EAE 6015-F

IMPORTANT

This manual obsoletes the similar shop manual data in manual FO-2. If you have FO-2, destroy it.

T&T SHOP SERVICE

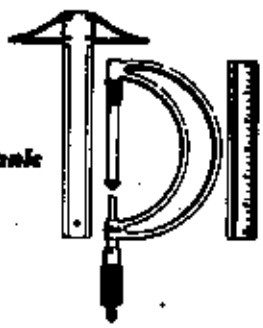
FORD

SHOP MANUAL

MODEL ■ NAA

MANUAL NO. FO-19

$7.00



KNOWLEDGE
The Measure of a Mechanic

Technical Publications

Information and Instructions

This individual Shop Manual is one unit of a series on agricultural wheel type tractors. Contained in it are the necessary specifications and the brief but terse procedural data needed by a mechanic when repairing a tractor on which he has had no previous actual experience.

The material is arranged in a systematic order beginning with an index which is followed immediately by a Table of Condensed Service Specifications. These specifications include dimensions, fits, clearances and timing instructions. Next in order of arrangement is the procedures section.

In the procedures section, the order of presentation starts with the front axle system and steering and proceeds toward the rear axle. The last portion of the procedures section is devoted to the power take-off and power lift systems. Interspersed where needed in this section are additional tabular specifications pertaining to wear limits, torquing, etc.

HOW TO USE THE INDEX

Suppose you want to know the procedure for R&R (remove and reinstall) of the engine camshaft. Your first step is to look in the index under the main heading of ENGINE until you find the entry "Camshaft." Now read to the right where under the column covering the tractor you are repairing, you will find a number which indicates the beginning paragraph pertaining to the camshaft. To locate this wanted paragraph in the manual, turn the pages until the running index appearing on the top outside corner of each page contains the number you are seeking. In this paragraph you will find the information concerning the removal of the camshaft.

I&T SHOP SERVICE

Published by

TECHNICAL PUBLICATIONS DIV.
INTERTEC PUBLISHING CORPORATION

P.O. Box 12901, Overland Park, Kansas 66212

SHOP MANUAL

FORD

MODEL NAA

The model NAA Ford tractor was introduced during the 50th year of the Ford Motor Company, so is generally referred to as the "Golden Jubilee" model. The hood emblem of model NAA tractors manufactured in 1953 bear the legend "GOLDEN JUBILEE;" the legend being eliminated from the hood emblem of NAA tractors manufactured in 1954.

Tractor Serial Number is stamped on transmission housing to rear of starting motor except on early production units (prior to tractor Serial Number 22239) which have the tractor Serial Number stamped on right side of engine block. Ford tractors have no separate engine Serial number.

INDEX (By Starting Paragraph)

Printed in U. S. A.

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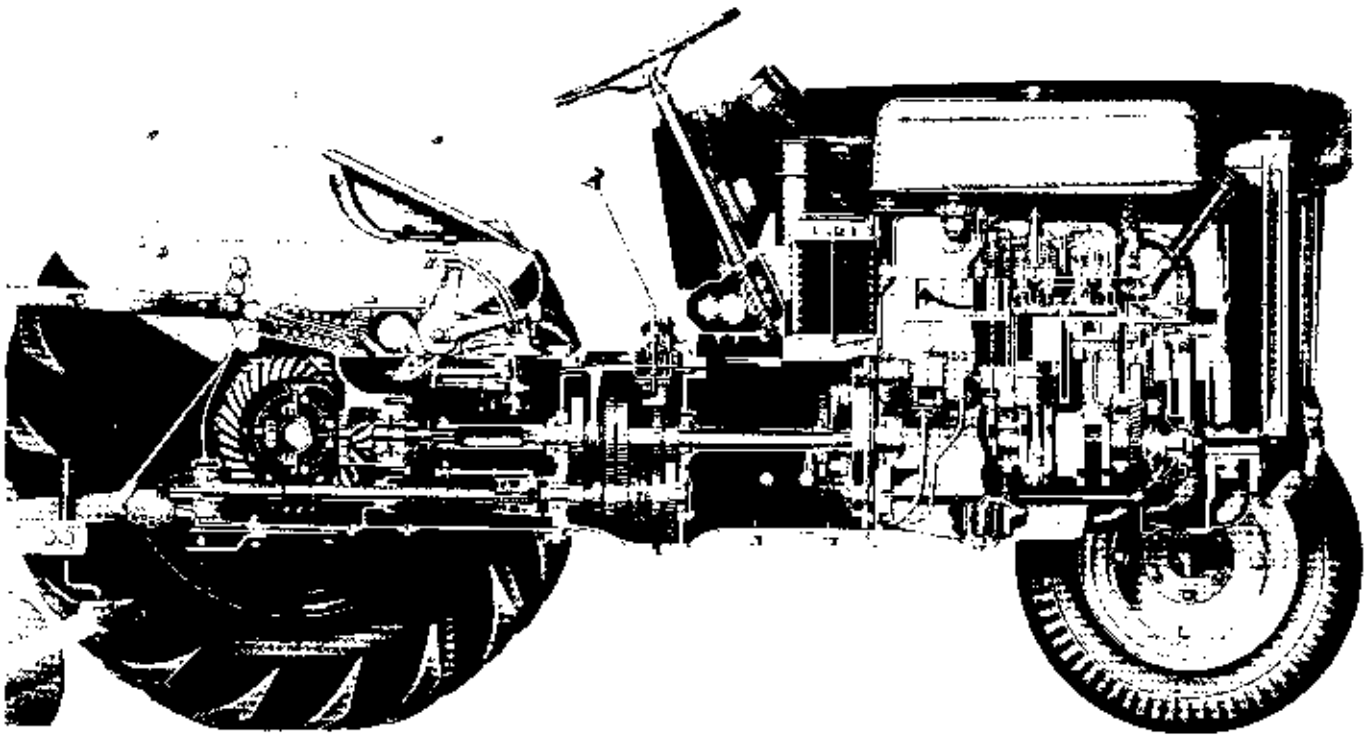


Sectional View of NAA Tractor

FRONT SYSTEM AND STEERING

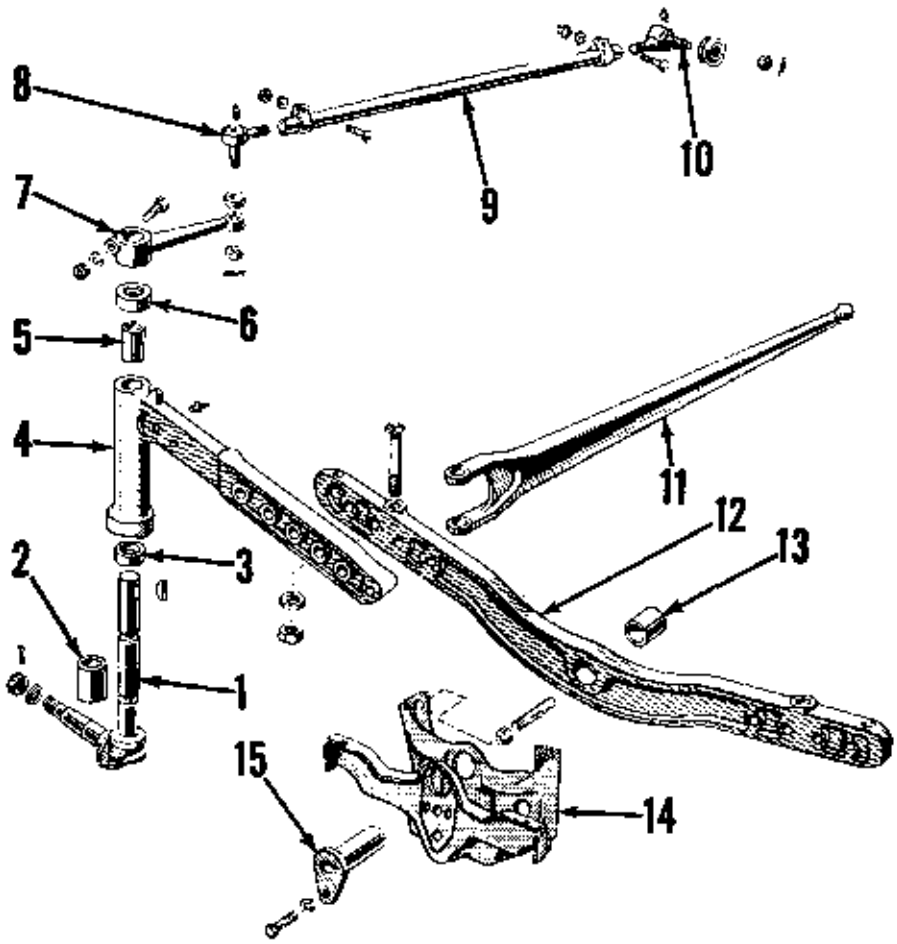


Fig. FO1—Exploded view of front axle and related parts. Original type front axle support (14) and pivot pin (15) are shown. Refer to Fig. FO2 for later style service front support and pivot pin.

1. Spindle assembly
2. Lower bushing
3. Thrust bearing
4. Axle extension
5. Upper bushing
6. Dust seal
7. Steering arm
8. Tie rod end
9. Tie rod sleeve
10. Tie rod end
11. Radius rod
12. Center axle
13. Pivot bushing
14. Front support
15. Pivot pin

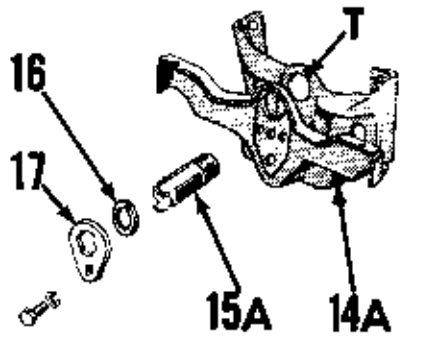


Fig. FO2—Service installed front support has threads (T) for threaded front axle pivot pin (15A).

14A. Front support
15A. Pivot pin
16. Snap ring
17. Locking flange

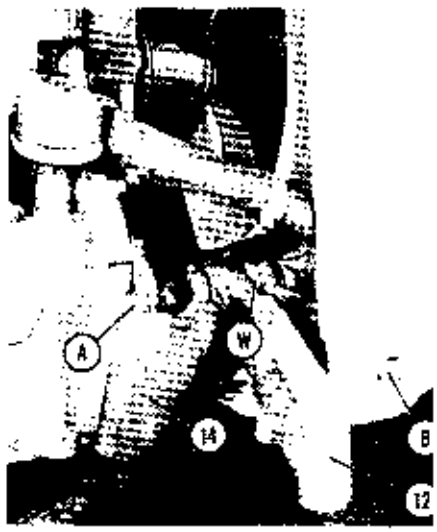


Fig. FO3—View showing axle center member (12) and front support (14) with R. H. axle extension and front wheel assembly removed. Washers (W) are no longer used and may be discarded when servicing front support. Four stud nuts (A) retain front support to engine. Cap screws (B) attach front end of hood to front support.

SPINDLE BUSHINGS

1. Refer to Fig. FO1. To renew the spindle bushings (2 and 5), support front of tractor, disconnect steering arms (7) from wheel spindles (1) and slide wheel and spindle assemblies out of axle extensions (4). Drive old bushings from axle extensions and install new bushings using a piloted drift. New bushings will not require final sizing if not distorted during installation. Renew thrust bearings (3) if rough or worn.

AXLE CENTER MEMBER AND PIVOT PIN BUSHING

2. To remove the axle center member (12—Fig. FO1), support front of tractor, remove the grille and unbolt radius rods and axle extensions from axle center member. Swing the axle extension and wheel assemblies away from tractor. On models with original type pivot pin (15), remove the cap screw retaining the axle pivot pin to the front support and using a slide hammer as shown in Fig. FO4, remove the pivot pin. On models with service installed threaded pivot pin (15A — Fig. FO2), remove the cap screw and locking flange (17) and unscrew the threaded pin by turning it counter-clockwise as shown in Fig. FO5. Loosen radiator retaining nuts at bottom if necessary to provide clearance and withdraw axle center member from either side of tractor.

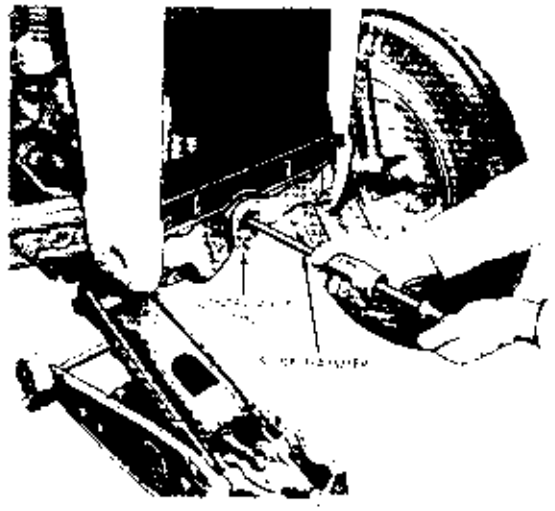


Fig. FO4 — Removing original type non-threaded front axle pivot pin using a slide hammer arrangement.

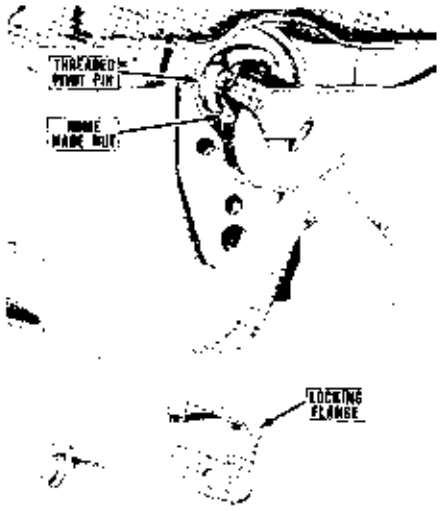


Fig. FO5—Removing threaded service type front axle pivot pin with home made nut. Nut is made by welding lugs on hex bar. Bar should fit inside diameter of pivot pin and lugs be shaped to engage notches in end of pin.

The axle pivot pin bushing (13—Fig. FO1) can be renewed at this time. Make certain that the front axle pivot pin fits freely in bushing before reinstalling axle center member. Thrust washers (W—Fig. FO3) originally installed on front axle pivot pin are no longer used and may be discarded.

On threaded type front axle pivot pin, install snap ring (16—Fig. FO2) on pivot pin and thread pin into front support until snap ring contacts front support firmly, then back-out pin until lugs on pin will engage slots in locking flange (17). Secure locking flange with cap screw and lock washer.

FRONT SUPPORT

3. To remove the front support, first remove the grille and unbolt radiator from front support. Place floor jack under engine, then remove axle pivot pin as in paragraph 2. Remove the retaining stud nuts, pry front support forward to clear studs, then remove front support from below. Lower hood side panels will spring out far enough to clear lower part of radiator when moving front support forward. It may be necessary to loosen drag links if pivot thrust washers are installed.

When installing, tighten the retaining stud nuts to a torque of 135-150 Ft.-Lbs.

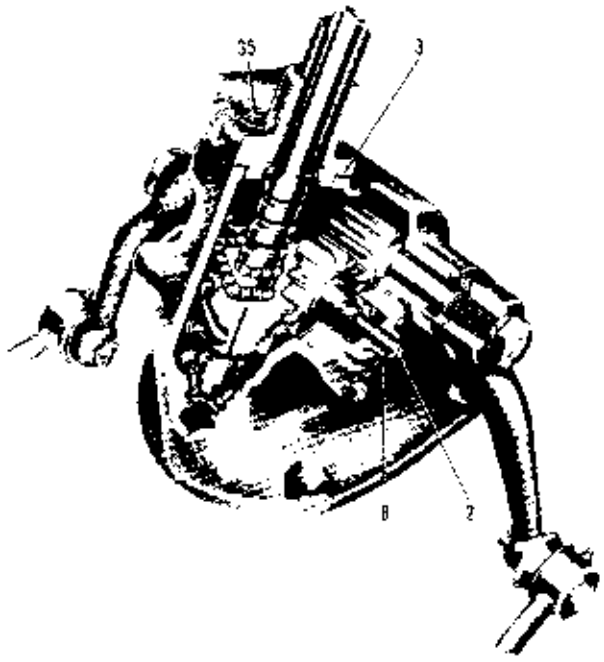


Fig. FO6—Adjustment of steering gear worm-shaft bearings is controlled by shims (3). Backlash of each sector gear is controlled by a screw (2) on each side of housing.

DRAG LINKS & TOE-IN

4. Drag link ends are of the non-adjustable automotive type. The procedure for renewing the drag link ends is evident. Vary the length of each drag link an equal amount to provide a front wheel toe-in of ¼-inch.

FRONT SPLIT

5. Removing the front axle and support assembly in one unit is a job required to prepare for removal of engine from tractor. Proceed as follows:

Drain cooling system, and if engine is to be disassembled, drain engine oil pan. Remove air cleaner screen and funnel from left hood side panel. Remove grille and unbolt front end of hood from front support. Detach hood side panels from hood rear center panels. Unhook head light wire and remove hood from tractor.

Support front end of tractor under front end of transmission. Remove front support to engine stud nuts. Disconnect drag links and radius rods at rear, then roll front support and axle assembly forward out of way.

Reverse removal procedures to reinstall. Tighten front support to engine stud nuts to a torque of 135-150 Ft.-Lbs.

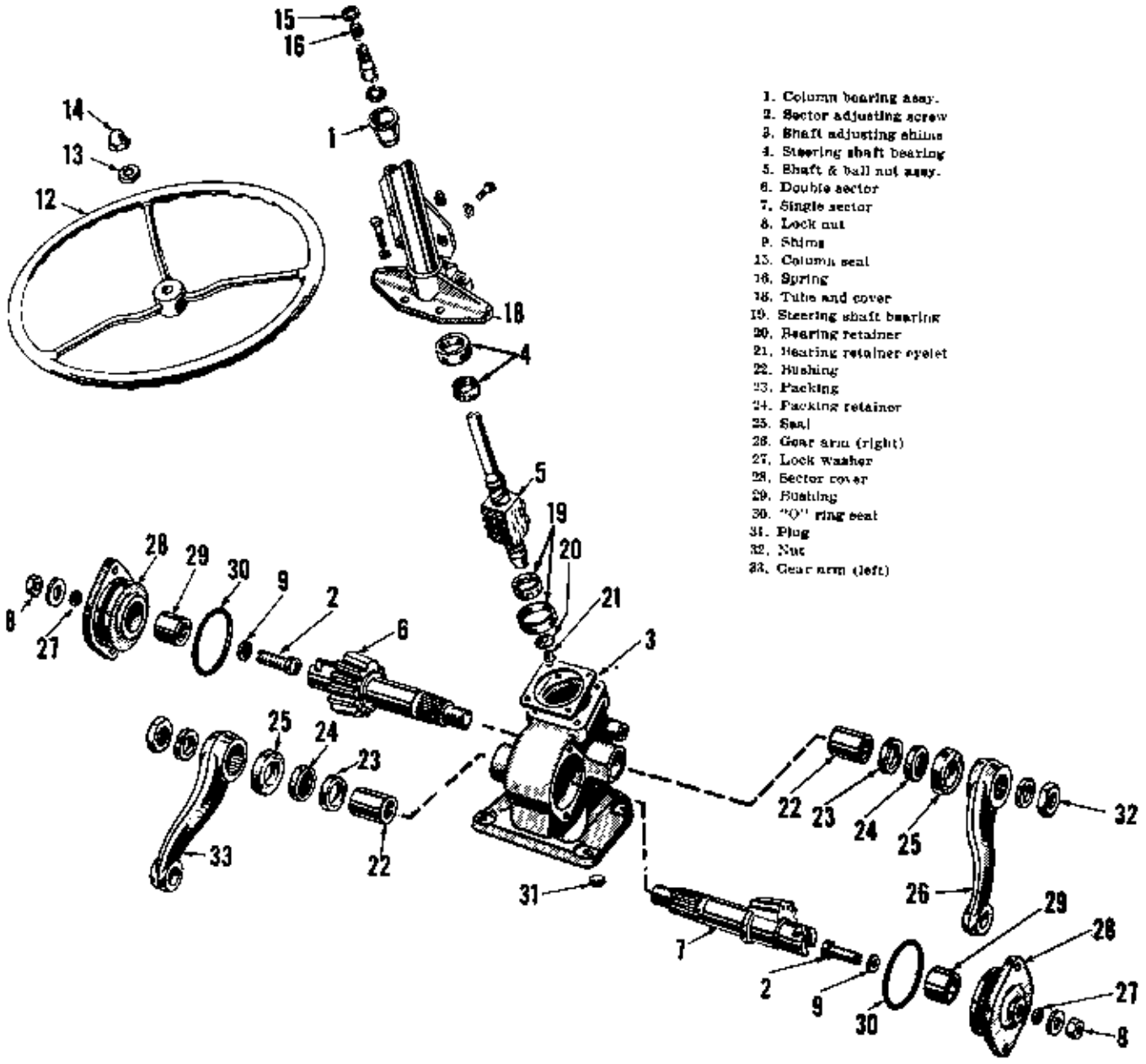


Fig. FO7—Exploded view of circulating ball nut steering gear used on model NAA tractors. Wormshaft bearing end play is adjusted by varying shims (3). Sector backlash is adjusted with adjusting screws (2).

STEERING GEAR

6. **ADJUSTMENT.** To adjust the steering gear, first make certain that gear housing is properly filled with lubricant, disconnect both drag links from steering gear arms to remove load from the gear unit and proceed as follows:

7. WORMSHAFT END PLAY. To check wormshaft end play, first loosen the lock nuts on the sector shaft adjusting screws (2—Fig. FO-6) and back the screws out at least two full turns. If the end play of the wormshaft (steering wheel shaft) is not within the desired limits of 0.006-0.010, adjust the end play by varying the thickness of the shim stack (3) between the steering shaft tube and the steering gear housing. Shims are available in thicknesses of 0.002, 0.005, 0.010 and 0.030. Ford recommends a minimum shim stack installation of not less than three 0.002 shims or not less than two 0.005 shims. Tighten the steering shaft cover retaining cap screws to a torque of 25-30 Ft.-Lbs. Renew wormshaft bearings as outlined in paragraph 10 if end play is over 0.010 with minimum recommended shim stack thickness.

After checking or adjusting wormshaft end play, readjust sector shaft end play as follows:

8. SECTOR SHAFT END PLAY. Before adjusting sector shaft end play, be sure that wormshaft end play is

correctly adjusted as outlined in paragraph 7, then proceed as follows: Disconnect drag links from sector shaft arms and turn the steering wheel to the mid or straight ahead position. With the lock nuts on both sector shaft adjusting screws loosened and the adjusting screw on the right hand side (as viewed from rear of tractor) backed out several turns, turn the adjusting screw on left side of steering housing in (clockwise) until there is no perceptible end play in the sector shaft to which the right steering arm is attached. While holding the adjusting screw in this position, tighten the lock nut. Then, turn the adjusting screw on right side of housing in until there is no perceptible end play in the sector shaft to which the left steering arm is attached, hold the adjusting screw in this position and tighten the lock nut.

Reconnect the drag links to the steering arms.

8. **REMOVE AND REINSTALL.** To remove the steering gear and housing assembly, first remove steering wheel, then withdraw the spring, felt packing and spring seat from top of steering column. Remove hood. Disconnect throttle rod from bell crank and unbolt throttle rod bracket from transmission. Disconnect the Proof-Meter cable, ammeter lead wire and oil pressure gage line at instrument panel. Disconnect the battery ground cable from steering gear housing and wires from junction block on steering column.

Remove the generator regulator from bracket on steering column and disconnect the temperature gage wire from fuel tank frame. Unbolt instrument panel, slide the panel over top of steering column and lay it on top of fuel tank. Unbolt battery carrier from steering gear housing. Disconnect head light switch and ignition switch from the hood rear lower panel; then, unbolt and remove the hood rear lower panel from tractor. Unclip tail light wire from steering gear housing and disconnect drag links from pitman arms. Remove the cap screws retaining steering gear housing to transmission case and lift the steering gear assembly from tractor.

10. **OVERHAUL.** Major overhaul of the steering gear unit necessitates the removal of the unit from tractor as outlined in paragraph 9. Remove the pitman arm retaining nuts and pull pitman arms from sector shafts. Unbolt the sector shaft side covers and remove the adjusting screw lock nuts (8—Fig. FO7). Turn the adjusting screws in and remove the side covers and sector shafts. Unbolt steering housing upper cover from housing and remove cover, shims, shaft and ball nut assembly. Do not disassemble the ball nut assembly (5) as component replacement parts are not available. If the steering shaft and/or ball nut are damaged, renew the complete assembly. The need and procedure for further disassembly and/or overhaul is self-evident.

The renewable bushings in steering gear side covers have a bore diameter of 1.1255-1.1260; bushings in housing have a bore diameter of 1.245-1.250.

Shims (9) on the adjusting screws (2) are available in thicknesses of 0.063, 0.065, 0.067 and 0.069. When reassembling, use a shim of proper thickness to provide zero to 0.002 clearance between adjusting screw head and slot in sector shafts.

When reassembling, center the ball nut on wormshaft and insert shaft in housing. Bolt the housing upper (steering shaft) cover in position using the necessary number of shims (3) to provide 0.006-0.010 end play of wormshaft. Note: Ford recommends a minimum installation of two 0.005 shims or three 0.002 shims for proper sealing of cover to steering gear housing. If wormshaft end play is over 0.010 with the minimum number of shims installed, renew the wormshaft bearings. Tighten the cover retaining cap screws to a torque of 25-30 Ft.-Lbs.

Assemble the sector shafts and their adjusting screws (2) to the side covers, using the screws to pull the shafts into cover bushings. Center the ball nut rack on the steering worm and install the double sector shaft (shaft with most sector gear teeth) into housing with the one blocked tooth groove up; the middle tooth on the sector shaft must mesh with the middle groove in the ball nut rack. Install the single sector shaft and cover meshing the fourth tooth of this shaft with the fourth groove in the left sector shaft previously installed. Tighten the side cover retaining cap screws to a torque of 25-30 Ft.-Lbs. Refill steering gear housing with gear lubricant. Adjust the sector shaft end play as outlined in paragraph 8 and tighten the adjusting screw lock nuts.

Turn steering gear to mid or straight ahead position and install steering arms.

ENGINES AND COMPONENTS

R&R ENGINE WITH CLUTCH

15. To remove the engine and clutch as an assembly, first perform a front split as outlined in paragraph 5; then, proceed as follows:

Shut off fuel and remove fuel line. Unbolt the fuel tank support brackets from engine and lift fuel tank and brackets from tractor. Remove exhaust pipe.

Disconnect proofmeter cable from hydraulic pump. If equipped with a live power take-off clutch, disconnect lines from power take-off pump. Drain hydraulic lift and detach pump pressure and suction lines from differential center housing. Then, unbolt pump from engine and remove pump and lines as a unit.

Disconnect battery ground strap and wire to starter motor. Unbolt and remove starter from engine. Remove choke rod, throttle link from bell crank to governor arm and remove engine oil pressure gage line. Disconnect wires from coil, distributor and generator. Remove temperature gage bulb from cylinder head.

Attach hoist to engine, remove bolts and cap screws retaining engine to transmission housing, work engine forward until free of engine clutch shaft and lift engine to bench or engine stand.

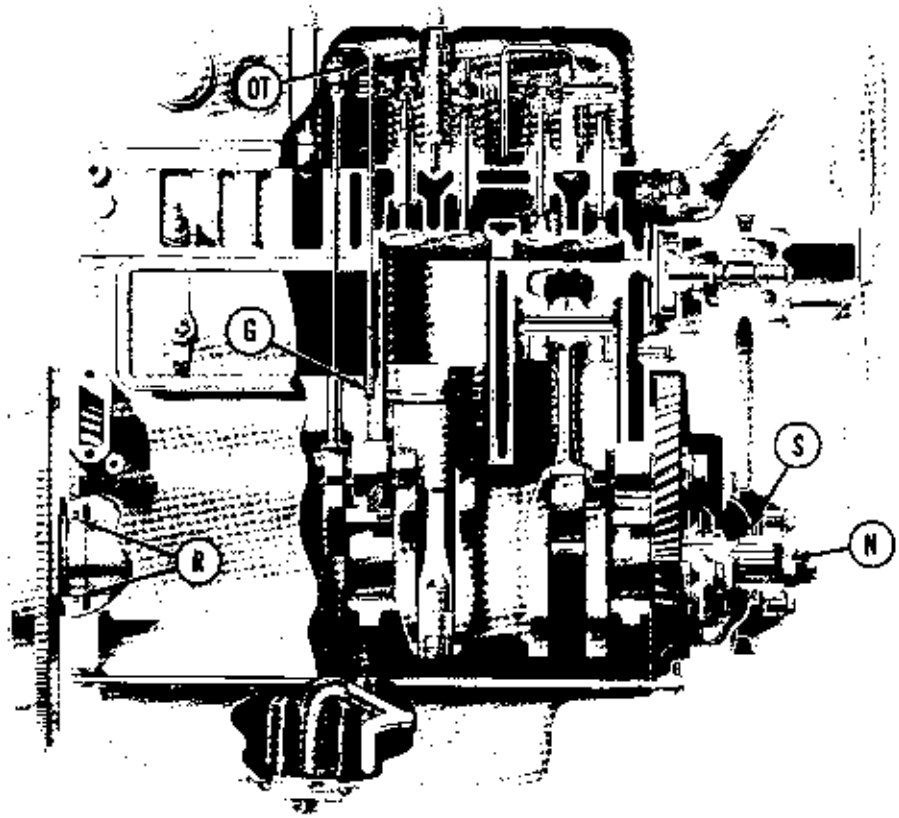


Fig. FO10—Section of NAA tractor engine showing oil tube grommet (G), front and rear oil seals (S) and (R). (N) is a ratchet nut.

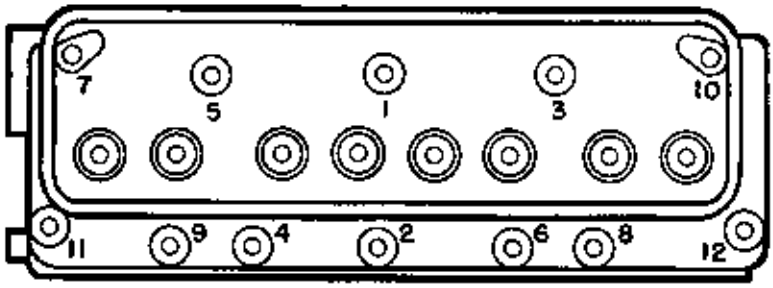


Fig. FO11—Cylinder head hold down screws should be tightened in this numbered order.

CYLINDER HEAD

16. To remove the cylinder head, first drain the cooling system and remove hood. Shut off the fuel and disconnect the fuel line. Unbolt fuel tank supports from cylinder head and remove fuel tank and supports. Remove muffler, then disconnect the air cleaner hose, choke rod and governor link from carburetor. Remove manifold and carburetor as a unit. Remove the cylinder head water outlet casting, or the upper radiator hose; then disconnect the temperature gage sending unit (bulb) from cylinder head. Remove the rocker arm cover and extract the oil inlet and outlet lines. If grommet (G—Fig. FO10) is missing from the rear oil tube, remove the engine side plate, extract the grommet and install same over lower end of tube. Remove the cap screws retaining rocker shaft supports to head and remove the rocker arms and shaft assembly and push rods. Exhaust valve rotor caps (Fig. FO12) will be exposed at this time. Be sure to mark these caps so they can be reassembled to their mating valves. Remove the head retaining cap screws and lift the cylinder head from engine.

