Standard Torque Data for Nuts and Bolts

Recommended torque, in foot pounds, for all Standard Application Nuts and Bolts, provided:

A. All thread surfaces are clean and lubricated with SAE-30 engine oil. (See NOTE.)

B. Joints are rigid, that is, no gaskets or compressible materials are used.

C. When reusing nuts or bolts use minimum torque values.

NOTE: Multiply the standard torque by:

.65 when finished jam nuts are used.
.70 when Molykote, white lead or similar mixtures are used as lubricants.
.75 when parkerized bolts or nuts are used.
.85 when cadmium plated bolts or nuts are used.
.90 when hardened surfaces are used under the nut or bolt head.

Bolt or Stud Diameter	Type 1 Studs Only		Type 1 Bolts 6" length or less		Type 1 Bolts longer than 6"		Type 2 (all lengths)		Type 3 (all lengths)		Type 4 (all lengths) Only when used in cast (gray) iron		Type 4 (all lengths) All other applications	
	Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Min	Max.	Min.	Max.	Min.	Max.
1/4	5	6	5	6	3	3	9	10	11	13	11	13	12	14
5/16	12	13	12	13	6	7	19	21	24	27	24	27	27	30
3/8	21	24	21	24	11	13	33	37	43	47	43	47	45	50
7/16	35	38	35	38	19	21	53	60	69	76	69	76	75	85
1/2	52	58	52	58	29	32	80	90	104	117	104	117	115	130
9/16	70	80	70	80	41	46	115	130	150	170	150	170	165	185
5/8	98	110	98	110	57	63	160	180	210	230	210	230	220	250
3/4	174	195	174	195	100	112	290	320	350	390	350	390	400	450
7/8	300	330	162	181	162	181	420	470	570	630	570	630	650	730
1	420	470	250	270	250	270	630	710	850	950	850	950	970	1090
1-1/8	600	660	350	380	350	380	850	950	1200	1350	1200	1350	1380	1550
1-1/4	840	940	490	540	490	540	1200	1350	1700	1900	1700	1900	1940	2180
1-3/8	1100	1230	640	710	640	710	1570	1760	2300	2500	2300	2500	2600	2800
1-1/2	1470	1640	850	940	850	940	2000	2300	3000	3300	3000	3300	3300	3700
1-3/4	2350	2450	1330	1490	1330	1490	3300	3700	4700	5200	4700	5200	5300	6000
2	3500	3900	2000	2200	2000	2200	5000	5500	7000	7800	7000	7800	8000	9000

