8N
FORD TRACTOR

SERVICE TRAINING MANUAL

PREPARED BY THE SERVICE DEPARTMENT
DEARBORN MOTORS CORPORATION
DETROIT 3, MICHIGAN

Ford TRACTOR

Dearborn FARM EQUIPMENT

FOREWORD

This manual contains materials for use in connection with the 8N FORD TRACTOR ADVANCED SERVICE TRAINING PROGRAM. It is designed to help you train dealer service personnel in the latest methods of servicing and overhauling the 8N Ford Tractor. This knowledge is one of the important fundamentals to our over-all objective of providing quality service to the owners of Ford Tractors and Dearborn Farm Equipment.

ADVANCED SERVICE TRAINING OUTLINE
FOR
8N FORD TRACTOR

The Service Training conference topics outlined below, represent related material that will be presented to the entire group in training on a directed conference basis, prior to actual performance of Service Training Jobs.

The Service Training Jobs listed below are the jobs personnel in Training will be required to perform in connection with and following each training conference outlined in the left hand column.

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
INTRODUCTION TO 8N FORD TRACTOR ADVANCED SERVICE TRAINING PROGRAM I. ABC's of Quality Service A. Introduction B. The Formula for Quality Service C. The Key to Quality Service II. Service Training and Its Relationship to Quality Service III. The 8N Ford Tractor Advanced Service Training Program A. Specific Objective of the Program B. Organization of Training Material IV. Conference Conclusion	1	1	**DISASSEMBLY OF 8N FORD TRACTOR FOR TRAINING PURPOSES** I. Draining the Tractor II. Removing the Hood III. Removing the Radiator IV. Removing the Battery and Tool Box V. Removing the Air Cleaner and Battery Rack VI. Removing the Wiring Harness VII. Removing the Engine Accessories VIII. Removing the Instrument Panel IX. Removing the Steering Assembly, Seat and Fenders X. Removing the Engine XI. Removing the Transmission	1	1¼
ENGINE AND CLUTCH ASSEMBLY I. Introduction A. Tie-in with previous conference B. Subject of conference C. Objectives	2	¾	**SERVICING THE VALVES AND CAMSHAFT** I. Removing Valve Assemblies II. Removing, Checking and Replacing the Camshaft III. *Grinding Valves and Valve Seats (Demonstration)*	2	1 1

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
ENGINE AND CLUTCH ASSEMBLY—Contd. II. Basic Principles of Four Cycle Internal Combustion Engine Operation A. Principle parts of such an engine B. Operation—the four strokes of a cycle C. Summary of operation III. 8N Ford Tractor A. Importance of servicing B. Servicing the valves C. Servicing the camshaft D. Servicing the rods, pistons and cylinders E. Servicing the camshaft and flywheel F. Engine lubrication IV. The Clutch A. Construction and operation B. Servicing the clutch assembly V. Conference Conclusion			**SERVICING THE VALVES AND CAMSHAFT—Contd.** A. *Cleaning* B. *Refacing valves* C. *Reseating Valve seats* D. *Testing refaced valves and seats* IV. Installing Valves **SERVICING THE RODS, PISTONS AND CYLINDERS** I. Removing the Rods and Pistons II. Servicing Piston Rings III. Removing and Replacing Piston Pins and Bushings IV. Renewing the Rod Bearing Inserts V. *Checking the Piston (Steel) Clearance, Removing and Installing Cylinder Sleeves (Demonstration)* VI. Installing Rods and Pistons **SERVICING THE CRANKSHAFT, CLUTCH FLYWHEEL ASSEMBLY AND OIL PUMP** I. Removing the Crankshaft II. Renewing the Crankshaft Oil Seals III. Checking Crankshaft Journals and Replacing the Bearing Shells IV. Checking the Oil Pump V. Installing the Crankshaft VI. Installing the Rods and Pistons VII. *Renewing the Flywheel Ring Gear (Demonstration—Optional)*	3 1 4	¾ 1¾
TRANSMISSION ASSEMBLY I. Introduction A. Tie-in with previous conference B. Usefulness of the tractor C. Objectives II. The 8N Ford Tractor Transmission A. Construction and operation B. The main drive gear C. The reverse idler gear assembly D. The transmission shift assembly E. Servicing the transmission	3	1	**TRANSMISSION ASSEMBLY OVERHAUL** I. Disassembling the Gearshift Unit II. Reassembling the Gearshift Unit III. Disassembling the Transmission IV. Servicing the Reverse Idler Gear Assembly V. Servicing the Countershaft Assembly VI. Servicing the PTO Shifter Assembly VII. Servicing the Main Shaft Assembly	5	3¼