When reinstalling the head, tighten the retaining cap screws in the sequence shown in Fig. FO11 and to a torque of 65-70 Ft.-Lbs. Tighten the rocker arm support cap screws to a torque of 45-55 Ft.-Lbs. When installing the rocker arm oil lines, be sure that grommet (G—Fig. FO10) on lower end of the rear oil line is seated in the counterbore in cylinder block directly above the camshaft center bearing. Adjust the intake and exhaust tappet gap to 0.014-0.016 when engine is at operating temperature.

VALVES AND SEATS

17. Exhaust valves are equipped with free type rotators shown in Fig. FO12 and the valves seat on renewable type seat inserts which are a shrink fit in the cylinder head. Intake valves seat directly in the cylinder head and are equiped with stem oil deflectors. Valves have a face angle of 44 degrees and a seat angle of 45 degrees. Desired valve seat width is 0.060-0.080 for the intake, 0.090-0.110 for the exhaust. Seats can be narrowed, using 30 and 60 degree stones. Total seat runout should not exceed 0.0015.

Recommended valve stem to guide diametral clearance is 0.0011-0.0029 for the intake, 0.0021-0.0039 for the exhaust. A special Perfect Circle intake valve stem seal is available separately as a service item.

New intake valve stem diameter is 0.3415-0.3425. Exhaust valve stem diameter is 0.3405-0.3415. Renew the valves if bent, or if stems are excessively worn or scored.

Recommended tappet gap for both intake and exhaust is 0.014-0.016 with engine at operating temperature. Gap can be adjusted without removing hood and fuel tank by removing the fuel tank sediment bowl and rocker arm cover.

VALVE GUIDES AND SPRINGS

18. Intake and exhaust valve guides are interchangeable and can be pressed from cylinder head if renewal is required. The inside diameter of a new guide is 0.3436-0.3444 for all guides. Before removing guides, measure their height above the valve spring contacting surface of the head and install new guides to the same dimension.

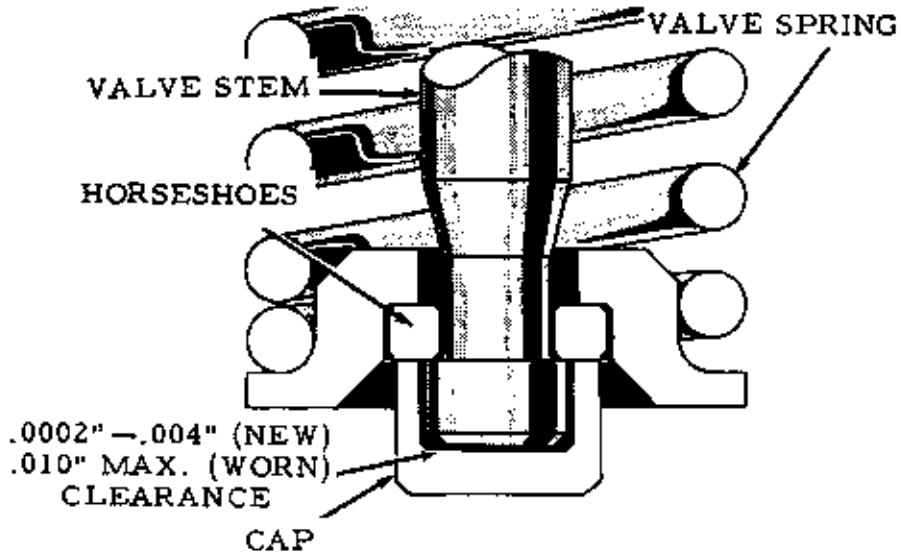


Fig. FO12—Section of release type (Free Valve) exhaust valve rotator. Note required end clearance between stem and cap.

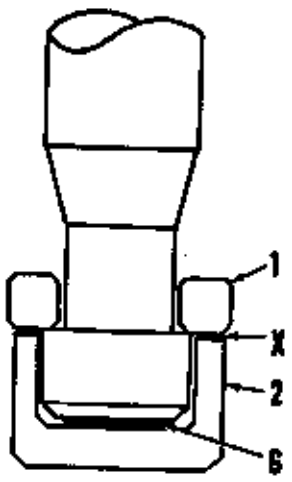


Fig. FO13—Feeler stock method of checking end clearance between rotator cap and end of valve stem.

1. Valve lock
2. Rotator cap
G. .010 feeler stock disc
X. Gap between rotator cap and valve lock

A special Perfect Circle intake valve stem seal is available as an accessory. A step must be machined on upper outside diameter of guide for seal installation. Installation instructions are provided in seal installation kit.

Valve stem diameter and running clearance is listed in paragraph 17.

Intake and exhaust valve springs are interchangeable. Renew any spring that has lost its protective coating or does not test 54-62 lbs. when compressed to 1-53/64 inches or 124-140 lbs. when compressed to 1½ inches.

Install all valve springs with the dampener coils (closed end) toward cylinder head.

EXHAUST VALVE ROTATORS

19. Refer to Fig. FO12. The free-valve type rotators will not function unless there is a measurable clearance or end gap between the end of the exhaust valve stem and the inside floor of the cap when the open end of the cap just contacts the spring keeper or horseshoe as shown. Desired end gap is 0.0002-0.004. Special micrometer gages are available for measuring this gap. Rotator cap gaps should be checked and if necessary adjusted each time the valves are reseated.

19A. One of the simpler methods of checking is shown in Fig. FO13. From a strip of flat shim stock of 0.010 thickness, cut a 3/16-inch diameter disc. Lay this disc (G), which must be flat, on inside floor of rotator cap (2) and install valve lock or keeper (1) on valve stem. Now, while simultaneously presing downward on valve lock and upward on rotator cap, measure with a feeler gauge the gap (X) between cap and valve lock. If gap measures anywhere between 0.006 and 0.009, it is within desired limits. If gap (X) is less than 0.006, grind or lap open end face of cap; if more than 0.009, grind end of valve stem.

VALVE TAPPETS

20. The mushroom type tappets (cam followers) ride directly in the machined un-bushed bores in the cylinder block. Tappets are supplied only in the standard diameter of 0.4989-0.4995. Desired running clearance of tappets in block bores is 0.0005-0.0021. To remove tappets it is necessary to first remove the camshaft as in paragraph 25 after which the tappets can be lifted out.

ROCKER ARMS

21. To remove the rocker arms, it is recommended that fuel tank be removed. Remove the rocker arm cover and extract the oil inlet and outlet lines. If grommet (G—Fig. FO10) is missing from the rear oil tube, remove the engine side plate, extract the grommet and install same over lower end of tube. Remove the cap screws retaining the rocker shaft supports to head and remove the rocker arms and shaft assembly. Push rods can now be removed.

All of the rocker arms are identical and interchangeable. The 0.780-0.781 diameter rocker arm shaft should have a clearance of 0.002-0.004 in the rocker arms.

When reassembling rocker arm shaft to cylinder head, tighten the rocker arm support cap screws to a torque of 45-55 Ft.-Lbs. When installing the rocker arm oil lines, be sure that grommet on lower end of the rear oil line is seated in the counterbore in the cylinder block directly above the camshaft center bearing. Adjust the intake and exhaust tappet gap to 0.014-0.018 when engine is at operating temperature.

TIMING GEAR COVER

Note: Early production models were equipped with a two-piece governor housing and timing gear cover; the governor housing being retained to the timing gear cover with four cap screws. On later production, both the timing gear cover and governor housing were changed to incorporate five governor housing retaining cap screws. Governor housing to timing gear cover gaskets with either four or five bolt holes are available for service. However, the timing gear cover now available for service incorporates an integral governor housing and neither the separate governor housing or timing gear cover are available. Therefore, if either the governor housing or timing gear cover are damaged, it will be necessary to discard both parts and install the timing gear cover with integral governor housing.

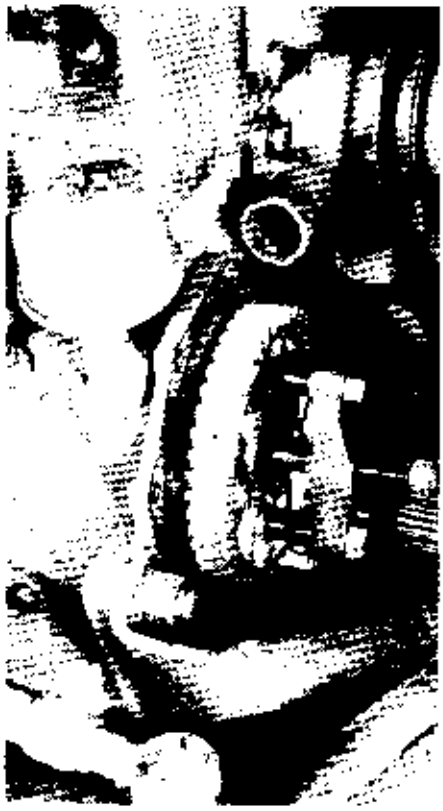


Fig. FO14—Using puller to remove camshaft gear.

Fig. FO15—Camshaft is properly timed when punch mark on tooth space of camshaft gear is in register with punch mark on crankshaft gear teeth.

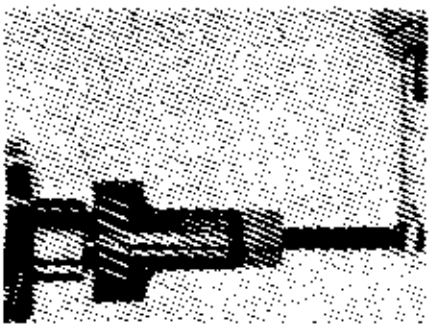


Fig. FO16—A puller which engages rear face of gear must be used to remove crankshaft gear as shown.

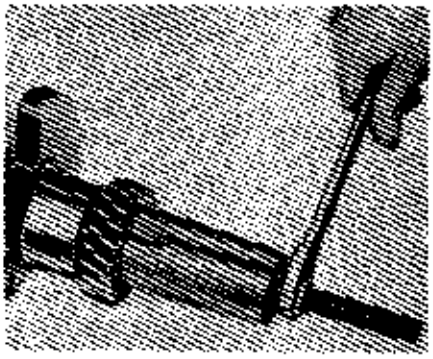


Fig. FO17—Internally threaded front end of crankshaft permits use of stud, sleeve and nut to push gear on to shaft.

tighten governor housing to timing gear cover cap screws to a torque of 10-15 Ft.-Lbs.

Note: On tractors equipped with service installed Pierce governor (see paragraph 41), be sure to tighten the crankshaft pulley retaining cap screw or ratchet screw to a torque of 100 Ft.-Lbs. to prevent crankshaft from rotating inside of governor weight unit, causing erratic governor action.

TIMING GEARS

Note: Original production camshaft timing gear was an aluminum gear moulded on a cast iron hub. Gear was press fit and keyed on shaft and retained with a cap screw, lock washer and flat washer. The aluminum gear and camshaft with cap screw are no longer available for service. Service parts now available consist of a cast iron gear that is press fit and keyed to camshaft and retained with a snap ring. All parts are interchangeable; the aluminum gear may be installed on new camshaft using snap ring, or the cast iron gear may be installed on original camshaft using cap screw and washers.

22. **REMOVE AND REINSTALL.** To remove the timing gear cover, first drain cooling system and remove the lower radiator hose. It is recommended that the engine oil pan be drained and removed; then, reinstall pan with new gasket after timing gear cover is installed to prevent possible oil leaks. Remove the fan, fan belt and crankshaft pulley. Disconnect linkage from governor arm.

On models with separate governor housing, unbolt and remove governor housing from timing gear cover and withdraw the governor weight unit from engine crankshaft. Then, on all models, unbolt and remove timing gear cover from front of engine.

The crankshaft front oil seal (S—Fig. FO10) can be renewed at this time.

When installing the timing gear cover, reverse the removal procedure and use all new gaskets. Use Permatex or equivalent sealer on the top timing gear cover retaining cap screws that extend into the engine water jacket. Tighten the timing gear cover retaining cap screws to a torque of 15-18 Ft.-Lbs., and on engines so equipped,

23. **CAMSHAFT GEAR.** To remove the camshaft gear, first remove the timing gear cover as outlined in paragraph 22. Measure the end play clearance between gear hub and camshaft thrust plate using a feeler gage or dial indicator. Clearance should measure 0.003-0.007. If clearance is excessive, renew the thrust plate during reassembly. Check the timing gear backlash which should be 0.002-0.006. Camshaft gear is available in standard size as well as oversizes of 0.006 and 0.010 to facilitate obtaining the desired backlash.

Remove the cap screw, lock washer and flat washer (or snap ring) from front end of camshaft and pull the gear as shown in Fig. FO14. Note: When engine is equipped with service installed camshaft using snap ring to retain gear, some mechanics may prefer to remove camshaft as outlined in paragraph 25 and use a press to remove and install gear. This new type camshaft does not have threaded hole in front end to aid in installing gear on shaft.

Inspect aluminum timing gear for being loose on cast iron hub; renew gear if this condition is noted.

When reassembling, mesh the punch marked tooth space on camshaft gear with the punch marked tooth on crankshaft gear as shown in Fig. FO15.

On engines equipped with original production type camshaft, gear can be installed with 7/16"—14 stud threaded into front end of shaft by using a nut and washer as a pusher. Tighten the gear retaining cap screw to a torque of 35-45 Ft.-Lbs.

To install gear on a service installed camshaft (one with snap ring), heat

Fig. FO18—To remove pump gear from rear end of camshaft it is necessary to remove flywheel and this access plate.

gear in hot oil or boiling water for 15 minutes; then, buck up camshaft and bump gear into position using suitable drift.

24. **CRANKSHAFT GEAR.** To gain clearance for pulling crankshaft gear, it is recommended that a front split be performed as outlined in paragraph 5. Remove timing gear cover and governor as outlined in paragraph 22.

Crankshaft gear can then be removed with suitable puller as shown in Fig. FO16. Be careful not to damage threaded hole in front end of crankshaft when removing gear. Install new gear as shown in Fig. FO17 and mesh timing marks as shown in Fig. FO15.

CAMSHAFT

Note: Original production camshaft had a threaded hole in front end of shaft and camshaft gear was retained by a cap screw, lock washer and a flat washer. Hydraulic pump drive gear was retained to rear end of shaft with four ¼"—28 x .62 cap screws and lock washers. The camshaft now available for service does not have the threaded hole in front end of shaft and camshaft gear is retained by a snap ring. Also, hydraulic pump drive gear is retained by four 5/16"—18 x .75 screw and washer assemblies. To install a new replacement camshaft in early models, obtain and use the following additional parts: Snap ring, part No. 370612-S; Pump drive gear, part No. EAF-907-B; Four 5/16"—18 x .75 screws, part No. 42759-S8.

25. To remove the camshaft, first remove the engine as outlined in paragraph 15, timing gear cover as outlined in paragraph 22 and rocker arm assembly and push rods as outlined in paragraph 21. Remove the clutch, flywheel and engine rear plate. Remove the hydraulic pump drive gear access plate as shown in Fig. FO18 and remove the hydraulic pump drive gear from rear end of camshaft. Remove the ignition distributor.

Remove the engine oil pan and side cover plate, push tappets up in their bores and retain with spring loaded clothes pins or invert the engine so that tappets will fall away from the camshaft. Working through openings in camshaft gear, remove the two cap screws retaining camshaft thrust plate to engine block and withdraw the camshaft from engine.

Check the camshaft and associated parts against the following values:

Camshaft journal diameter	1.925-1.926
Bearing bore diameter in block	1.9275-1.9285
Journal running clearance	0.0015-0.0035
Camshaft end play	0.003-0.007

Reinstall the camshaft by reversing the removal procedure and tighten the hydraulic pump drive gear access plate retaining cap screws to a torque of 12-16 Ft.-Lbs., camshaft thrust plate screws to a torque of 12-16 Ft.-Lbs. and the camshaft gear retaining cap screw on early models to a torque of 35-45 Ft.-Lbs. Retime the ignition as outlined in paragraph 52.

CONNECTING ROD AND PISTON UNITS

26. Connecting rod and piston units are removed from above after removing the cylinder head and oil pan. Be sure to remove top ridge from cylinder bores before attempting to withdraw the assemblies.

Connecting rod and bearing caps are numbered to correspond to their respective cylinder bores. Service installed connecting rods should have cylinder number stamped on rod and cap prior to installing connecting rod in engine.

When reassembling, make certain that the oil squirt hole in the connecting rod faces toward camshaft side of engine and the dimple or indentation in top of piston is toward front of engine. Tighten the connecting rod nuts to a torque of 45-50 Ft.-Lbs. Install new pal nuts and tighten them to a torque of 3-3½ Ft.-Lbs. (or finger tight plus ⅓-turn).

PISTON RINGS

27. Two compression rings and one oil control ring are fitted to each piston. Production type ring sets are available in standard size and oversizes of 0.020, 0.030 and 0.040. New rings are marked to indicate the top side and should be installed accordingly. Top compression ring is chrome plated. Both compression rings have tapered faces and largest diameter of rings should be installed towards bottom of piston. All rings should have an end gap of 0.010-0.020. Top compression ring should have a side clearance of 0.002-0.0035; second compression ring should have a side clearance of 0.0015-0.0035; and oil control ring side clearance should be 0.0015-0.003.

Service re-ring (2-in-1 chrome) sets are also available in standard size and oversizes of 0.020, 0.030 and 0.040. Observe piston and cylinder wear limits as outlined in instructions packed with re-ring sets.

Production type rings are recommended if cylinder liners are renewed or rebored to fit oversize pistons. Re-ring sets are recommended when renewing only the piston rings.

PISTONS AND CYLINDERS

28. Original production engines and early service cylinder blocks were equipped with cast iron dry type cylinder sleeves (liners). Latest service cylinder block is sleeveless. Sleeves are available for service repairs on both sleeved and unsleeved engines.

Reboring and installation of oversize pistons and rings, rather than resleeving, is the recommended overhaul procedure for both sleeved and unsleeved engines. Standard cylinder bore diameter is 3.4368-3.4388; however, pistons must be individually fit using a pull scale and feeler gage ribbon as outlined in paragraph 29.

Oversizes of 0.020, 0.030 and 0.040 are available for the pistons and rings. Cylinders should be rebored if badly scored; if pistons cannot be fitted as outlined in paragraph 29; if out-of-round exceeds 0.003 or if taper exceeds 0.008. When reboring cylinder walls, leave 0.0015 stock below the minimum finished diameter for finish honing and selective fitting of pistons. After cylinders have been rebored, finish hone as outlined in paragraph 30.

If the cylinder walls cannot be

cleaned up by reboring to 0.040 oversize, the cylinder sleeves must be renewed or the unsleeved cylinder block must be bored out and cylinder sleeves installed. Bore sizes for installation of sleeves in unsleeved engine blocks are as follows:

Block bore diameter.....3.650-3.651
Counterbore diameter 3.748-3.752
Counterbore depth 0.178-0.180

29. FITTING PISTONS. Before checking piston fit, deglaze the cylinder wall using a hone or de-glazing tool. Attach a ½-inch wide feeler gage ribbon of specified thickness to a piston pull scale. Invert the piston, keeping pin bore parallel to crankshaft, and insert piston and feeler ribbon (90° from pin bore as shown in Fig. FO19) into cylinder until edge of piston skirt is aproximately ½-inch below top of cylinder. Slowly withdraw the feeler ribbon, using pull scale, and note pull scale reading. Fit is correct when 5-10 pounds pull is required to withdraw feeler ribbon.

Recommended thickness of feeler ribbon is as follows:

New piston in new bore..... 0.0015
New piston in used bore..... 0.002
Used piston in used bore..... 0.003

30. FINAL SIZING OF CYLINDERS. Use a rigid type hone and No. 220 grit stones. A drill with a speed of 250 to 450 rpm should be used to drive the hone. The stones must be used dry to obtain the desired cylinder bore finish. Cover the crankshaft with clean rags.

NOTE: The speed of the hone and rapidity of the stroke govern the crosshatch marks in the bore. The crosshatch marks should intersect at approximately 90° for proper ring seating.

Operate the hone through the bore 10 or 12 complete strokes. Remove the hone, clean the bore with dry rags, and recheck the piston fit as per paragraph 29.

Repeat the above procedure until the necessary amount of material has been removed for the specified piston-to-bore fit as tabulated in paragraph 29.

CAUTION: Do not use gasoline or kerosene to clean the cylinder walls after the honing operation. Solvents of this type will not remove the abrasive but will further imbed small abrasive particles into the pores of the cylinder bores.

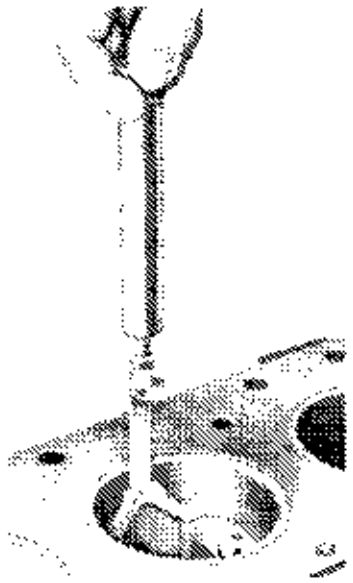


Fig. FO19—Recommended piston fit is 5-10 pounds pull to extract a ½-inch feeler ribbon of specified thickness when inserted as shown. Refer to paragraph 29.

CLEANING AFTER HONING. After the honing is completed, clean the cylinder block of all foreign material as follows:

Wipe or remove as much of the abrasive material as possible.

Swab each cylinder wall with clean SAE 10 Engine Oil at least twice.

Wipe the oil out of the bores with clean rags.

Wash the bores with hot soapy water.

Flush water jackets to remove foreign material which might cause excessive wear to the water pump.

Remove the rags from the crankshaft and wash the crankshaft off with hot soapy water.

Dry the cylinder block thoroughly, using compressed air. Check cylinder for being clean by rubbing walls with a clean white cloth; repeat cleaning procedure if any dark spots appear on cloth.

PISTON PINS

31. The 0.8120-0.8123 diameter floating type piston pins are retained in the piston pin bosses by snap rings and are available in standard size only. Piston pins should have a clearance of 0.0001-0.003 in connecting rod bushing and in piston. New bushings must be final sized and the 0.187 diameter oil hole drilled after installation in connecting rod. When reassembling, oil squirt hole in connecting rod must face camshaft side of engine and dimple or indentation in top of piston must be towards front end of engine.

CONNECTING RODS AND BEARINGS

32. Connecting rod bearings are of the non-adjustable, slip-in precision type, renewable from below after removing the oil pan and connecting rod bearing caps. When installing new bearing shells, make certain that the bearing shell projections engage the milled slot in connecting rod and bearing cap. Assemble with oil squirt hole in connecting rod facing camshaft side of engine and with bearing shell projections in rod and cap on same side of connecting rod assembly (cylinder number on rod and cap in register). Bearing inserts are the same for all cylinders and are available in standard size as well as undersizes of 0.001, 0.002, 0.003, 0.010, 0.020, 0.030 and 0.040.

Check the crankshaft crankpins and the rod bearing inserts against the values which follow:

Crankpin diameter 2.2978-2.2986
Regrind if out-of-round.....0.001
Regrind if tapered.....0.001

Bearing running clearance 0.0004-0.002

Renew bearing if clearance exceeds 0.003

Rod side play 0.003-0.012

Connecting rod should be checked for alignment and straightened or renewed if twist exceeds 0.012 measured 4 inches from centerline of rod or if rod is bent 0.004 or more.

When reassembling, tighten the connecting rod nuts to a torque of 45-50 Ft.-Lbs. Install new pal nuts and tighten them to a torque of 3-3½ Ft.-Lbs. (or finger tight plus ⅓ turn).

CRANKSHAFT AND MAIN BEARINGS

33. Crankshaft is supported in three main bearings of the non-adjustable, slip-in precision type, renewable from

Fig. FO20 — Sealing strips seal the sides of the rear main bearing cap to the cylinder block.

below after removing the oil pan, oil pump pipes and main bearing caps. Bearing inserts are available in standard size, as well as undersizes of 0.001, 0.002, 0.010, 0.020, 0.030 and 0.040. Normal crankshaft end play of 0.002-0.006 is controlled by the flanged center main bearing inserts. Renew inserts if end clearance exceeds 0.008.

To remove the crankshaft, first remove engine as in paragraph 15; then, remove the clutch, flywheel, timing gear cover, oil pan, oil pump, engine end plate and rod and main bearing caps. Lift crankshaft from cylinder block.

Check the crankshaft and main bearing inserts against the values which follow:

Max. run-out at center main	0.003
Crankpin diameter	2.2978-2.2986
Regrind if out-of-round	0.001
Regrind if tapered	0.001
Main journal diameter	2.4974-2.4982
Regrind if out-of-round	0.001
Regrind if tapered	0.001
Main bearing running clearance	0.0007-0.0023
Renew bearing inserts if clearance exceeds	0.003
Crankshaft end play	0.002-0.006
Renew bearing inserts if end play exceeds	0.010
Journal radii	0.08-0.10
Main bearing bolt torque	85-105 Ft.-Lbs.

Both side faces of the rear main bearing cap are sealed to the cylinder block with wedge type neoprene impregnated seals. Install new seals by dipping in oil, inserting them into grooves and bumping them until flush as shown in Fig. FO20. Ford Motor Company recommends that seals be installed immediately after dipping in oil because the oil causes rapid expansion of the seal material. Do not remove any material from ends of seals. Seals are available in standard and 0.010 oversize.

CRANKSHAFT OIL SEALS

34. **FRONT SEAL.** The crankshaft front oil seal is pressed into the governor housing and can be renewed after governor housing (or late type timing gear cover) is removed as outlined in paragraph 22.

35. **REAR SEAL.** Original production crankshaft rear oil seal was a two-piece rope type seal with one half of the seal fitted into a groove in the cylinder block and the other half in a groove in the rear main bearing cap. This type seal is now obsolete.

To remove upper half of rope type seal, if engine is so equipped, loosen the front and center main bearing caps to lower the crankshaft; then, thread a screw into one end of the seal and pull seal from the groove in cylinder block.

A two-piece neoprene lip type seal is now available for service, and can be installed after removing the rear main bearing cap. To install seal, proceed as follows: Place one half of the seal against the crankshaft (with sealing lip forward) and turn the seal into the groove in cylinder block. Place the other half of the seal (with sealing lip forward) on the crankshaft so that ends of the two seal halves butt together. Then, turn both seal halves so that the seal parting line is about 45° from the main bearing cap to cylinder block parting line.

FLYWHEEL

36. The flywheel can be removed after detaching the engine from the transmission and removing the clutch. Flywheel can be reinstalled in one position only. Tighten the flywheel retaining bolts to a torque of 75-85 Ft.-Lbs.

Starter ring gear is installed from rear face of flywheel and thus can be renewed without removing flywheel from crankshaft. To facilitate installation of the gear, heat same uniformly to about 360 degrees F.

OIL PAN

37. The gasket surface of the stamped oil pan is flat and the pan functions only as an oil container. It is entirely independent structurally from the front support. Method of removal of the pan unit is conventional.

OIL PUMP AND RELIEF VALVE

CAUTION. In cases of low engine oil pressure, remove the engine oil filter cartridge and inspect for being dirt-clogged or for being wrong type for use in the full flow oil filtering system. In either case, a by-pass valve located in the filter cover retaining bolt may open and allow the engine oil pressure to drop to approximately 4-7 psi. If in doubt, renew the oil filter cartridge using cartridge meeting Ford specifications and recheck engine oil pressure before attempting repairs to oil pump, relief valve or engine. At a nominal cost, an adapter plate may be obtained which allows installation of the later design throw-away type oil filter.

Note: Original production oil pumps were of the gear type as shown in Fig. FO21. Body (5) of pump was changed from cast iron to aluminum on later service pumps. All parts are available for servicing the gear type pumps except the pump body. Complete gear type pump assemblies are

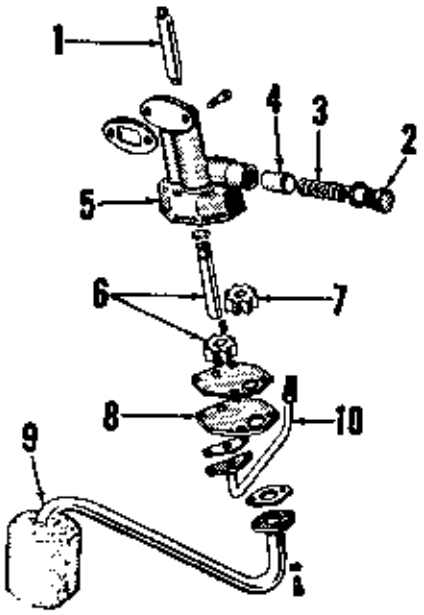


Fig. FO21—Exploded view of gear type oil pump assembly used in original production of the model NAA tractor. Pump body (5) may be either cast iron or die cast.

1. Intermediate shaft
2. Plug
3. Spring
4. Relief valve
5. Pump body
6. Drive shaft & gear
7. Driven gear
8. Cover plate
9. Suction tube
10. Pressure tube

not available for service. Therefore, if necessary to renew either the pump body or complete gear type pump, a later production G-rotor type pump (See Fig. FO22) must be used. In addition, the pump inlet tube (9—Fig. FO21), outlet (pressure) tube (10) and tube to pump gaskets must be discarded and the later type installed.

Gear Type

38. Refer to Fig. FO21. The oil pump assembly is mounted inside the cylinder block and is retained to right hand wall of same by two Allen head bolts. The bolt heads are located on right exterior surface of block. Pump is driven by the ignition distributor.

To remove the pump, remove the oil pan, oil filter pipe and the Allen head bolts. Withdraw the pump and inlet pipe assembly from engine. Disassemble the pump and check the component parts against the following values:

Drive shaft clearance in pump body.....0.0015-0.0029
Driven gear to pin clearance 0.001-0.002
Gear side clearance (radial) in pump body.....0.005 Max.
Relief valve spring tension .....9.8 lbs. @ 1.56 inches

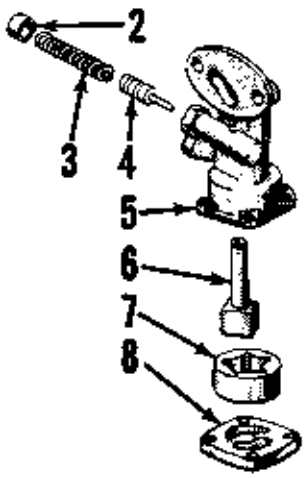


Fig. FO22—Exploded view of "G-rotor" type pump available for service installation in model NAA engines.

2. Plug
3. Spring
4. Relief valve
5. Pump body
6. Shaft & drive rotor
7. Driven rotor
8. Cover plate

Relief valve opening pressure ....45-50 psi @ 1400 rpm

Renew the oil pump cover plate if machined surface of same shows wear.

When reassembling, tighten the cover cap screws to a torque of 15-18 Ft.-Lbs. and the pump mounting bolts to a torque of 30-35 Ft.-Lbs.

G-Rotor Type

39. Refer to Fig. FO22. Pump removal and installation procedure is same as for gear type pump. See paragraph 38. To disassemble the pump, remove the cover (8) and withdraw the inner rotor (6) and outer rotor (7). Examine the parts for wear or scoring. Relief valve spring (3) should test 9.8 lbs. when compressed to a height of 1.56 inches.

To check the rotor clearances, reassemble rotors in housing, making sure the correlation marks on outer and inner rotors are on the same side. Measure the clearance between points of inner rotor (6) and mating surface of outer rotor (7). Clearance should be 0.003-0.008 with rotors in any position. Lay a straight edge across gasket surface of pump body (5) and measure clearance between straight edge and lower surface of rotors. The clearance should not exceed 0.004. Renew any parts which are scored, worn or otherwise damaged. Assemble by reversing the disassembly procedure. Tighten the oil pump retaining cap screws to a torque of 30-35 Ft.-Lbs., and the cover cap screws to 10-15 Ft.-Lbs.

