

# HYDRAULIC SYSTEM

## Part 8—Section A

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## HYDRAULIC SYSTEM

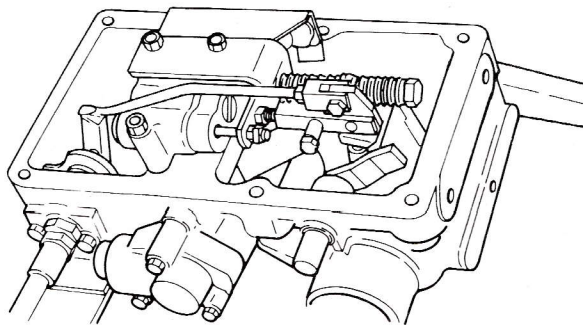
## GENERAL

## Gear Pump

The pump is driven by the timing gears of the engine, and shares oil with the transmission. The gear pump is located on the left side of the engine except for the M-F 1040/1045 Tractors which is on the right side of the engine.

## Hydraulic Lift Cover

The hydraulic lift cover is composed of the lift housing with control valve, lift cylinder, cover assembly (includes relief valve) and housing cover (includes lowering speed adjust mechanism). The control valve switches the oil flow between pump, cylinder and sump by means of a spool. A poppet and a check valve are installed for secure switching. An unload valve directs oil flow, with no restriction from pump to sump while in lowering and neutral modes. The relief valve in the cover assembly keeps the hydraulic system maximum pressure below a specified setting. The lowering speed adjust control in the housing cover controls the oil flow from the cylinder while in lowering mode. The oil flows unrestricted into the cylinder while in the raising mode.

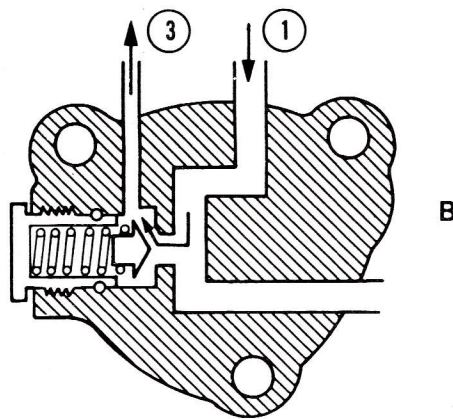
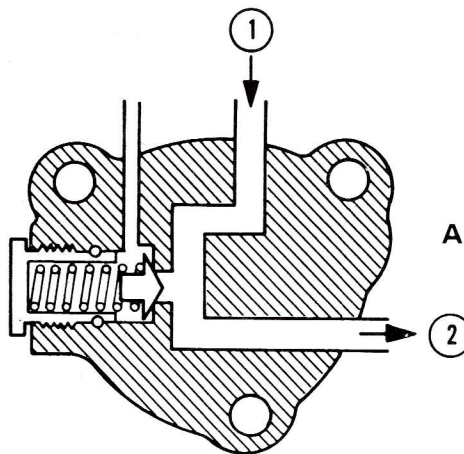


## Relief Valve

The relief valve cover assembly is located on the right side of the hydraulic lift cover, except for M-F 1010 Tractors which is located on the left side. A relief valve, incorporated in the assembly, is set to open at 13.7 to 14.2 N.m<sup>2</sup> (2020 to 2090 psi) and divert excess pressure to the sump.

## Key

- A. Diagram — Relief valve closed
- B. Diagram — Relief valve open
- 1. Oil Flow from Gear Pump
- 2. Oil Flow to Control Valve
- 3. Oil Flow to Sump



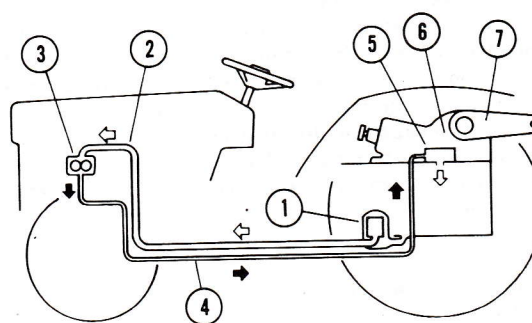
### Control Valve

When the engine is running the pump is driven and draws oil from the sump via the suction filter. Oil is delivered by the pump to the lift cover via the relief valve. Then the oil enters the control valve where it may be returned to the sump or fed to the lift cylinder depending on the setting of the position control lever relative to the linkage arms.

**NOTE: M-F 1040/1045 also incorporate a second filter to filter return oil to the sump.**

### Key

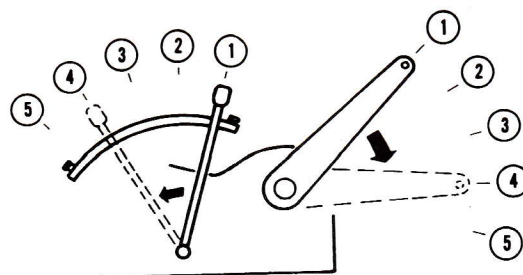
1. Suction Filter
2. Suction Tube
3. Gear Pump
4. Delivery Tube
5. Control Valve
6. Hydraulic Lift Cover
7. Lift Arm



### Operation — Position Control

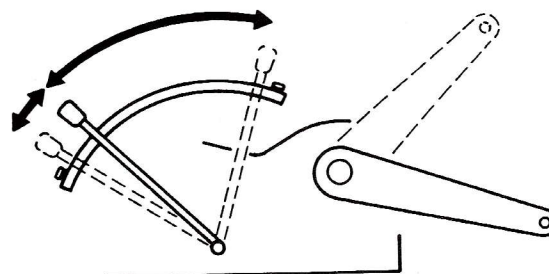
#### Position Control

Hydraulic power on a tractor is used only for lifting, and the implement lowers by its own weight when oil in the cylinder is removed. The lift arms (implement) are maintained at a height corresponding to the control lever position while the engine is running. When the lever is moved, the control valve switches and starts feeding oil into the cylinder (or releases oil from the cylinder) until the lift arms complete movement to the position corresponding to the lever position. Then, the control valve switches back to neutral.