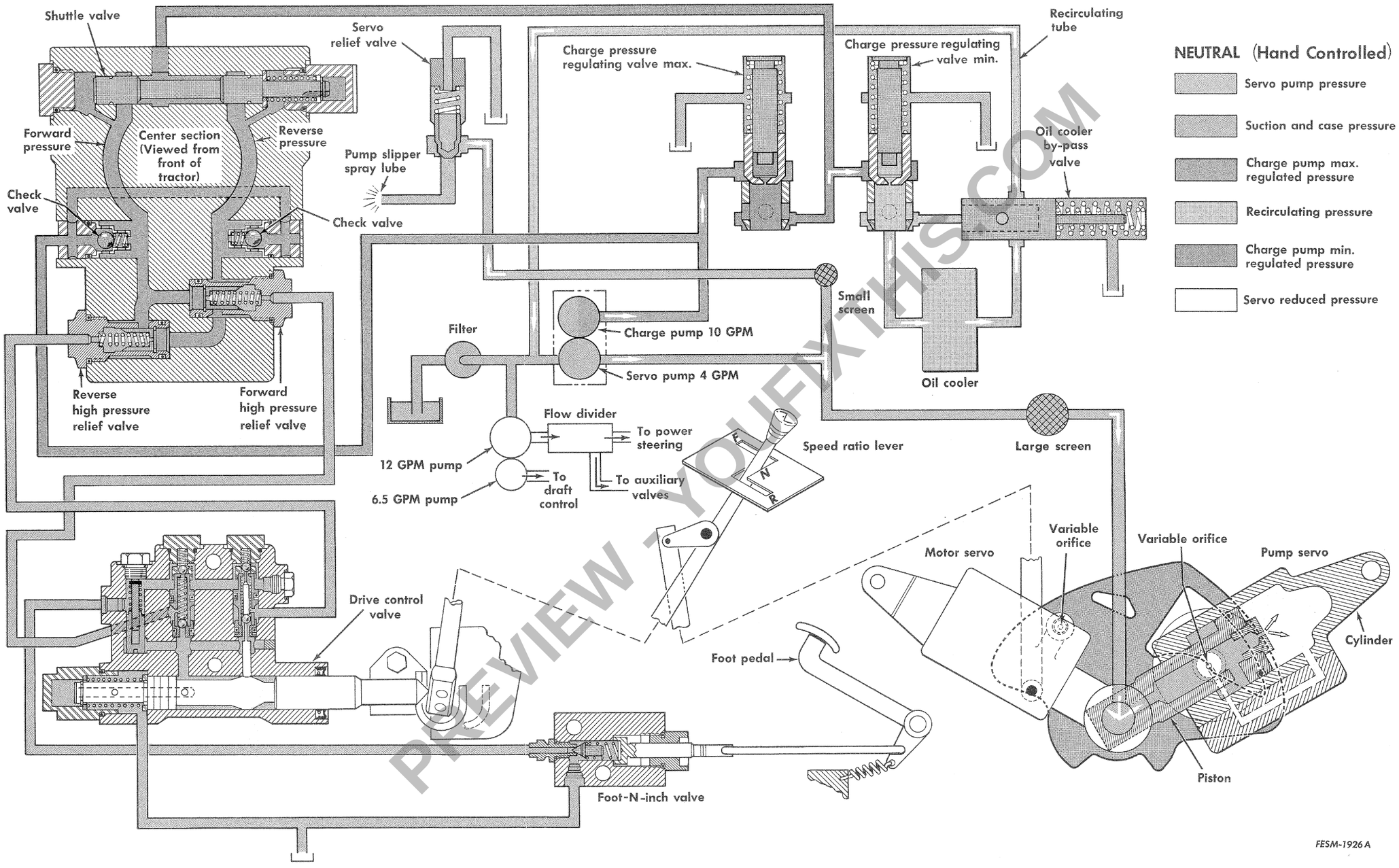
Bolt Type Identification Chart

IH TYPE	S.A.E. GRADE	DESCRIPTION	BOLT HEAD MARKING *
1	1 or 2	WILL HAVE IH STANDARD MONOGRAM IN THE CENTER OF THE HEAD Low or Medium Carbon Steel Not Heat Treated	
2	5	WILL HAVE AN IH AND 3 RADIAL LINES Quenched and Tempered Medium Carbon Steel	
3	6	WILL HAVE AN IH AND 4 RADIAL LINES No longer used in production. For replacement, use Type 4 if Type 3 is not available.	
4	8	WILL HAVE AN IH AND 6 RADIAL LINES Quenched and Tempered Special Carbon or Alloy Steel	

* The center marking identifies the bolt manufacturer. The IH monogram is currently used. Some bolts may still have a raised dot which previously identified IH bolts.

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NEUTRAL (Hand Controlled)

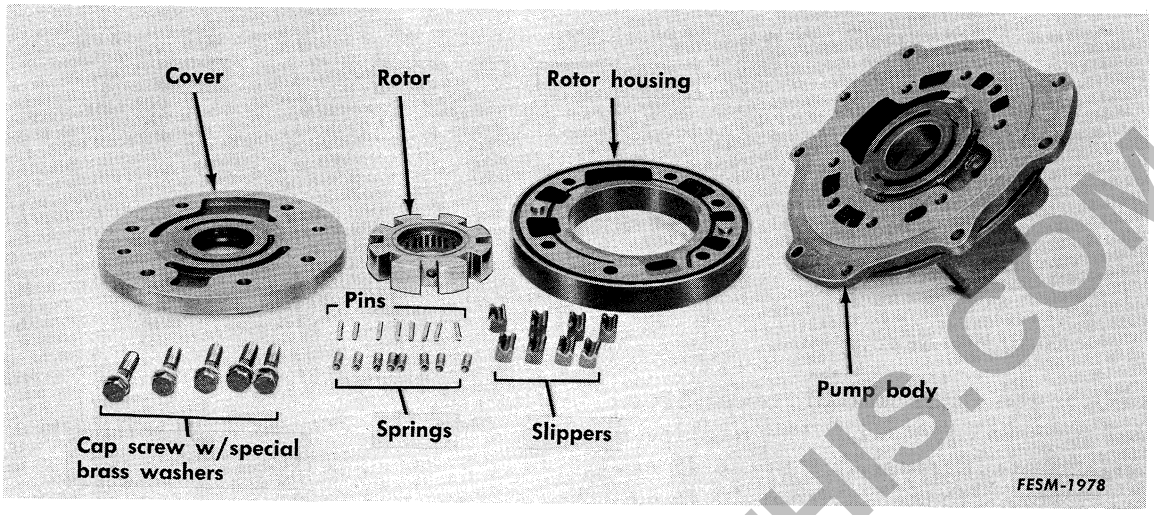
- Servo pump pressure
- Suction and case pressure
- Charge pump max. regulated pressure
- Recirculating pressure
- Charge pump min. regulated pressure
- Servo reduced pressure

FESM-1926 A

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Disassembly



Illust. 118. Charge pump disassembled.

1. Remove the charge pump cover retaining capscrews. Refer to Illust. 118.

2. Remove the cover while holding the rotor down through the shaft hole. The cover is doweled. If it is not held down the rotor may come out with the cover and the slippers, springs and pins will be dropped.