CARBURETOR

40. The carburetor is a Marvel-Schebler up-draft type, model TSX-428. A removable fuel strainer is built into the fuel inlet elbow. Make sure that packing in drain hole at bottom of carburetor is in place or dirt and dust will be drawn into the system. The idle mixture adjustment controls air; turning the screw clockwise (in) richens the mixture. The main or power adjustment is located adjacent to the fuel inlet elbow and controls fuel flow. Turning the needle clockwise (in) leans the mixture. Initial setting for main needle is 1½ turns open. Adjust throttle stop screw to obtain recommended slow idle speed of 450 rpm.

Float setting is ¼ inch from nearest face of float to gasket face of throttle body. Only the idle mixture jet and the main needle nozzle of the calibration are renewable. Neither the throttle body or the float chamber portions of the carburetor are available separately. Parts data are as follows:

Repair kit 286-1010
Gasket set 16-675
Inlet needle and seat.....233-536
Nozzle 47-270

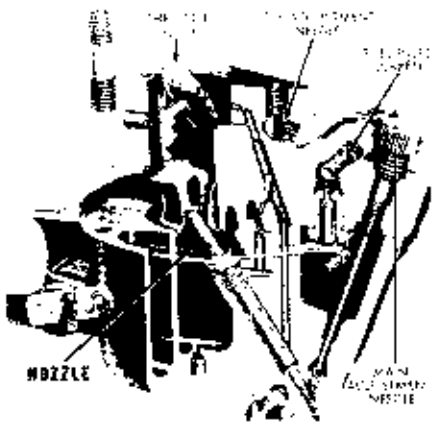


Fig. FO23—Cutaway of Marvel Schebler TSX carburetor used on NAA tractors.

GOVERNOR

41. A Novi flyball type governor was used in original production. Individual parts of the Novi centrifugal unit (Items 7 to 15—Fig. FO25) are available for service; however, the unit is not available as a complete assembly. If necessary to renew the complete Novi unit, a later production Pierce flyweight type centrifugal unit (Items 16 to 21) is available as an assembly. In addition, it will be necessary to install a new governor compensating spring assembly (C — Fig. FO24) that is balanced to the Pierce centrifugal flyweight unit.

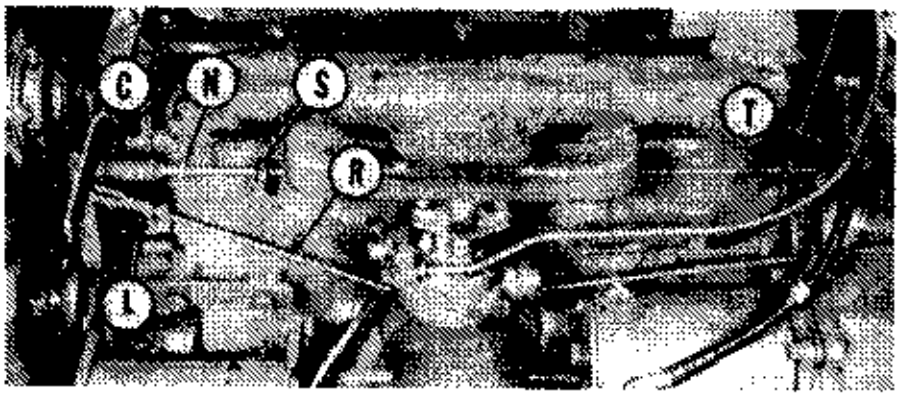


Fig. FO24—View of left side of engine showing governor adjustment points.

C. Governor compensating unit
L. Lock nut
N. Lock nut
R. Throttle rod
S. High speed stop
T. Tension adjusting nut

42. **SPEED ADJUSTMENT.** For proper engine performance, it is recommended that governor adjustments be made in the following sequence.

With engine dead, disconnect governor lever to carburetor link (R) from carburetor throttle arm as shown in Fig. FO24. With the throttle lever in wide open position, adjust length of link at (L) so that link will reattach to carburetor throttle shaft arm when throttle shaft is held in wide open position. An alternate method for this step is to leave link attached to carburetor and, with throttle lever in wide open position, adjust length of link by loosening lock nut (L) and turning link in or out of clevis until the carburetor throttle arm is just touching the wide open stop.

Start engine and adjust the throttle stop screw to obtain a slow idle speed of 450 rpm.

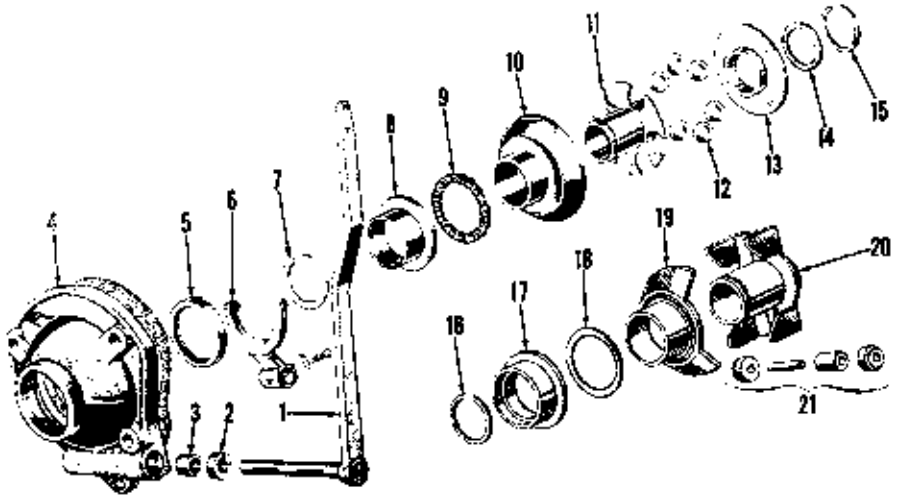


Fig. FO25—Exploded view of governor unit showing original production Novi flyball weight unit (Items 7 to 15) and Pierce flyweight unit (Items 16 to 21) that is available for service. Governor housing (4) is not available for service; a one-piece governor housing and timing gear cover is now used for service. Governor shaft needle bearings (3) and Welch plug (not shown) are not available for service.

1. Governor shaft & lever assy.
2. Governor shaft seal
3. Needle bearing
4. Governor housing
5. Crankshaft front oil seal
6. Governor fork
7. Snap ring
8. Thrust base
9. Thrust bearing
10. Front race assembly
11. Sleeve & driver assembly
12. Governor ball weights
13. Rear race
14. Thrust washer
15. Snap ring
16. Snap ring
17. Governor fork base
18. Thrust bearing
19. Front race assembly
20. Race, sleeve & driver assy.
21. Roller weights (2)

Fig. FO26—Using special size driver to install governor shaft seal. (Separate governor housing shown is not available for service).

With engine dead and throttle lever in slow idle position, loosen locknut (N) and adjust governor compensating unit (C) in or out until front end of compensating unit just touches governor lever when carburetor throttle shaft lever is held against idle stop.

With engine running, adjust position of stop (S) on governor control rod so that engine high idle speed is 2200 RPM with throttle lever in wide open position and the stop (S) contacts the guide attached to one of the manifold bolts.

If hand throttle tends to creep towards slow idle position or is too difficult to move, remove cotter pin and turn tension adjusting nut (T) in or out until desired tension on throttle bell crank is obtained.

43. R&R AND OVERHAUL. Refer to paragraph 22 for governor removal and reinstallation procedure. Refer to following paragraphs for governor overhaul procedure.

To remove the governor shaft and lever assembly, remove locking screw or roll pin from fork and withdraw shaft and lever from fork and governor housing or timing gear cover. Pry out governor shaft oil seal and install new seal with lip to inside using drift of correct size as shown in Fig. FO26. Governor shaft bearings or bushing and Welch plug are not available for service. The crankshaft front oil seal can be renewed without disassembling governor housing or timing gear cover. Install new seal with lip facing inward and make sure seal is fully bottomed.

To disassemble the removed original production Novi flyball weight unit, remove the two snap rings (7 and 15—Fig. FO25). Check the balls, sleeve and races for wear, pitting and scoring. Parts must work freely without binding.

To disassemble the removed weight unit of the service installed Pierce flyweight governor, remove snap ring (16) and separate parts. Check thrust bearing (18) and the bearing contacting surfaces of the race (19) and the fork base (17). Pay particular attention to the sleeve in the race assembly (19) to see that it is in good condition and not loose.

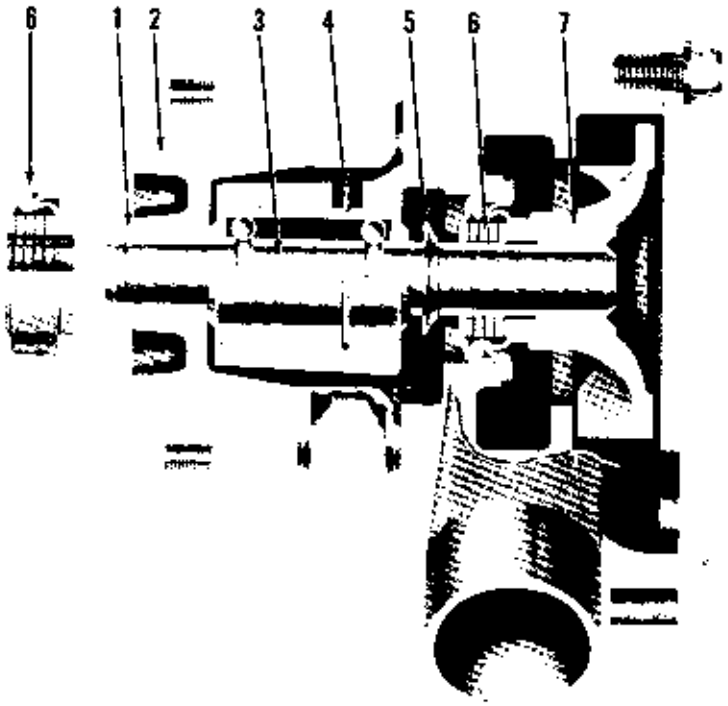


Fig. FO27—Cross-section view of water pump. Original production impeller had stainless steel thrust cap; service impeller has a ceramic insert which contacts seal (6).

1. Lock ring
2. Pulley
3. Bearing and shaft
4. Snap ring
5. Slinger
6. Seal assembly
7. Impeller

COOLING SYSTEM

RADIATOR AND FAN SHROUD

NOTE: Radiator should be equipped with a 3½-4½ psi pressure cap.

45. To remove the radiator assembly it is necessary to first remove the tractor hood as follows: Remove 4 cap screws from each side of hood at rear. Working through hood opening, remove cap screws attaching top of hood to instrument panel and two stove bolts at top rear of hood. Remove air intake screen or precleaner connection from left panel. Remove two cap screws attaching side panels to front support, and lift off hood and side panels.

Drain cooling system, disconnect hoses and unbolt and lift radiator from front support.

To remove or renew the fan shroud attached to rear face of core, it is necessary to first remove the radiator from the tractor.

WATER PUMP

46. To remove the pump, drain the radiator and cylinder block and loosen the fan belt adjustment. Disconnect hose from pump and unbolt and remove fan blades unit from pulley. Remove cap screws retaining the pump assembly to the cylinder block and withdraw the pump.

To disassemble the pump, refer to sectional view Fig. FO27 and proceed as follows: Remove lock ring (1) and rear cover plate and pull (don't drive) the pulley (2) off the shaft. Extract the bearing retainer ring (4) and press the shaft and bearing (3), seal (6) and impeller (7) out of the body as a unit. Remove impeller from shaft. Examine seal (6) and seal contacting portion (stainless steel cap or ceramic insert) of impeller. If surface of impeller cap is scratched or pitted, install a new impeller as the cap or insert is not available.

THERMOSTAT

47. A thermostat is located in the cylinder head back of the cylinder head water outlet elbow. Thermostat starts to open at approximately 157-162 degrees F. and is fully open at 177-182 degrees F. The word "top" stamped on the unit should be up.

ELECTRICAL AND IGNITION SYSTEM

GENERATOR AND REGULATOR

50. A Ford generator, Part No. FAC-10002-A, regulated by a two-unit Ford regulator, Part No. FAG-10505-A, is used. Regulator is a sealed unit. Specifications follow:

Generator

Brush spring tension.....26-34 oz.
Field Draw
  Volts 6.0
  Amperes 1.5-2.0
Field resistance ....3.2 ohms @ 70° F.
Output (rated)
  Maximum amperes..20 @ 1650 RPM
  Volts 6.0

Regulator

Cut-out relay
  Closing voltage @ 75° F. 6.0-6.6
Voltage regulator (limiter)
  *Voltage range @ 75° F. 7.1-7.5

*Deduct 0.05 volts for each 5° rise in temperature; add 0.05 volts for each 5° drop in temperature below 75° F.

Ground polarity .....positive

STARTING MOTOR

51. A Ford 6-volt starting motor, Part No. FAC-11002-E was used in original production. (Part No. for service starting motor is FAC-11002-N.) Specifications follow:

Brush spring tension.....48-56 oz.
No load test
  Amperes 100
Cranking load test
  Amperes 140-190
Lock test
  Amperes 800

IGNITION SYSTEM

52. **TIMING TO ENGINE.** Firing order is 1-2-4-3. To time distributor to engine proceed as follows: Adjust breaker contacts to 0.025 gap. Remove spark plug from front (No. 1) cylinder and cover from timing hole (Fig. FO28) on right side of engine. Crank engine until front piston is just starting up on compression; then, using a screw driver as a pry bar on flywheel teeth, rotate flywheel in normal direction until the 31° BTDC mark on flywheel is in register with the index mark at timing port. With crankshaft in this position rotate distributor shaft until contact finger of rotor is pointed towards number one cap terminal and temporarily install the distributor to the engine. Rotate the breaker cam in normal direction as far as it will go. Holding the cam in this position rotate distributor body in opposite direction until contacts just start to open. Tighten the distributor clamp bolts.

When checked with timing light and engine running at 2000 rpm, the 31° BTDC mark should register with the index line at inspection port. At idle speed below 450 rpm, the index line should register with a point on the flywheel between the lines indicating 6 degrees and 10 degrees. If fully advanced timing is O.K. but idle timing is not within the limits of 6 to 10 degrees before top center, a malfunctioning advance governor is indicated.

Fig. FO28 — Flywheel marks extend to 30 degrees before top center, each line representing one degree.

53. **TEST AND OVERHAUL.** Recommended breaker contact gap is 0.024-0.026. Breaker arm spring tension should be 17-20 ounces. To increase the tension loosen condenser lead nut and slide leaf spring in direction towards point end of breaker arm so as to decrease the radius of the spring at the arm pivot.

Governor advance curve is as follows:

	——Distributor——	
	Degrees	RPM
Start Advance	0	225-250
Intermediate Advance	4.5-6	600
Maximum Advance	10.5-11.5	1000

To convert these values to flywheel degrees and engine rpm, multiply each value by two.

Fig. FO29—Distributor shaft gear may be removed after removing the retaining rivet.

54. The following points should be observed when overhauling the distributor unit: To remove the shaft from the distributor, file off and remove the drive gear retaining rivet and drift the gear as shown in Fig. FO29. Always renew the shaft oil seal and "O" ring. The drive shaft bushing should be renewed if running clearance exceeds 0.004 and should be final sized after installation. Upper end of bushing should be flush with top of spot face in distributor body. Before riveting the gear to drive shaft, check end play of shaft which should be within the limits of 0.021-0.046.

If new distributor shaft is being installed, press gear on shaft until proper end play is obtained; then, using rivet hole in gear as template, drill hole through shaft for rivet. Rivet holes are not drilled in service shafts.

ENGINE CLUTCH

Note: At tractor Serial No. NAA-40524, the tractor flywheel was changed to incorporate a ball type clutch pilot bearing instead of the bushing type used on earlier models.

60. ADJUSTMENT. Refer to Fig FO32. Recommended free travel of clutch pedal is ⅝ inch as shown. To adjust the free travel, remove the clevis pin (C) and rotate the eye bolt. Rotating the eye bolt clockwise increases the pedal travel; counterclockwise rotation of the eye bolt decreases the pedal travel.

SPLIT TRACTOR

61. Drain the hydraulic system, remove the air cleaner bowl and unhook governor compensating spring. Disconnect governor compensating rod at bell crank and remove cap screws attaching the throttle control arm bracket to transmission housing. Loosen castellated nut from bell crank stud and remove bell crank and friction disc assembly. Remove choke control rod and starting motor; then remove the remaining cap screws retaining steering gear housing to top of transmission. Disconnect wire from starter switch, tail light wire from transmission and lay wires over the steering gear housing. Remove exhaust pipe. Unbolt hydraulic pump from engine, disconnect pump lines from center housing and remove pump and lines from tractor. Disconnect radius rods from transmission. Place wood wedges between front axle and front support.

Support both halves of tractor separately and remove the bolts and cap screws retaining engine to transmission. Carefully raise the engine and at the same time pry up on the steering gear housing until it is free of the locating dowels.

Move engine forward until front side of steering gear housing meets with the bell crank stud. Continue to raise engine half of tractor until steering gear housing clears the bell crank stud and carefully move the engine forward until the clutch is clear of the clutch housing. It may be necessary to pry steering gear up to clear bell crank stud.

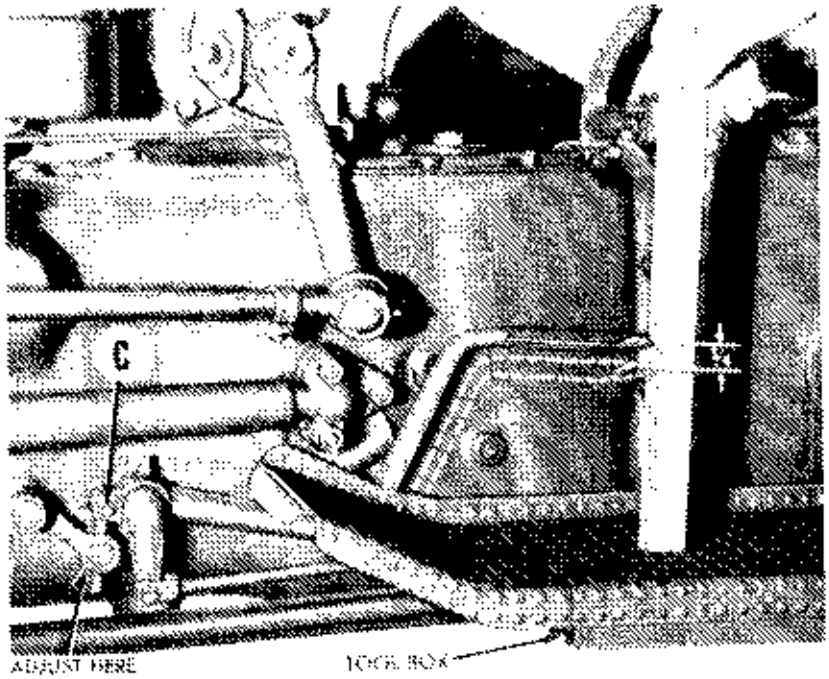


Fig. FO32—To adjust clutch pedal free travel remove pin (C) and rotate the eye bolt.

R&R AND OVERHAUL

62. After tractor is split as outlined in paragraph 61, remove clutch cover assembly and lined disc from flywheel by evenly loosening and removing the cap screws that retain cover plate to flywheel.

Clutch pressure plate and cover unit is serviced as an assembly only. Renew the assembly if pressure plate is scored, warped, cracked or excessively worn or if the cover, release fingers or springs are damaged.

Friction disc is serviced as a complete assembly or the friction facings (linings) may be renewed. Renew the facings if retaining rivets are loose or if the facings are worn to 1/64-inch or less from the rivet heads. Renew the complete disc assembly if rivet holes in disc are elongated or if hub or disc is damaged in any way.

Note: Both the clutch cover assembly and lined friction disc are available as regular or heavy duty units. Like units must be used together; that is, a heavy duty friction disc must be used with a heavy duty cover assembly and a regular duty friction disc must be used with a regular duty cover assembly.

Inspect clutch pilot bushing or bearing in flywheel and renew or lubricate as necessary.

Inspect the clutch throw-out (release) bearing and renew if rough, loose or seized. Note: The throw-out bearing is a pre-lubricated assembly and cannot be disassembled or lubricated in service. Do not wash bearing assembly in solvent or oil.

When reinstalling the clutch, place the lined disc in position (long hub rearward) on flywheel and hold with pilot inserted through hub of disc into clutch pilot bearing or bushing. Position cover assembly over disc and install retaining cap screws and lock washers. Tighten cap screws evenly and alternately to a torque of 12-16 Ft.-Lbs. Clutch cover assembly and flywheel are balanced independently; therefore, pressure plate need not be reinstalled in same position from which it was removed.

ENGINE CLUTCH SHAFT

63. The engine clutch shaft (transmission main drive gear on models without Sherman transmission) may be removed as outlined in paragraph 80. On models with Sherman transmission, refer to paragraph 68.

SHERMAN TRANSMISSION

Many model NAA tractors have been equipped with a Sherman Combination Transmission as a field installation. This three range (over, under and direct) transmission is installed between the engine clutch and the main transmission. The manufacturer of this transmission has been acquired by the Ford Motor Company and service parts are available through all Ford Tractor Dealers. Complete transmissions are also available for field installation.

REMOVE AND REINSTALL

65. Separate (split) tractor as outlined in paragraph 61, then disconnect the clutch release bearing springs and remove the bearing. Remove the left brake pedal and the brake cross shaft. Remove the socket head screw from the Sherman Transmission shift lever and remove the lever, then unbolt and remove the Sherman Transmission from the mounting flange on front face of the main transmission housing.

The Sherman Transmission mounting flange can be removed at this time by removing the four socket head screws and pulling flange and shims from the tractor transmission housing as shown in Fig. FO35.

Reinstall by reversing removal procedure and check bearing pre-load of the Sherman Transmission as outlined in paragraph 70.

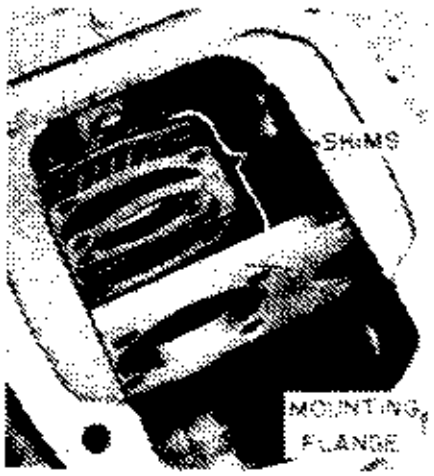


Fig. FO35—View showing mounting flange exploded from front wall of tractor transmission. Notice the shims between flange and transmission which control preload of Sherman transmission output shaft bearings.

OVERHAUL

66. **SHIFTER RAILS AND FORKS.** To remove shifter rails and forks, the Sherman Transmission must be removed as outlined in paragraph 65. Refer to Fig. FO36 and remove the retaining cap screws and lift shifter cap assembly (48) from gear case. Remove the two detent caps (45), detent springs and detent balls from shifter cap. Remove lock wires and the drilled head cap screws from shifter fingers (forks) (33). Remove the Welch plugs (49) from the shifter rod bores at the rear of the shifter cap, then drive the shifter rods (34) out the front of shifter cap. Remove the set screw from the interlock bore and remove the interlock (40). Remove the snap ring from the groove on the selector shaft (42) and slide the selector fork (41) and snap ring (46) toward the end of the selector shaft which is opposite from the shoulder stop. Remove the Woodruff key (47) from selector shaft then withdraw selector shaft from the shifter cap (48). Remove selector shaft seal (52) from bore in shifter cap.

Wash all parts in a suitable solvent and proceed as follows: Position the shifter rods (34) and selector shaft (42) in their respective bores and check for freedom of movement; if binding occurs due to rods or shaft being bent, renew the bent part. If binding occurs due to rods or shaft being scored, it may be possible to recondition the scored part by using Crocus cloth. Inspect the shifter fingers (forks) (33) and selector fork (41) and renew them if they show signs of contact at points other than the contact pads. Inspect the interlock (40) for flat spots or signs of scoring and renew if necessary.

67. When reassembling, use new seal (52) and Welch plugs and proceed as follows: Place the selector shaft oil seal (52) in its bore and drift into position using a socket of proper size. Start the selector shaft in its bore and place the selector fork (41) and snap ring (46) on shaft. Install Woodruff key in its slot then slide selector shaft (42) into place and position snap ring in its groove. Start a shifter rod (34) in the bore farthest (opposite) from the interlock plug and be sure the end with the two grooves is toward the detent end of shifter cap. Place a shifter finger (fork) (33) over shifter rod so that the recess in shifter finger will engage selector fork (41). Note: The shifter fingers (forks) and shifter rods are identical and can be interchanged. Position parts and align the center groove in the shifter rod (34) with the tapped hole in the shifter finger (33), then secure shifter finger with the drilled head cap screw (32). Install the interlock and tighten socket head screw (39). Install the other shifter rod (34) and shifter finger (33) in the same manner as the first was installed, then install lockwires (31) in the drilled head cap screws (32) and the holes provided in the shifter fingers (33). Place the detent balls (43) and springs (44) in their bores and install the detent caps (45). Install new Welch plugs.

Use a new gasket and install shifter cap assembly to gear case and make sure the shift fingers engage the shift collars. Reinstall Sherman Transmission to tractor transmission as in paragraph 65 and rejoin tractor by reversing procedure outlined in paragraph 61.

68. **CLUTCH SHAFT.** With tractor separated (split) as outlined in paragraph 61, and the unit drained, the clutch shaft (23—Fig. FO36 can be removed by unbolting the support assembly (29) and pulling the support assembly and clutch shaft from the gear case. Remove the roller bearing (22) and the thrust washer (21) from the pilot end of drive shaft (10). Remove the three socket head screws (58) from front support (29) and remove the clutch shaft assembly from support. Remove the snap ring (25) and press ball bearing (24) from clutch shaft. Remove oil seal (26) from front support using an Owatonna No. 956 bearing puller and slide hammer, or its equivalent.

Wash all parts in a suitable solvent and check the ball bearing (24) and roller bearing (22) for rough spots, flat spots, freedom of movement or other signs of wear. Check clutch shaft (23) for chipped teeth, cupping of the pilot bore, scoring or other signs of wear or damage. Check thrust washer (21) for scoring or undue wear. Renew parts as needed.

When reassembling use new oil seal (26) in front support (29). Press bear-

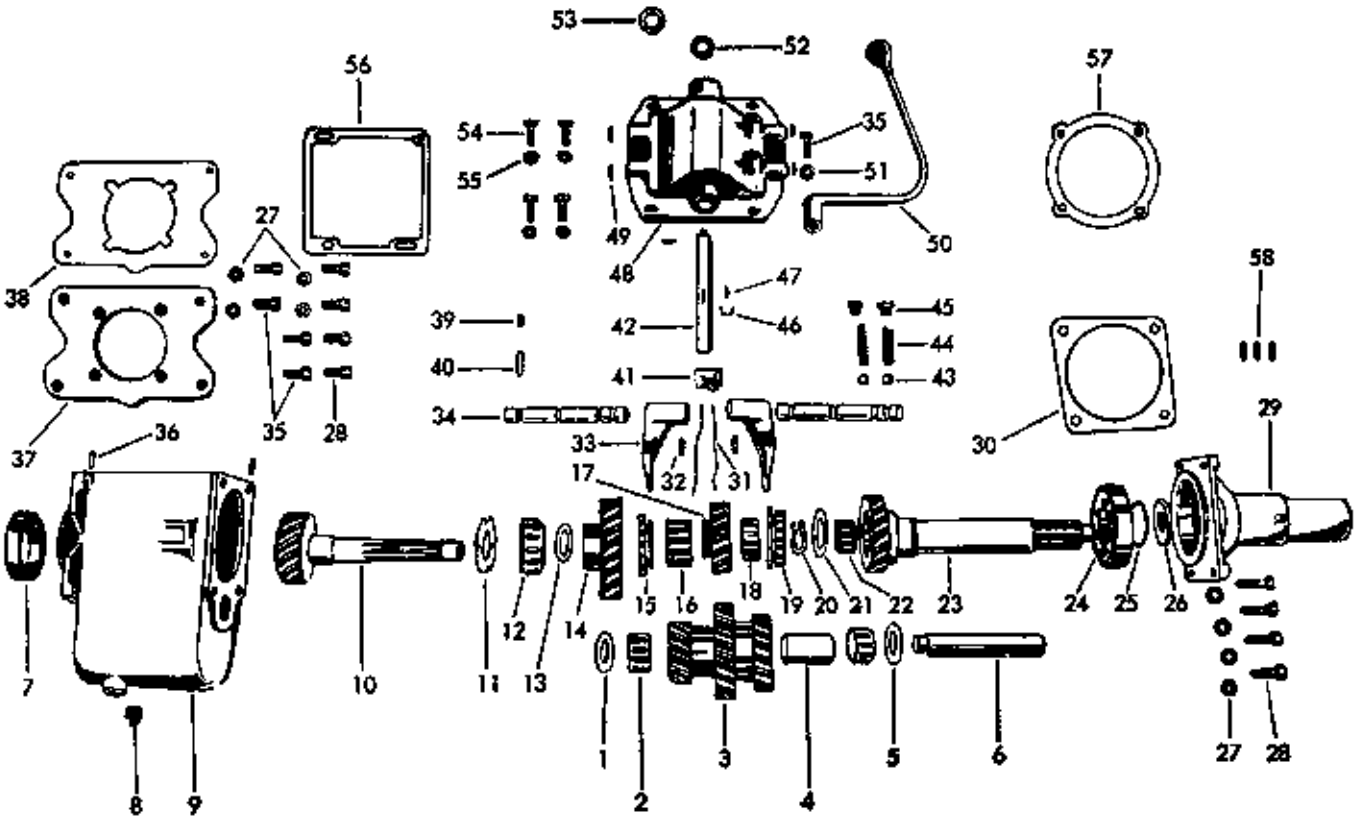


Fig. FO36—Exploded view of the Sherman transmission showing the component parts.

1. Thrust washer
2. Bearing
3. Cluster gear
4. Bearing spacer
5. Thrust washer
6. Cluster shaft
7. Bearing cup
9. Gear case
10. Drive (output) shaft
11. Oil slinger
12. Bearing
13. Gear washer
14. Step down gear
15. Rear shift collar
16. Spline sleeve, long
17. Step-up gear
19. Spline sleeve, short
19. Front shift collar
20. Snap ring
21. Thrust washer
22. Needle bearing
23. Clutch (input) shaft
24. Ball bearing
25. Snap ring
26. Oil seal
29. Support assembly
32. Drilled set screw
33. Shifter finger
34. Shifter rod
36. Dowel
37. Mounting flange
38. Flange gasket
40. Interlock
41. Selector fork
42. Selector shaft
43. Detent balls
44. Detent spring
45. Detent cap
46. Snap ring
47. Woodruff key
48. Shifter cap
49. Welch plugs
52. Seal
53. Rubber grommet
57. Shim (0.005, 0.012)

ing (24) on clutch shaft and secure with snap ring (25). Install the clutch shaft and bearing in the front support and secure with the three socket head screws (58). Note: Use caution when inserting shaft into support to avoid damaging oil seal. Fill unit with proper lubricant. Place the thrust washer (21), then the roller bearing (22) on the pilot end of drive shaft (10) and, using a new gasket, install the front support and clutch shaft assembly after making certain that the oil return hole in front support is on the bottom.