#### Floating Position

The final 50 mm (2") towards the lowest position on the control lever is called the "floating" position, and this range is used for operating implements at a constant depth, using a tail wheel or gauge wheel with the three-point linkage. In the normal position control range, the lift arm moves according to the position of the control lever, and the control valve is maintained at the neutral position. In the "floating" position, however, the lever is pulled down farther than the lowering position, and the valve maintains the "lowering" position, during floating. Oil is allowed to flow freely from the cylinder.



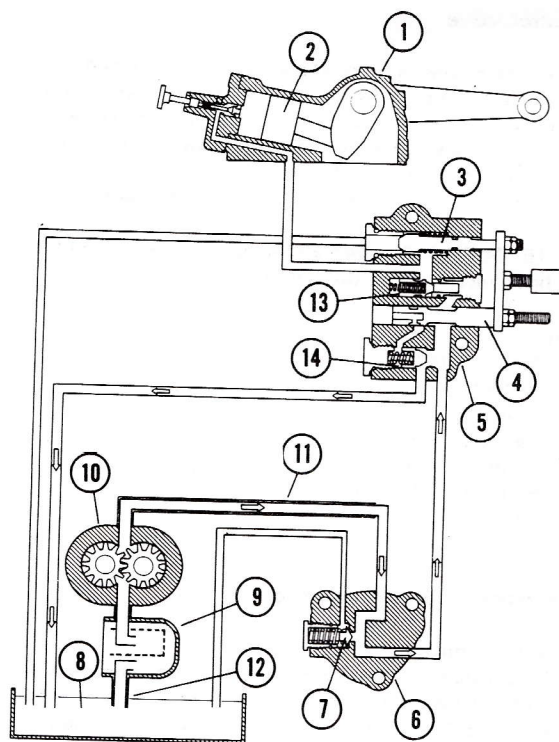
## HYDRAULIC SYSTEM

**Control Valve — Neutral**

With the control lever in neutral, the oil returns to sump by action of the valves in the control valve assembly. Supplied oil cannot flow through the control valve to the cylinder due to spool positioning. The check valve is held closed by back pressure of oil already in the lift cylinder. Inlet oil pressure easily overcomes the tension of the unloading valve spring and when the unloading valve opens, all oil flow is directed to the sump.

**Key**

1. Hydraulic Lift Cover
2. Piston
3. Poppet
4. Spool
5. Control Valve Assembly
6. Cover Assembly
7. Relief Valve
8. Sump
9. Oil Filter
10. Gear Pump
11. Delivery Tube
12. Suction Tube
13. Check Valve
14. Unload Valve





**Raising (Position Control)**

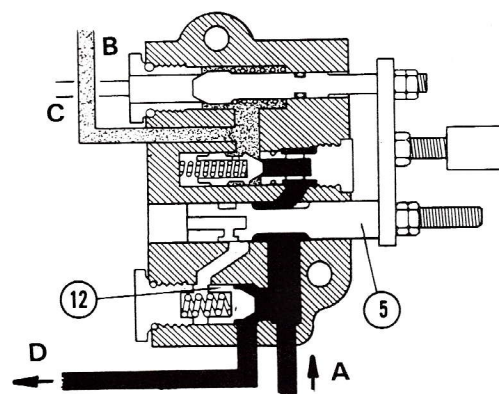
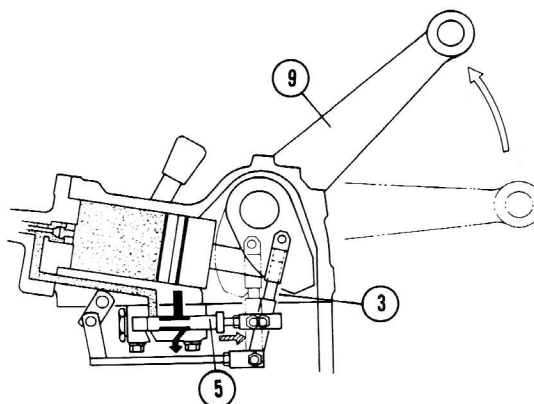
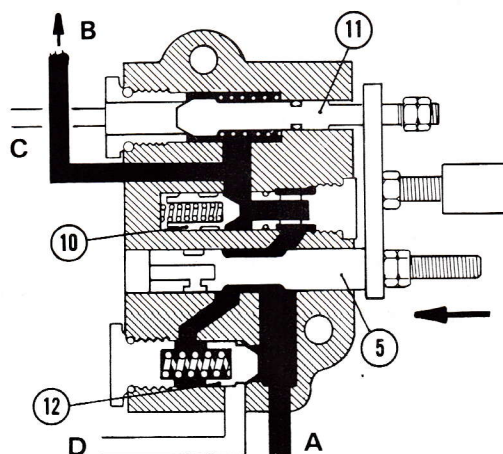
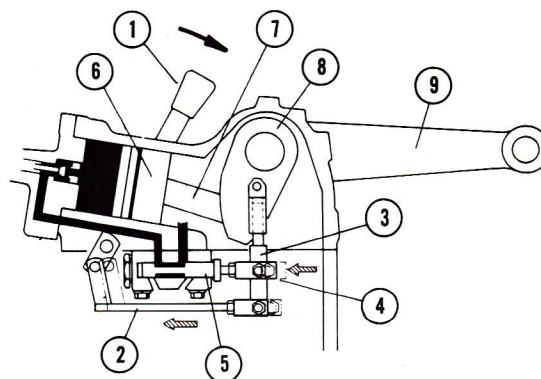
When the position control lever, 1, is moved upward, link, 3, is pulled forward by link, 2. This action causes the turnbuckle, 4, to shift in the direction of the arrow, and the control valve spool, 5, is pushed in. The pump port and the cylinder port of the control valve are then connected, causing oil from the pump to enter the cylinder. As a result, 6, the piston moves to raise the lift arms via the push rod, 7, and the hydraulic arm, 8.