3. Remove the rotor, slippers, pins and springs.

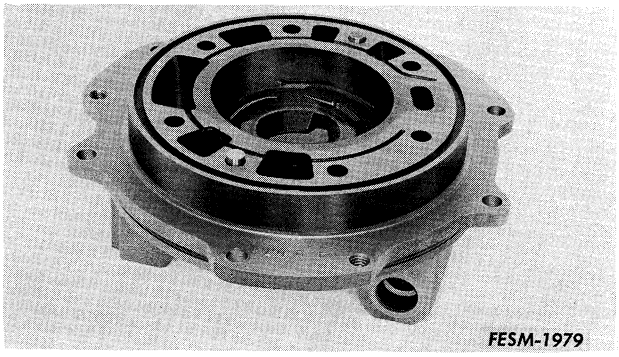
4. Remove the rotor housing. It is doweled to the pump body.

Inspection

The rotor, rotor housing, pins, springs and slippers are furnished as a service package. The pump body, pump cover seal rings and seal are all serviced separately.

Inspect all parts for excessive wear and replace all worn or damaged parts.

Reassembly



Illust. 119. Rotor housing installed.

1. Place the pump body on a bench and using a new seal ring install the rotor housing as shown in (Illust. 119).

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The movement in degrees of the pump and motor swash plates is as follows:

The angle of the pump swash plate is varied from 0 degrees to 16 degrees both in Forward and Reverse. The angle of the motor swash plate is varied from 18 degrees to 8 degrees in both forward and reverse. This difference between the foot control models and the hand control models is accomplished by using different cam control slots and different swash plates. The stops on the swash plates are ground to different angles.

The size of the pump variable orifice button is also smaller on the foot control models.

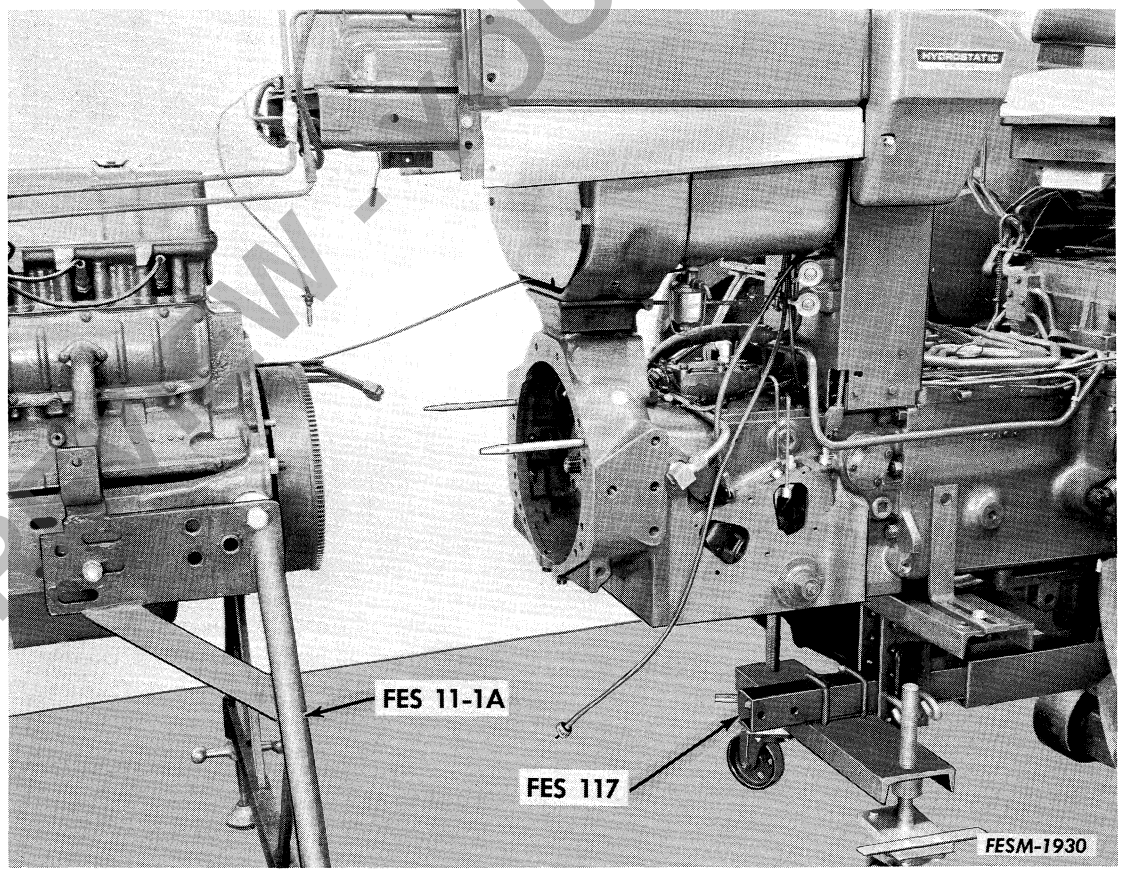
UNIT SERVICE

Hydrostatic Transmission

Removal

1. Make a front end split, as shown in Illust. 16.

NOTE: It is necessary to remove the starter as one of the bolts is in the bell housing behind the starter motor.