With unit reassembled, rejoin engine and transmission housing.

69. **DRIVE SHAFT.** With the Sherman Transmission removed as outlined in paragraph 65, remove shifter cap assembly as in paragraph 66 and the front support and clutch shaft assembly as in paragraph 68. Refer to Fig. FO36 and remove snap ring (20) from drive shaft (10); then remove front shift collar (19), short spline sleeve (18), step-up gear (17), rear shift collar (15), long spline sleeve (16), step-down gear (14) and washer (13) from drive shaft (10). NOTE: Identify shift collars (15 & 19) so they can be reinstalled in their proper positions. Pull the drive shaft (10), oil slinger (11) and taper bearing (12) from rear of gear case; then, using a suitable press or puller, remove the taper bearing and oil slinger from the drive shaft. Remove bearing cup (7) from gear case, if necessary.

Clean all parts in a suitable solvent and inspect the taper bearing (12) for rough spots, freedom of movement or other signs of wear. Inspect all drive shaft gears for erratic wear patterns, damaged teeth or splines, cupping, overheating on the gear end faces or scoring of inside diameters and renew as necessary.

Reinstall drive shaft as follows: Place oil slinger (11) on drive shaft and then press on the taper bearing. Place shaft and bearing in gear case and install parts as follows: Install gear washer (13) and step-down gear (14) with hub of gear facing rearward. Install long spline sleeve (16), then position the rear shift collar (15) with teeth toward rear. Install step-up gear (17) with the shift collar engaging teeth rearward. Install the short spline sleeve (18), then position the front shift collar (19) with engaging teeth toward front. Now install snap ring (20). Install the shifter cap assembly.

Note: With the drive shaft assembly and the shifter cap assembly installed, a bearing pre-load must be established in the Sherman Transmission as follows:

70. Remove mounting flange (37) and install approximately 0.050 of shims (57) behind the mounting flange as shown in Fig. FO35. Be sure flat side of mounting flange is at top and reinstall the flange. Shims are avail-

Fig. FO37—View showing clutch shaft and support assembly removed from gear case. Note thrust washer.

Fig. FO38—Clutch shaft and bearing assembly can be removed from front support after loosening Allen screws in support.

Fig. FO39—View showing drive (output) shaft partially disassembled. Note the position of the long and short spline sleeves.

able in thicknesses of 0.007 and 0.012. Position new mounting flange gasket (38) and install the Sherman Transmission; at which time, the drive shaft (10) should have some end play. Now, remove shims (57—Fig. FO36) from behind mounting flange until drive shaft has zero end play, then remove one 0.007 thick shim to preload the drive shaft bearing.

71. Fill unit with specified lubricant and install the clutch shaft assembly as outlined in paragraph 68, then, rejoin engine and transmission housing.

72. **CLUSTER GEAR AND SHAFT.** Remove the Sherman Transmission from tractor as in paragraph 65 and the shifter cap, clutch shaft and drive shaft assemblies as outlined in paragraphs 66 through 69. Refer to Fig. FO36 and drift cluster shaft (6) toward rear of gear case and catch cluster gear (3) and thrust washers (1 & 5) as shaft is driven out. Remove the roller bearings (2) and the spacer (4) from the inside diameter of cluster gear (3).

Check cluster gear for chipped teeth, cupping of end faces, signs of overheating and wear of inside diameter. Check roller bearings for flat spots and freedom of movement or other signs of wear. Check cluster shaft for pitting, scoring or wear of outside diameter. If wear or damage is found on any of the above parts, it is recommended by the Ford Motor Company that the cluster shaft, gear and bearings be renewed as an assembly.

Reassembly is evident; however, keep in mind that the larger of the two end gears of the cluster gear is toward the front of the gear case. Reassemble the balance of the transmission as outlined in paragraphs 66 through 69 and reinstall in tractor as outlined in paragraph 65.

TRANSMISSION

REMOVAL

75. To completely overhaul the transmission, it is first necessary to remove the unit as follows: Drain transmission and hydraulic system and, to aid in reassembly of transmission to center housing, drain rear axle center housing and remove power take-off shaft. Split engine from transmission as outlined in paragraph 61.

76. Remove power take-off shifter control from left side of rear axle center housing; then, remove the step plates, brake and clutch linkage. Block up the rear axle center housing and unbolt same from transmission. Separate transmission and rear section and place the transmission on bench or stand.

OVERHAUL

77. **SHIFTER RAILS AND FORKS.** Rails and forks may be removed without splitting the transmission from the engine, but the transmission top cover must be removed and the rear axle center housing must be separated from transmission case as outlined in paragraph 76. Lift out the top shifter rail spring (25—Fig. FO45) and detent ball (24), loosen lock nut (21), back off shifter fork lock screw (22) and remove shifter rail and fork. Remove shift plate pivot screws (10) from both sides of transmission housing and remove shift plates.

78. To remove the second and fourth gear shift fork (12) and rail (13), first remove the spring seat (6), gasket (7), spring (8) and detent ball (9) from right side of transmission housing. Then, loosen lock nut (14), back-out screw (15) and slide shift rail out to rear. Remove fork out top opening.

79. Reverse shift fork (16) and rail (19) may be removed after first removing spring seat (43), gasket (42), spring (41) and detent ball (40) from left side of transmission housing. Then, loosen lock nut (17), back out screw (18) and slide rail out to rear. Remove fork (16) out top opening.

Renew worn or damaged parts and reinstall shifter rails and forks in reverse of removal procedure. The square cornered slots in lower shift rails must face inward.

80. **MAIN DRIVE GEAR.** (Clutch Shaft on models without Sherman Transmission.) This gearshaft (6—Fig. FO46) may be removed after transmission and engine are separated as in paragraph 61. However, if adjustment of the shaft bearings is required, it will be necessary to perform the rear section split as outlined in paragraph 76 to gain access to the adjustment shims. Remove gearshaft and retainer (1) as a unit. Refer also to Fig. FO47.

Renew worn or damaged parts and reassemble. Coat shaft with oil and rotate same when assembling it to the retainer so as to avoid damaging the oil seal. Lip of seal (3—Fig. FO46) should face towards rear. After shaft is reinstalled, adjust end play as per paragraph 82. However, if the

mainshaft is not being overhauled, end play of zero to 0.002 can be tolerated.

81. **MAIN (OUTPUT) SHAFT.** To remove this shaft (18—Fig. FO46), first remove transmission from tractor as per paragraphs 75 and 76. Also remove the top shifter rail and fork and shift plates as per paragraph 77.

Then remove mainshaft rear bearing retainer (21) and the adjusting shims. Remove clutch shaft (main drive gear) and retainer (1) as a unit or remove Sherman transmission on models so equipped. It may be necessary to slide the second and fourth gear fork (12—Fig. FO45) and reverse gear fork (16) forward to provide clearance. Lift out the mainshaft and gear cluster as a unit. Disassemble and renew worn or damaged parts including the oil seal. Refer to Fig. FO46 as a guide for reassembly.

Before installing the main shaft, it is advisable to check the countershaft preload as shown in Fig. FO49. Desired preload of 15-30 inch lbs. is controlled by shims (36—Fig. FO46) located between the pto support and rear face of transmission.

Reinstall the mainshaft assembly, clutch shaft (main drive gear) and retainer or Sherman transmission on models so equipped to the transmission by reversing the removal procedure. Move shifter forks to neutral position and check the adjustment of the main shaft bearings. If a scale is not available, adjust bearings to a very slight preload. If a scale is available, check and adjust the bearings as per paragraph 82.

82. To test mainshaft bearing adjustment, rotate rear end of mainshaft with transmission in neutral and measure turning torque as shown in Fig. FO48. If torque is 20 to 35 inch pounds measured with shaft in motion, bearing adjustment is correct. Vary the number of shims (20—Fig. FO46) under rear bearing retainer to obtain this adjustment.

Note: If the countershaft preload is on the low side of specifications given, the mainshaft preload should also be on the low side. The reverse is also true. Tighten the rear bearing retainer cap screws to a torque of 25-30 Ft.-Lbs.

83. **COUNTERSHAFT.** This shaft (32—Fig. FO46) can be removed after removing mainshaft as outlined in paragraph 81 and the second and fourth gear shift fork and rail as outlined in paragraph 78. Remove the power take-off bearing support (38) at rear end and bearing carrier (23) from front end of transmission housing. Remove the countershaft and gears as a unit through top opening of transmission housing.

Note: The countershaft second gear (31) obtained as a service part may have one less tooth than the old gear removed from the transmission. However, it is completely interchangeable and there is no need to renew the mainshaft second gear (10) unless otherwise necessary.

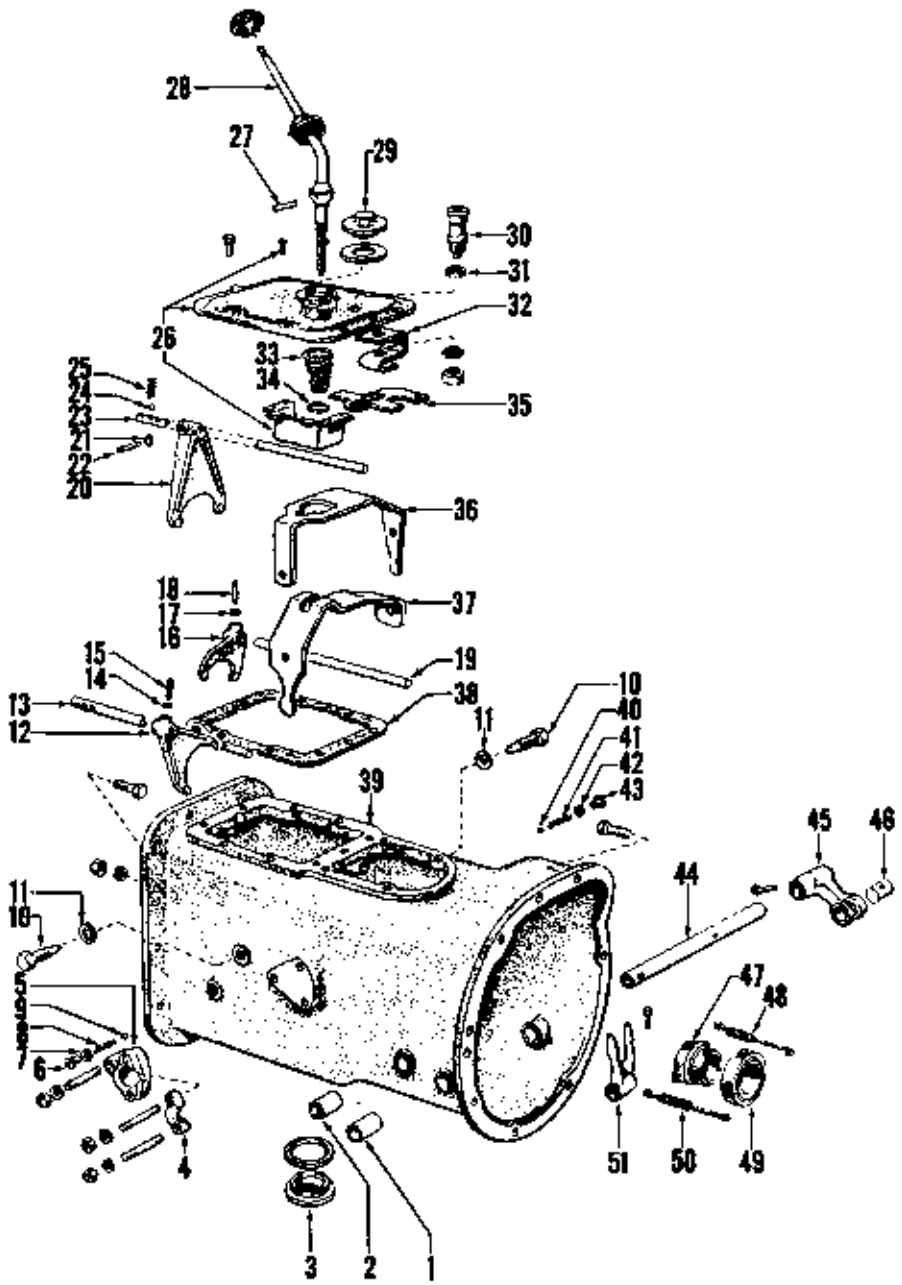


Fig. FO45—Exploded view of transmission gear shifting mechanism, transmission housing and related parts. Reverse shift fork (16) is different than shown above; refer to Fig. FO52.

1. Clutch shaft bushing
2. Brake shaft bushing
3. Drain plug
4. Radius rod cap
5. Radius rod socket
6. Detent spring seat
7. Gasket
8. Spring
9. Detent ball
10. Shift plate pivot
11. Gasket
12. 2nd & 4th shift fork
13. 2nd & 4th shift rail
14. Lock nut
15. Lock screw
16. Reverse shift fork
17. Lock nut
18. Lock screw
19. Reverse shift rail
20. 1st & 3rd shift fork
21. Lock nut
22. Lock screw
23. 1st & 3rd shift rail
24. Detent ball
25. Spring
26. Shift cover assy.
27. Pin, shift lever
28. Shift lever
29. Filler plug
30. Starter switch
31. Gasket
32. Starter switch support
33. Spring
34. Spring seat
35. Starter safety latch
36. Reverse shift plate
37. 2nd & 4th shift plate
38. Gasket
39. Transmission housing
40. Detent ball
41. Spring
42. Gasket
43. Detent spring seat
44. Clutch shaft
45. Clutch lever
46. Pin
47. Clutch bearing hub
48. Clutch release spring
49. Clutch release bearing
51. Clutch release fork

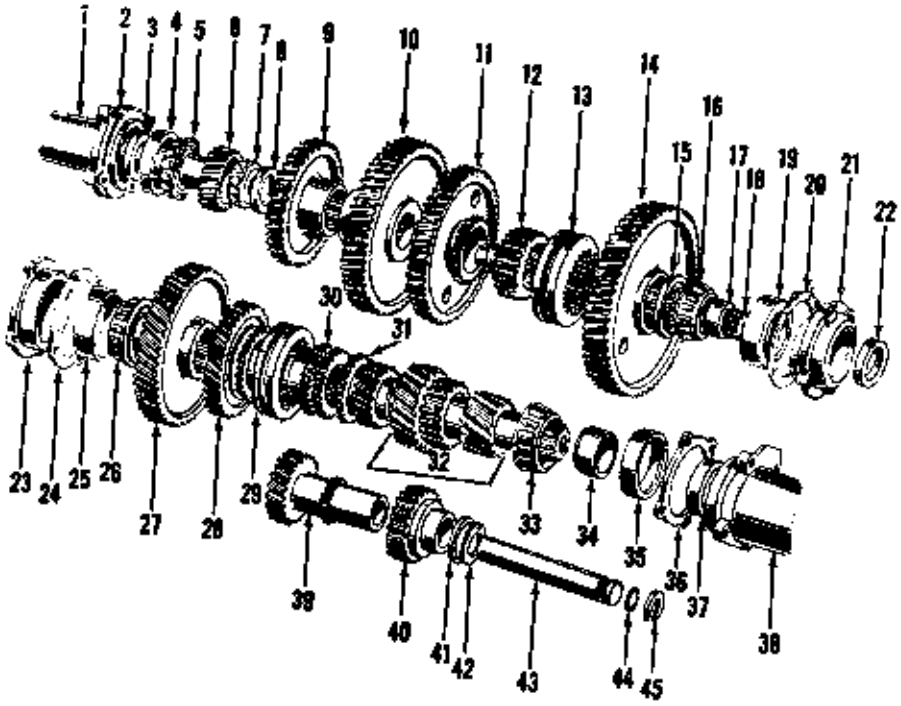


Fig. FO46—Exploded view of transmission gears and shafts.

1. Input shaft housing*
2. Gasket*
3. Shaft seal*
4. Bearing cup*
5. Bearing cone*
6. Main drive gear (input shaft)*
7. Pilot bearing
8. Washer
9. Mainshaft 4th gear
10. Mainshaft 2nd gear
11. Mainshaft 3rd gear
12. Connector
13. 1st/3rd coupling
14. Mainshaft 1st gear
15. Thrust washer
16. Rear bearing
17. Oil seal sleeve
18. Main shaft
19. Bearing cup
20. Shim pack
21. Bearing retainer
22. Oil seal
23. Countershaft front bearing retainer
24. Gasket
25. Bearing cup
26. Countershaft front bearing
27. Countershaft drive gear
28. Countershaft fourth gear
29. 2nd/4th coupling
30. Connector
31. Countershaft 2nd gear
32. Countershaft
33. Rear bearing
34. Oil sleeve
35. Bearing cup
36. Shim pack
37. Oil seal
38. Pto shifter support
39. Reverse idler
40. Reverse idler gear
41. Thrust washer
42. Thrust washer
43. Reverse idler shaft
44. "O" ring
45. Retainer

*Not used on models with Sherman transmission.

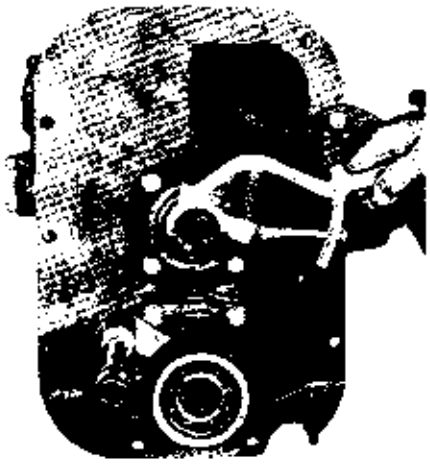


Fig. FO48—Desired adjustment of mainshaft bearings is 20-35 inch pounds torque to rotate the shaft.

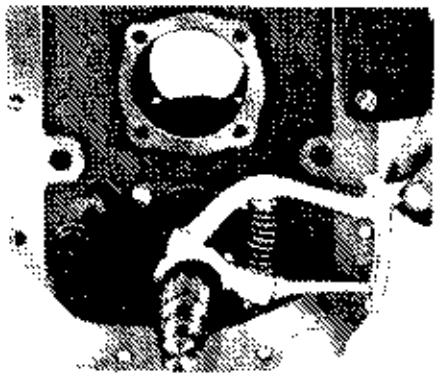


Fig. FO49—Desired adjustment of countershaft bearings is 15-30 inch pounds to rotate the shaft when mainshaft is out of the transmission.

Renew any worn or damaged parts including the oil seal in the pto shifter support and reassemble as shown in Fig. FO46. Reinstall the assembly and adjust bearings by means of shims (36) to obtain a bearing preload of 15-30 inch pounds torque to rotate shaft. Shaft can be rotated for checking bearing adjustment by inserting the pto shaft in shifter unit as shown in Fig. FO49.

84. **REVERSE IDLER GEARS.** These gears (39 and 40—Fig. FO46) can be removed after the countershaft is removed as outlined in paragraph 83 and the reverse fork and rail are removed as outlined in paragraph 79. Pull idler shaft (43) out to rear and remove gears and washers (41 and 42) out top opening of transmission. Reverse idler gear (39) has two renewable bushings. The idler driven gear (40) rotates on the idler gear (39). Rebush gear (39) or renew parts as necessary and reinstall as follows:

Assemble driven gear (40) on idler

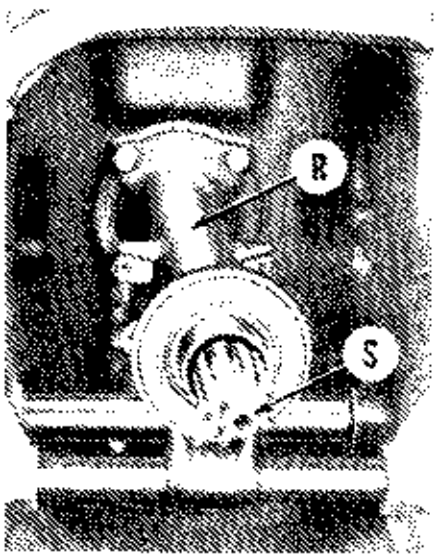
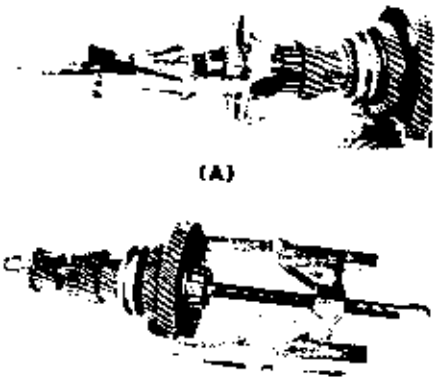


Fig. FO47 — Front view of transmission showing main drive gear (clutch shaft) "S" and bearing retainer "R" which can be removed without detaching (splitting) at the rear axle center housing.



(A)

(B)

Fig. FO51—Using a puller to disassemble the removed countershaft assembly. (A) Pull the rear bearing cone and oil seal sleeve from rear end of shaft. (B) Pull the countershaft drive gear and front bearing cone from front end of shaft and slide off fourth gear, second and fourth gear connector and the countershaft second gear.

gear and place gears and thrust washers (41 and 42) in transmission making certain that the tang on washer (42) fits in recess in transmission housing and oil grooves in washer (41) face to rear. Install "O" ring (44) and retainer ring (45) on reverse idler shaft and slide shaft into transmission through thrust washers and idler gears.

PTO BEARING SUPPORT AND SHIFTER UNIT

For information on overhaul of the pto bearing support and shifter unit, refer to paragraph 96.

Fig. FO52—View of reverse idler gears, shaft, shift fork and shift rail installed in transmission case. Note position of notch in shift rail.

DIFFERENTIAL, BEVEL GEARS AND REAR AXLE

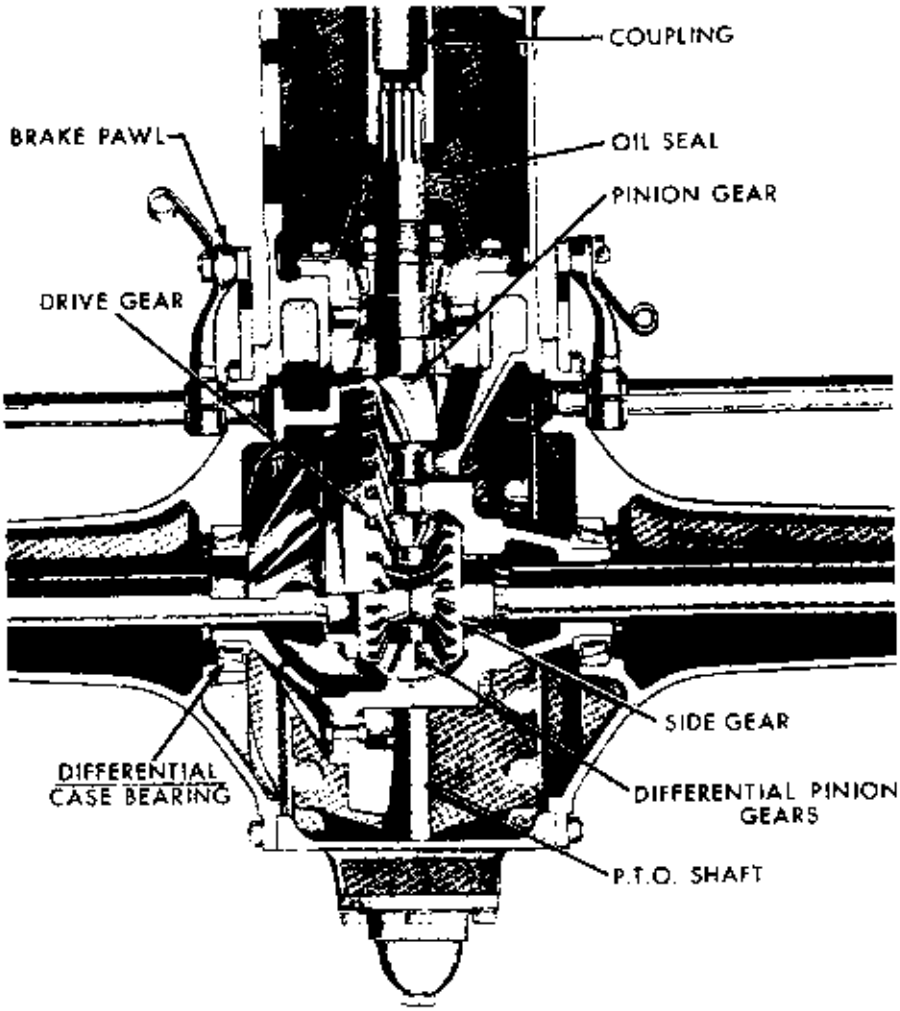


Fig. FO55 — Cross-section view of final drive unit. For exploded view of main drive bevel pinion and differential assembly, refer to Fig. FO56.

DIFFERENTIAL

85. **REMOVE AND REINSTALL.** To remove the differential unit, first drain the rear axle center housing (rear drain plug). Block up under the center housing to raise the rear wheels. Remove the left rear wheel and disconnect the left brake linkage, left hydraulic lower lift arm at axle housing and wire to tail light. Unbolt the left axle housing from the center housing and move the housing and axle assembly away from the tractor. Withdraw the differential unit from the center housing.

When reinstalling the axle housing, use only one standard gasket between the axle housing and center housing to obtain correct adjustment of differential carrier bearings.

86. **OVERHAUL.** Remove the differential assembly as outlined in paragraph 85. Check the differential case at parting line for correlation marks and mark both case halves if no mark is present. Remove the eight bolts (17—Fig. FO58) and separate the two halves. Remove spider, differential pinions and thrust washers. Remove the two side gears and thrust washers.

Inspect thrust surfaces and holes for spider shafts in differential case halves; renew differential case if thrust surfaces are excessively worn or scored or if holes for spider pinion shafts are elongated. Renew spider, pinion gears, axle side gears or thrust washers if excessively worn, scored or broken.

Note: On original production spider (22—Fig. FO56), ends of spider pinion shafts were flush with surface of differential case. To reduce the possibility of extensive damage to differential and center housing in case of spider breakage, later service spider has shorter pinion shafts and outer ends of holes for spider in the differential case are partially closed. Thus, in case of spider breakage, the broken parts are held in the differential case. If reinstalling either an original production type spider or differential case, it is suggested that 1/8-3/16 inch be ground off of the ends of the spider pinion shafts and that the holes in the differential case be staked with a center punch to close holes slightly over ends of spider.

Check the differential carrier bearings and renew if required. If bearing cups are to be renewed, both axle housings must be off the tractor and

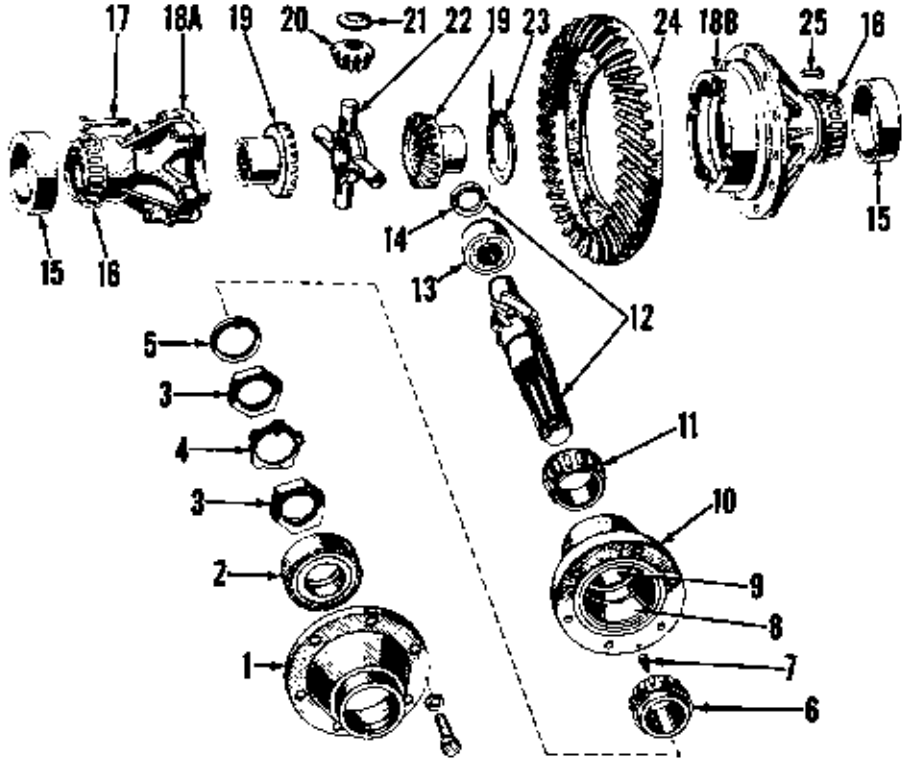


Fig. FO56 — Exploded view of main drive bevel pinion, ring gear and differential assembly.

1. Seal support
2. Pinion seal
3. Adjusting nuts (2)
4. Locking washer
5. Thrust washer
6. Front bearing cone
7. Dowel pin
8. Front bearing cup
9. Rear bearing cup
10. Bearing support
11. Rear bearing cone
12. Bevel pinion assy.
13. Pilot bearing
14. Snap ring
15. Carrier bearing cup
16. Carrier bearing cone
17. Special cap screws (8)
18A & B. Differential case
19. Axle side gears
20. Spider pinion gears (4)
21. Thrust washers (4)
22. Spider
23. Thrust washer (2)
24. Bevel ring gear
25. Rivets (or bolts)

the axle shafts removed from their housings to provide clearance for removing the bearing cups.

When reassembling the differential unit, check prefix of casting number on left hand side of differential case. If the prefix is "NAA", tighten the cap screws (17) to a torque of 80-90 Ft.-Lbs.; if the prefix is "NCA", tighten the cap screws to a torque of 90-100 Ft.-Lbs. Install locking wire if cap screw heads are drilled.

Inspect ring gear teeth for excessive wear, chipped teeth or metal flaking. If necessary to renew ring gear, refer to caution preceding paragraph 87 and proceed as follows: To remove ring gear when riveted to differential case, center punch and drill through rivet heads on ring gear side of asembly using a 7/16-inch drill. Then, press rivets out and remove gear from case. Both rivets and special bolts are available for service installation of ring gear. To install ring gear using rivets, insert rivets from differential case side of assembly and upset ring gear end of rivets cold in a high capacity press. Upset ends of rivets must not be more than 0.06 above flat surface of ring gear. If special bolts and nuts are used, insert bolts from ring gear side of assembly, tighten the nuts to a torque of 90-110 Ft.-Lbs. and install cotter pins.

Note: The differential assembly is not available for service as a complete unit; component parts must be obtained and assembled to renew the complete differential. However, it is possible to obtain a differential assembly for the later Ford Series 600 and 601 tractors and adapt the assembly for use in an NAA tractor by removing the axle side gears and installing NAA axle side gears (19).

MAIN DRIVE BEVEL GEARS

CAUTION: Effective with tractor Serial No. NAA-44482, the gear tooth pressure angle of the main drive bevel gears (ring gear and pinion) was changed from 20° to 25° in production. Only the 25° pressure angle gears are available for service and they may be identified by a "25 PA" stamped into the splined end of the pinion and the flat face on the tooth side of the ring gear. Although matched main drive bevel gear sets are not available, gears with teeth of same pressure angle must be installed.

87. **BEVEL PINION.** To remove the main drive bevel pinion, first remove the differential unit as outlined in paragraph 85; then, proceed as follows: Drain the hydraulic system, remove PTO output shaft assembly and remove the hydraulic lift cover as outlined in paragraph 121. Remove the power take-off shifter cover, the hydraulic pump to center housing tubes and, if so equipped, the live power take off pump suction and pressure tubes. Disconnect rear light wiring harness. Place wooden wedges between front axle and front axle support, place floor jack under transmission and remove the bolts retaining transmission to center housing. The front unit may then be rolled away from the center housing. Remove cap screws retaining the bevel pinion bearing carrier to center housing and remove the oil seal retainer. Bump or pull bevel pinion shaft assembly out to front. Be careful not to lose the stepped dowel pin (7—Fig. FO56) that locates pinion bearing support to center housing.