Inside the control valve during raising, inward movement of the control valve spool, 5, routes oil flow to unseat the check valve, 10, past closed poppet, 11, and to the lift cylinder. At the same time, pressurized oil is allowed behind the unload valve, 12, to hold it on its seat.

This condition continues until lift arms, 9, reach their selected position. When this occurs, link, 3, also connected to hydraulic arm, 8, pulls control valve spool, 5, outward to neutral position. Oil flow is then diverted to the sump as the pressurized oil behind the unload valve, 12, is released and the unload valve opens. Oil in the lift cylinder circuit is trapped behind closed check valve and closed poppet and the lift links remain in the stationary position.

**Key**

- |                           |                            |
|---------------------------|----------------------------|
| 1. Position Control Lever | 9. Lift Arms               |
| 2. Link                   | 10. Check Valve            |
| 3. Link                   | 11. Poppet                 |
| 4. Turnbuckle             | 12. Unload Valve           |
| 5. Control Valve Spool    | A. Oil Flow From Pump      |
| 6. Lift Cylinder Piston   | B. Cylinder Port           |
| 7. Push Rod               | C. Return (Discharge) Port |
| 8. Hydraulic Arm          | D. Sump Port               |



## HYDRAULIC SYSTEM

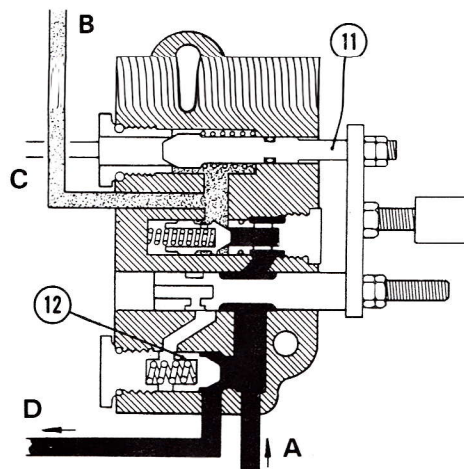
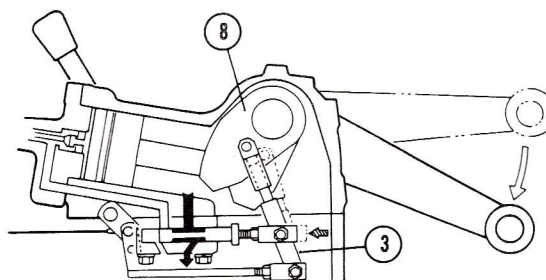
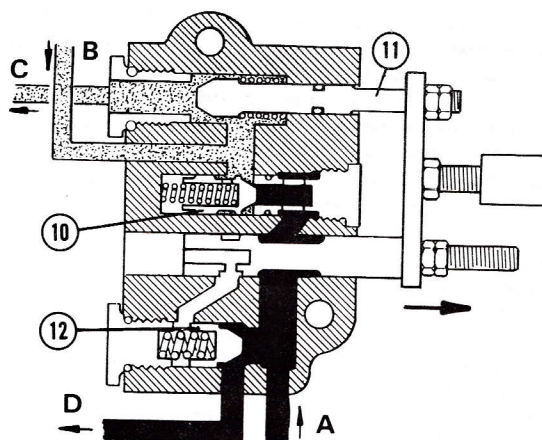
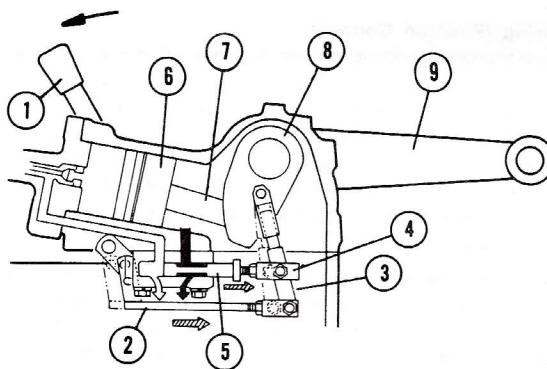
**Lowering (Position Control)**

When the position control lever, 1, is moved downward, link, 3, is pushed rearward by the link, 2. The poppet, 11, in the control valve is pulled out. The cylinder port and return port of the control valve are then connected and oil in the cylinder returns to the sump. The weight of the implement pushes the piston causing the lift arms to go down as the oil is released behind the piston. Return oil from the cylinder utilizes a separate access to the sump. This access is equipped with operator adjusted orifice (response control) and thus the lowering rate of the linkage can be varied. Note that oil from the pump is diverted also to the sump as unload valve, 12, remains unseated.

As the lift arms go down, the hydraulic arm, 8, is pushed forward. This moves link, 3, forward to push the poppet to the closed position. Oil flow from the cylinder is stopped in the neutral position, and the lift arms stop at the desired height.

**Key**

- |                           |                            |
|---------------------------|----------------------------|
| 1. Position Control Lever | 9. Lift Arms               |
| 2. Link                   | 10. Check Valve            |
| 3. Link                   | 11. Poppet                 |
| 4. Turnbuckle             | 12. Unload Valve           |
| 5. Control Valve Spool    | A. Oil Flow From Pump      |
| 6. Lift Cylinder Piston   | B. Cylinder Port           |
| 7. Push Rod               | C. Return (Discharge) Port |
| 8. Hydraulic Arm          | D. Sump Port               |



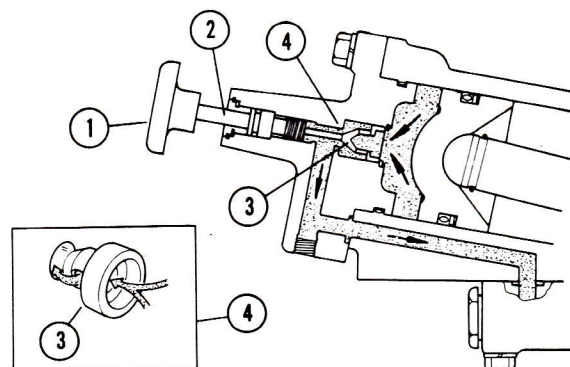
### Lowering Speed Adjustment — Operation

Lowering speed variation is provided by a floating piston in the lift cylinder cover with an adjustable stop pin to regulate movement and size of the cylinder opening during implement lowering. During raising, incoming oil pushes the piston rearward, eliminating any restriction during raising.