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
TRANSMISSION ASSEMBLY—Contd. III. The PTO Shifter Assembly A. Function B. Construction and Operation C. Servicing the PTO Shifter Assembly IV. Conference Conclusion			**TRANSMISSION ASSEMBLY OVERHAUL—Contd.** VIII. Servicing the Main Drive Gear and Shaft IX. Complete Transmission Assembly		
FINAL DRIVE AND BRAKES I. Introduction A. Tie-in with previous conference B. Objectives II. The Final Drive A. Basic Parts III. Servicing The Final Drive A. Drive Shaft B. Drive Pinion C. Ring Gear and Differential D. Rear Axle Assembly IV. Conference Conclusion	4	¾	**SERVICING THE DRIVING PINION** I. Removing The Pinion Assembly II. Disassembling The Pinion Unit III. Assembling The Pinion IV. Removing and Replacing The Rear Pinion Bearing V. Installing the Pinion Gear	6	1½
			SERVICING THE DIFFERENTIAL I. Removing the Differential II. Disassembling the Differential III. Assembling the Differential IV. Removing and Replacing the Differential Bearing Cup	7	1
			SERVICING THE REAR AXLE I. Disassembling the Rear Axle II. Renewing the Rear Axle Bearing (Outer) III. Servicing the Rear Axle Bearing Cup (Outer) IV. Reassembling the Rear Axle Unit	8	1
			SERVICING THE BRAKES I. Removing the Brake Shoes II. *Relining Brakes (Demonstration)* III. Installing the Brake Shoes IV. Adjusting the Brakes	9	½ ½
			PARTIAL ASSEMBLY OF THE TRACTOR I. Attaching the Transmission to the Center Housing II. Attaching the Engine to the Transmission Housing III. Attaching the Front Axle Assembly IV. Completing the Assembly	10	½

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
STEERING ASSEMBLY, FRONT AXLE, WHEELS AND TIRES I. Introduction A. Tie-in with previous conference B. Objectives II. Front Axle Assembly A. Construction B. Servicing the Front Axle Assembly and Front Wheels III. Steering Assembly A. Construction and Operation B. Servicing the Steering Assembly IV. Liquid Weighting Tires A. Introduction B. What Liquid Weighting Is C. What solution is best D. Liquid Weighting Procedure V. Conference Conclusion	5	¾	**SERVICING THE STEERING ASSEMBLY** I. Disassembling the Steering Unit (with unit removed from the tractor) II. Replacing the Lower Bearing Cup III. Replacing the Sector Shaft Housing Bushing IV. Reassembling and Adjusting the Steering Unit	11	1¼
			SERVICING THE FRONT AXLE I. Replacing the Axle Pin Bushing (Hood, Radiator, and Engine accessories Removed) IA. Replacing the Axle Pin Bushing (Hood, Radiator and all accessories on the tractor) II. Replacing the Spindle Bushings III. Replacing the Front Wheel Bearings IV. Adjusting the Toe-In	12	1
			LIQUID WEIGHTING TIRES *(Demonstration)* I. *Filling the Tires With Liquid* II. *Emptying Liquid From The Rear Tires* III. *Front Tires*	13	1
ENGINE ACCESSORIES (Non-Electrical) I. Introduction A. Tie-in with previous conference II. The Manifold A. Function B. Servicing III. The Carburetor A. Function B. Construction and Operation C. Servicing IV. The Air Cleaner A. Introduction B. Servicing	6	¾	**SERVICING THE GOVERNOR** I. Removing the Governor From the Tractor II. Disassembling the Governor III. Overhauling the Governor IV. Assembling the Governor	14	¾
			SERVICING THE CARBURETOR I. Removing the Carburetor from the Tractor II. Disassembling the Carburetor III. Assembling the Carburetor IV. Adjustment	15	½