Illust. 16. Front section split (F-656).

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EXAMPLES OF CHARGE FLOW CHECKS AS A GUIDE TO TROUBLE SHOOTING

(Charge Pressure is assumed to be as per specifications except in the last two examples)

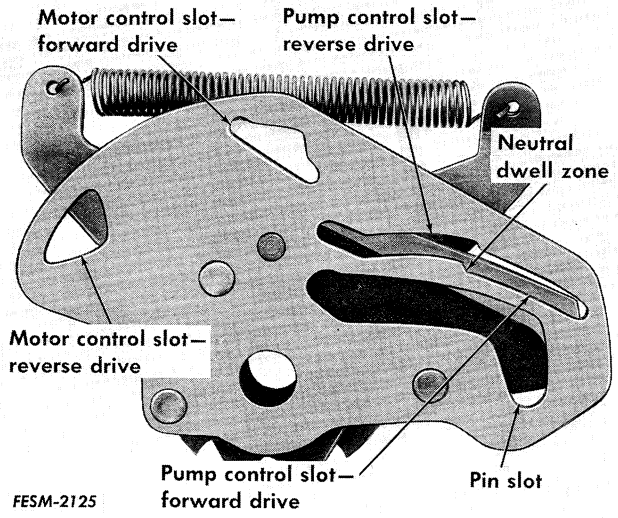
NOTE: Flow readings are only typical of those which indicate the problem given. Actual readings may vary considerably from those given.

Problem	Charge Flow (Neutral Stroke)			Forward Drive Pressure	Reverse Drive Pressure	Part to Check	Further Check on Remedy
Low Reverse Drive	RPM 2300 2000 1500 1200 900 675	GPM 10.5 9 6.5 5 3.5 1 to 2	GPM Same as in Neutral*	5200 psi (at the Foot-N-Inch valve . . . . OK)	400 psi to 2000 psi	1. Drive control valve 2. Reverse check valve 3. Reverse high pressure fittings leak	1. Adjust drive control valve, page 76. 2. Isolate drive control valve, page 96. 1. Replace, page 68. 2. Tighten or replace.
Won't build drive pressure in either direction	RPM 2300 2000 1500 1200 900 675	GPM 10.5 9 6.5 5 3.5 1 to 2	GPM FWD. REV. Same as Neutral*	100 psi to 500 psi	100 psi to 500 psi	1. Either high pressure relief valve open 2. Drive control valve 3. Foot-N-Inch valve	1. Disconnect fitting at valves & measure spool position before removing & compare measurement after removal. Dirt or over-tightening can cause them to stick. 2. Adjust linkage page 76. Isolate as outlined page 96. 3. Isolate as outlined page 96.
Tractor hesitates going forward and then jumps as control is advanced.	RPM 2300 2000 1500 1200 900 675	GPM 10.5 9 6.5 5 3.5 1 to 2	GPM FWD. REV. Same as in Neutral*	Low at the start and 5200 psi after pressure builds	5200 psi	1. Center section shuttle valve snap ring broken 2. Check valve in center section 3. High pressure relief valve 4. Drive control valve	1. Replace snap ring if groove is OK otherwise replace shuttle valve. 2. Remove and clean or replace, page 69. 3. Check for sticky valve spool that "hangs" occasionally, page 68. 4. Adjust as per page 76.

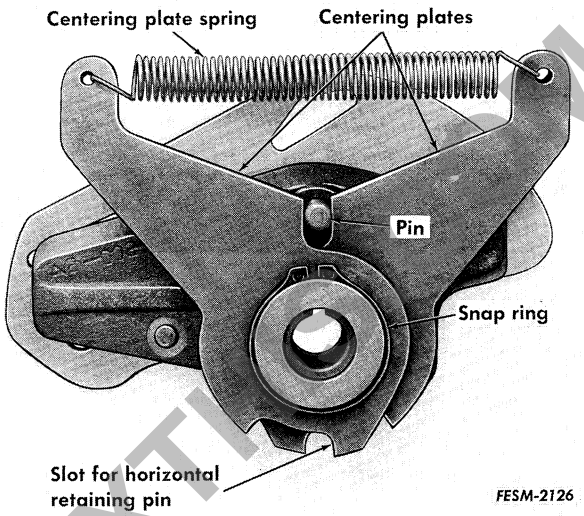
* Charge flow may be slightly lower at 1200, 900 and lower RPM. This is normal.

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Controls



Illust. 12. Servo control cam (foot control).



Illust. 13. Centering mechanism for control cam (foot control).

The cam for controlling the servos is keyed to the shaft operated by the foot pedals. The cam has slots which are the controls and line up with the variable orifices for the pump and motor. There are three of these slots. See Illust. 12.