During lowering, oil flow outward pushes the tapered piston outward towards its seat. The control knob regulates how far outward the piston will move, this regulating discharge hole opening and thus the lowering speed of the linkage.

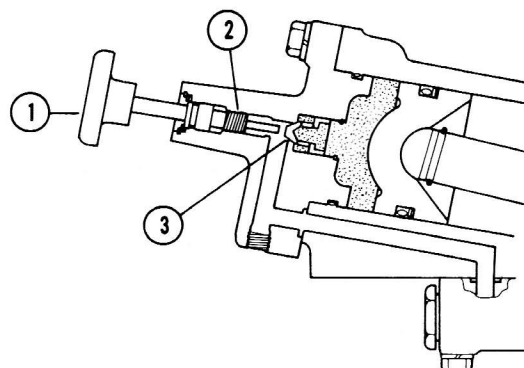
#### To Increase Lowering Speed

1. Turn knob counterclockwise.
2. Lowering adjustment screw moves inward (left-hand thread).
3. Lowering adjustment valve is pushed toward the cylinder.
4. The clearance between valve and valve seat is increased.
5. Oil in cylinder flows out quickly through the increased clearance.
6. Lowering speed of implement increases.



#### To Decrease Lowering Speed

1. Turn knob clockwise.
2. Lowering adjustment screw moves outward.
3. Lowering adjustment valve is pushed forward by oil in the cylinder.
4. The clearance between valve and valve seat is decreased.
5. Oil in cylinder flows out slowly through the decreased clearance.
6. Lowering speed of implement decreases.



#### To Lock

1. Turn knob clockwise until stopped.
2. Lowering adjustment screw moves outward.
3. Lowering adjustment valve is pushed forward by oil in the cylinder and the clearance between valve and valve seat is closed.
4. Oil in cylinder cannot flow out.
5. Implement is held at fixed position.

**NOTE:** Lifting speed is controlled by engine speed. Whenever the hydraulic control lever is moved to UP position, the implement is always lifted, regardless of the knob position.



## HYDRAULIC SYSTEM

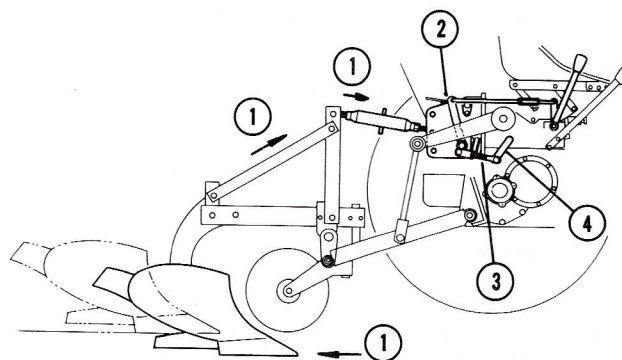
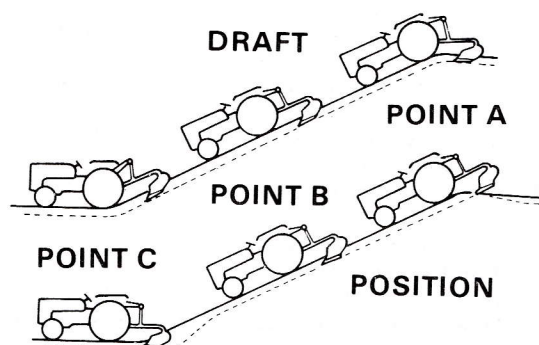
## Operation — Draft Control

## General

Draft control monitors variable draft loads of the implement from the top link to the sensor bracket (exclusively for the draft), and the varying loads are fed back to the control valve through a linkage rod. This is how the implement is moved up and down for adjusting the plowing depth, thus keeping the draft load constant.

Difference between Draft Control and Position Control — In reference to plow operations on a hilly field, the difference between the draft control and position control is shown:

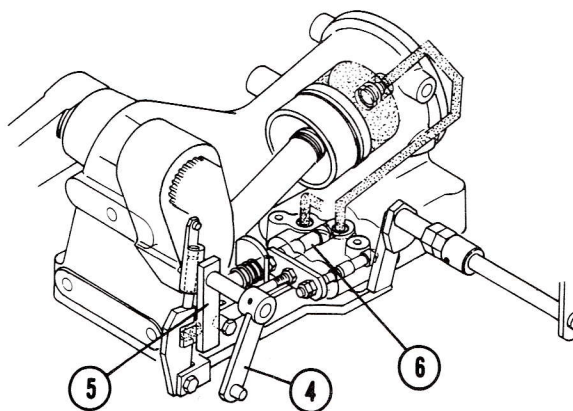
- Point A: Draft Control —  
The tractor moves from the ascending to descending slope. The implement goes down, keeping the plowing depth constant, since the draft load decreases as the height of the implement increases. Working depth is maintained as it is.
- Position Control —  
Since the implement is kept constant in height, it follows the tractor movement, reducing the plow depth.
- Point B: Draft Control —  
The plow depth is kept constant.
- Position Control —  
The plow depth is kept constant.
- Point C: Draft Control —  
The tractor moves from the descending slope to the ascending slope. The implement is raised, keeping the plow depth constant, since the draft load increases as the height of the implement decreases. The plowing depth is kept constant.
- Position Control —  
Since the height of the implement is kept constant, the implement follows the tractor movement, increasing the plow depth.



## Draft Control Linkage —

As draft load increases due to harder soil, the upper link, 1, is pushed forward. Sensor bracket, 2, pivots inward as the spring is compressed. The rod, 3, is pushed forward, and active lever, 4, is pushed forward. Internal lever, 5, acts against a roller to push control valve spool, 6, into control valve and raise the lift arms.

As draft load decreases due to softer soil, inward force on top link decreases and spring pressure against pivot sensor bracket, 2, moves it rearward. This has an opposite effect on the linkage and allows the implement to be lowered until an equilibrium is achieved between top link force and spring in reaction bracket, 2.