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
ENGINE ACCESSORIES (Non-Electrical)—Contd. V. The Governor A. Function B. Construction C. Operation D. Servicing VI. The Oil Filter A. Function B. Operation C. Servicing D. Breather Cap VII. Conference Conclusion			**SERVICING THE WATER PUMP** I. Removing the Water Pump from the Tractor II. Disassembling the Water Pump III. Replacing the Water Seal Assembly IV. Assembling the Water Pump	16	½
THE ELECTRICAL SYSTEM I. Introduction A. Tie-in with previous conference B. Objectives II. Basic Principles of an Electrical System A. Introduction B. Ignition C. Starter and Generator D. The Regulator III. Servicing the Electrical System A. The Battery B. The Coil, Breaker Points, Condenser and Distributor Cap C. The Spark Plugs IV. Conference Conclusion	7	1	**SERVICING THE GENERATOR** I. Removing the Generator from the Tractor II. Disassembling the Generator III. Cleaning and Inspecting the Generator IV. Assembling the Generator V. Adjusting the Generator VI. Installation on the Tractor	17	½
			SERVICING THE DISTRIBUTOR I. Removing the Distributor from the Tractor II. Disassembling the Distributor III. Replacing and Adjusting the Points IV. Basic Timing of the Distributor	18	½
			SERVICING THE STARTER I. Removing the Starter from the Tractor II. Disassembling the Starter III. Cleaning and Inspecting the Starter IV. Assembling the Starter V. Disassembling the Bendix VI. Assembling the Bendix VII. Installing the Starter on the Tractor	19	½
			NOTE: Installation of Accessories		½

CONFERENCE TOPIC	CONFERENCE GUIDE NO.	TIME (HRS.)	SERVICE TRAINING JOBS	JOB PLAN NUMBER	TIME (HRS.)
THE HYDRAULIC CONTROL I. Introduction II. Construction of the Ford Tractor Hydraulic Control A. Introduction B. The Hydraulic Pump C. The Hydraulic Lift Cover Assembly III. Operation A. Introduction B. The Hydraulic Pump C. The Hydraulic Lift Cover Assembly IV. Servicing the Hydraulic Control A. The Pump B. The Lift Cover Assembly V. Conference Conclusion	8	1	**SERVICING THE HYDRAULIC PUMP** I. Removing the Hydraulic Pump from the Tractor II. Disassembling the Hydraulic Pump III. Cleaning and Inspecting the Hydraulic Pump IV. Assembling the Hydraulic Pump **SERVICING THE HYDRAULIC LIFT COVER ASSEMBLY** I. Removing the Hydraulic Lift Cover Assembly from the Tractor II. Disassembling the Hydraulic Lift Cover Assembly III. Cleaning and Inspecting the Hydraulic Lift Cover Assembly IV. Assembling the Hydraulic Lift Cover Assembly V. Adjusting the Hydraulic Control Mechanism VI. Installing the Hydraulic Lift Cover Assembly on the Tractor	20 21	1 1½
PRE-DELIVERY CHECK AND ENGINE ANALYSIS I. Introduction A. Tie-in with previous conference B. Objectives II. Pre-Delivery Check A. Introduction B. What constitutes a complete pre-delivery check III. Engine Analysis A. Introduction B. Selling Service C. The Owners Service Test Set IV. Conference Conclusion	9	½	**PRE-DELIVERY CHECK** **OWNERS SERVICE TEST SET (DEM.)** **ENGINE ANALYSIS** I. Battery Capacity and Condition Test II. Starter Amperage (Cranking Engine) Test III. Starter Amperage (No Load) Test IV. Starter Circuit Resistance Test V. Tachometer Test VI. Voltage, Regulator and Voltage Cut-In Test VII. Generator Output Test VIII. Generator Field Current Test IX. Generator Armature Test X. Cylinder Compression Test XI. Ignition Dwell Test XII. Ignition Circuit Resistance Test XIII. Spark Intensity at Plug Test XIV. Manifold Vacuum Test XV. Combustion Analysis Test	22 23	1½ 1 1½
ADVANCED SERVICE TRAINING TEST **IT'S ALL OVER BUT — - -?** I. Introduction II. Summary of Program A. Opening Session B. Overhaul Procedures C. The Other Fellow's Shoes	10	1 ½			

CAPACITIES (U. S. MEASURES)

Fuel Tank	Crank-Case	Cooling System	Transmission & Center Housing	Steering Assembly	Belt Pulley	Air Cleaner
10 Gal.	6 Qts.	12 Qts.	5 Gal.	1 Pt.	5/8 Pt.	1 Pt.