Note: After removing differential unit, condition of bevel pinion may be checked by turning pinion. Also closely inspect center housing around area of bevel pinion pilot bearing. If center housing is damaged, follow procedure as outlined in paragraph 89 to renew center housing instead of procedure outlined in preceding paragraph.

To disassemble the removed pinion shaft assembly, refer to Fig. FO56 and proceed as follows: Straighten tabs of washer (4) and remove adjusting nuts and washers from pinion shaft. Press pinion shaft out of bearing support and front bearing cone (6). Pull rear bearing cone (11) from shaft. Remove snap ring (14) and pull pilot bearing (13) from shaft. Inspect and renew parts as necessary.

Reverse disassembly procedures to reassemble. Use new locking washer (4) and adjust bearing preload with nuts (3) so that 12-16 inch-pounds torque is required to turn shaft in bearings. Bend tabs down over adjusting nuts to secure nuts. Reinstall pinion shaft assembly in center housing and reassemble tractor.

88. **BEVEL RING GEAR.** To renew the bevel ring gear, follow procedure outlined in paragraph 86. Refer to caution preceding paragraph 87.

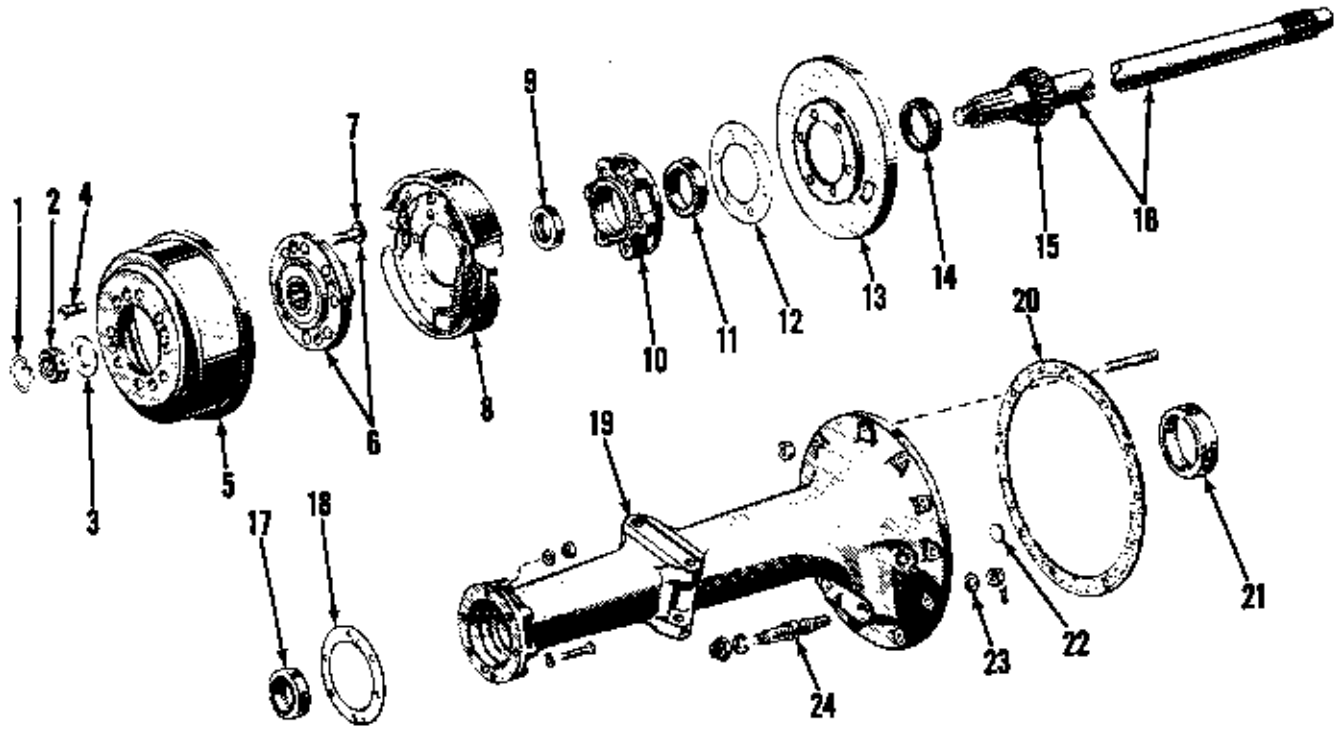


Fig. FO60—Exploded view of rear axle assembly. Bearing (15) is packed with multi-purpose grease. Seal (17) prevents differential lubricant from diluting grease. Seal (9) seats on rear wheel hub (6) and cork seal (14) is required to seal hub to axle.

1. Locking ring
2. Axle nut
3. Washer
4. Screws
5. Brake drum
6. Wheel hub
7. Wheel bolts
8. Brake assembly
9. Outer seal
10. Bearing retainer
11. Bearing cup
12. Shims (2)
13. Brake backing plate
14. Cork seal
15. Bearing cone
16. Axle
17. Inner seal
18. Shim pack
19. Axle housing
20. Gasket
21. Differential carrier bearing cup
22. Weish plug
23. Nut
24. Draft link pivot pin

DIFFERENTIAL CENTER HOUSING

89. **REMOVE AND REINSTALL.** To remove the differential center housing, proceed as follows: Drain hydraulic system and differential lubricant. Unbolt and withdraw PTO shaft assembly. Disconnect hydraulic pump pressure and suction lines from bottom of center housing. (If equiped with a live power take-off clutch, remove PTO pump suction and pressure lines.) Remove PTO shift lever and cover assembly. Disconnect brake linkage and remove both step plates. Remove hydraulic lift cover as outlined in paragraph 121. Place wood wedges between the front axle and front support on each side. Remove differential unit as outlined in paragraph 85. Remove right rear wheel and disconnect lower right lift arm from axle housing. Unbolt and remove right axle housing assembly from the differential center housing. Move support from under center housing to below transmission; then, unbolt and remove center housing from transmission.

Remove cap screws retaining main drive bevel pinion bearing support to center housing and remove bevel pinion seal support and seal assembly. Bump or pull bevel pinion and bearing support assembly out to front. Be careful not to lose the stepped dowel pin (7—Fig. FO56) that locates pinion bearing support to center housing.

Reverse removal procedures to install center housing. If new housing is being installed, transfer hydraulic back pressure valve, relief valves, top link rocker, etc., from old housing or install new parts. Install only one standard thickness gasket between the center housing and each rear axle housing to obtain correct differential carrier bearing adjustment.

WHEEL AXLES, BEARINGS, SEALS AND HOUSING

90. **BEARING ADJUSTMENT.** To check wheel axle shaft bearing adjustment, jack up rear end of tractor and remove rear wheels and brake drums. Thread a long screw through a brake drum retaining screw hole in one of the wheel hubs and tighten the screw against the brake anchor plate to remove all end play from that axle. Check end play of opposite axle with a dial indicator or by threading a long screw through the wheel hub and checking end play with a feeler gage inserted between end of screw and brake anchor plate. Desired end play is 0.002-0.006.

91. To adjust end play, add or remove shims (18—Fig. FO60) between axle housing and brake backing (dust) plate to obtain desired end play of 0.002-0.006. Shims are available in thicknesses of 0.009, 0.016 and 0.021.

To change thickness of shim stack, disconnect brake rod, remove the nuts and cap screws retaining axle assembly to outer end of axle housing, and carefully withdraw the axle assembly to avoid damaging seal (17). (Seal can be renewed at this time if necessary.) Place the corrected shim stack on the four bolts extending through the brake backing plate and carefully reinstall axle through axle inner seal.

Note: Two shims (12) are placed between the brake backing plate (13) and outer bearing retainer (10) in lieu of a gasket at this location. Production installed shims at both (12) and (18) are varnished before installation to improve sealing of axle assembly. It is recommended that a light coat of gasket sealer be applied to shim surfaces when servicing the rear axle assembly.

92. **RENEW AXLE SHAFT, BEARINGS AND/OR SEALS.** To renew a wheel axle shaft, bearing and/or seals, proceed as follows: Remove locking ring (1—Fig. FO60) and loosen axle nut (2). Jack up rear end of tractor and remove rear wheel and brake drum. Remove axle nut and, using a suitable puller, remove hub (6). Remove the two cap screws from brake anchor plate and the four nuts and washers from axle housing side of assembly; then, remove brake unit (8). Remove the two cap screws from axle housing side of assembly and remove bearing retainer (10) and axle shaft.

Inspect seal contact surfaces on hub and axle and remove any burrs, rust or roughness. Inspect bearing cone on axle and bearing cup in retainer and renew if necessary. It is usually good service procedure to renew the seals (9) and (17). Always renew the cork spacer (14).

Note: If wheel hub (6) was loose on axle splines before disassembly and splines are worn, both the hub and axle shaft must be renewed to correct the difficulty. Experience has shown that shimming of splines, or renewal of hub only, will not satisfactorily correct this problem.

To reassemble, proceed as follows: Drive inner seal (17) into axle housing with lip facing inward. Drive bearing cone (15) tightly against shoulder on axle shaft, lubricate seal (17) and carefully insert axle through seal and into side gear in differential. Drive bearing cup and outer seal (9) into bearing retainer with lip of seal towards bearing cup. Pack bearing with about 3-3½ oz. of multi-purpose grease. Apply light film of gasket sealer to shim surfaces and install shim stack (18), brake backing plate (13), two shims (12) and bearing retainer, securing these parts to axle housing with two long cap screws inserted through axle housing into bearing retainer. Attach brake assembly (8) to bearing retainer with two short cap screws and install the four bolts from brake anchor plate side of assembly. Place new cork spacer (14) on axle shaft and install hub, brake drum and rear wheel. Remove jack and tighten axle nut to a torque of 450 Ft.-Lbs., then install locking ring.

BRAKE SYSTEM

Bendix expanding shoe type brakes are used. Linings are bonded to brake shoes.

93. **ADJUSTMENT.** To adjust brakes, jack up rear end of tractor, remove adjusting screw cover (4—Fig. FO61) and turn adjusting screw (13) towards rear of tractor until the wheel cannot be turned by hand. Then, back off adjusting screw until wheel is free or only a slight drag can be felt. Repeat this procedure on opposite brake and adjust clevis on left brake pedal rod to equalize pedals.

94. **R&R BRAKE SHOES.** Jack up rear end of tractor and remove rear wheels and brake drums. Disconnect the shoe retracting springs. Note: Right hand brake uses only one retracting spring (9—Fig. FO61). Left hand brake uses two retracting springs (7 and 9). Spread brake shoes at front and remove shoes, adjusting screw and spring (11) as a unit.

Brake shoes and lining assemblies are available individually or in kit for one wheel only. (Two kits are required to renew both brakes.) One shoe and lining fits either R.H. upper or L.H. lower position; the other shoe fits either R. H. lower or L.H. upper position.

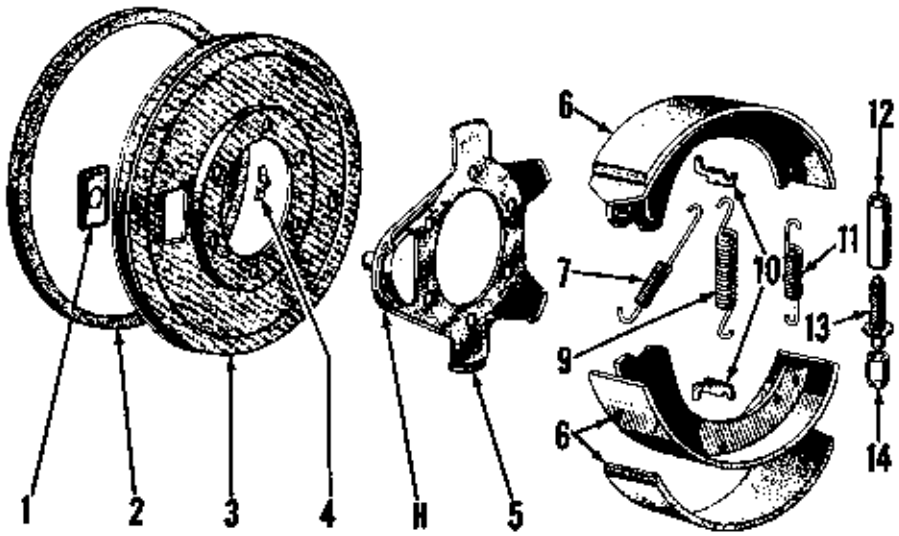


Fig. FO61—Exploded view of brake assembly. Spring anchors (10) fit in slots in brake shoes and brake retracting spring (9) hooks into notches in anchors. On left brake only, secondary retracting spring (7) hooks into upper spring anchor and hole (H) in anchor plate (5). Brake linings are bonded to shoes. Same brake backing plate (13) and anchor plate (5) are used in both R.H. and L.H. brake assemblies. Left brake assembly is shown; right brake is inverted.

1. Shaft hole cover
2. Felt dust seal
3. Backing plate
4. Adjusting hole cover
5. Anchor plate
6. Brake shoe assy.
7. Secondary retracting spring
9. Retracting spring
10. Spring anchors
11. Adjusting screw spring
12. Nut
13. Screw
14. Bucket

To reinstall brake shoes, hook adjusting spring into rear end of shoes and place adjusting screw in notches. Spread front end of shoes and install on anchor plate. Reinstall brake retracting springs (only one retracting spring used on R.H. brake) and spring anchors. Adjust brakes as outlined in paragraph 93 after reinstalling brake drums and rear wheels.

POWER TAKE-OFF

Model NAA tractors are equipped with a transmission driven type power take-off. Some NAA tractors are equipped with a field installed 'live power take-off' clutch in the drive line in front of the main drive bevel pinion. The clutch permits stopping ground travel without interrupting power to the PTO shaft. Refer to paragraphs beginning with 100 for information on the clutch.

OUTPUT SHAFT

95. To remove the output shaft assembly, first drain the hydraulic system and differential lubricant. Then, remove the cap screws (11—Fig. FO63) retaining cover (10) to center housing and withdraw the shaft assembly.

Note: If shaft is broken, it may be necessary to split the tractor between the transmission and center housing as outlined in paragraph 96 to remove remainder of shaft.

Rear oil seal (7) may be renewed as follows: Remove front snap ring (4) and pull cover (bearing support) (10) from bearing and shaft. Remove rear snap ring (8) and press seal from cover. Reverse removal procedures to install new seal. Inspect sleeve (8) and remove any burrs or rough spots before reassembling.

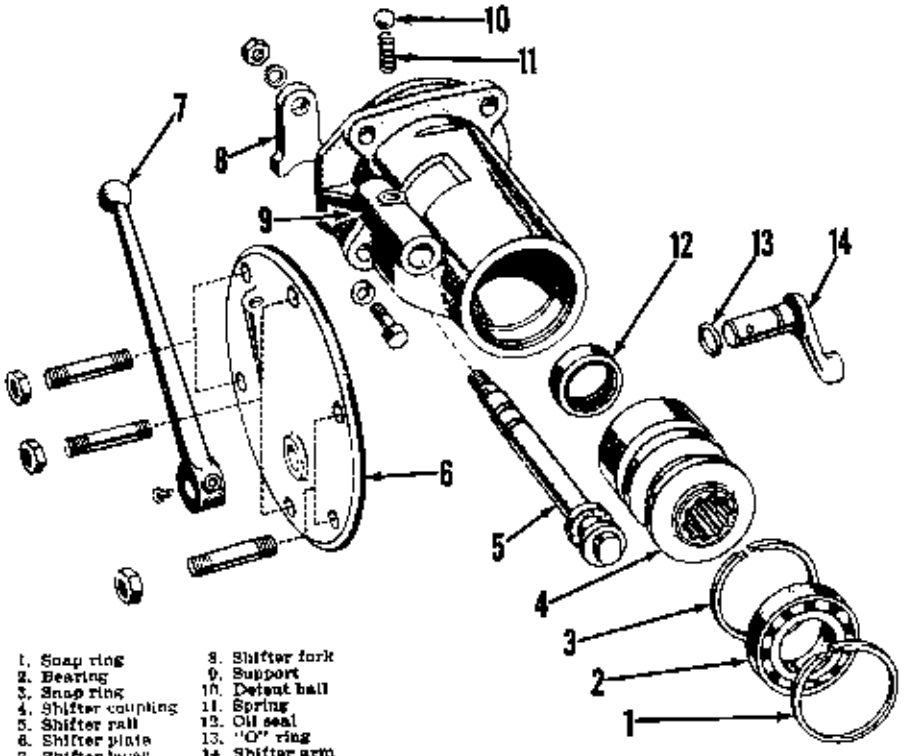
Rear bearing (5) may be renewed while cover (10) is removed from shaft. Split the sleeve (8) with a sharp cold chisel and pull bearing and sleeve from shaft. Press new bearing on shaft; then, heat new sleeve evenly until color turns to blue and drop sleeve on shaft against bearing. After sleeve is cool, remove any scale or rough spots to avoid damage to seal (7).

To renew the shaft center thrust bushing (2) and/or seal (1), the tractor must be split between the transmission and center housing as outlined in paragraph 96. Bushing and seal are pressed into the wall dividing the hydraulic sump and differential compartment.

Reverse removal procedure to reinstall PTO shaft assembly.

SHIFTER UNIT

96. To overhaul the PTO shifter and front bearing support unit, it will be necessary to split the tractor between the transmission and center housing as follows: Remove the power take-off shaft assembly as outlined in paragraph 95, and if shifter unit is to be removed from rear face of transmission, drain the transmission lubricant. If equipped with a live power take-off clutch, refer to paragraph 110. Disconnect the tail light wire and unbolt hydraulic pump suction and pressure lines from center housing. Remove both step plates and the PTO shift lever and cover assembly. Place wood wedges between front axle and front axle support. Block up under transmission and place floor jack under front end of center housing. Unbolt center housing from transmission, separate tractor and roll rear section away.



1. Snap ring
2. Bearing
3. Snap ring
4. Shifter coupling
5. Shifter rail
6. Shifter plate
7. Shifter lever
8. Shifter fork
9. Support
10. Detent ball
11. Spring
12. Oil seal
13. "O" ring
14. Shifter arm

Fig. FO62—Exploded view of pto shifter mechanism and front bearing support. Support (9) also functions as transmission countershaft rear bearing support.

97. Except for renewing seal (12—Fig. FO62) or support (9), the PTO shifter unit can be serviced without removing the support from rear face of transmission. To remove bearing (2), remove snap ring and pull bearing from support. To remove shifter collar (4), first remove hex nut from shift rail (5) and withdraw rail from support and fork (8). Take care not to lose the detent ball (10). Then, remove snap ring (1), bearing (2) and front snap ring (3) and withdraw collar from support.

98. To renew support and/or seal, remove the four retaining cap screws and pull support from rear face of transmission. Be careful not to lose or damage shims located between support and transmission housing. Remove the shifter parts from the support as outlined in paragraph 97 and drive or pull seal and bearing cup from support. Press new seal into support and reinstall bearing cup.

Lubricate lips of seal with Lubriplate or similar grease and carefully reinstall support with same number of shims as were removed. Tighten retaining cap screws to a torque of 25-30 Ft.-Lbs.

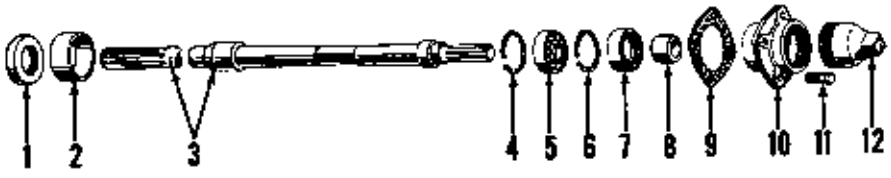


Fig. FO63—Components of pto output shaft assembly. View also shows shaft front seal (1) and support bushing (2) which are a part of the differential center housing assembly.

1. Oil seal
2. Bushing
3. Pto shaft
4. Snap ring
5. Ball bearing
6. Snap ring
7. Oil seal
8. Sleeve
9. Gasket
10. Cover
11. Cap screws (4)
12. Cap

POWER TAKE-OFF CLUTCH

A hydraulically operated multiple disc "live power take-off clutch" was available as a field installation in NAA tractors. The clutch, when released, stops ground travel of the tractor without interrupting power to the PTO shaft. As the PTO clutch is located between the transmission and final drive, the engine clutch must be released before shifting transmission gears.

NOTE: Several components of the original design clutch installation were either changed or deleted in a modification program. Only the later design parts shown or discussed in this section are available for service.

CLUTCH OPERATION

100. The multiple disc clutch unit (1—Fig. FO65) is installed in place of the drive shaft between the transmission output shaft and the final drive bevel pinion. Hydraulic power required to operate the clutch is supplied by the pump (40) mounted on rear end of the hydraulic lift system pump. The clutch control valve is located in the PTO shifter plate (20) and is operated by the lever (34). Oil from the control valve is directed to the clutch piston through the flexible oil line (19—Fig. FO68) and collector ring (3).

When the tractor engine is not running, the clutch piston (7) is forced to the rear by six spring washers (8). As the outer pressure plate (14) is connected to the piston by two links (15), the pressure plate is also moved to the rear with the piston. The clutch unit is then in "mechanical lock-up" as internal splines in the pressure plate engage the splines on the clutch hub (11).

When use of the pto clutch is not desired, mechanical lock-up may be obtained with the tractor engine running by opening the valve (31—Fig. FO67) which by-passes oil from the pto pump directly into the hydraulic oil reservoir.

When the engine is running and the valve (31) is closed, oil pressure is directed to the clutch control valve. With the control lever (34) in the forward position, the control valve spring (22) is fully compressed and all oil from the pto pump is transmitted to the clutch unit through the line (19—Fig. FO68) and collector ring (3). Oil pressure builds up and forces the clutch piston forward compressing the eight driving plates (12) and the eight driven plates (13) between the outer pressure plate (14) and the piston. The clutch is then in "hydraulic lock-up". When in hydraulic lock-up, system oil pressure is limited by a relief valve located under the plug (6) in the clutch drum.

Moving the control lever rearward against the adjustable stop (36—Fig. FO67) reduces spring pressure on the control valve. Note: Control valve is not shown, but is located in bore in the pto shifter plate ahead of the spring (22). The control valve then moves to rear and partially by-passes oil from the pto pump to the hydraulic reservoir allowing system pressure to drop. Springs (8—Fig. FO68) can then move clutch piston rearward releasing pressure on the clutch discs, and stopping tractor ground travel. Sufficient system pressure must be maintained to keep the piston return springs from moving the clutch unit into mechanical lock-up.

Moving the clutch lever forward increases spring pressure on the control valve increasing system pressure and hydraulically engages the clutch unit as the piston compresses the return spring and pressure is applied to the clutch discs.

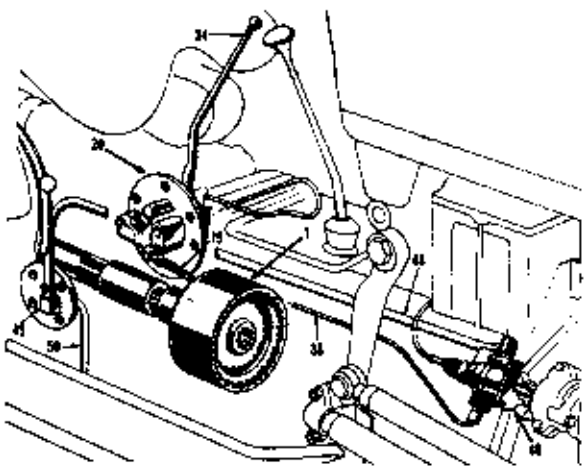


Fig. FO65 — Phantom view of the live power take-off clutch installation. Clutch unit (1) mounts in drive line between transmission and final drive. Clutch pump (40) draws oil from hydraulic sump through pick-up tube (50) and suction line (48). Oil from pump travels through pressure line (38) to control valve (pto shifter) plate. Lever (34) operates control valve to regulate pressure in line (19) to clutch piston.

TROUBLE SHOOTING

Most of the troubles encountered with the live pto clutch unit will be of a hydraulic nature as the clutch locks up mechanically when no oil pressure is applied to the clutch piston. Information in the following paragraph should aid in trouble shooting operational problems if the cause of the trouble is not obvious.

101. If clutch unit will not disengage from mechanical lock-up, check hydraulic system oil level. If oil level is at full mark on dip stick, detach pump pressure line from fitting (21—Fig. FO67) on pto shifter plate and turn engine with starter. If oil does not flow from line, check pump prime, mechanical drive to pump (drive can be assumed OK if proofmeter is operational), and pump suction line for obstructions. Renew pump as outlined in paragraph 108 if oil flow from pressure line cannot be obtained.

102. If oil flows from pump pressure line when checked as in paragraph 101, remove PTO shifter cover and check the following: tube between control valve and collector ring, control valve linkage and operating spring and "O" rings on valve (31). Operation of clutch unit can be checked by applying air pressure through the flexible tube (19—Fig. FO68). If leak at collector ring, tube, or clutch unit appears excessive, or if clutch does not operate, remove and overhaul the clutch unit as outlined in paragraph 110.

103. If clutch goes into hydraulic lock-up but slips under a load, a worn pump, oil leak in control valve unit, oil leak in tube, oil leak at collector ring or in clutch unit, or a faulty relief valve in clutch drum should be suspected. Note: Clutch should be operated in mechanical lock-up whenever live pto operation is not required, especially on heavy draft loads.

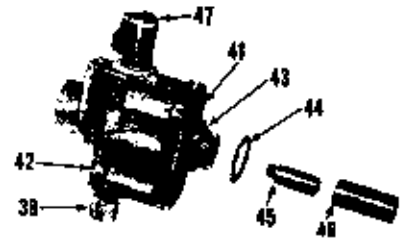


Fig. FO66—View of pto pump. Pump is serviced only as assembly shown; however, attaching parts shown are available as separate items.

40. Elbow
41. Adapter plate
42. Cap screws
43. Jam nut
44. Gasket
45. Drive shaft
46. Sleeve
47. Elbow

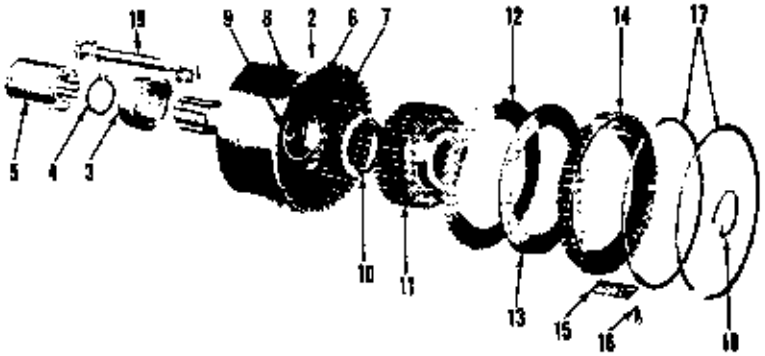


Fig. FO68—Exploded view of clutch unit. Mechanical lock-up of clutch is provided by engagement of splines in I.D. of pressure plate (14) in splines on clutch hub (11). Collector ring (3) must be free on shaft of clutch drum (2), yet fit closely to avoid oil leakage.

2. Clutch drum
3. Collector ring
4. Snap ring
5. Coupling
6. Relief valve plug
7. Clutch piston
8. Spring washers (6)
9. Snap ring
10. Thrust bearing
11. Clutch hub
12. Driving plates (8)
13. Driven plates (8)
14. Pressure plate
15. Connecting links (15)
16. Socket head screw
17. Snap ring
18. Thrust spring

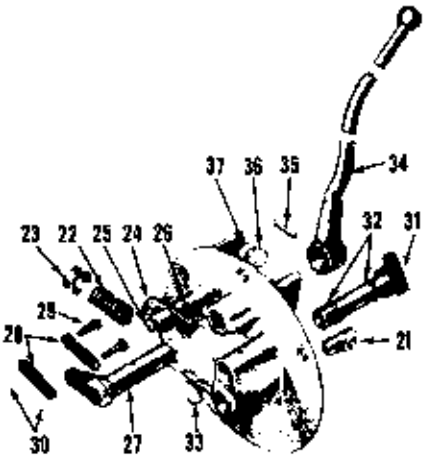


Fig. FO67—Exploded view of control valve unit. Pto shifter lever is also installed in plate, but is not shown in above view.

21. Elbow
22. Spring
23. Guide
24. Pawl
25. Clevis pin
26. Roll pin
27. Arm
28. Links (arm to pawl)
29. Clevis pins
30. Cotter pins
31. Valve spool (by-pass)
32. "O" rings
33. Snap ring
34. Control lever
35. Groove pin
36. Stop bolt
37. Jam nut

104. If the clutch will go into mechanical lock-up with engine dead and into hydraulic lock-up with engine running, but will not release, readjust control lever stop as outlined in paragraph 107. If adjustment of the stop has no effect, check control valve for sticking in bore in PTO shifter plate.

105. If clutch ratchets, or makes similar noise when released, readjust control lever stop as outlined in paragraph 107.

ADJUSTMENTS

106. **SYSTEM RELIEF PRESSURE.** When clutch is in hydraulic lock-up, system pressure is limited by the relief valve located under plug (6—Fig. FO68) in clutch drum. Relief valve is non-adjustable and should be renewed as outlined in paragraph 110 if suspected of being faulty.

107. **CLUTCH RELEASE PRESSURE.** A low oil pressure must be maintained in the clutch unit to keep it from going into mechanical lock-up when released. This pressure is determined by the spring pressure applied to the control valve when the control lever is against the stop (36—Fig. FO67). If the pressure is too high, the clutch will not release; if too low, the pressure plate internal splines will contact the splines on the clutch hub and either make a noise or go into mechanical lock-up.

To adjust, loosen lock nut (37) and, with engine at slow idle speed, turn stop screw in or out until creep is at a minimum, but without any noise due to contact of pressure plate and hub. Note: Make adjustments only when hydraulic oil is at operating temperature.

PTO PUMP

108. **R&R OR RENEW.** To remove the pto pump, proceed as follows: Disconnect proofmeter drive and oil lines from pto pump and hydraulic pump. Loosen jam nut (43—Fig. FO66). Unbolt and remove hydraulic pump from engine; then, unscrew pto pump from rear of hydraulic pump.

Pump is serviced only as a complete assembly and must be renewed as a unit if damaged or worn. Attaching and drive parts shown in Fig. FO66 are available as separate items, however.

Fill pto and hydraulic pumps with oil and reinstall by reversing removal procedures; tighten jam nut (43) after lines are attached to pto pump. Pumps should prime readily after engine is started; if not, prime hydraulic pump as outlined in paragraph 132. Pto pump can be primed by loosening pressure line and applying air pressure to hydraulic reservoir.

CONTROL VALVE

109. **R&R AND OVERHAUL.** Drain hydraulic system oil level to below level of pto shifter plate or raise right side of tractor. Remove right rear step plate bracket or complete step plate and brake lock plate. Remove pto shift plate by working shifter lever out of opening in side of center housing and disconnecting line to pto clutch collector ring.

Disassembly of control valve unit is obvious after inspection of unit and reference to Fig. FO67. Control valve is not shown but is located in bore beneath spring (22). Renew "O" rings on valve (31) if leaking to outside or internal leak is suspected. Control valve should move freely in bore.

Reverse removal procedures to reinstall pto shifter plate and control valve unit.