**To Decrease Implement Depth —**

1. Move the draft lever rearward (up).
2. The lever is turned rearward.
3. The rod is pushed by lever.
4. The active lever is pushed.
5. The internal sensor lever is moved rearward.
6. The clearance between the internal sensor lever and roller becomes wider.

In short, when the upper link is pushed by maximum effort, draft control is acted.

**To Increase Implement Depth —**

1. Move the draft lever forward (down).
2. The lever is turned forward.
3. The rod is pulled by lever.
4. The active lever is pulled.
5. The internal sensor lever is moved forward.
6. The clearance between the internal sensor lever and roller becomes closer.

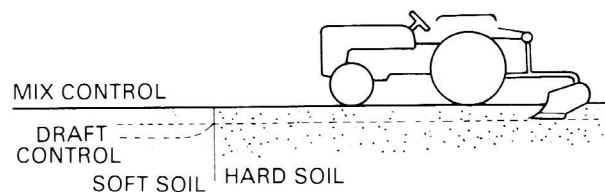
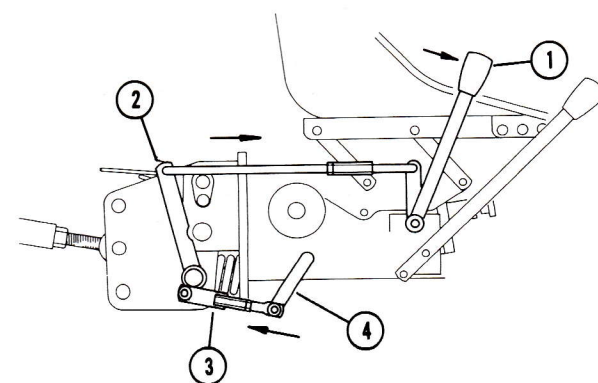
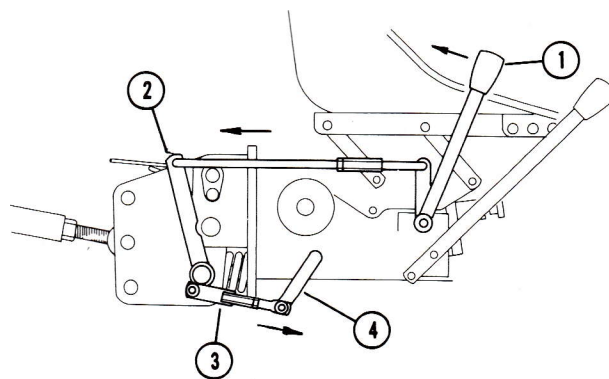
In short, when the upper link is pushed by minimum effort, draft control is acted.

**Operation — Mix Control**

In addition to the draft control, the position control may also be employed. When the plowing operation is carried out using only the draft control (with the position control lever at the lowest position) in a field mixed with hard and soft soil, the implement goes deeper and shallower to maintain even draft load. Working depth is subjected to wider variations.

To prevent this, if the plow DOWN position is controlled by the position control lever, the plow is not deeper than the controlled DOWN position in soft soil, thus making it possible to keep the plowing depth constant.

In other words, this method uses a hydraulic control system in which the working machine DOWN position is controlled by the position control and the draft control functions in the range above that position.



## HYDRAULIC SYSTEM

**Using Mix Control**

To lower the maximum lowered position of working machine —

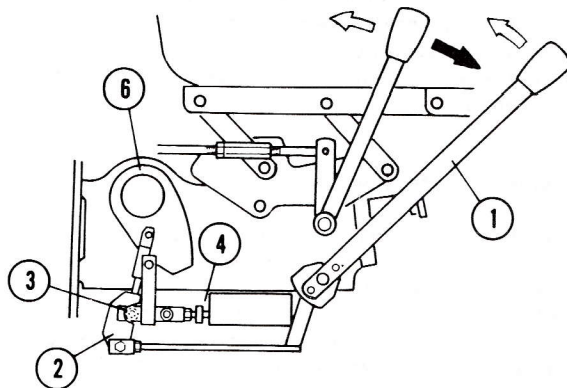
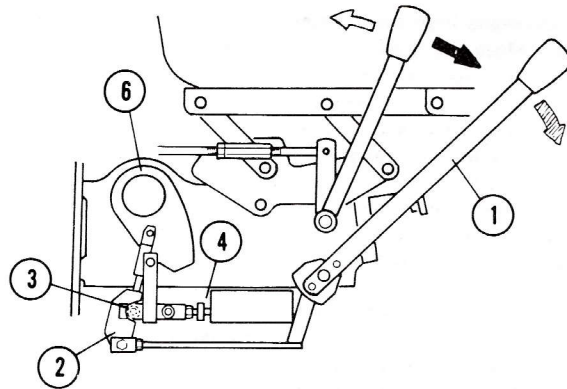
1. Move the position control lever forward.
2. Link is pushed backward.
3. The draft roller is moved backward.
4. The control valve spool is then pulled backward.
5. The oil flows to the sump, from the cylinder.
6. The lift arms lower and implement is lowered.

In short, maximum lowered position of the implement is lowered, but draft control is acted as implement can be moved freely upward. The draft resistance can still be adjusted by the draft control lever.

To raise the maximum lowered position of working machine —

1. Move the position control lever backward.
2. Link is pulled forward.
3. The draft roller is moved forward.
4. The control valve spool is then pushed forward.
5. The oil flows into the cylinder.
6. The lift arms raise, raising the implement.

In short, maximum lowered position of the implement is raised, but draft control is acted as implement can be moved freely upward. The draft resistance can still be adjusted by the draft control lever.



(RESERVED)

8A-12

HYDRAULIC SYSTEM

(RESERVED)



**HYDRAULIC PUMP****Removal and Installation**

8A-01-13

**Removal**

1. Place drain pan beneath the hydraulic pump.
2. Remove the bolt from the inlet fitting.
3. Remove the o-rings.
4. Remove the pressure line from the pump.
5. Remove the two securing bolts and washers.
6. Carefully slide the pump off to the rear.
7. Remove the o-ring from the pump.