The long one controls the pump for Forward and Reverse and contains a neutral dwell zone. The center slot controls the motor servo in Forward and the outside slot controls the motor during Reverse.

The angle of the motor swash plate is reduced during Reverse to give high speed reversing and is different in this respect from the models with hand controls.

A pin located in the pump servo variable orifice adjusting block restricts the movement of the cam and prevents the operator from forcing the control cam any further than the servo travel will allow it. The pin moves with the pump servo which allows the cam to be rotated further.

The servo control cam has two cam centering plates which are secured to the cam plate casting by a snap ring. See Illust. 13.

As one foot pedal is depressed and the cam is rotated, the pin in the cam moves the centering plate and the spring is extended. The other centering plate is prevented from rotating by the horizontal retaining pin shown in Illust. 14.

When the foot pedal is released for slower speed, the spring returns the centering plate and cam to the new position of the pedal. When one pedal is depressed the opposite pedal is moved up by the bellcrank. The control cam cannot be rotated unless the tractor is operating as the pin in the slot keeps it from moving unless the pump servo is also moving.

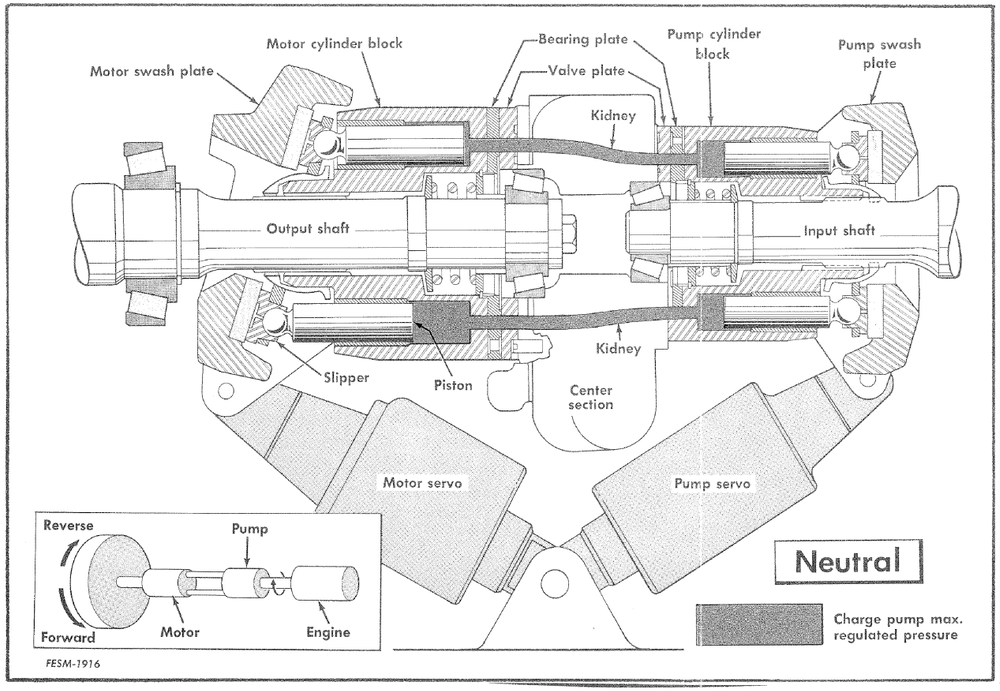
The overtravel assembly shown in Illust. 15 allows the foot pedal to be depressed without overloading the pin in the cam slot if the pedal is depressed faster than the servo moves. The over ride springs also return the pedals to neutral.

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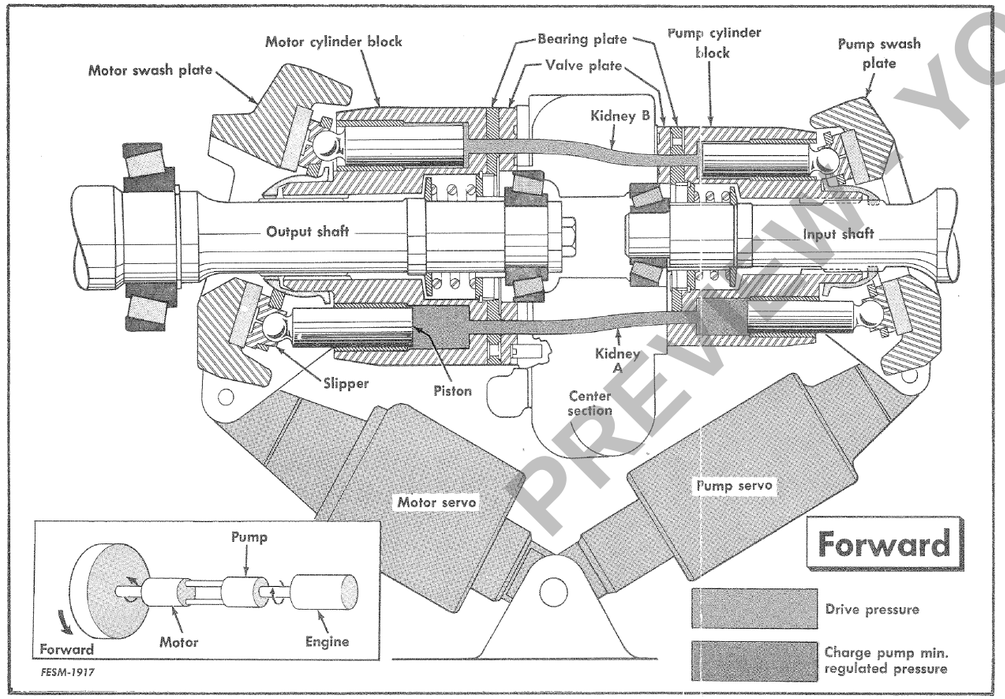
FOLDOUT NO. 1

