SECTION 250 AND TEST IMPLEMENT RELIEF PRESSURE.**

**IF LEAKAGE IS MORE THAN SPECIFICATION: REPLACE CONTROL VALVE.**

MX,159027020,17-19-24APR95

**4b Models 318 and 420**



M36682 -UN-25JAN90

A—JT03339 Connector  
 B—JT03107 Adapter  
 C—JT03017 Hose  
 D—JT03345 Gauge  
 20,000 kPa (3,000 psi)

MX,159027020,18-19-24APR95

Heat hydraulic oil to 43°C (110°F). See ' in this group.

Make test port connections from JT01765 Lawn and Grounds Care Products Hydraulic Fitting Kit.

Remove control valve return line from "OUT" port on control valve.

If steering valve return line is connected into control valve return line, it must be plugged in order to isolate only the control valve leakage.

Put container under control valve to catch leakage.

Hold a control valve lever in "raise" position.

Start engine and run at fast idle for

one minute.

Stop engine. Record amount of oil in container. Amount must be less than 15 mL/min (1/2 fl oz/min). Pressure must be 5860—6550 kPa (850—950 psi).

Repeat test for "lower" position.

Repeat test for remaining control lever(s).

IF PRESSURE IS NOT WITHIN SPECIFICATIONS: GO TO SECTION 250 AND TEST IMPLEMENT RELIEF PRESSURE.

IF LEAKAGE IS MORE THAN SPECIFICATION: REPLACE CONTROL VALVE.

MX,159027020,19-19-03MAY95

## Ö BLEED HYDRAULIC SYSTEM

After installing a repaired or replacement part, follow this run-in procedure to assure that air is purged from the hydraulic system.

1. Start engine and idle for 10 minutes.
2. Run engine at high idle for one minute.
3. Turn steering wheel full left and hold for five seconds.
4. Turn steering wheel to straight forward for 10 seconds.
5. Turn steering wheel full right and hold for five seconds.
6. Return steering wheel to straight forward. Travel vehicle forward about 20 feet and then make two hard left turns.
7. Then make two hard right turns.
8. Travel vehicle in reverse for 10 feet.
9. Cycle mower deck up and down three times.
10. Shut engine off and inspect hydraulic components for leaks.
11. Fill reservoir as required with John Deere Low Viscosity HY-GARD® oil.

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MX,159027020,20-19-29MAR95

**Section 299**

# **DEALER FABRICATED TOOLS**

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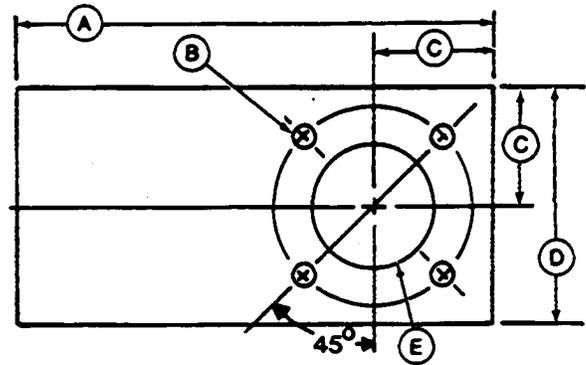


### DFMX1 STEERING VALVE FIXTURE

Steering valve fixture is used to hold steering valve during disassembly and assembly procedures.

Material required: One piece of 5 x 102 x 203 mm (3/16 x 4 x 8 in.) 1020 mild steel flat stock.

- A—203 mm (8.0 in.)
- B—9.5 mm (3/8 in.)\*
- C—51 mm (2.0 in.)
- D—102 mm (4.0 in.)
- E—51 mm (2.0 in.) Diameter Hole



M36677 -UN-28APR89

\*Four diameter holes equally spaced on a 83 mm (3-1/4 in.) diameter circle.

MX,159129900,1 -19-24FEB95

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### DFMX2 ALIGNMENT SHIMS

Alignment shims are used to align steering valve metering assembly with drive plates during assembly.

Material required: Six pieces of 13 x 38 mm (1/2 x 1-1/2 in.) long, 0.18 mm (0.007 in.) thick shim stock.

MX,159129900,2 -19-24FEB95

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