**Installation**

8. Reverse procedures 1 to 7, except:
  - (a) Replace all o-rings.
  - (b) Refill transmission with approved oil.
  - (c) Start tractor and operate hydraulic controls to purge air from system.

## HYDRAULIC SYSTEM

## HYDRAULIC PUMP

## Disassembly and Reassembly

8A—02—14

## Disassembly

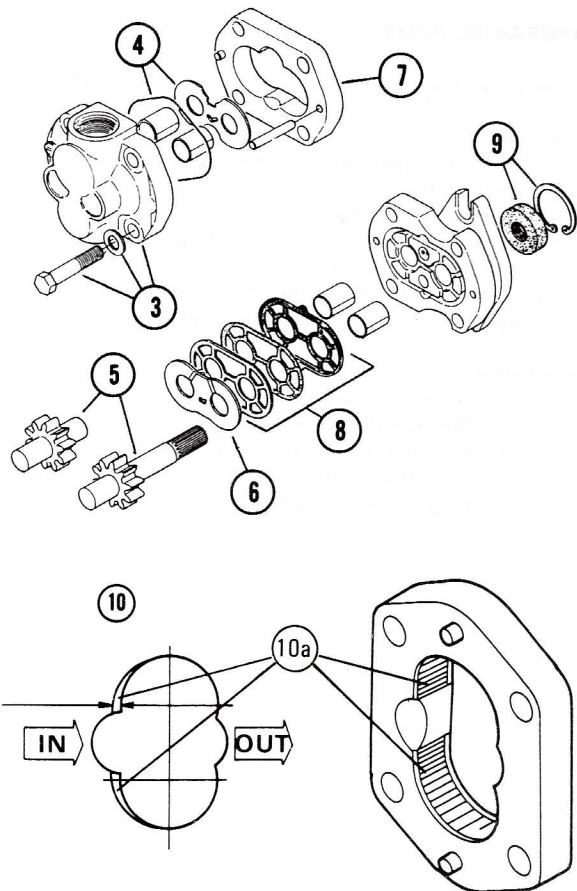
1. Remove the pump, Operation 8A—01—13.
2. Clean the pump exterior, and secure the pump flange in a vise positioning with the flange at the bottom.
3. Remove four bolts and washers and remove the cover in the axial direction. If necessary, tap with a wooden hammer to remove.
4. Remove the o-ring, and the side plate.
5. Pull out the drive gears. Make alignment marks on them for easier reassembly.
6. Pull out the side plate.

**NOTE:** If it is tilted and becomes stuck, install the drive shaft and gently push it in at the higher section of the side plate. Check that the side plate is in its original position, then repeat the pulling out procedure.

7. Remove the gear plate by tapping the gear plate with a wooden hammer.
8. Remove the balance seal, outer gasket, and inner gasket.
9. Remove the snap ring and seal.

## Examination

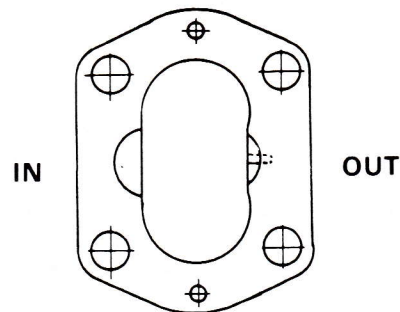
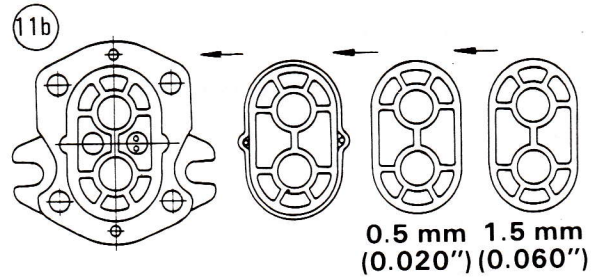
10. Check the disassembled parts for stains and scoring, clean with hydraulic oil or light oil, and inspect as follows. Repair or replace as needed.
  - (a) Gear Plate —  
Contact traces will be seen at the suction port of the gear plate in a pump that has been run. Length of a normal contact trace should be less than 1/2 the inner periphery of the gear hole, and its depth should be within 0.1 mm (0.00394"). Replace the gear plate when the depth of a contact trace exceeds 0.15 mm (0.0059").
  - (b) Drive Gear and Driven Gear —  
If the surface of the shaft or gear sides feels rough when rubbed with fingernail, replace the gears.
  - (c) Sided Plates —  
The copper alloy side should normally be glossy. Replace if there are many scratches in the radial direction that can be felt with a fingernail. The non-contact surface should normally be dull.
  - (d) Renew o-rings and balance seals every time the parts are disassembled.



**Reassembly**

11. Reverse procedures 1 to 9, except:

- (a) Clean each part prior to reassembly, and apply grease to the lips of the oil seals.
- (b) Install balance seal in the mounting flange, and place inner gasket and outer gasket in this order, over the balance seal. Place the entire assembly on a flat board and clamp them in a vise. Apply pressure over the entire surface of the gasket until it is at the same level as the top of the mounting flange.
- (c) Secure the mounting flange in a vise, and place the gear plate after inserting the dowel pin.
- (d) Insert the side plate with the copper alloy side facing up, into the gear plate (apply hydraulic oil on the copper alloy surface).
- (e) Assemble the drive gear and the driven gear aligning the mating marks made during disassembly.
- (f) Insert the side plate, with the copper alloy side facing down, into the gear plate (apply hydraulic oil on the copper alloy surface).
- (g) Install o-ring in the groove on the cover, and replace the cover for the gear plate (with the IN mark on the suction side). Tighten the bolts to a torque of 34.3 to 39.2 N.m (25.2 to 28.8 ft.-lbs.).
- (h) Secure the drive gear in a vise at the shaft end, and check for smooth turning of the pump. If a seal is stuck, the pump may not turn smoothly. If this happens, disassemble, check and re-assemble properly.