ANTI-FREEZE CHART

Temperature	Alcohol (Denatured 90%—180 Proof)	Ethylene Glycol
20° F	5½ Pts.	4½ Pts.
10° F	8½ Pts.	7 Pts.
0° F	11¼ Pts.	8½ Pts.
—10° F	12½ Pts.	11¼ Pts.
—20° F	15½ Pts.	12½ Pts.
—30° F	17 Pts.	16¾ Pts.

TUNE-UP DATA

Intake Valve Stem Clearance	Exhaust Valve Stem Clearance	Firing Order	Breaker Opening	Spark Plug Gap	Carburetor Idle Adj.	Power Jet Adj.	Float Setting
.010 to .012 cold	.014 to .016 cold	1-2-4-3	.015	.025	1¼ TCCW to 1½ TCCW	1½ TCCW—Rich 1 TCCW—Lean	9/32"

BEARING PRE-LOAD

Main Shaft	20-35 in. lbs.
Countershaft	15-30 in. lbs.
Pinion	12-16 in. lbs.

TIGHTENING TORQUE VALUES

Main Bearing Nuts or Cap Screws	75 to 85 Ft. Lbs.
Rod Nuts—Castellated	35 to 40 Ft. Lbs.
Rod Nuts—Self Locking	35 to 40 Ft. Lbs.
Cylinder Head Nuts	50 to 55 Ft. Lbs.
Cylinder Head Cap Screws	65 to 70 Ft. Lbs.
Flywheel Cap Screws	75 to 85 Ft. Lbs.
Spark Plugs	25 to 30 Ft. Lbs.

INDENTIFICATION DATA

Model	Serial No. Range	Cylinders Bore & Stroke	Compression Ratio	Displacement Cu. In.
8N	8N-1 to 84999	4 Cylinders 3 3/16 x 3¾	6 to 1	119.7
8N	8N-85000 and up	4 Cylinders 3 3/16 x 3¾	6.2 to 1	119.7

ENGINE CLEARANCES AND DIMENSIONS

	New	Wear Limit
CYLINDER		
Diameter	3.1875-3.1885	
Out of Round		.003
Taper or Max. Wear		.004
PISTON, STEEL		
* Skirt Clearance	.0025-.004	.005
PISTON, ALUMINUM		
* Skirt Clearance	.0015-.0026	.0045
PISTON RINGS		
Side Clearance		
Compression Rings	.0015-.0035	.004
Oil Control Rings	.0010-.0025	.004
End Gap	.012-.017	.035
PISTON PIN		
Pin Diameter	.7501-.7504	
** Clearance in Piston	.0001-.0005	
*** Clearance in Rod	.0002-.0005	
VALVES (in tractors 8N-to 42160)		
Stem Diameter		
Intake and Exhaust	.3105-.3115	.004

	New	Wear Limit
PUSH RODS		
Diameter	.9994-.9996	.001
Bore Diameter	1.000-1.0005	.002
Clearance in Bore	.004-.0011	.003
Push Rod Length	1.722-1.723	*1.710
Valve Lash		
Intake	.010-.012	.013
Exhaust	.014-.016	.017
CRANKSHAFT		
Journal Diameter		
Main	2.248-2.249	
Crankpin	2.0935-2.0945	
Out of Round		
Main Crankpin		.0015
Taper		
Main Crankpin		.001
Bearing Clearance		

ENGINE CLEARANCES AND DIMENSIONS

	New	Wear Limit
CYLINDER		
Diameter	3.1875-3.1885	
Out of Round		.003
Taper or Max. Wear		.004
PISTON, STEEL		
* Skirt Clearance	.0025-.004	.005
PISTON, ALUMINUM		
* Skirt Clearance	.0015.-0026	.0045
PISTON RINGS		
Side Clearance		
Compression Rings	.0015-.0035	.004
Oil Control Rings	.0010-.0025	.004
End Gap	.012-.017	.035
PISTON PIN		
Pin Diameter	.7501-.7504	
** Clearance in Piston	.0001-.0005	
*** Clearance in Rod	.0002-.0005	
VALVES (in tractors 8N-to 42160)		
Stem Diameter		
Intake and Exhaust	.3105-.3115	.004
Clearance in Guide		
Intake	.0025-.0045	.004
Exhaust	.0015-.0035	.006
Seat Angle	45°	
Spring Test	37-40 lbs. @ 2⅛"	36 lbs.
VALVES (in tractor 8N-42 161 and up)		
Stem Diameter		
Intake	.3410-.3420	.004
Exhaust	.3405-.3415	.004
Clearance in Guide		
Intake	.0020-.0040	.004
Exhaust	.0025-.0045	.006
Seat Angle	45	
Spring Test	41-44 lbs. @ 1.80"	36 lbs.