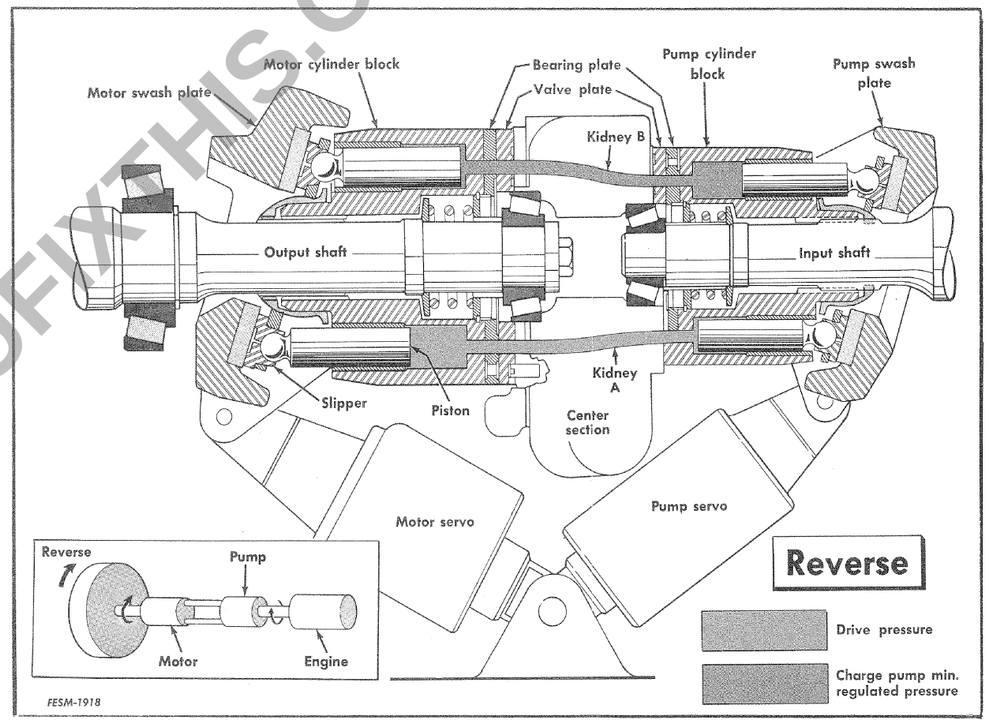
HYDROSTATIC PUMP-CENTER SECTION AND MOTOR

SWASH PLATE VERTICAL



SWASH PLATE LEFT





SWASH PLATE RIGHT

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CONTROLLING THE TRACTOR
(Hand Controlled Models)

High-Low Range Selector

The mechanical portion of the transmission has a high range, low range and neutral. See Foldout No. 2. High range is direct drive.

When starting the tractor the Range-Selector should always be in the neutral position. When operating the tractor the engine speed is set to the desired speed. The range transmission is then set for either low or high range by the lever on the right side of the instrument panel called the Range-Selector.

The low range, forward position of lever, is for forward speed from zero to 8 miles per hour and zero to 4 miles per hour reverse and is always used for heavy work.

The high range, rear position of lever, is for forward speed from zero to 20 miles per hour and from zero to 9 miles per hour in reverse. The range transmission can only be shifted with the tractor stopped.

The range transmission must always be in Neutral when the tractor is towed. Towing, even for a short distance, with the Range transmission engaged can result in damage to the Motor. The tractor must never be towed in an effort to start a dead engine.

Speed-Ratio Control

After the range selection is made, the direction and speed of the tractor are controlled by the Speed-Ratio (S-R) lever on the left side of the instrument panel. In the neutral position of the lever, the spool in the Drive Control valve is in the neutral position. See Foldout No. 5.

As the lever is moved across the horizontal position of the Z-pattern to the right, the spool is placed into the position for forward operation, zero speed.

As the Speed-Ratio lever is moved forward, the control rod also moves a single servo cam which controls both servos. The cam has slots which control the size of the variable orifice for each servo, and therefore the pressure differential within the servo cylinder. (See Servo Cylinders, page 14, for more complete description.) The servo cylinders move in response to a change in pressure differential.