## HYDRAULIC SYSTEM

## RELIEF VALVE ASSEMBLY

## Disassembly and Reassembly

8A-03-16

**NOTE:** Relief valve assembly is located on left side of MF 1010 lift cover. Relief valve is located on right side on all other models.

## Disassembly

1. Remove the three bolts securing relief valve to side of lift cover.
2. Remove the assembly.
3. Remove the three o-rings from the lift cover and clean the valve assembly.
4. Remove the plug and o-ring.
5. Take out the shims, spring, poppet and seat.

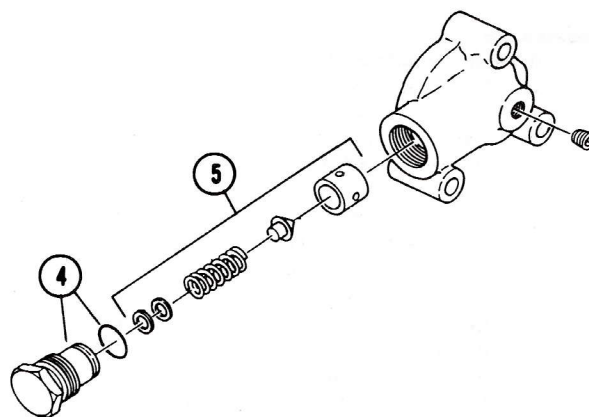
## Examination

6. Clean each part with light oil. If parts are left disassembled for an extended period, coat with hydraulic oil or other oil to protect against rusting.
7. Check each part for burrs, scratches, scoring and other defects. All burrs must be removed by oil stone or lapping. If badly marred, replace.
8. Pay special attention when checking seat surfaces of the seat and the poppet for scratches.

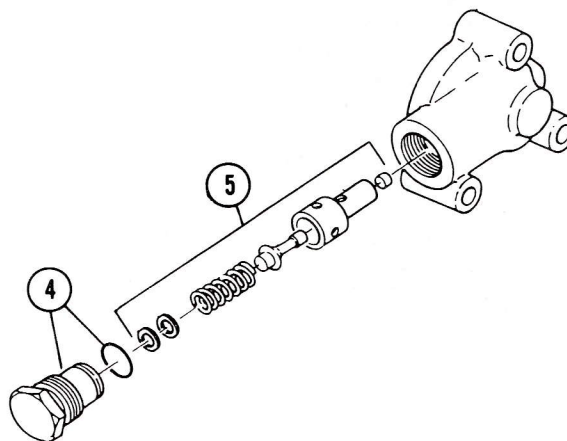
## Reassembly

9. Reverse procedures 1 to 5, except:
  - (a) Use new o-rings coated with grease.
  - (b) Place the seat and poppet in the body, and install shims (thinner shims first) followed by spring in the plug.
  - (c) Screw the plug into the cover to a tightening torque of 3.5 to 4.5 Kg.m (31 to 73 in.-lbs.).
  - (d) Install the relief valve assembly to the hydraulic lift cover.

Tightening Torque . . . . 17.6 to 20.6 N.m  
(13.0 to 15.2 ft.-lbs.)



MF 1010 STANDARD ONLY



ALL OTHER MODELS

	M-F 1010 STANDARD ONLY	ALL OTHERS
Relief Set Pressure	13.7 to 14.2 N.m <sup>2</sup> (2020 to 2090 psi)	13.7 to 14.2 N.m <sup>2</sup> (2020 to 2090 psi)
Max. Flow Capacity	20 litre/min (5.3 gpm)	35 litre/min (9.2 gpm)
Pressure Change Per 1 mm Shim	Approx. 1.37 N.m <sup>2</sup> (200 psi)	Approx. 2.51 N.m <sup>2</sup> (370 psi)



## RELIEF VALVE

## Pressure Checking and Adjusting

8A-04-17

Special Tools: 7553 Adapter (M-F 1010 Standard Only)  
 213785 Adapter (All Other Models)  
 5000 PSI Gauge

1. Completely lower the hitch.
2. M-F 1010 Standard Only —  
 Remove plug in relief valve assembly and install adapter 7553 and gauge.
3. All Other Models —  
 Remove plug at cylinder end cover at front of lift cover and install adapter 213785 and gauge.
4. Locate stop bolt on right side of lift cover for position control lever (bolt limits maximum rearward movement of position control lever).
5. Loosen lock nut and alter stop bolt position to increase rearward movement of position control lever. See Page 8A-30 for stop bolt detail.
6. Start tractor and operate at maximum rpm.
7. Raise hitch fully until relief valve opens (can be heard).
8. Observe maximum reading on pressure gauge.  
 Correct Pressure ..... 13.7 to 14.2 N/mm<sup>2</sup>  
 (2020 to 2090 psi)
9. Lower hitch and shut off tractor.

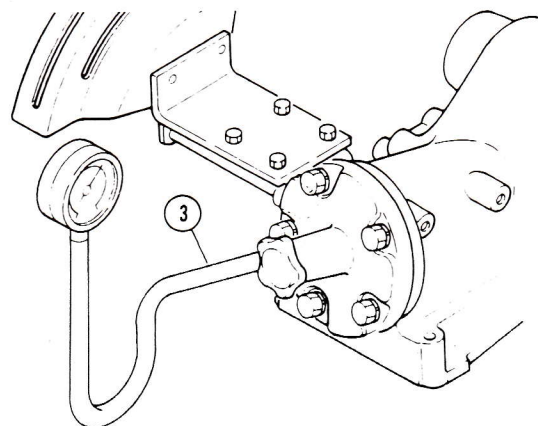
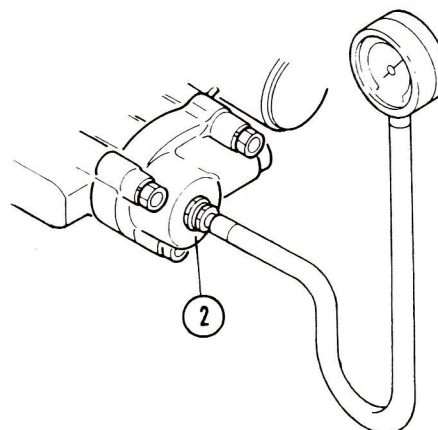
**NOTE: Do not allow relief valve to blow for extended periods. Oil overheating and possible relief valve damage will result.**

10. Adjust pressure by altering shim thickness, Operation 8A-03-16.

**NOTE: Every 1 mm (0.040") in shim thickness:**

- Alters approximately 1.37 N/mm<sup>2</sup> (200 psi) for M-F 1010 Standard.
- Alters approximately 2.51 N/mm<sup>2</sup> (370 psi) for all other models.