	New	Wear Limit
PUSH RODS		
Diameter	.9994-.9996	.001
Bore Diameter	1.000-1.0005	.002
Clearance in Bore	.004-.0011	.003
Push Rod Length	1.722-1.723	*1.710
Valve Lash		
Intake	.010-.012	.013
Exhaust	.014-.016	.017
CRANKSHAFT		
Journal Diameter		
Main	2.248-2.249	
Crankpin	2.0935-2.0945	
Out of Round		
Main Crankpin		.0015
Taper		
Main Crankpin		.001
Bearing Clearance		
Main	.001-.003	.005
Crankpin	.0013-.0035	.005
End Play	.002-.006	.008
CAMSHAFT		
Bore Diameter	1.7985-.1.7990	
Journal Diameter	1.7965-1.17970	.0015
Bearing Clearance	.001-.002	.004
End Play	.0015-.004	.005
TIMING GEAR BACKLASH	.003-.004	.006
OIL PUMP GEAR BACKLASH	.003-.004	.006

* *6-10 lbs. pull on ½ inch wide .003 feeler gauge.*
** *Thumb push fit.*
*** *Slip fit.*
* *Regrind limit.*

GOVERNED ENGINE SPEEDS

	P.T.O. R.P.M.	Engine R.P.M.	Belt Pulley R.P.M.
FULL LOAD	727	2000	1358
% OF FULL LOAD	736	2025	1375
	745	2050	1392
	754	2075	1409
	763	2100	1426
	772	2125	1442
	782	2150	1460
	791	2175	1478
NO LOAD	800	2200	1494

TIRE CHART

Tire Size	Tire Pressure Lbs. Per Sq. In.	Max. Rec. Tire Loads Per Wheel (Pounds)	Max. Calcium Chloride Solutions		
			Pounds Cal. Chloride	Gallon of H_2O	Weight of Solution (Pounds)
Rear 10-28 4 Ply	12-14-	1575-1720	116	23	310
11-28 4 Ply	12	1890	163	33	434
Front 4-19 4 Ply	20-28-	470-575	15	3	40
6-16 4 Ply	20-28-	1020-1240	30	6	80

BATTERY

Part No.	Volts	Plates	Amp. Hrs.
2N-10655-A	6	13	80
2N-10655-B Low Gravity	6	13	80

STARTER

Part No.	Amperes No Load	Amperes Load Cranking Warm Engine
9N-11001	45-60	100-150
8N-11001	45-60	100-150

APPROXIMATE VOLTAGE DROP AROUND IGNITION CIRCUIT WITH SWITCH ON AND ENGINE STOPPED

Circuit	Normal	Max.
Neg. Battery to Terminal Block	0.025	0.2
Terminal Block to Switch Side of Resistor	0.115	0.2
Across Resistor	3.65	
Resistor to Coil	0.025	0.2
Coil to Ground	2.45	

GENERATOR—GENERAL ELECTRICAL SPECIFICATIONS

Part No.	Engine RPM To Test Voltage	Watts	Engine RPM Charge Starts	Maximum Rate		Field Part No.	Field Resistance		Armature Part No.
				Amps	Engine RPM		Ohms at 70°	Ohms at 140°	
9N-10000-C	1200	75	500	11.5	925	40-10175	1.5	1.7	18-10005
8N-10000 8N-10000-A	1200	75	560	11.5	1500	8N-10175-A	4.0	4.8	8N-10005
8N-10000-B	1200	140	625	20.0	1100	8N-10175-B	3.2	3.8	8BA-10005

GENERATOR CONTROL			CUT-IN VOLTAGE		VOLTAGE REGULATOR	
Generator No.	Control No.	Type Control	Min.	Max.	Min.	Max.
9N-10000-C	9N-10505-B	Cutout	7.0	8.5	None	None
8N-10000 8N-10000-A	8N-10505 8N-10505-A	Voltage Regulator and Cutout	6.1	6.5	6.9*	7.4*
8N-10000-B	8N-10505-B	Voltage Regulator and Cutout	6.1	6.5	6.9*	7.4* 6.8**

*With regulator at normal operating temperature and generator current of 5 amperes.