CLUTCH ASSEMBLY

110. **R&R AND OVERHAUL.** To remove the clutch unit as an assembly, first remove the pto shifter plate and control valve unit; then, split tractor between transmission and differential center housing as outlined in paragraph 96. Take care when separating tractor that clutch unit is not dropped.

Clearance between the collector ring (3—Fig. FO68) and clutch drum shaft should be 0.0004-0.0007. If shaft is damaged or worn, it may be reground to 0.002 or 0.004 undersize and a 0.002 or 0.004 undersize collector ring installed. Collector ring should turn freely on shaft with minimum clearance.

To disassemble clutch unit, remove

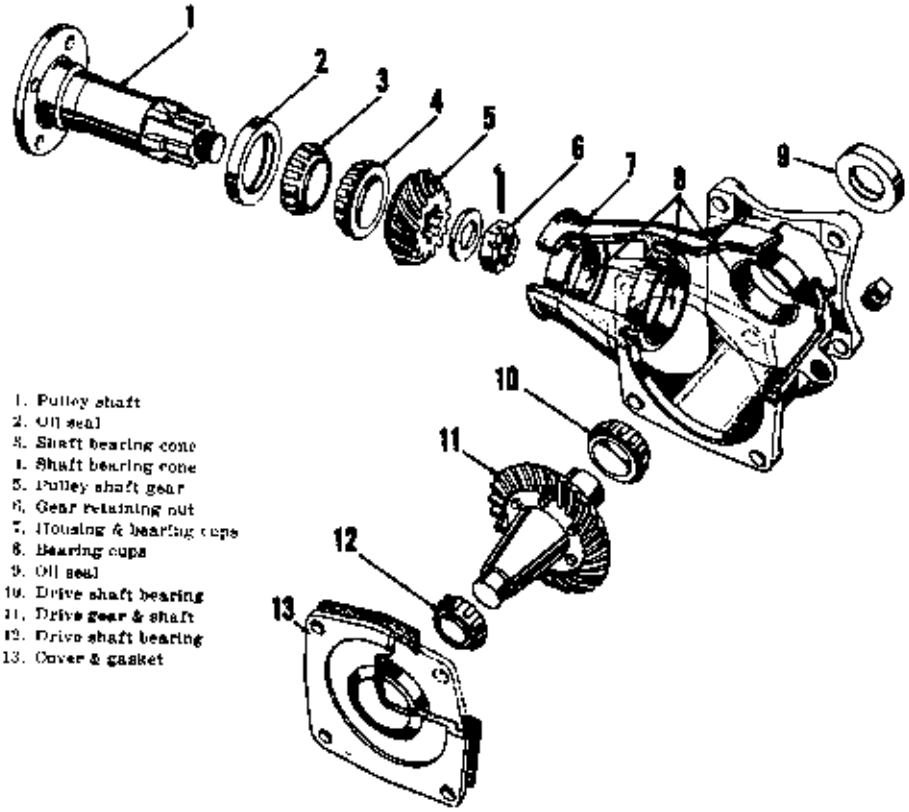
snap ring (17) and screws (16) retaining piston connecting links (15) to pressure plate (14). Then remove the pressure plate and the eight alternately placed driving plates (12) and eight driven plates (13), the clutch hub (11) and thrust bearing (10). Spring (18) is placed between clutch and end of transmission output shaft to take up end thrust.

Compress the clutch springs and remove snap ring (9); then remove the six springs and three spacers. The clutch piston and connecting links can now be removed from the drum. Note: Be sure to note position of piston return springs and spacers so that they may be reinstalled in the same position. Renew piston sealing rings and lubricate same prior to reinstalling piston.

Remove the plug (6), spring and relief valve. Valve may be either the poppet type or a ½-inch diameter steel ball. The poppet type valve seats on a non-renewable 60 degree seat in clutch drum; if seat is damaged, renew drum and relief valve. The steel ball type relief valve seats on either a renewable or non-renewable 90 degree seat in the clutch drum; if non-renewable type seat is damaged, the clutch drum and relief valve must be renewed. Renew the relief valve spring if questionable in any way.

BELT PULLEY

The belt pulley is supplied as extra equipment and may be mounted and operated in right or left horizontal position or in down vertical position. The belt pulley revolves at 1358 rpm when the crankshaft speed is 2000 rpm or 1494 rpm when the crankshaft speed is 2200 rpm.



1. Pulley shaft
2. Oil seal
3. Shaft bearing cone
4. Shaft bearing cone
5. Pulley shaft gear
6. Gear retaining nut
7. Housing & bearing cups
8. Bearing cups
9. Oil seal
10. Drive shaft bearing
11. Drive gear & shaft
12. Drive shaft bearing
13. Cover & gasket

Fig. FO70—Components of the belt pulley assembly.

R&R AND OVERHAUL

112. Removal of unit requires removal of four cap screws which hold unit to rear axle center housing. To reinstall, engage splines on power take-off shaft and belt pulley unit and install four cap screws after locating unit in desired operating position.

113. Overhaul procedure is as follows: Drain lubricant and remove housing cover (13—Fig. FO70) and gasket. Remove castellated nut (6) from inner end of pulley shaft. This nut must be unscrewed in stages as shaft is being removed. Withdraw shaft (1) and remove drive shaft and gear (11) out through housing cover opening.

Pulley shaft gear (5) and drive shaft gear (11) are furnished only as a matched set. The mesh and backlash of these gears is fixed and non adjustable. Install oil seals with lips facing inward.

Adjust pulley shaft bearings to a just perceptible preload by means of pulley nut (6) prior to installing cover (13). Correct preload is when 5-12 inch pounds is required to rotate the shaft in its bearings. Adjust the drive shaft bearings to a slight preload by varying the number of gaskets installed between cover (13) and housing (7). Correct preload is when 15-34 inch pounds is required to rotate the belt pulley when the unit is completely assembled. Shim gaskets for drive shaft bearings are available in thicknesses of 0.012-0.023.

HYDRAULIC LIFT SYSTEM

DESCRIPTION OF SYSTEM OPERATION

114. The hydraulic lift system incorporates automatic draft and implement position control. The system control levers are shown in Fig. FO-71. When the selector lever (19) is in the vertical position shown, position of the lift arms is determined by position of the control lever (29) on the quadrant (implement position control). If the position of the control lever is changed, the system control valve is moved to raising (or lowering) position. When the lift arms reach the position selected by placement of the control lever, a cam on the lift arm shaft returns the system control valve to neutral position. If, due to a leak in the system or operation of the ram cylinder safety valve (See paragraph 131), oil is lost from ram cylinder allowing the lift arms to lower, movement of the cam places the system control valve in raising position until the lift arms are returned by the position determined by placement of the control lever.

The system control valve does not direct the flow of oil from the pump but operates, through use of system back pressure, a shuttle type valve (unloading valve) which either bypasses oil back into the reservoir or directs it into the ram cylinder according to position of the control valve. Thus, with only a small movement of the control valve, the full flow of oil from the pump can rapidly be directed to the lift cylinder piston or to the sump.

When the selector lever is moved to a horizontal position (forward), draft reaction pressure is required on the top link of the 3-point hitch to hold the system control valve in neutral position (constant draft control). Moving the control lever downward increases the amount of draft reaction required to hold the control valve in neutral position. At a set control lever position, an increase in draft reaction will move the control valve to raising position or a decrease in draft reaction will move the control valve to lowering position. Thus a constant draft is maintained on the tractor which, when ignoring soil condition, provides constant depth control of an implement. When operating in constant draft control, moving the control lever to top position on the quadrant places the system control valve in raising position. When the lift arms are fully raised, the skirt of the ram cylinder piston contacts a pin in the control linkage returning the control valve to neutral (or hold) position.

Fluid supply for the system is contained in an isolated compartment in the front portion of the differential center housing. Recommended fluid for the system is a special Ford specification M-4864-A for temperatures above 10° F., or specification M2C41 for temperatures below 10° F.

The constant running hydraulic pump is mounted on the engine and is driven by a gear on the rear end of the engine camshaft. Either a vane type (original production) or piston type (service replacement) pump is used. External oil tubes running below the transmission carry oil from the reservoir to the pump and from the pump to the lift system. A pump pressure relief valve (See Fig. FO77) is located in the bottom of the differential center housing in the hydraulic pump pressure line. A ram cylinder safety valve (69—Fig. FO73) is located on the lift cylinder and control valve housing.

TROUBLE SHOOTING

Much time can be saved in servicing the NAA hydraulic system by correctly locating the cause or causes of any difficulty before attempting repairs. It is possible, of course, that several different malfunctioning parts or units may cause difficulties with similar symptoms. Also to be considered is the fact that more than one malfunctioning part or unit may be present and a complete check of system operation as outlined in paragraph 118 should be made before releasing the tractor from the shop.

115. In the NAA hydraulic lift system, malfunction of any of the system parts will usually show up in (a) failure of the system to lift, (b) inability to lift heavy loads within capacity of the system, (c) inability to hold implement in lift position without up and down bobbing motion, (d) erratic action such as over-travel or locking in lift position, (e) pump loses prime or is noisy. The probable causes of trouble and methods of locating source of trouble are outlined in paragraphs 115A through 115E.

115A. **WILL NOT LIFT.** First, check hydraulic fluid level on dip stick located in right hand side of differential center housing. If level is below full mark, add correct amount of Ford recommended fluid, specification M-4864-A in temperatures above 10° F.

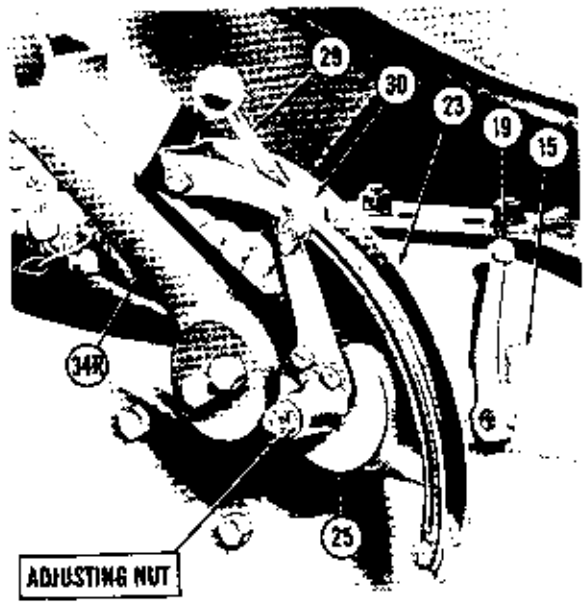


Fig. FO71 — View showing hydraulic control levers and associated parts. Adjustable stop (30) may be set on quadrant (23) by operator so that control lever can be returned to desired setting. Selector lever (19) is shown in "position control" whereby position of lift arms (34R) is controlled by position of control lever on quadrant. Selector lever detent ball and spring is located under plug (15). Tension on lever friction plate (25) is controlled by adjusting nut.

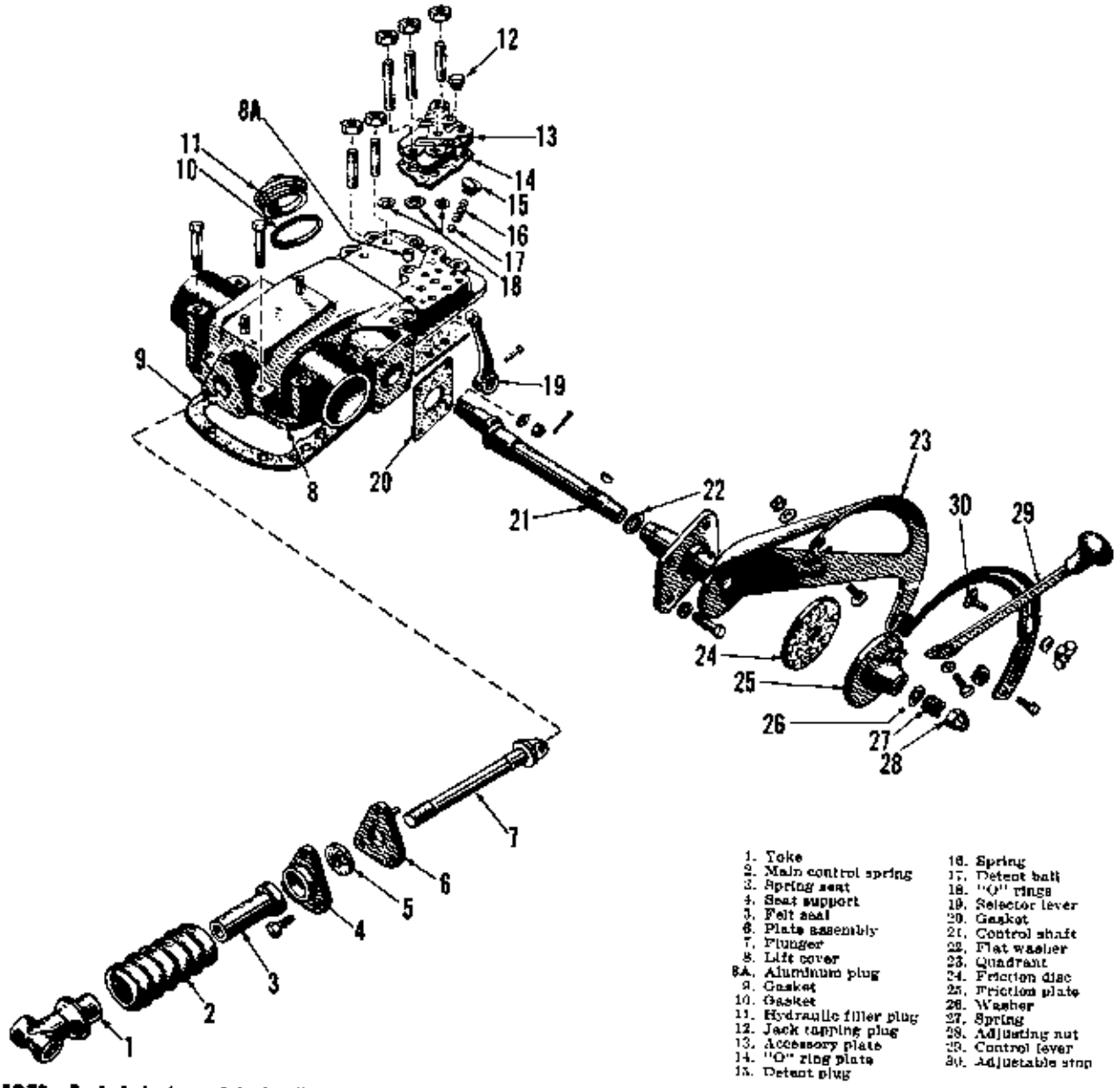


Fig. FO72—Exploded view of hydraulic lift cover and related parts. Parts shown in Fig. FO73 complete the lift cover assembly. "O" ring retainer plate (14) was used on early production only.

and M2C41 in temperatures below 10° F., or equivalent. Note: When remote cylinders of large capacity (for example, a hydraulic wagon hoist) are used, it will be necessary to add additional oil to the system. If trouble is not corrected, proceed with following checks:

SELECTOR VALVE SETTING. In some cases of linkage maladjustment, the system will lift in position control and not in draft control. If the selector lever (See Fig. FO71) is in the forward (horizontal) position, move it to the vertical position shown. If system lifts in implement position control, remove the lift cover and inspect and adjust the linkage as outlined in paragraphs 119 and 120.

If the system will not lift with the selector lever in either position, check pump prime as outlined in following paragraph.

PUMP PRIME. On vane type pump, turn Hy-Trol knob all the way in. If this has no effect, disconnect the pressure (small) tube from pump and turn engine over with starter. If no oil flows from open port, head front of tractor down a ramp or apply air pressure momentarily to oil reservoir through oil dip stick hole. If pump prime cannot be obtained, remove and overhaul or renew pump. If oil flows from loosened pressure line, but system will not lift after line is reconnected, remove and overhaul lift cylinder as outlined in paragraph 127.

On piston type pumps, remove the socket head plug from front cover of pump and connect a hose from this opening to filler plug opening in hydraulic lift cover. Start engine and run until a steady stream of oil is flowing back into the hydraulic reservoir. Note: Piston type pumps may operate when only partially bled of air which will cause the lift arms to raise with an unsteady motion. On some pumps, the pump may have to be operated for several minutes with by-pass hose attached to bleed all air from the pump. If a full, steady flow of oil cannot be obtained, remove and overhaul pump as outlined in paragraph 134. If oil flows steadily from

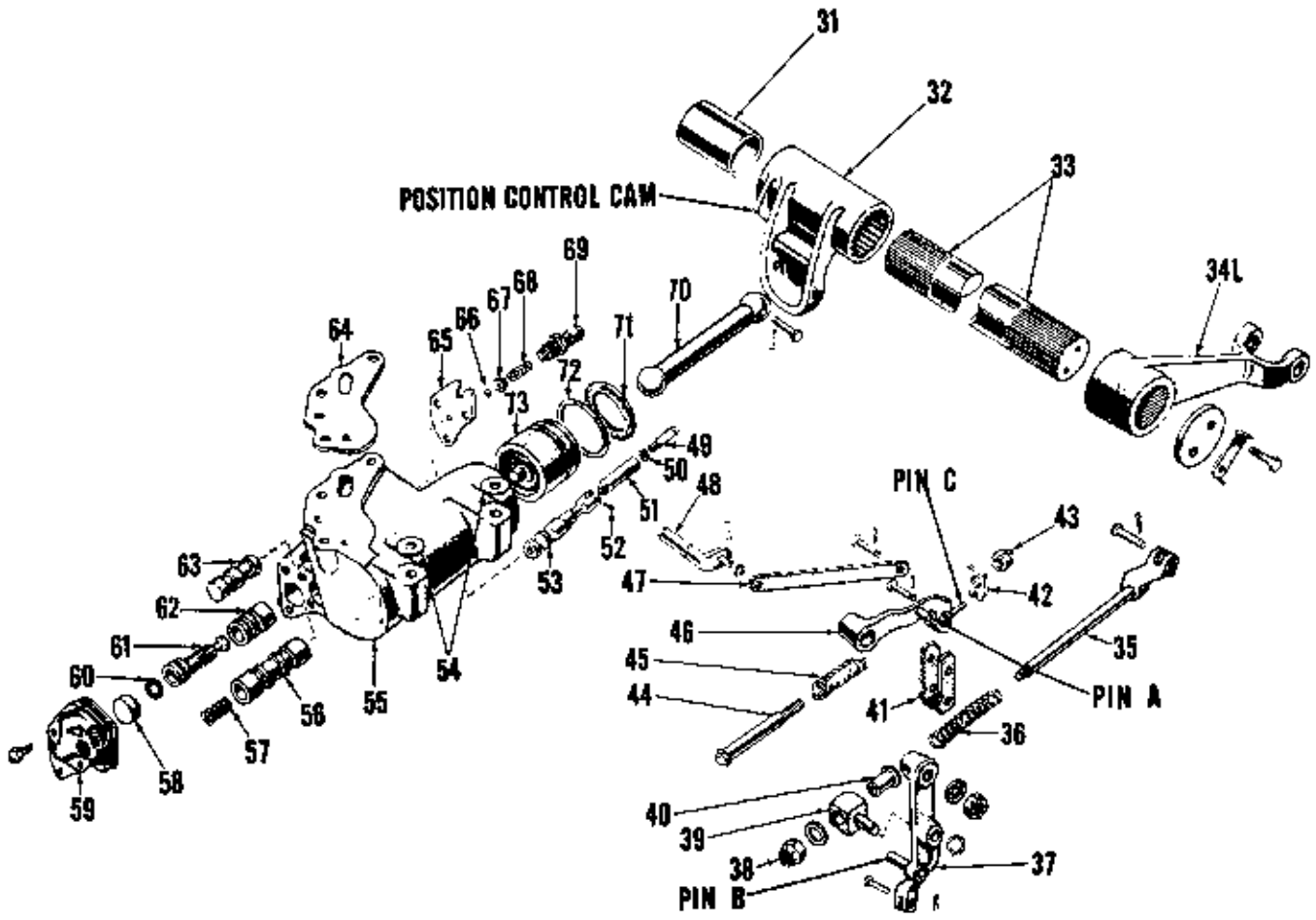


Fig. FO73—Exploded view of hydraulic lift cylinder and associated parts. Refer to Fig. FO72 for remainder of parts of complete lift cover assembly. Pin "A" contacts position control cam on lift arm (32). Pin "B" is contacted by piston (73) skirt when in raised position in "draft control" to return control valve to neutral position. Pin "C" holds plate (42) in correct position.

31. Bushing (2)
32. Lift arm
33. Lift shaft
34L. Lift arm (LH)
35. Draft control link
36. Draft control spring
37. Control lever
38. Self locking nut
39. Pivot
40. Bushing
41. Cam
42. Threaded plate
43. Lock nut
44. Position control rod
45. Position control spring
46. Position control cam
47. Link
48. Selector lever arm
49. Control link
50. Jam nut
51. Adjusting nut
52. Rivet
53. Control valve
54. Gasket spacers
55. Cylinder casting
56. Control valve bushing
57. Valve return spring
58. Unloading valve plug
59. Baffle plate
60. Unloading valve "O" ring
61. Unloading valve
62. Unloading valve bushing
63. Check valve seat
64. Cylinder gasket
65. Control valve retainer plate
66. Check valve (7/16 in. steel ball)
67. Check valve pilot
68. Check valve spring
69. Safety valve
70. Piston rod
71. Leather back-up ring
72. "O" ring
73. Piston

pump, but system will not operate after by-pass hose is disconnected and socket head plug reinstalled, remove and overhaul the hydraulic lift cylinder as outlined in paragraph 127.

115B. **WILL NOT LIFT HEAVY LOADS.** A pressure check of the system will determine if the system is operating (lifting) at maximum capacity, but is not essential in determining cause of difficulty where low lifting capacity is an obvious fact. If system will lift and hold light loads, but will not lift heavy implements such as a disc harrow or plow, proceed as follows:

Remove the pto shifter cover (oil level may have to be lowered slightly). With hydraulic oil at operating temperature, attach heavy implement to 3-point hitch, run engine at fast idle speed, move hydraulic control lever to top of quadrant and selector lever to vertical (position control) position. If oil around area of relief valve in reservoir is turbulent, renew the relief valve as outlined in paragraph 125. If no turbulence or oil leaks are noted, remove and overhaul or renew hydraulic pump. Note: If equipped with a vane type pump and lifting capacity seems normal when oil is cold, but is greatly reduced when oil is hot, a worn pump should be suspected. Though a possibility, reduced lifting capacity is not generally associated with piston type pumps. Note: A squealing or buzzing sound at bottom of center housing is usually noted when relief valve is by-passing oil.

115C. **BOBBING (HICCUPS).** A leak in the lift cylinder circuit may result in an up and down bobbing motion (hiccups) in the lift when holding an implement in raised position. This condition usually becomes more pronounced as the hydraulic oil reaches operating temperature. A serious leak in the lift cylinder circuit may also affect depth (draft) control of an implement. To locate the source of the leak, proceed as follows:

Operate tractor to bring hydraulic oil to operating temperature. Mount a heavy implement such as disc harrow or plow on the 3-point hitch. Remove the hydraulic oil filler cap, raise the implement and visually check for leakage around piston at rear of lift cylinder. If leakage is noted, remove lift cover and renew

the piston seal rings. Refer to paragraph 127 and 128.

If no leak is noted at piston, shut off engine with implement in raised position. If implement falls about 6-12 inches, then stops; or if rate of fall decreases noticeably after falling about one foot, renew the control valve and bushing. Refer to paragraphs 127 and 129.

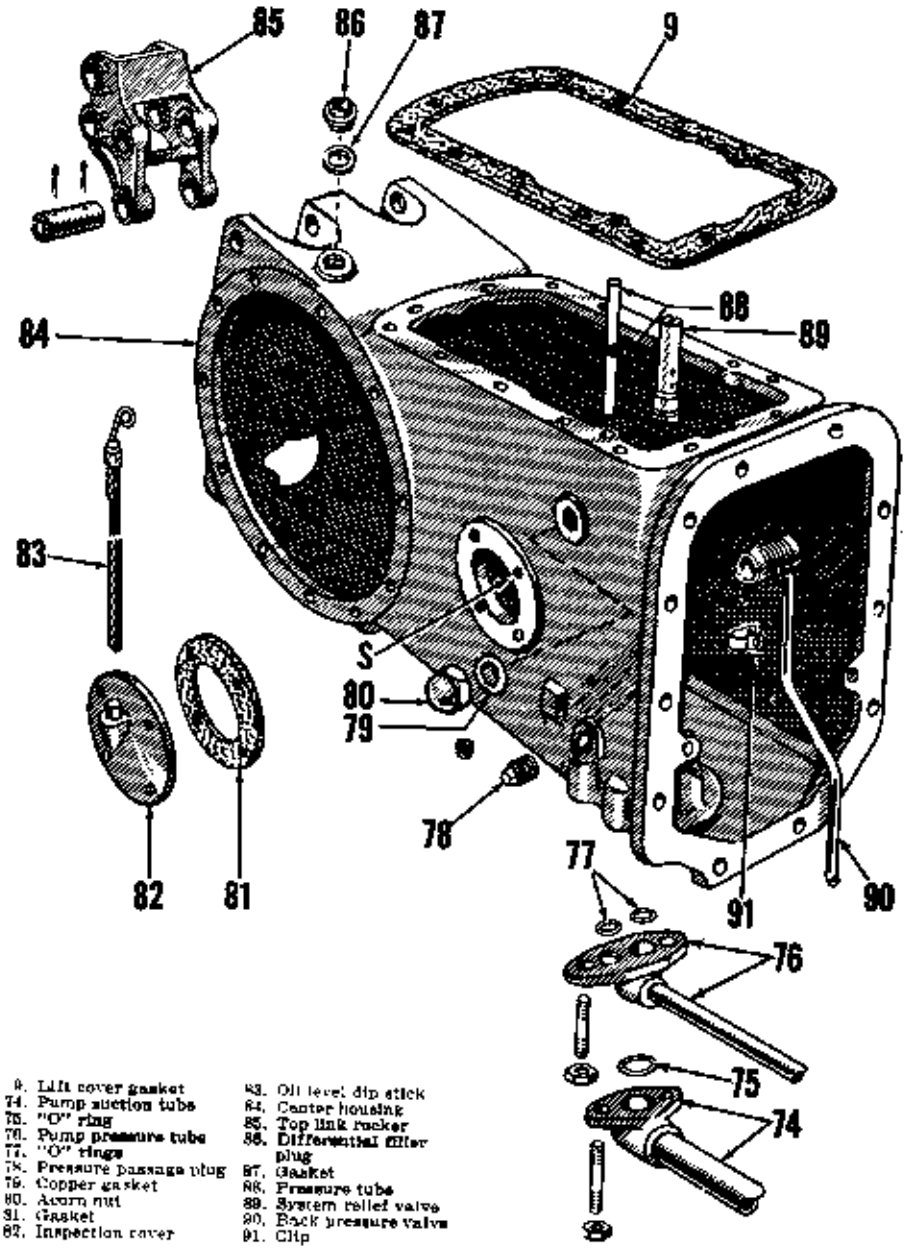
If, in making test as in preceding paragraph, implement falls all the way to ground at a steady rate, a leaking check valve or safety valve is usually indicated. Any leak at safety valve can be visualy checked by operating system with pto shifter plate removed from left side of center housing or with inspection plate removed from right side of center housing. If leaking safety valve is noted, renew valve as outlined in paragraph 131. Also inspect for any possible leak between cylinder casting and lift cover; remove lift cover and renew gaskets between cylinder and lift cover if leak is noted. If no leak is noted at safety valve or gaskets, renew the check valve ball and seat as outlined in paragraph 131.

Note: A surging flow of oil from baffle plate opening while implement is bobbing is only a normal reaction from automatic action of system unloading valve and should not be confused with source of leak causing bobbing motion.

115D. **ERRATIC ACTION.** Erratic action or over-correction of the hydraulic system is usually caused by binding control linkage, control valve sticking in bushing or unloading valve sticking in bushing. It may also be caused by operating the Hy-Trol valve on the vane type pump in maximum flow position or by installation of a 4.0 G.P.M. piston type pump designed for later series Ford tractors.

If erratic operation is observed with Hy-Trol valve of vane type pump in minimum flow position or with correct size piston type pump, remove the lift cover and check linkage, control valve and unloading valve for binding conditions.

115E. **PUMP LOSES PRIME OR IS NOISY.** Loss of pump prime is usually caused by a leak in the pump suction line or in the intake side of the pump. Additional possible causes are aeration (foaming) of hydraulic oil due to use of improper type oil, from relief valve baffle not being installed, or from discharge pipe on back pressure valve being improperly located. Remove oil filler cap from lift cover and visually check for oil foaming and placement of back pressure valve discharge pipe (Refer to paragraph 126). Drain system and refill with recommended fluid if oil is foaming excessively or remove lift cover and install relief valve baffle and relocate tube on back pressure valve if necessary. Remove pump suction tube and renew the sealing "O" rings. If noise and/or loss of prime persists, remove and overhaul hydraulic pump. Pay particular attention to condition of shaft bearings, seal contact surface of shaft and "O" rings and shaft seal on intake side of pump.



9. Lift cover gasket
74. Pump suction tube
75. "O" ring
76. Pump pressure tube
77. "O" rings
78. Pressure passage plug
79. Copper gasket
80. Acorn nut
81. Gasket
82. Inspection cover
83. Oil level dip stick
84. Center housing
85. Top link rocker
86. Differential filler plug
87. Gasket
88. Pressure tube
89. System relief valve
90. Back pressure valve
91. Clip

Fig. FO74—View of center (differential) housing and associated hydraulic system parts. Pump tubes (74 and 76) are replaced by a tube and manifold assembly when piston type pump is used.

HYDRAULIC SYSTEM TESTS

When servicing the tractor hydraulic system, the complete system should be checked out as outlined in the following paragraphs before releasing the tractor from shop.

116. Operate tractor until hydraulic fluid is at operating temperature. Attach a heavy implement such as a

plow to the three-point hitch and raise to full lift position. Minor position corrections can be tolerated if occuring not oftener than ten times per minute although they should not occur more often than once per minute. Rapid and severe position corrections would indicate a leak in the lift cylinder circuit. (A system in perfect condition will often hold a heavy implement in raised position for several minutes before a position correction occurs and the correction will be very minor.)

With the implement in raised position, move selector lever from draft control to position control or vice-versa. Outer ends of lift arms (draft links) should remain within two inches of their previous position. Excessive movement of lift arms indicates maladjustment of control linkage.

Move the system control lever up and down the quadrant in small movements with the selector lever in position control. The lift arms should move and stop with the control lever and the lift should hold steady in any position.

To check the system for maximum lifting capacity (correct system relief valve setting), remove the pipe plug from lift cover accessory plate or from lower front corner of right side of differential housing and install an oil pressure gage of 3000 psi capacity. Anchor the lift arms to the rear axle housings with heavy chain and place the control lever in lift position. The gage should then register approximately 2000 psi and hold steady. On tractors equipped with a vane type pump, a high reading followed by a decline in pressure indicates a worn pump. CAUTION: Do not hold control lever in lift position for more than 10 seconds when lift arms are anchored because of possible damage to pump.