11. Recheck pressure following adjustment.
12. Install stop bolt to original setting to prevent constant relief valve opening at transport.
13. Remove gauge and adapter.



(RESERVED)

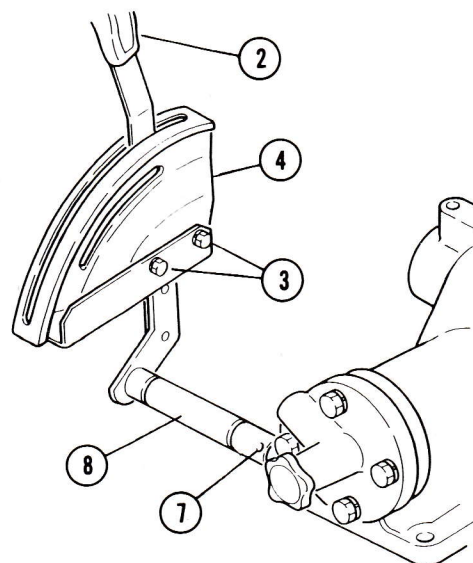
## HYDRAULIC LIFT COVER (M-F 1010)

## Removal and Installation

8A-06-19

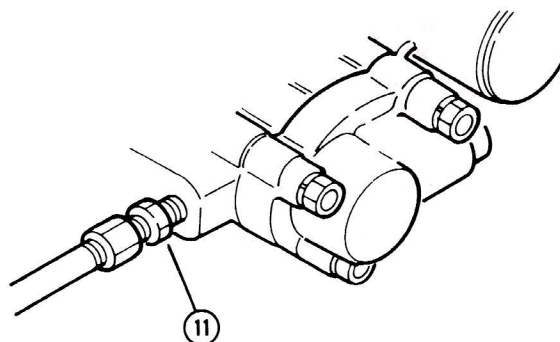
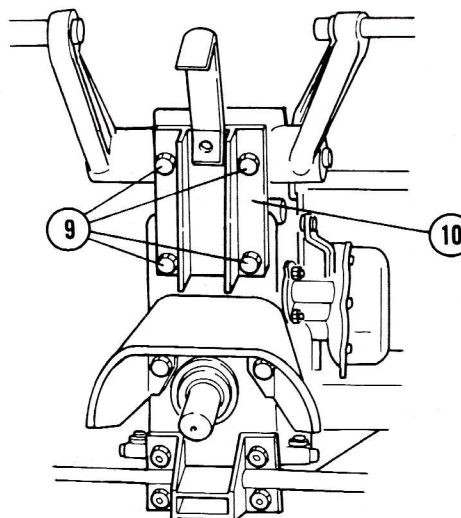
## Removal

1. Remove the seat assembly, Part 2A.
2. Pull off the control knob.
3. Remove the two bolts.
4. Remove the lever guide.
5. Remove the two bolts.
6. Remove the fender, back panel and center panel, Part 2A.
7. Remove the roll pin in lever shaft.
8. Pull out the lever shaft from control shaft.
9. Remove two bolts and two nuts.
10. Remove the upper link bracket.
11. Disconnect the delivery line from the left side of the lift cover.
12. Remove bolts and nuts.
13. Carefully lift up the hydraulic lift cover.



## Installation

14. Reverse procedures 1 to 13, except:
  - (a) Use new gasket.



## HYDRAULIC SYSTEM

## HYDRAULIC LIFT COVER (M-F 1010)

## Disassembly and Reassembly

8A-07-20

## Disassembly

1. Remove the hydraulic lift cover, Operation 8A-06-19.
2. Remove the E-ring, washer, cotter pin, castle nut and bolt.
3. Remove the working link and turnbuckle as an assembly.
4. Remove the three bolts from control valve.
5. Remove the E-ring from hydraulic arm.
6. Remove the control valve with turnbuckle and working link.
7. Remove the adjusting bolt and lock nut.
8. Remove the roll pin and cam.
9. Remove the control shaft.
10. Remove the four bolts.
11. Remove the housing cover assembly and o-rings.
12. Drive out the roll pin securing the lowering speed adjusting knob.
13. Pull off the adjusting knob.
14. Remove the snap ring.
15. Remove the flow control valve.
16. Remove the snap ring and washer.
17. Unscrew and remove flow control screw with o-ring.
18. Set the hydraulic arm in the lower position, then push out the piston.
19. Remove the piston o-ring and backup ring.
20. Remove the bolts and washers.
21. Pull the lift arms off the lift arm shaft.
22. Drive out the lift arm shaft to the right with a soft hammer.
23. Remove the two collars and seals.
24. Remove the hydraulic arm and the push rod together.
25. If necessary, remove roll pins and separate push rod.

## Reassembly

26. Replace shaft bushings if necessary. Right (larger) bushing must be recessed 22.5 mm (0.88") below edge of cover shown as 'A' and left bushing recessed 12.5 mm (0.49") as shown as 'B'. Liberally grease bushings.
27. Service the control valve, Operation 8A-14-27.
28. Reverse procedures 1 to 24, except:
  - (a) Do not over tighten pivots. Check that all linkages move freely. Use new cotter pins.
  - (b) Conduct "Lift Cover Adjustments", Operation 8A-15-29.
  - (c) Replace all o-rings and backup washers.
  - (d) Adjust lock nuts at right end of control shaft to set control lever friction.
  - (e) Align punch marks on arm, shaft, and lift arms when assembling.