**With generator current of 20 amperes voltage should not exceed 6.8 volts.

GENERATOR MECHANICAL SPECIFICATIONS

Part No.	Brushes			Generator Replaced In Service By	Pulley Part No.	Pulley Pitch Diameter
	No.	Original Length In.	Wear Limit Length			
9N-10000-C	3	0.8	.35	8N-10000 8N-10000-A	9N-10130-B	3.5
8N-10000 8N-10000-A	3	0.8	.35	8N-10000-B	9N-10130-B	3.5
8N-10000-B	2	0.86	.40	None	8N-10130	3.5

STARTER CIRCUIT VOLTAGE DROP

(CRANKING WARM ENGINE)

Circuit	Max.
Ground to Battery	0.1 Volt
Battery Negative Terminal to Starter Terminal	0.2 Volt
Maximum total voltage drop cranking warm engine	.3 Volts

DISTRIBUTOR GENERAL SPECIFICATIONS

Part No.	Initial Advance Crank-Shaft Degrees B.T.D.C.	Distributor Advance W. O. T.			Total Advance W. O. T. Crankshaft Min.	Breaker Arm Spring Tension	Contact Point Spacing Inches	Dwell Percent at Idle	Dwell Degrees	Rotor Gap		Minimum Center and Shaft to End of Electrode	
		Min.	Max.	Engine R.P.M.						Min.	Max.	Manu-facture	Wear Length Max.
9N-12100	0	12°	13°	2000	25°	20 to 24 oz.	0.014 0.016	39 to 42.5	35 to 38	.006	.008	1.275	1.272

CONDENSER SPECIFICATIONS

Part No.	Capacity	Minimum Insulation Resistance	Dielectric Strength	Power Factor	Oil
91A-12300	.29-.32 Mfd.	5 Megohms @ 210° F	700 V.-RMS 60 Cycles — 210° F	0.6% @ 60 Cycles — 75° F	Tight at 240° F

COIL

Primary		Secondary	
No. Turns	Ohms Resist.	No. Turns	Ohms Resist.
170.5	0.470 0.510	16,500	5800 Min.

MANIFOLD VACUUM IN. HG.

RPM	Full Load	Half Load	¼ Load	No Load
500	.20	10.1	13.15	19.7
1000	.70	10.95	15.10	18.75
1500	1.4	10.5	14.85	17.45
2000	1.9	10.0	14.3	19.0

APPROX.

TACHOMETER

	Idle	Full Throttle
Engine R. P. M.	400—500	2200 No Load

SPARK PLUG

Part No.	Type	Size	Gap	Torque
9N-12405	H-10	14MM	0.25 0.28	24 to 30 Ft. #

COMPRESSION

Compression Ratio 6.2 to 1			
Cranking Speed 120 RPM (all spark plugs removed)			W.O.T.
Altitude	Cylinder Compression	Barometric Pressure	Min. Press.
Sea Level	115 Lbs.	29.92 Lbs. (Approx.) at 60° F	86.8
1000 Ft.	111 Lbs.	28.8 Lbs. (Approx.) at 60° F	90.
2000 Ft.	108 Lbs.	27.7 Lbs. (Approx.) at 60° F	92.7
3000 Ft.	104 Lbs.	26.7 Lbs. (Approx.) at 60° F	96.
4000 Ft.	99 Lbs.	25.7 Lbs. (Approx.) at 60° F	100.9
5000 Ft.	94 Lbs.	24.7 Lbs. (Approx.) at 60° F	106.2
6000 Ft.	90 Lbs.	23.8 Lbs. (Approx.) at 60° F	111.
7000 Ft.	87 Lbs.	22.9 Lbs. (Approx.) at 60° F	114.8
8000 Ft.	81 Lbs.	22.1 Lbs. (Approx.) at 60° F	123.3
9000 Ft.	78 Lbs.	21.2 Lbs. (Approx.) at 60° F	128.1
10000 Ft.	74 Lbs.	20.4 Lbs. (Approx.) at 60° F	135.