With a gradual movement of the lever, the pump servo alone moves initially. It rotates the pump swash plate from its zero output position towards the left and the pump develops pressure in the forward kidney and starts driving the motor.

At zero speed the motor swash plate is at 18 degrees. The pump swash plate moves from zero to -18 degrees in forward travel and from zero to +16 degrees in reverse travel.

At maximum motor swash plate angle the least amount of pressure is required to turn the motor and move the tractor. As the speed of the motor increases because the load is moving, torque requirement is lowered. The motor swash plate angle is decreased from 18^{o} toward 9^{o} as its servo changes the motor swash plate.

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23. Dip the slipper assembly in Hy-Tran and reassemble the pump and motor assemblies.

24. Inspect all gears and bearings and replace as necessary.

IMPORTANT: USE ONLY IH BEARINGS ORDERED BY SPECIFIC PART NUMBER AS THEY ARE SELECTED FOR CLOSE TOLERANCES AND BEARING MANUFACTURER'S NUMBERS MAY BE THE SAME BUT NOT MATCHED TO THE NECESSARY CLOSE TOLERANCES.

25. Inspect the swash plate trunnion bearings for damaged cones or burnelling of the cups and replace as necessary.

26. Inspection of the charge pump, servo cylinders, center section, multiple valve body, and drive control valve is covered under each of these units.

Reassembly

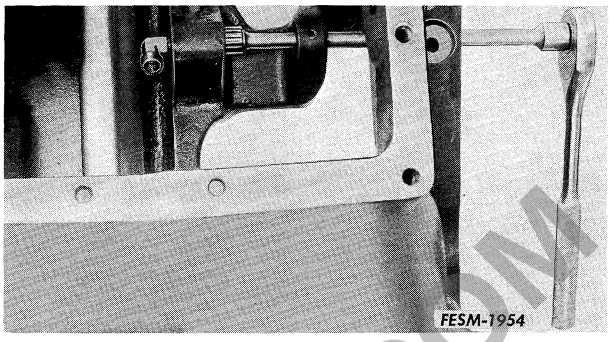
IMPORTANT: Whenever the charge pump, hydrostatic pump shaft bearings, pump shaft or center section is replaced the adjustments for hydrostatic pump bearing pre-load must be made.

Whenever the center section is replaced both hydrostatic pump and motor bearing pre-load adjustments must be made.

Whenever the motor shaft or motor shaft bearing only are replaced it is only necessary to adjust motor shaft bearings.

Seal, O-ring and gasket packages are furnished for doing a complete tear down. Always replace all O-rings and use petroleum jelly during installation. O-rings "swell" when exposed to Hy-Tran and even though used O-rings look O.K. they may be cut during installation if they are reused.

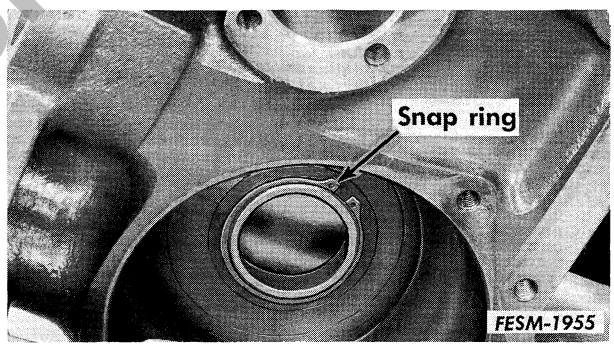
1. Mount the transmission on Engine stand FES-52 as shown in Illust. 19.



Illust. 69. Installing servo supply fittings.

2. Install the servo tube elbow and servo tube fitting with O-ring. Use a tie rod end tool to tighten the fitting and the elbow together. See Illust. 69.

NOTE: Even when these parts are tightened together they are free to move until the servo anchor shaft is installed.



Illust. 70. Suction tube snap ring.

3. Install the lower suction tube with O-ring and secure into place with the snap ring. The snap ring may be installed after removal from engine stand. Illust. 70. Adjust the swash plate trunnion bearings as follows:

a. Mount the motor swash plate on the trunnion bearings with no shims on either trunnion. Use the O-ring on the left-hand trunnion and torque to standard torque. Omit the O-ring on the right-hand trunnion using two capscrews opposite one another in the trunnion.

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Center Section Components

Check Valves, High Pressure Relief Valves and Shuttle Valve

General Information

The check valves must seal and the high pressure relief valves must seal or hydrostatic pump flow will merely go from one side of the closed loop to the other and no pressure is developed.

A check valve leaking would only effect that side. A high pressure relief valve leaking will normally effect both sides in the same manner.