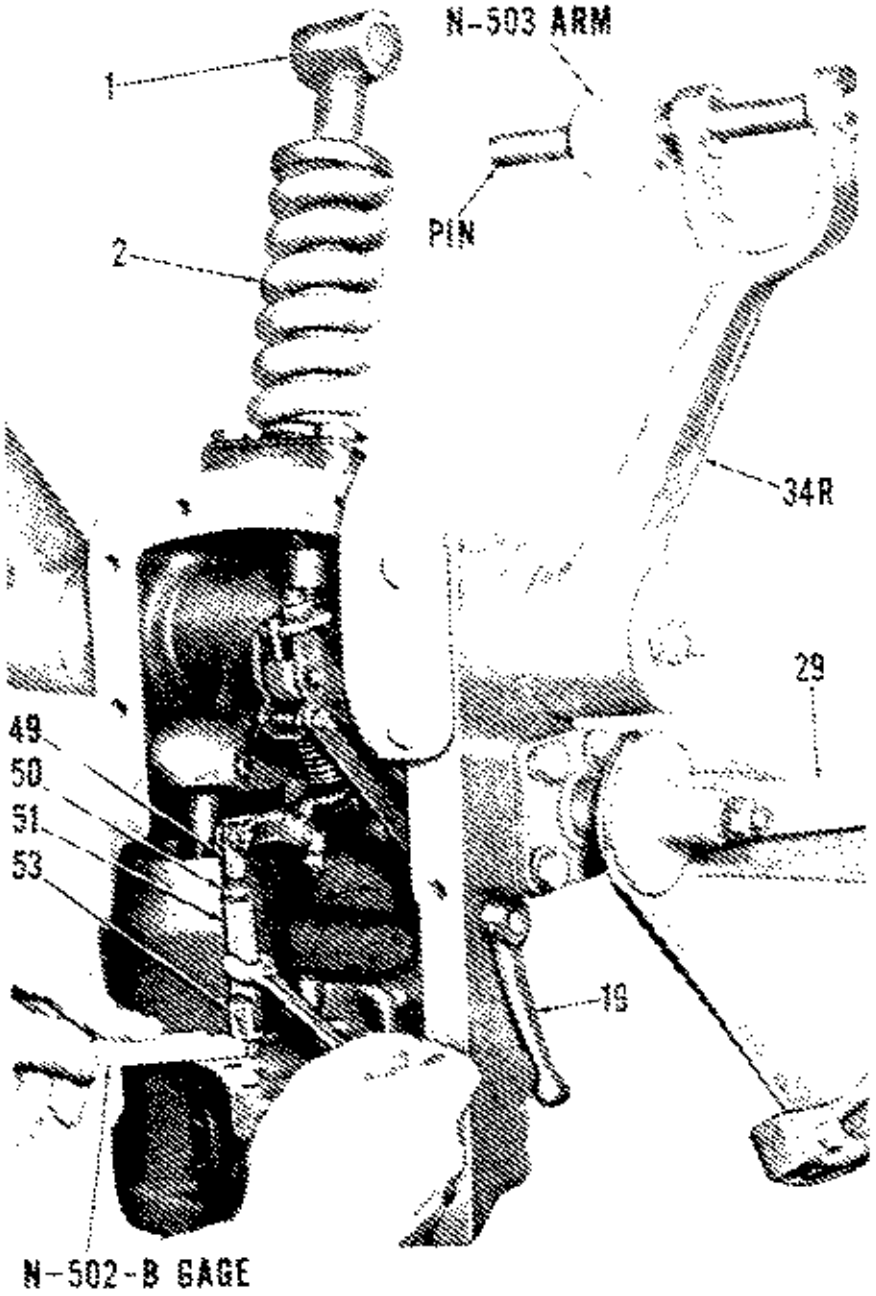


Fig. FO75—View showing method of adjusting draft control linkage. Selector lever (19) is in draft control position and control lever (29) is against top stop on quadrant. Changing draft control adjustment affects position control linkage adjustment; adjust position control linkage after making draft control adjustments. Refer to Figs. FO72 and FO73 for legend.

CONTROL ADJUSTMENTS

117. **MAIN CONTROL SPRING ADJUSTMENT.** To meet varying conditions, the main control spring (2—Fig. FO75) should be adjusted as follows: Remove the pin connecting the top link rocker (85—Fig. FO74) to the main control spring adjusting yoke (1—Fig. FO75). For normal draft loads, turn the adjusting yoke in or out so that the main control spring can just be turned by hand; then, turn the adjusting yoke either way to closest horizontal position so that connecting pin may be reinstalled in rocker and yoke.

For heavy draft loads such as plowing in heavy soil, draft reaction may be improved by tightening the adjusting yoke ½-turn from normal adjustment position.

118. **CONTROL LINKAGE ADJUSTMENT.** Adjustment of the draft control linkage may be made in an emergency through the pto shifter plate opening with lift cover on the tractor. However, as adjustment of the draft control linkage also affects adjustment of the position control linkage, it is recommended that the lift cover be removed from the tractor as outlined in paragraph 121 and both draft control and position control linkage be adjusted as outlined in paragraphs 119 and 120 which follow:

119. ADJUST DRAFT CONTROL LINKAGE. Mount the removed lift cover assembly rear end up in a large vise. Clean off any gasket material adhering to lift cover and attach the locating arm (Nuday Tool No. N-503) to lift cover and insert locating pin through arm and lift arm as shown in Fig. FO75. Tighten yoke (1) to remove all end play from control spring (2).

Move the selector lever (19) to position nearly parallel with lift cover mounting surface as shown. Move the control lever (29) through range of travel several times to be sure there is no binding in linkage. If bind exists, correct the condition before proceeding further. Move the control lever (29) against upper stop of quadrant. Note: The upper stop is a bolt with an eccentric head; be sure bolt is turned so that eccentric lobe is towards opposite end of quadrant.

At this time, the "draft" end of the thickness gage (Nuday Tool No. N-502-B) should just fit between the machined shoulder on the control valve and the lift cylinder casting. If not, loosen jam nut (50) on link (49) and turn adjusting nut (51) so that gage is a snug slip fit between shoulder on control valve and cylinder casting.

Note: On early production NAA tractors, the control valve retaining plate (65—Fig. FO73) may not permit inserting the N-502-B gage in gap between control valve shoulder and cylinder casting. If this condition is encountered, remove the retaining plate while making adjustments to control linkage.

After obtaining correct draft control adjustment, tighten jam nut (50—Fig. FO75) and recheck adjustment. Then, move control lever (29) through range of travel several times and recheck adjustment again. Variance in adjustment would indicate binding or wear in linkage which should be corrected.

CAUTION: It is possible that one of several obsolete thickness gages (Nuday Tool Nos. N-502, N-502-A and N-502-A1) may still be in use. If so, they should be discarded and the proper gage, Nuday Tool No. N-502-B, be obtained.

If special Nuday locating arm and thickness gage are not available, draft control linkage may be adjusted as follows: Following general procedure as outlined in adjustment with gages, position hydraulic lift arms so that pin hole in arm is ½-inch above gasket surface of lift cover and adjust linkage so that gap between shoulder on control valve and lift cylinder casting is exactly 0.342 inch.

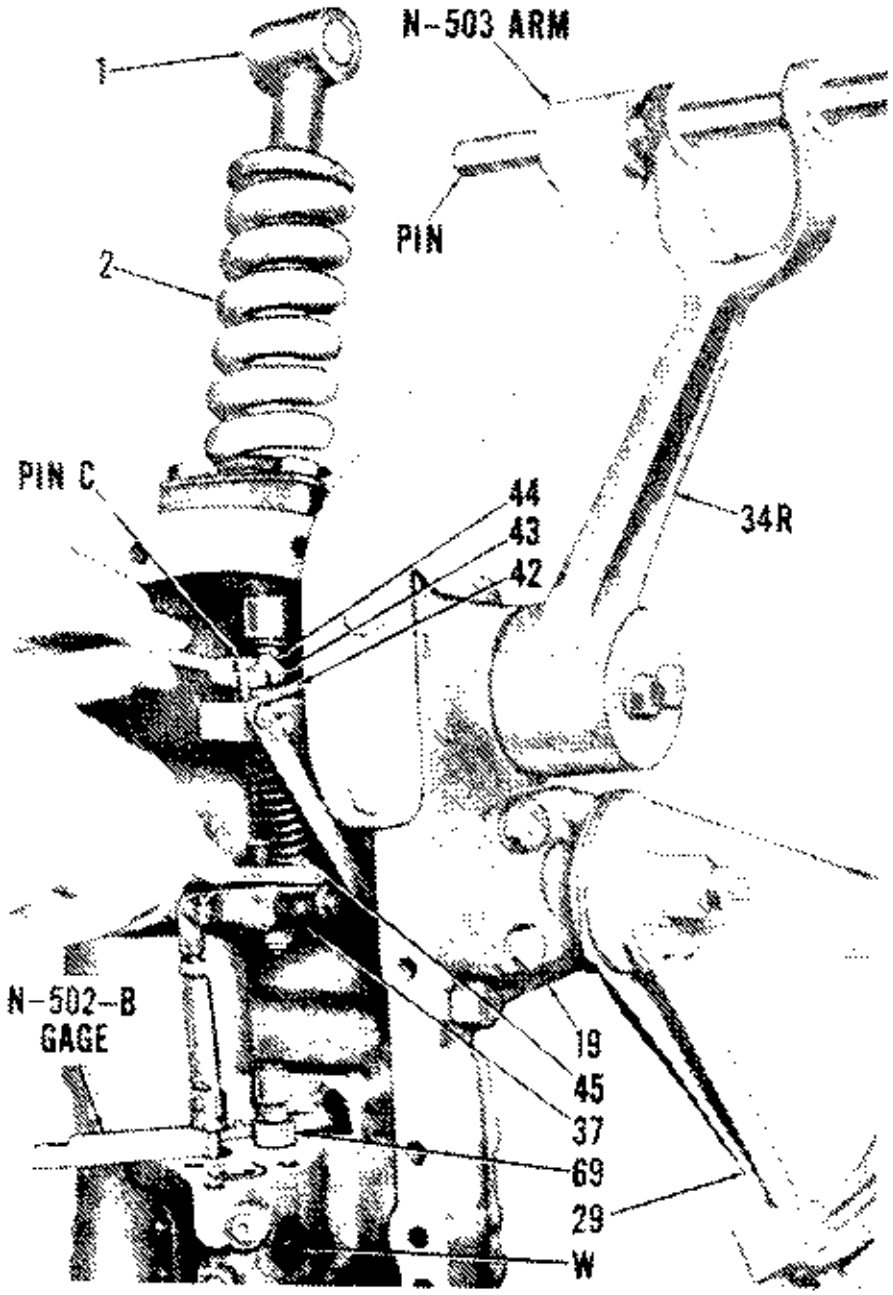


Fig. FO76—View showing method of adjusting position control linkage. Selector lever (19) is in position control and control lever (29) is placed against bottom stop on quadrant. Always adjust draft control linkage before attempting to adjust position control linkage. Refer to Fig. FO72 and Fig. FO73 for legend.

After adjusting draft control linkage, adjust position control linkage as outlined in following paragraph.

120. ADJUST POSITION CONTROL LINKAGE. Be sure that draft control linkage is properly adjusted as outlined in paragraph 119; then, proceed as follows to adjust the position control linkage:

Move the selector lever (19) to a position vertical to lift cover as shown in Fig. FO76. Move control lever against lower stop on quadrant. At this time, the "position" end of the thickness gage (Nuday Tool No. N-502-B) should be a snug slip fit between the shoulder on the control valve and the lift cylinder casting. If not, readjust linkage as follows: Hold the threaded plate (42) from turning and loosen the jam nut (43). Turn position control bolt (44) in or out of threaded plate (42) to obtain correct adjustment; then, tighten jam

nut (43). A thin tappet adjustment wrench will aid in making the position control adjustment as it will fit in between position control spring (45) and control lever (37).

Note: If either draft or position control adjustment cannot be made because of lack of adjustment thread length, the control linkage is worn and/or bent and must be renewed as outlined in paragraph 122.

If special Nuday locating arm and thickness gage are not available, position control linkage may be adjusted as follows: Following general procedure as outlined for adjustment with gages, position hydraulic lift arms so that pin hole in arm is ½-inch above gasket surface of lift cover and adjust linkage so that gap between shoulder on control valve and lift cylinder casting is exactly 0.432 inch.

After making draft and position control linkage adjustments, reinstall lift cover on tractor as outlined in paragraph 121.

LIFT COVER, WORK CYLINDER AND VALVES

The lift cover assembly includes the lift (rock) shaft, control quadrant, work cylinder and control valves. The control valves are contained in the casting which forms the work cylinder. The hydraulic pump pressure relief valve is located in the bottom of the hydraulic reservoir (See Fig. FO77). The system back pressure valve is located in the reservoir and is retained in the right hand side of the center (differential) housing.

121. **R&R LIFT COVER ASSEMBLY.** To remove the lift cover unit from tractor, first remove the tractor seat assembly and pin connecting the top link rocker to the main control spring yoke. Move the selector lever to draft control (horizontal) position and the control lever to lowest position on quadrant. Push the lift arms down to force excess hydraulic fluid from work cylinder. Disconnect lift shaft arms from lift links by removing the cotter pins and clevis pins.

Remove the acorn nut (60 — Fig. FO74) and back out the threaded bushing several turns to move the back pressure valve assembly away from the lift cylinder casting. Remove the cap screws from around edge of lift cover that retain the lift cover to center (differential) housing. Do not remove nuts from stud bolts that extend through lift cover and accessory plate. Pry the lift cover loose from center housing and remove cover assembly from tractor.

When reinstalling the lift cover assembly, be sure that all particles of the old gasket are removed from both lift cover and center housing gasket surfaces, and that gasket surfaces are smooth. Insert a new rubber washer (W—Fig. FO76) in side of cylinder casting and make sure that the back pressure valve is properly positioned as outlined in paragraph 126. Place new lift cover gasket on center housing and carefully lower the cover assembly into place. Insert the cover retaining cap screws and tighten finger tight. Turn the threaded back pressure valve bushing in until valve is firmly seated against rubber washer in side of lift cylinder and install and tighten acorn nut on bushing. Be sure that copper sealing washer is in place. Then, tighten the lift cover retaining cap screws to a torque of 65-70 Ft.-Lbs.

122. **CONTROL LINKAGE.** With lift cover removed, remove the lift shaft as outlined in paragraph 124. Inspect position control cam on cylinder lift arm (32—Fig. FO73) and pin "A" in control arm (46). Renew lift arm and/or pin if excessively worn. Disconnect control link (49) from lever (37), remove cylinder assembly and lay it aside.

Remove yoke (1—Fig. FO72), main control spring (2), spring seat (3), support (4), felt (5) and plate assembly (6). Surface on plate (6) towards inside of cover should be flat; renew plate if plunger has seated into plate or if pin is loose, worn excessively or missing.

Note: If yoke (1) is seized to plunger (7), do not use excessive force in attempting to remove yoke: extensive damage to control linkage could occur if pin in plate (6) shears off. Apply heat to yoke, use penetrating oil on threads or use other shop methods to remove yoke. Some mechanics prefer to saw the plunger (7) in two between coils of main control spring and renew plunger (and yoke, if threaded part of plunger cannot be removed). Apply Lubriplate or similar waterproof grease to threads when reassembling.

Remove self-locking nut (38—Fig. FO73) and washer from front end of draft control link and fork assembly (35). Note: Hold pressure against spring (36) to keep parts from flying when nut (38) is removed.

Remove nut (28—Fig. FO72), spring (27) and washer (26) from outer end of control lever shaft (21). Unbolt and remove lever (29) from friction plate (25). Slide friction plate from shaft and remove Woodruff key. Note: If friction plate is frozen on shaft, consider the friction plate expendable and break it from shaft with chisel; do not batter end of shaft. Remove the four cap screws retaining the quadrant (23) to lift cover and slide quadrant from shaft. Remove cotter pin and nut from inner end of control shaft and slide the control lever (37—Fig. FO73) off of shaft.

Disconnect selector lever control link (47) from arm (48) and remove the control shaft and position control arm (46) with assembled parts from lift cover.

Selector lever (19—Fig. FO72) can be removed from arm (48—Fig. FO-73) after removing the pin retaining it to the arm. The arm can be removed from lift cover after removing the detent assembly (15, 16, 17 & 18 —Fig. FO72).

To disassemble the removed position control linkage, place head of bolt (44 — Fig. FO73) in vise and hold threaded plate (42) from turning while loosening lock nut (43). Renew pin "A" and/or pin "C" in control arm (46) or renew arm if pins are bent or damaged or if arm is twisted.

Pay particular attention to the draft control linkage as any defect in the linkage will affect both adjustment and operation of the system. Renew the draft control plunger (7—Fig. FO72) if shoulder has worn down where it contacts the plate (6) or if pin hole where it attaches to control link and fork assembly (35 — Fig. FO73) is elongated. (Pin should fit snugly, but should not bind.)

Control link and fork assembly (35) should be compared to a new part, if possible, to be sure that this part is not bent or twisted in any way. Renew the assembly if pin hole is elongated or if doubtful about straightness of part.

Renew pin "B" in control lever (37) if pin is bent. Pin should protrude far enough from lever to contact skirt of piston (cannot be checked unless lift cover and linkage is assembled). Renew lever if twisted or bent in any way, or if pivot holes are worn or elongated.

Reassemble linkage and cover in reverse of disassembly procedure. Tighten nut (38) until seated against shoulder on link (35). Leave lock nut (43) loose until linkage adjustments are made after reassembly. Refer to paragraph 123 for reassembling cylinder to lift cover.

123. **R&R LIFT CYLINDER ASSEMBLY.** After removing the lift cover assembly as outlined in paragraph 121, disconnect the control link (49 — Fig. FO73) from the control lever (37). Then, remove stud nuts on studs extending through the accessory plate (13 — Fig. FO72) and cover (8). Remove the accessory plate from top of lift cover and the cylinder assembly from bottom of cover.

Note: At tractor Serial No. NAA-20900, the accessory plate (13) was changed to accommodate "O" rings within the casting. The "O" ring retaining plate (14) is not used after this production change and is not available for service. If necessary to renew either the previous accessory plate or the "O" ring retaining plate, discard mating part and install the later type accessory plate. "O" ring usage depends upon type of accessory plate used.

When reinstalling lift cylinder assembly on lift cover, always use new gaskets (54 and 64—Fig. FO73). The round gasket spacers (54) must be of the exact same thickness as the cylinder gasket (64); therefore, do not attempt to reuse old gaskets or substitute gaskets of different material in either location.

Be sure that the gasket surface of both lift cover and lift cylinder are clean and free of burrs that would prevent proper sealing. Remove any burrs with a flat file. Place the gaskets on cylinder studs and install cylinder in position on lift cover. Install the accessory plate on top of cover using new "O" rings. Install lift cylinder retaining nuts, being sure that cylinder is pushed as far forward as clearance of studs in bolt holes will allow and that the cap screw holes in accessory plate and lift cover are aligned; then, tighten the nuts to a torque of 65-70 Ft.-Lbs. Reconnect the control valve link (49) to control lever (37). Prior to installing the lift cover assembly on the tractor, it is recommended that the control linkage be adjusted as outlined in paragraphs 119 and 120.

Note: At tractor Serial No. NAA-110272, the lift cylinder and lift cover were changed in production to incorporate six cylinder retaining studs instead of the five studs used previously. The later production service lift cover has six bolt holes with the sixth hole being closed with an aluminum plug. Only the cylinder having five studs is available for service; when renewing the later type cylinder, install the aluminum plug (8A—Fig. FO72) in unused hole in lift cover. Gaskets with either five or six bolt holes are available for service.

124. **LIFT SHAFT.** Remove lift cover from tractor as outlined in paragraph 121. Remove piston rod from cylinder lift arm. Remove lift arm from either end of shaft and pull or bump lift shaft and remaining arm from opposite side of lift cover. Bushings (31—Fig. FO73) fit loosely in lift cover and on shaft. Shaft and lift arms have master splines to insure correct reassembly. Reverse removal procedures to reinstall lift shaft and lift arms.

Note: Service replacement lift shaft may be shorter than original equipment shaft and have only one threaded hole in each end of shaft for lift arm retaining cap screws. Special self-locking cap screws and retaining washers are required to install this later type lift shaft. Tighten lift arm retaining cap screws evenly and only enough to hold end play out of lift shaft and arm assembly. Do not overtighten.

If end of lift shaft has two threaded holes for lift arm retaining cap screws, tighten all cap screws securely and bend tabs of lock plate against cap screw heads.

125. **SYSTEM RELIEF VALVE.** The relief valve is located in the pressure passageway in bottom of center housing (See Fig. FO77). To renew the relief valve, first remove the lift cover as outlined in paragraph 121, drain the hydraulic fluid, remove the relief valve baffle and remove the pump pressure (small) tube if equipped with vane type pump or the hydraulic tube and manifold assembly if equipped with a piston type pump. The pump relief valve can then be removed by driving the valve downward out of center housing. Note: If tractor is split between center housing and transmission for other service, the lift cover does not need to be removed to renew pump relief valve.

Drive new valve (See Fig. FO78) up through bore in center housing until shoulder (S) on valve is seated against center housing. Install the relief valve baffle, reinstall pump tube(s), refill reservoir and reinstall the lift cover assembly as outlined in paragraph 121.

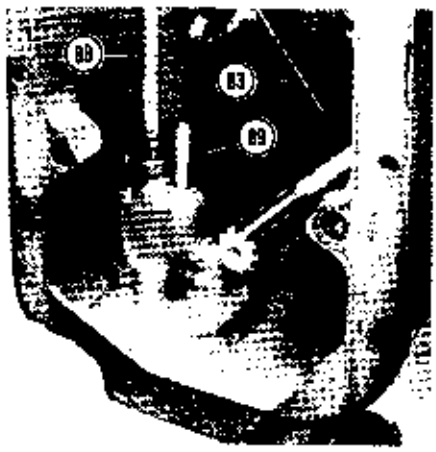


Fig. FO77—View showing location of system relief valve (89), and hydraulic pressure tube (88). Oil level dip stick is at (83). Relief valve baffle is not shown.

Fig. FO78—View of removed system relief valve. Latest type valve has six oil discharge holes; only three are visible. Shoulder (S) retains valve in center housing casting.

Note: The pump relief valve is pre-set at correct relief pressure at the factory and sealed with a drop of solder. Do not attempt to reset the relief valve pressure; renew valve assembly if valve is malfunctioning.

126. **SYSTEM BACK PRESSURE VALVE.** The back pressure valve (90—Fig. FO74) maintains approximately 40-45 psi back pressure within the system when the control valve is in neutral or lowering position. This back pressure is required to operate the unloading valve to direct oil to the lift cylinder piston whenever the control valve is placed in raising position.

The back pressure valve is located between the right side of the center (differential) housing and the lift cylinder. It is retained by a bushing on the valve that is threaded into the side of the center housing. The back pressure valve assembly can be removed after removing the lift cover assembly as outlined in paragraph 121. The threaded bushing, bushing

retaining snap ring and bushing sealing "O" ring are available for service; otherwise, the valve is serviced as an assembly.

The open end of the back pressure valve discharge tube must not be located near the pump suction tube opening in the bottom of the center housing. To insure that the valve stays in proper location when reinstaling the lift cover assembly, a clip (81) on the tube is placed over the top front stud bolt (S) that retains the inspection (dip stick) cover to the right side of the center housing. This stud has longer threads than the other three cover retaining studs and extends into the center housing. Do not secure the clip with a nut.

127. OVERHAUL LIFT CYLINDER ASSEMBLY. To overhaul the lift cylinder assembly, first remove the cylinder assembly as outlined in paragraph 123. As service of only one component of the assembly may be indicated, overhaul procedure for each component is outlined in the following paragraphs:

Note: The original production NAA hydraulic system valves were changed in a modification program to improve performance of the system. Although all tractors should have the later type valves, it is possible that some obsolete parts may be found when servicing the tractor lift system. If the control valve and bushing, unloading valve and bushing, check valve seat and valve, cylinder safety valve, system relief valve or back pressure valve do not correspond to the views shown or descriptions included in the text of this section, the parts should be discarded and the later type parts installed.

128. PISTON AND SEALING RINGS. To remove the piston from cylinder bore, direct low pressure air into the pressure passage to the piston. Inspect piston and cylinder bore for scoring or other defects that would damage piston sealing rings and renew piston and/or cylinder as necessary.

Note: If piston sealing rings are badly damaged or completely missing and piston and cylinder bore are smooth, it can be assumed that piston skirt is extending far enough in lift position to expose the sealing rings and they are being cut when reentering cylinder. Refer to Fig. FO79: If piston is original production ("A") type, discard piston and install later service replacement piston ("B"). CAUTION: Do not attempt to remove the black protective coating from the new service piston; the coating is applied to prevent the piston from scoring cylinder wall during break-in period.

Fig. FO79 — View showing early type "A" piston and later type "B" piston. "O" ring groove of "B" piston is closer to head of piston which helps prevent damage to piston sealing rings.

Soak new leather back-up ring (71—Fig. FO73) in hydraulic oil to soften leather prior to installing ring on piston. Install leather ring with rough side of leather towards front (closed) end of piston. Roll the rubber "O" ring over front end of piston into groove in front of the leather ring.

Note: Installation of the leather ring can be difficult as the leather must be stretched over the piston skirt. Some mechanics prefer to place the leather ring on the outside of a small band type ring compressor, expand the compressor over the piston skirt and slide the leather ring onto the piston.

Be sure the piston and cylinder bore are clean, lubricate piston and cylinder wall with hydraulic fluid and push piston, with closed end forward, into cylinder bore. A ring compressor may be used to aid in piston installation; however, the end of cylinder is chamfered and trouble is not usually experienced.

129. CONTROL VALVE AND BUSHING. To remove the control valve, first remove the retaining plate (65—Fig. FO73) and withdraw the control valve (53) and link assembly. The control valve return spring (57) may be removed at this time. After removing the cylinder baffle plate (59), the control valve bushing may be pressed out towards open end of cylinder.

The cylinder casting is color coded with a paint spot adjacent to the control valve bushing bore. The color code indicates the control valve outside diameter size range for use in selecting new bushing. Install a new control valve bushing having a blue color code if the paint spot on the cylinder is either white or blue; install a new bushing having a yellow color code if the paint spot on the cylinder adjacent to the bushing bore is yellow. To install bushing, insert chamfered end of bushing (See Fig. FO80) into front (closed) end of cylinder and press bushing in until flush with machined surface at rear (open) end of cylinder.

Note: The control valve bushing may be removed and installed with a special tool, Nuday Tool No. N-508; if tool is not available, the bushing may be removed and installed in a press providing a properly sized, smooth sleeve is used when pressing the bushing from the cylinder.

The fit of the control valve in the bushing requires extremely close tolerance and the proper size valve must be selected by trial and error as follows: Do not attempt to fit valve

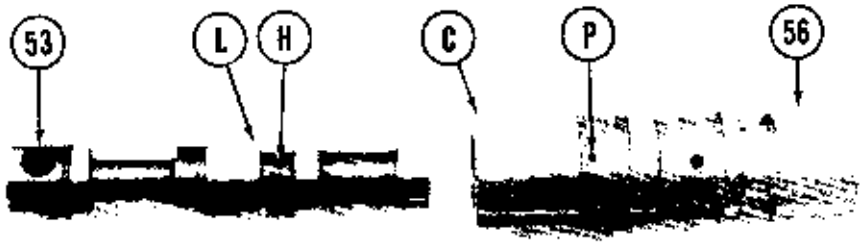


Fig. FO80—View of control valve spool and control valve bushing. Control valve land "L" covers port "P" in bushing retaining oil in lift cylinder; control valve moves to left when in lowering position opening port "P" allowing oil from cylinder to return to sump through hole "H" drilled through the hollow control valve spool. Oil flowing from right end of spool is discharged to sump through the cylinder baffle plate (59—Fig. FO73). Inspect control valve for erosion in approximate location of arrow pointing from "L".

in bushing prior to installing bushing in cylinder. After bushing is pressed into cylinder, lubricate a new control valve with hydraulic fluid and insert the valve into the bushing. For a proper fit, the valve should require light pressure to move within its normal range of travel but should not show any binding tendency. If valve tends to stick in bushing, select a smaller diameter valve for trial fit; if valve moves in bushing without any noticeable drag, select a larger diameter valve for trial fit.

Note: Control valve spools are available in three size ranges and are color coded white, blue and yellow indicating, in order, small, medium and large diameter size ranges. As the color code indicates a size range only and as diameter of valves may vary within 0.0002 in a size range, it is possible that a valve may fit properly while another valve of the same color code may be either too tight or too loose a fit in the bushing.

CAUTION: The color code on the control valve bushing indicates the size range of the outside diameter of the bushing only and has no relationship to the size or color code of the control valve spool. Do not attempt to fit a control valve to a bushing by matching color codes.

In some instances, to obtain proper fit of control valve to bushing, a number of valves may be tried without obtaining proper fit. If the supply of control valve spools available have been tried without obtaining a proper fit and another new bushing of correct color code is available, it is advisable to install a different bushing in the cylinder and try the fit of control valves again rather than to obtain more new control valves. It is probable that two bushings of the same color code (outside diameter) will have different inside diameters.

After proper size of valve is selected, remove link from old valve by grinding off end of riveted pin. Install control link on end of new control valve using new rivet. CAUTION: Take care not to strike the control valve while peening the end of the rivet as the valve material is very brittle and even a light blow could break one of the prongs off of the valve spool.

Reinstall baffle plate using new gasket. Drop control valve return spring into bushing bore and insert lubricated control valve in bushing. Install valve retainer plate.

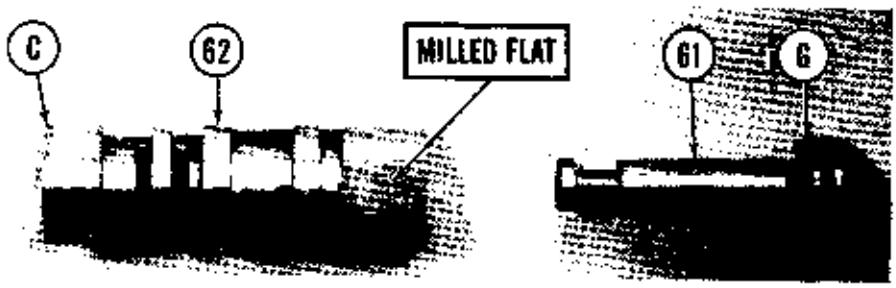


Fig. FO81—View of unloading valve (61) and unloading valve bushing (62). Milled flat on bushing must be aligned with the two threaded holes in the control valve casting as shown in Fig. FO82. Chamfered end (C) of bushing should be flush with machined surface at open end of lift cylinder.

130. UNLOADING VALVE AND BUSHING. The unloading valve is a shuttle type valve designed to rapidly direct the flow of oil from pump to lift piston during a draft correction or when it is desired to raise the lift arms and to rapidly unload the pump to prevent over-travel of the lift arms after a draft correction. When the control valve spool is in neutral or lowering position, oil pressure created by back pressure valve is directed to stem side of unloading valve piston with no pressure on unloading valve piston head. When the control valve is moved to lift position, back pressure is applied to both sides of unloading valve piston, and due to smaller area of stem side of piston, the unloading valve is moved to rear to block the by-pass from pump to reservoir. Oil from the pump is then directed to the lift piston. When control valve is returned to neutral, oil pressure on unloading valve piston head is released and pressure on stem side of piston returns the unloading valve to by-pass position.

To remove the unloading valve from cylinder, first remove the control valve retaining plate (65—Fig. FO73) and the cylinder baffle plate (59). Using a long thin punch or drift, drive the unloading valve (61) and plug (58) forward out of closed end of lift cylinder. The unloading valve bushing may be removed by pressing the bushing towards rear (open) end of cylinder. The bushing may be removed using a special tool, Nuday Tool No. N-508, or in a press using a smooth sleeve of proper diameter and length.