INTRODUCTION TO THE 8N FORD TRACTOR ADVANCED SERVICE TRAINING PROGRAM

CONFERENCE OBJECTIVE:

1. To explain the goals of the program and the methods to be followed in reaching them.

CONFERENCE TIME: 1 Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training Program.
2. Wall banner with three ABC cards suspended by cords below banner.
3. Cardboard key lettered with words "KNOW-HOW."
4. Conference Guide No. 1—(One copy for each trainee).

CONFERENCE PROCEDURE:

I. ABC's of Quality Service

ABC'S PRESENTATION

A. Introduction

1. The service training objectives of Dearborn Motors are, as I think you'll agree, basically simple, clear, and direct. We've summarized those objectives in a very condensed form in that wall banner on your right, which perhaps you've been wondering about.

READ BANNER AND CARDS

2. The formula for Quality Service is as fundamental as A B C. Actually, of course, we realize that a successful service operation is a business that includes a number of elements and takes a lot of work to accomplish.
(WALKS OVER TO WALL BANNER WHERE HE CAN EASILY REACH AND TURN ABC CARDS AROUND.)
3. But the basic principles represented by these letters are clear and easy to understand. It's really the meaning behind them that we're concerned with in making Dearborn service operations successful. So, let's take up those meanings, that fundamental formula, one part at a time.

B. The Formula for Quality Service

1. Ability in your job

TURN LETTER "A" "ABILITY IN YOUR JOB"

a. We all recognize that if anything is to be done right, if a business is to operate successfully, the men in that business must know their jobs and know them well. Ability is the product of experience and training and Dearborn Motors expects to provide a continuous training program to insure that every man in the service organization will have the ability his job takes. That means that he will not only know how to do his job to the complete satisfaction of the customer, but that he will also know how to do it profitably to his dealer and himself. But, you notice there's a *plus* on that element. It takes more than just ability.

2. Best work always

TURN LETTER "B" "BEST WORK ALWAYS"

a. It's not only important that we be able to do a job right, but

we must also build up a pride in workmanship and an understanding of the need for doing work to high quality standards which causes us to *do every* job right. It's *consistently* good service which builds a reputation for quality work. And it's a reputation for quality work that gives us the third element of our formula.

3. Customer confidence.

TURN LETTER "C"

"CUSTOMER CONFIDENCE"

READ FORMULA

a. A good service business is dependent upon customer confidence. On this basis the formula for quality service reads: Ability In Your Job, plus Best Work Always equals Customer Confidence which, of course, is the ultimate aim of any good service operation. The application of this formula will pay dividends in the form of a steadily increasing service business.

C. The Key to Quality Service

(WALKS BACK TO CENTER AND PICKS UP CARD BOARD KEY KEEPING LETTERING SIDE AWAY FROM AUDIENCE.)

"KNOW-HOW" KEY

1. There is one basic factor which gives us the key to all the elements of that formula and that key is . . .
(TURNS KEY AROUND REVEALING THE LETTERING "KNOW-HOW".)

"Know-how". It takes knowledge, the knowledge you get in a scheduled training program like this one and the knowledge you get from actual experience in the shop to give you Ability in your job. It takes knowledge, knowledge of reasons why and knowledge of methods how, to make it possible for you to do your Best work always. And it takes knowledge to enable you to build customer confidence. We're applying that yardstick of job knowledge as a basis for the confidence we give a man every day. You apply it to the doctor, the lawyer, the man you buy your groceries from. And you can bet your bottom dollar your customers are applying that yardstick to you just as constantly.

2. The need for plenty of that important "know-how" is the reason for these training sessions. If we don't have it we can be certain that customers will go to the man who does.

II. Service Training and Its Relationship to Quality Service

We've just considered the long-range fundamental aims which service as guide posts toward Quality Service. Such guide posts are necessary to keeping all our efforts directed toward the goal we want to reach. However, we know of course, that worthwhile goals aren't reached at a single jump. A goal, if it's worthy of the name, is reached a step at a time. We're here to take one of those important steps in

III. The 8N Ford Tractor Advanced Service Training Program

(TURNS BLANK PAGE REVEALING THE TITLE PAGE OF THE 8N FORD TRACTOR ADVANCED SERVICE TRAINING PROGRAM.)