However if one is stuck in such a position to create a very small leak in that direction, building pressure in the opposite direction may seat it. Once reseated it will again drive in both directions unless it sticks again. A valve with this type of intermittent malfunction will usually go back against the snap ring when the valve is removed which makes it difficult to trouble shoot. After disconnecting the High Pressure line and before loosening the valve a tag wire may be inserted through the fitting to check the position of the valve and rechecked after removal. Sticking valves must be replaced and properly torqued. A valve stuck open will allow the tractor to free wheel.

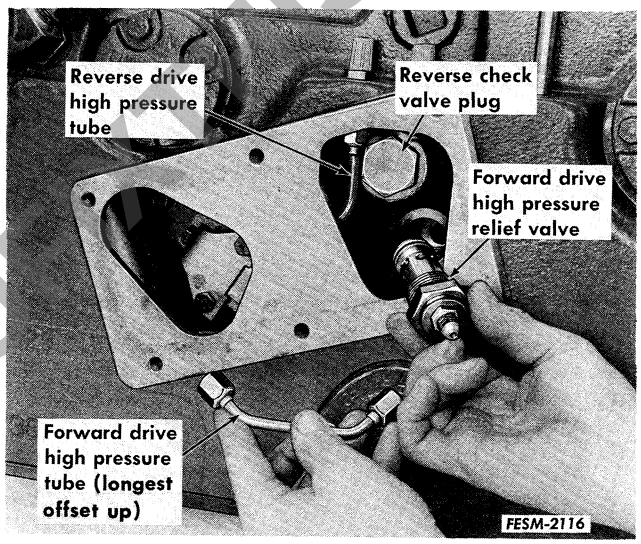
NOTE: It is not practical to interchange the Forward and Reverse relief valves to check for a defective valve. If a valve is stuck open it will affect both Forward and Reverse pressure in the same manner.

Importance of Proper Torque on High Pressure Relief Valves

If the high pressure relief valves are tightened above 20 ft. lbs., they can be distorted and stick open after they become hot.

Replacing Relief Valves

To replace the check valves and high pressure valves it is necessary to drain the fluid level of at least 5 gallons. The check valves require a 1-3/8" socket and the high pressure relief valve a 1-5/16" socket. The check valves are threaded for a 1/2" N.C. bolt for aid in removal. When replacing, special torques must be followed.



Illust. 124. Removing Forward drive high pressure relief valve.

1. Forward drive high pressure relief valve (left side). Remove the left hand cover, the Forward drive line and remove the valve complete. See Illust. 124. Correct torque on valve must be observed when replacements are made.

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2. Check the charge Pressure and Flow in Forward and Reverse as follows:

a. Wire the flo-rater to the left hand step and let the tractor creep. Motor must be rotating (wheels moving) for accurate readings.

b. Operate in Hi-Range, with the S-R lever below the blue line, and apply the brakes slowly pulling the engine rpm down to the same speeds as were checked in neutral and record them. Keep Drive Pressure just below relief valve pressure when checking flow. The brakes must hold in order to be able to build maximum Drive Pressure but the tractor must be moving.

IMPORTANT: It is important to watch engine rpm carefully as the pump flow is directly related to rpm.

c. Compare the pressure and flow for the same speeds as recorded in neutral. They may be slightly lower at lower Engine RPM's and they may vary between Forward and Reverse. This is normal.

3. If charge pressure is within specifications and charge flow stays very close to the figures recorded in Neutral, at all rpm's, the efficiency of the high pressure loop is good as no flow is being lost.

4. If Drive pressure is below relief pressure in both directions and charge Flow checks above indicates good efficiency check the following:

a. High pressure relief Valve stuck open.

b. Foot-N-Inch Valve adjustment or leak.

5. If Drive pressure is below specs in one direction only and flow is OK in both directions check the following:

a. Check Valve.

b. High pressure line leak on the side effected.

c. Drive Control Valve.

d. High pressure relief valve which sticks occasionally and "washes shut" when you build pressure in the opposite direction. (Then pressure Is O.K. again in both directions.)

6. If Drive pressure is below specifications in one direction only and charge flow falls off in that direction, but both drive pressure and charge flow are O.K. in the other direction check the following Non-Rotating Parts:

a. Center section.

b. Valve plate.

7. If drive pressure is below specs in both directions and Flow is below the figures checked for Neutral, fluid is leaking out of the high pressure loop from one or more of the following Rotating Parts:

a. Cylinder Block

b. Pistons and slippers

c. Bearing plates

NOTE: Slight wear on these parts may not be severe enough to prevent building Drive pressure when drive pressure is high. At low drive pressure and maximum motor speed (such as driving a tractor at maximum speed on the highway) if there are high pressure leaks they can cause an upset in the balance between the pressure being built and the ability to seal. This will show up as a loss of charge flow and pressure and Drive pressure.

IMPORTANT: The chart below is prepared as a guide to using charge pressure during trouble shooting. A careful use of this information can avoid many hours of unnecessary tear down. You will notice that if the charge pressure and flow are the same or very close in Neutral and in stroke nothing is wrong which would indicate a tear down.

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