The cylinder casting is color coded with a paint spot adjacent to the unloading valve bushing bore. The color code indicates the bushing outside diameter range for use in selecting a new bushing. If the color code (paint spot) is white or blue, install a new bushing having a blue color code. If the paint spot is yellow, install a new bushing having a yellow paint spot. To install bushing, insert chamfered end (See Fig. FO81) into the bore at front (closed) end of cylinder and press bushing in until flush with machined surface at rear (open) end of cylinder. CAUTION: When inserting bushing into bore, be sure the milled flat on the bushing is aligned with the two threaded holes in cylinder as shown in Fig. FO82. If positioned otherwise, a leak and malfunction of the lift system will result.

Only one size of unloading valve is available. Lubricate the valve and insert it in the bushing prior to installing "O" ring in groove (G— Fig. 81) on valve piston. The valve should move freely in the bushing without bind or drag. Withdraw the valve and install "O" ring. The valve should then fit in the bushing with a slight drag fit. "O" rings may vary in size slightly and selecting another "O" ring of same part number is indicated if valve binds or no perceptible drag due to "O" ring is noted.

CAUTION: Do not use an "O" ring of unknown quality on unloading valve piston. Some "O" ring materials may expand due to contact with hydraulic oil while other materials may contract. Either condition is likely to cause malfunction of the hydraulic system.

After unloading valve and bushing are installed in cylinder, drive plug (58—Fig. FO73) into bore at front (closed) end of cylinder. Install the control valve retaining plate and cylinder baffle plate using a new baffle plate gasket. Note: Only one size of unloading valve plug is available for service.

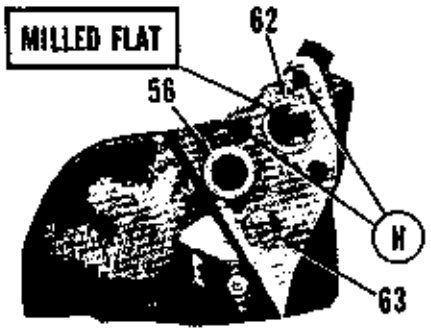


Fig. FO82—View of front (closed) end of the hydraulic lift cylinder. The milled flat on the unloading valve bushing must be installed in line with the two threaded holes (H) as shown. Also shown are the control valve bushing (56) and the check valve seat (63).

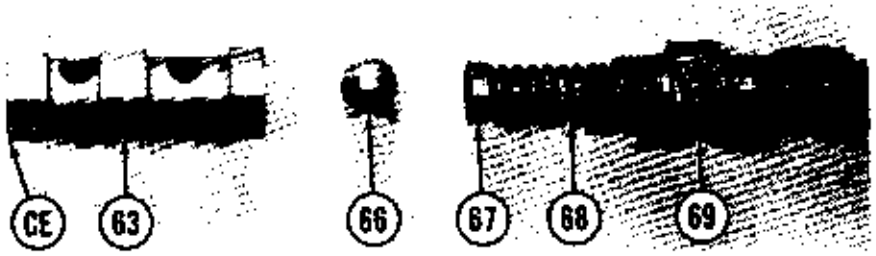


Fig. FO83—View showing check valve seat (63), check valve (66), check valve pilot (67), check valve spring (68) and cylinder safety valve (69) in order of assembly. Closed end (CE) of check valve seat should be installed flush with machined surface at closed end of lift cylinder as shown in Fig. FO82.

131. CYLINDER SAFETY VALVE AND SYSTEM CHECK VALVE. The cylinder safety valve (69—Fig. FO73) is threaded into a bore at the machined rear face of cylinder casting and retains the system check valve (66), check valve pilot (67) and check valve spring (68). The safety valve is serviced only as an assembly including the check valve spring and check valve pilot as shown in Fig. FO83. It is possible to renew the safety valve without first removing the lift cover by working through the pto shifter plate opening in left side of center housing. Take care not to loose the check valve (steel ball), check valve pilot or check valve spring. Be sure that there is no pressure in cylinder before removing safety valve.

The safety valve is pre-set at 2700 psi at the factory and the adjustment is sealed with a drop of solder. Do not attempt to repair or reset the safety valve; renew the valve if it leaks or if pressure setting is not correct. The valve is designed to operate only due to shock loads imposed on the cylinder through the lift linkage. The safety valve may be bench tested by using a high capacity hand pump (such as an injector tester) and a 3000 psi capacity gage.

To remove the check valve seat (63), remove lift cylinder as outlined in paragraph 123 and remove baffle plate from front (closed) end of cylinder. Remove safety valve, check valve spring, check valve pilot and check valve (steel ball); then, using a long thin punch or drift, drive check valve seat out towards front end of cylinder. The 90 degree check valve seat has aproximately 1/64-inch chamfer and should be renewed if chamfer becomes excessive or seat becomes chipped or rough. Renew the damaged in any way.

When renewing the check valve seat, install new seat having a blue color code if the paint spot adjacent to the check valve bore on cylinder casting is white or blue; install seat having yellow color code if the paint spot on the cylinder is yellow. Do not allow the new seat to become cocked in the cylinder bore while driving it in bore at front (closed) end of cylinder. When properly installed, the closed end of the seat will be flush with the machined surface of cylinder as shown in Fig. FO82. Drop steel ball into seat and install cylinder safety valve with check valve spring and pilot attached as shown in Fig. FO83.

PUMP AND OIL TUBES

A Vickers vane type pump was used as original production equipment on the NAA tractor hydraulic system. Output of the vane type pump was variable from 1.25-4.8 G.P.M.* by turning the Hy-Trol knob (17—Fig. FO87) on the pump.

A later Ford designed piston type 2.5 G.P.M.* pump (See Fig. FO89) is now available as a service replacement for the vane type pump. Installation of the piston type pump requires different hydraulic pump suction and pressure tubes and a different engine oil pressure gage line and fittings than used with the vane type pump.

Note: It is possible to install on the model NAA tractor a 4.0 G.P.M.* piston type pump that is designed for later Ford tractors as outside and mounting dimensions are identical to the 2.5 G.P.M. pump. However, this is not generally recommended as the higher capacity pump may cause the hydraulic system to over-correct in draft control. Use of the 4.0 G.P.M. pump is desirable only in certain instances such as operating front end loaders, etc.

*At 2000 engine RPM, 0-100 psi.

132. R&R HYDRAULIC PUMP. Removal procedure is as follows: Disconnect Proofmeter cable. If equipped with a live power take-off clutch, loosen jam nut on pto pump adapter and disconnect both oil lines at pto pump. Disconnect suction and pressure lines from hydraulic pump; then, unbolt and remove pump from tractor. Unscrew pto pump from rear end of hydraulic pump if so equipped.

Reinstall pump by reversing removal procedures. It is helpful in priming pump to fill it with oil prior to installing pump on tractor. Pour oil into intake opening and turn pump in direction of normal rotation until oil comes out pressure opening. If pump does not prime itself readily after starting engine, one or more of the following methods may be used to prime pump: (1) Loosen plug in front cover of piston pumps or plug at lower front corner on left side of center housing if equipped with a vane type pump and turn engine over with starter until oil flows; (2) Apply air pressure momentarily into oil reservoir through oil dip stick hole while engine is running; or (3) head tractor down ramp or raise rear end of tractor while engine is running.

Note: If installing a piston type pump as a replacement for a vane type pump, following steps and precautions should be noted: Drain hydraulic reservoir and remove pump tubes from bottom of center housing. Remove existing engine oil pressure gage line and fittings and install line and fittings designed for use with piston pump. Lay a cloth over oil pressure gage line fitting in side of engine block; then, install pump on mounting boss using one new gasket. Gradually tighten the mounting bolts; if cloth cannot be removed as the bolts become tight, there is not sufficient clearance between the pump and fitting. A small amount of clearance may be gained by grinding material from fitting or pump. In some instances, considerable interference is encountered. In these cases, the gage line fitting must be re-

moved from engine block, boss on block ground down and the threads cut deeper in the block. Any cuttings from this operation can be flushed out by starting engine before reinstalling fitting. CAUTION: Tightening pump down tightly where there is interference between pump and oil pressure gage line fitting may cause breakage of pump drive housing at bolt holes, an oil leak or noisy pump drive gears. After making certain that no interference exists, complete re-installation of pump and associated parts.

133. OVERHAUL VANE PUMP.

Note: Rather than make extensive repairs on the vane type pump, it is recommended that a piston type pump be installed due to comparative costs and extended service life. See note following paragraph 132.

Disassembly of the vane type pump is evident from examination of the unit and reference to the exploded view of the pump in Fig. FO87. Note: Pump is shown inverted from mounting position on tractor.

Carefully inspect for wear at the following points: Internal diameter of cam ring (21), fit of vanes (23) in rotor (22), flat surface of pump body (31) and pressure plate (20), oil seal contact surface and splines on pump shaft (26) and check shaft bearings (27) and (30).

Fig. FO85 — When installing pump shaft oil seal use a tool that contacts only the outside diameter of seal.

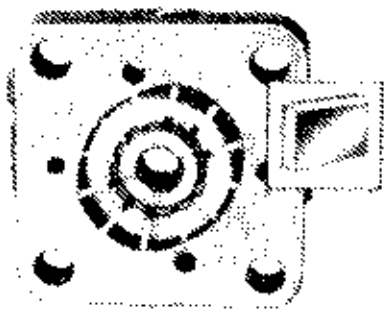


Fig. FO86 — Pump rotor vanes should be installed with rounded edge outward.

A service repair kit consisting of a new, wider rotor (22), vanes (23), cam ring (21) and longer manifold (9) has been available for some time and has probably been installed in most vane type pumps. Also included in the kit is a wire spring ring that is to be placed between the pump pressure plate (20) and cover (14). If equipped with original production narrow cam ring, vanes and rotor, front end of shaft (26) will be almost flush with front face of rotor when pump cover assembly and pressure plate are removed from pump. If the later wide vane kit has been installed, the front end of shaft will be slightly more than 3/16-inch below flush with front face of rotor.

Lubricate pump parts in hydraulic oil prior to reassembly and reassemble using all new "O" rings, gaskets and seal. Install the seal (29) with the two small drilled holes in seal shell facing rearward (towards pump drive gear). Install pump cam ring (21) with arrow on side of ring placed in direction of pump rotation. Reinstall pump as outlined in paragraph 132.

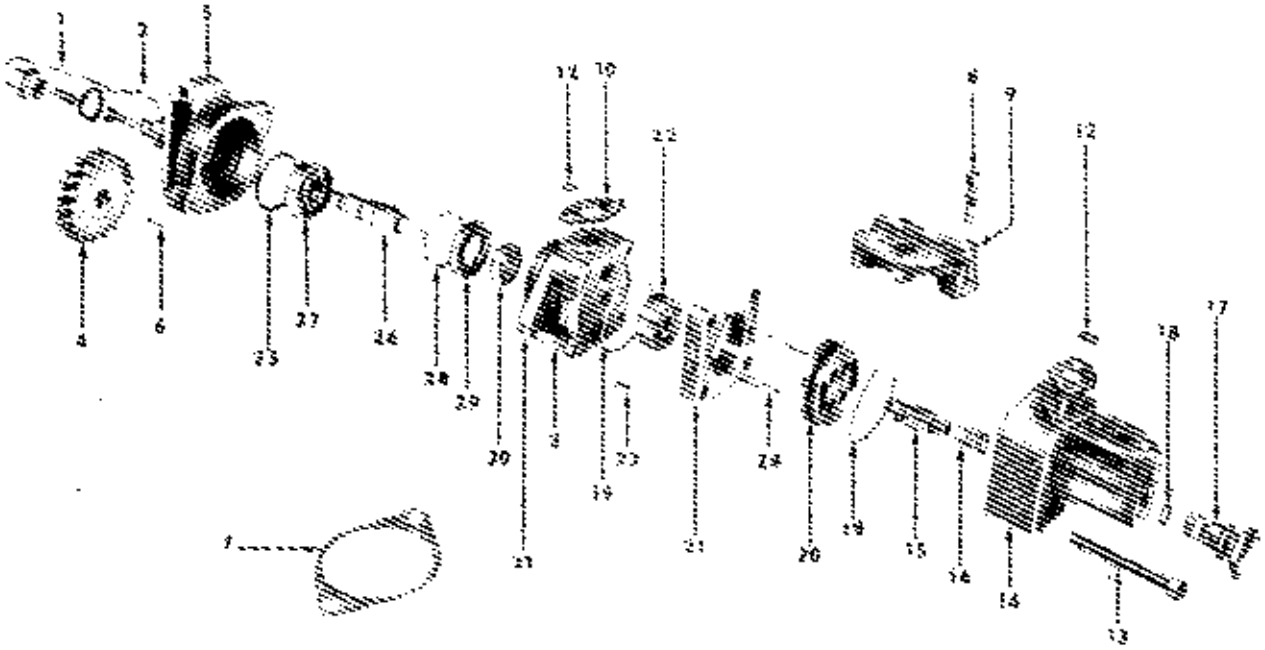


Fig. FO87—Components of original production vane type pump used in NAA hydraulic system.

1. Proofmeter drive
2. Proofmeter drive
3. Cap screw
4. Gear
5. Mounting housing
6. Square key
7. Gasket
8. Cap screw
9. Manifold
10. Gasket
12. "O" ring
13. Cap screw
14. Pump cover
15. Flow control plunger
16. Spring for plunger 15
17. Flow control valve (adjustable)
18. "O" ring
19. "O" ring
20. Pressure plate
21. Ring for rotor 22
22. Pump rotor
23. Rotor vane (kit)
24. Dowel pin
25. Snap ring
26. Pump shaft
27. Shaft outer bearing
28. Spacer
29. Shaft seal
30. Shaft inner bearing
31. Pump body

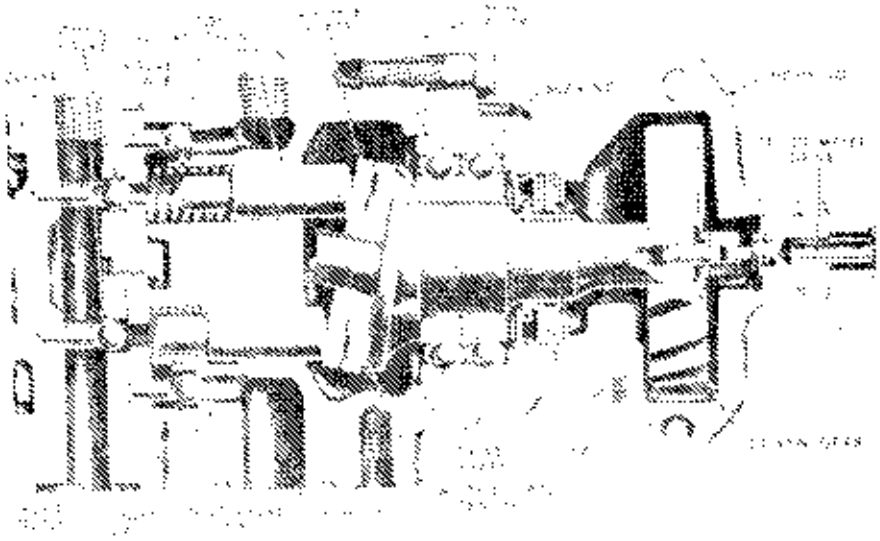


Fig. FO89—Cross-sectional view of piston type pump available for service installation on the NAA tractor.

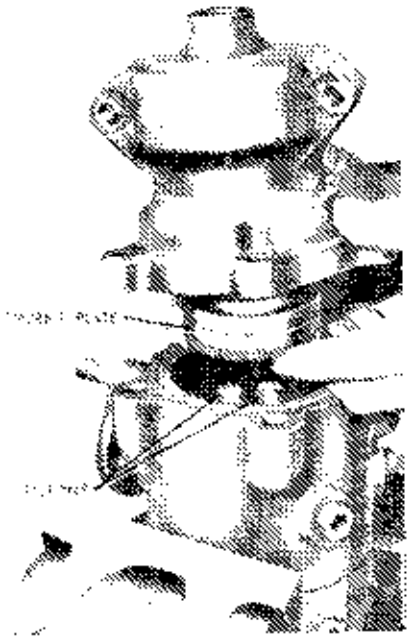


Fig. FO90—Always remove the drive housing end from pump first and install last when servicing piston type pump. This will eliminate pressure from piston springs interfering with removal and installation of head end of pump.

134. **OVERHAUL PISTON PUMP.** Refer to Fig. FO89 and proceed as follows: Remove pump as outlined in paragraph 132. Clamp pump in vise and remove the four cap screws retaining drive housing assembly to pump body, and remove the housing and drive assembly (See Fig. FO90). The wobble plate and wobble plate bearing assembly will fall from the shaft when the housings are separated. Extract the six pumping pistons and piston return springs. Remove the six cap screws retaining the front cover to pump body and carefully pry cover from body. Take care not to lose the six inlet valves (steel balls) and valve springs. Inlet valve seats may be removed from the pump body using a Nuday Seat Remover Tool No. NCA-600-G or equivalent.

Remove the hex head or Phillips head screw retaining the valve plate to front cover. Then, using a straight drift or punch inserted in the oversize bolt in cover, drive valve plate from cover. Be careful not to lose the six outlet valves (steel balls) and springs.

To disassemble drive end of pump, remove the Proofmeter adapter from rear end of housing and the slotted hex head cap screw and lockwasher from rear end of pump drive shaft. Using a long thin punch inserted in hollow end of drive shaft, drive the shaft and bearing assembly out of housing and remove the pump drive gear. The drive shaft may be equipped with either a double row ball bearing assembly as shown in Fig. FO89 or a tapered roller bearing and a needle bearing as illustrated in Fig. FO92. Method of further disassembly of either type drive unit is obvious. Renew the double row ball bearing if drive shaft shows any tendency to rock in bearings. Shaft on later type drive unit should fit without side play in needle bearing, but normal wear in tapered bearing is taken up by end thrust from pumping pistons.

Carefully clean, inspect and renew parts as necessary. Pistons must fit freely in bores and although a close fit of pistons to bores is desirable, considerable wear can be tolerated; whereas, a binding condition cannot.

A pump repair kit containing all necessary gaskets, "O" ring, drive shaft seal, inlet and outlet valves, valve springs, inlet valve seats and piston return springs is available or the necessary parts may be purchased separately. If using the repair kit, discard the piston return springs and pump body to valve plate gasket not applicable to the size pump being overhauled. In addition to the parts included in the repair kit, is it recommended that the valve plate be renewed also.

When renewing drive shaft seal, it is recommended that the spring loaded lip of the seal be installed towards the drive gear (rear) end of the pump instead of towards the front as shown in Figs. FO89 and FO92. The seal is located on the suction side of the pump. Lubricate the lips of the shaft seal with Lubriplate or similar grease when reassembling pump.

Reassembly procedure is as follows: Install inlet valve seats with sharp edge out in pump body using Nuday Seat Driver Tool No. NCA-851 or equivalent. Press double row ball bearing (or tapered roller bearing cone, if so equipped) onto pump drive shaft. Install needle bearing, if so equipped, in drive housing. Note: Press on lettered end of bearing cage only. Drive new seal into drive housing with spring loaded lip of seal towards drive gear. Lubricate lips of seal (and needle bearing, if so equipped), with Lubriplate or similar grease. Position drive gear in housing with flat side to front of pump and insert drive shaft through bearings, seal and drive gear. Install and tighten the slotted head cap screw and lock washer in rear end of drive shaft and install Proofmeter adapter using new gasket.

Place the pump cover in a vise with the valve face upward and install

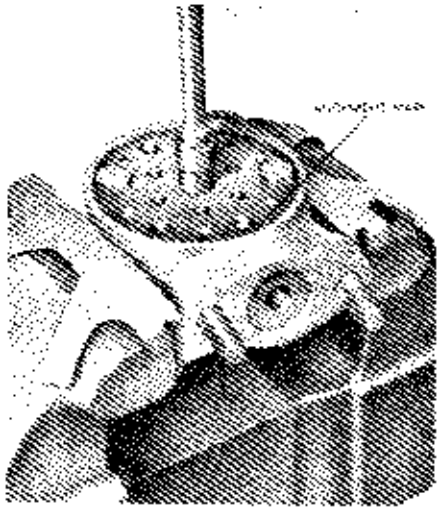


Fig. FO91—Place alignment mark as shown and use two bolts as guide pins when installing outlet valve plate in front cover of pump. Retaining screw may be either a hex head cap screw or a Phillips screw.

valve plate to cover gasket. NOTE: The alignment marks on the valve plate and gasket must be positioned at the bolt hole at the manifold outlet as shown in Fig. FO91. Assemble the outlet valve springs and balls into the pump cover and position the valve plate over the outlet valve balls. Insert the center retaining capscrew, and making sure that alignment marks are properly registered, tighten the capscrew. Apply a small amount of grease on the valve plate gasket and position the gasket on the valve plate. Place small end of inlet valve springs on inlet valve stop pins and remove cover assembly from vise. Clamp pump body in vise and insert inlet valve balls. Carefully position cover over pump body and check alignment of springs. Secure cover and tighten the capscrews to a torque of 40 to 50 Ft.-Lbs.

Invert the pump and insert the piston return springs in the piston bores. Coat the pistons with a light coat of oil and install same with the crowned end upward. Install new "O" ring in pump body groove. Position wobble plate bearing and wobble plate on the pump shaft and while holding the wobble plate in position install shaft and housing assembly as shown in Fig. FO90. Apply sufficient pressure on end of drive housing to start capscrews and tighten the capscrews to a torque of 40 to 50 Ft.-Lbs.

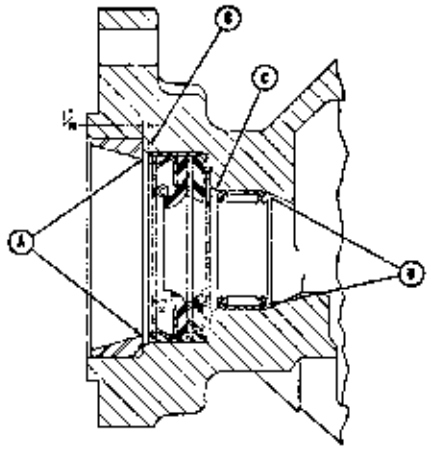


Fig. FO92—Later production of the piston type pump incorporates a tapered roller bearing and a needle roller bearing. Bearing and seal placement is as shown. Refer to text for recommendation on seal installation.

135. **HYDRAULIC TUBES.** On tractors equipped with a vane type pump, individual suction and pressure tubes connect the pump to the hydraulic reservoir (differential center housing). On tractors equipped with a piston type pump, the pump suction and pressure lines are permanently attached to a manifold which bolts to the pump but have separate attaching manifolds at bottom of differential center housing. Tube manifolds are sealed with "O" rings. Early production tubes for vane type pumps require spacers as the manifolds have no grooves for "O" rings.

In addition to the external tubes, a pressure transfer tube (88—Fig. FO 74) is located internally in the center housing. The pressure transfer tube may be removed when hydraulic lift cover and hydraulic pump pressure tube are removed by driving the tube upward out of the center housing. Apply Loctite to ends of new tube before driving it into place.

HYDRAULIC ATTACHMENTS

Many different hydraulic attachments have been available for the model NAA Ford tractor and space available does not permit complete coverage of all control valves and cylinders that may be found on these tractors. The two control valves discussed in paragraphs 136 and 137 were available for field installation at the time the NAA tractor was in production and

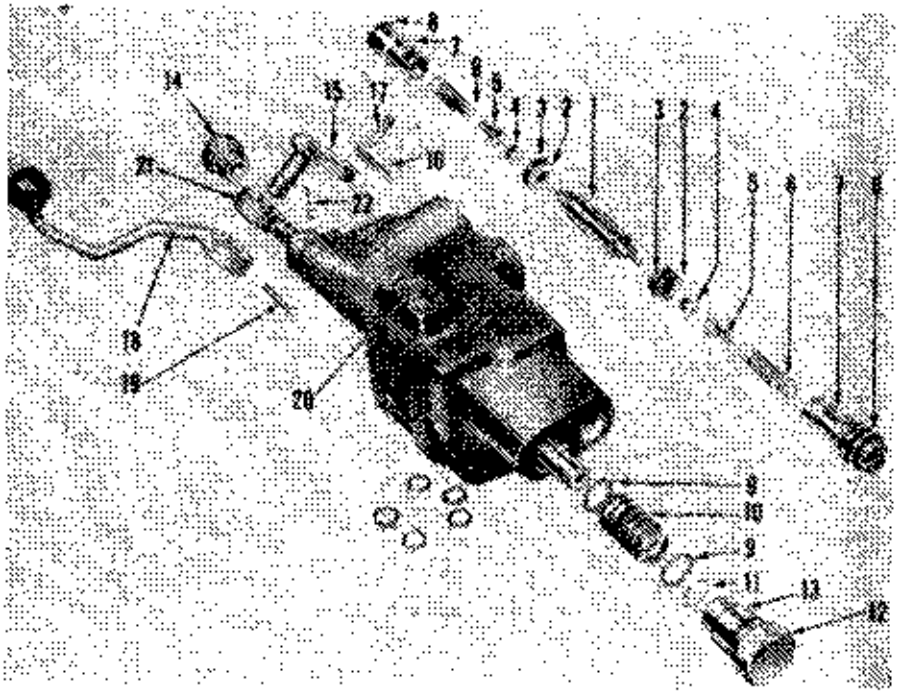


Fig. FO95 — Exploded view of two-way remote control valve that was available as an accessory for model NAA tractors.

1. Shuttle valve
2. Check valve seat
3. "O" ring
4. Check ball
5. Spring guide
6. Spring
7. Spring retainer
8. "O" ring
9. Washer
10. Spring
11. Snap ring
12. Cap
13. "O" ring
14. Retainer
15. Lever arm
16. Link
17. Pin
18. Control lever
19. Pin
20. Plug
21. Eye bolt
22. Pin

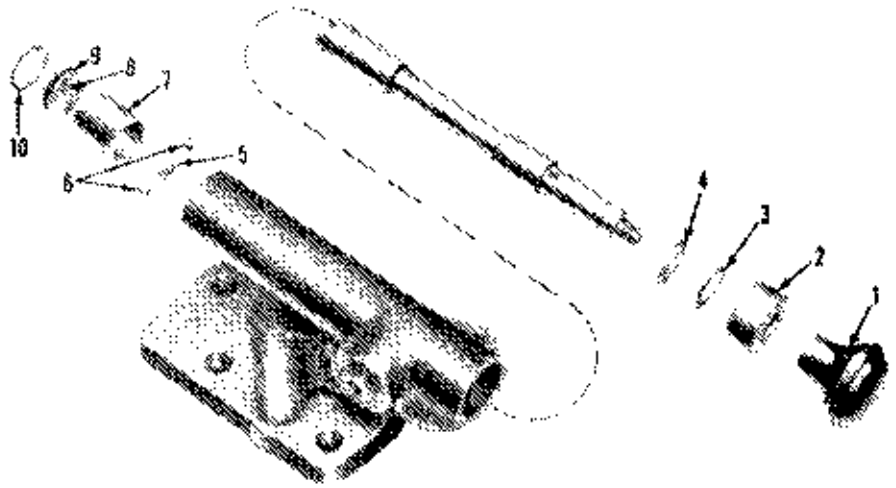


Fig. FO96 — Exploded view of "Selec-trol" valve that was available as an accessory for NAA tractors. Valve permits operation of single acting remote cylinders from tractor lift system control valve.

1. Knob
2. Seal
3. Snap ring
4. Washer
5. Detent spring
6. Detent ball
7. Detent sleeve
8. Plug
9. "O" ring
10. Snap ring

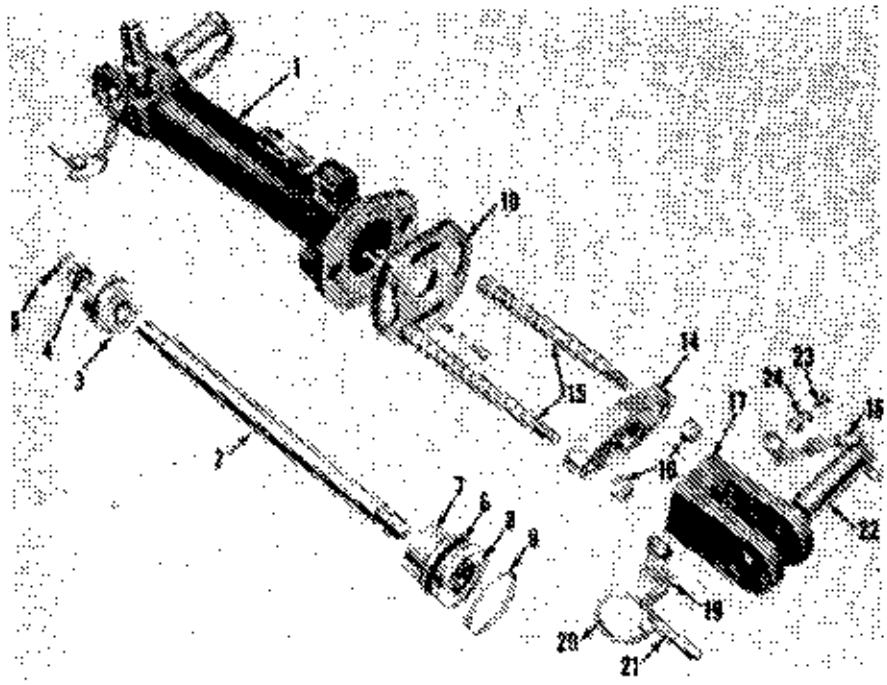


Fig. FO97 — Exploded view of double-acting remote cylinder. Cylinder has 2¼-inch bore and 8-inch stroke, and develops 7500 pounds thrust at 2000 psi. Cylinder may be converted to single-acting operation. See paragraph 138.

1. Cylinder tube
2. Piston rod
3. Piston
4. Nut
5. Cotter pin
6. "O" ring
7. Packing gland
8. Seal
9. Retaining ring
10. Stroke adjusting plate
14. Stop plate
15. Stroke adjusting rods
16. Lock nuts
17. Yoke

service parts are still available for these units. The two-way remote cylinder discussed in paragraph 138 is still available as a complete assembly.

136. **REMOTE CONTROL VALVE.** Refer to Fig. FO95. Although this valve is no longer available as a complete assembly, many may still be found in service. All parts are available for service except the control valve body and the control valve spool. Disassembly procedure is evident from the exploded view shown in Fig. FO95. The valve is not equipped with a separate relief valve; refer to paragraph 125 for information on the system relief valve.

137. **"SELEC-TROL" VALVE.** Refer to Fig. FO96. The "Selec-Trol" valve is used to direct fluid flow from the tractor hydraulic pump to either a one-way remote cylinder or to the tractor hydraulic system. The tractor hydraulic lift control lever is utilized to operate the one-way remote cylinder; therefore, no pressure can be directed to the remote cylinder if the tractor lift arms are at extreme top position as this places the tractor control valve in neutral position. Disassembly of the "Selec-Trol" valve is evident from examination of the unit and from reference to the exploded view shown in Fig. FO96.

138. **TWO-WAY REMOTE CYLINDER.** Refer to Fig. FO97 for exploded view of cylinder. Disassembly and overhaul procedure is evident from examination of unit and reference to exploded view.

The cylinder may be converted for use as a single-acting cylinder by installing a breather, Part No. 250225, in the piston rod end port.

The cylinder ports are ½-inch pipe thread. In case of leakage at the port threads, install a sealing nut, Part No. B9NN-B848-A, on the hose connections and, after tightening connection in port, tighten the sealing nut down against the port boss. Install nut with nylon face towards the cylinder. The port boss may have to be filed flat on some cylinders.