CHART 1-1
TITLE

(READS CHART)

The 8N Ford Tractor Advanced Service Training Program. And now

to get our sights adjusted, to see where we're headed let's take a look at the objective of this program.

(TURNS CHART TITLE PAGE NUMBER 1, REVEALING CHART PAGE NO. 2.)

A. Specific Objective of the Program

CHART 1-2
Objective

OUR OBJECTIVE:

To become proficient in the latest methods of servicing and overhauling the 8N Ford Tractor.

We have organized this program to include classroom and shop sessions fitted together to make it just as easy as possible for you to get the information and practice which will give you an understanding of the right procedures for doing the various jobs involved in servicing and overhauling the tractor. We have included some general background information on function and operation which many of you know and which we will cover in the form of a review to serve as a basis for the specific job instruction to be presented.

Next, for a bird's-eye view of how we plan to reach our goal, here's a quick glance at . . .

B. Organization of Training Material

1. Major units to be covered.

CHART 1-3
Road Ahead

(TURN CHART PAGE NO. 2, REVEALING CHART PAGE NO. 3)

Chart No. 3.

THE ROAD AHEAD:

1. Introduction
2. Engine and Clutch Assembly
3. Transmission Assembly
4. Final Drive and Brakes
5. Front Axle, Steering, Wheels and Tires
6. Engine Accessories (Non-Electrical)
7. Electrical System
8. Hydraulic Control
9. Pre-Delivery Check and Engine Analysis
10. It's All Over But . . . ?

(READ CHART)

2. Explanation of organization selected.

PLAN OF ORGANIZATION

Those are the major units we will cover on the way toward our objective. We've planned the order so that there would be as little duplication of effort as possible. This arrangement permits covering progressively the units of the tractor concerned with generating power, transmitting power and applying the power for accomplishing useful work.

3. Relationship of service training job time to flat rate time.

JOB TIME ALLOTMENTS

It is important that you realize that in no way is the time allotted for the accomplishing of the jobs in Service Training Job Plans to be considered as having any relation to a flat rate time which might be applied for labor charges. This is purely and only a time allotment based on training requirements.

4. Relationship of service training job procedures to actual shop procedures.

JOB PROCEDURES

One other point we should keep in mind is that the actual overhaul or repair of tractor parts undoubtedly will not follow in its entirety the plan which we have organized for most effective training use. For example, we will start by completely disassembling the tractor. That will make it possible for us to get the most done in the shortest amount of time. However, as we do each specific service or overhaul job we will use the procedure recommended for accomplishing that job.

Those procedures will be outlined in Service Training Job Plans which will be provided for each of the sessions of work in the shops which follow the conferences.

IV. Conclusion of Conference No. 1

A. Explanation of Service Training Job Plan No. 1

(HOLD UP JOB PLAN.)

JOB PLAN No. 1

Detailed instructions as to what's to be done, how it's to be done and the tools you'll need to do the work are all carried in these Service Training Job Plans. One of them will be distributed at the close of each conference session preceding a shop training period. I'm holding Service Training Job Plan Number 1. As I've indicated, the first step we're going to take in this program will be the disassembly of the tractor since that will permit us to move along most effectively with the rest of the work.

Job Plan Number 1 covers the following operations:

Draining the tractor and removal of: Hood, Radiator, Battery and tool box, Air cleaner and battery box, Wiring harness, Engine accessories, Dashboard, Steering assembly, seat and fenders, Engine, and Transmission.

B. Assignment of Personnel to Sections

(INSTRUCTOR IN ACCORD WITH PREVIOUSLY ARRANGED SCHEDULE TELLS EACH TRAINEE TO WHICH SECTION HE IS ASSIGNED AND ANNOUNCES WHERE EACH SECTION WILL WORK.)

C. Refer to Master Schedule and tell group of next conference topic and time it will start.

(ENGINE AND CLUTCH ASSEMBLY—TIME: .....)

D. Distribution of training material.

(DISTRIBUTE CONFERENCE GUIDE NUMBER 1.)

—END OF CONFERENCE NO. 1—

DISASSEMBLY OF 8N FORD TRACTOR FOR TRAINING PURPOSES

TRAINING TIME: 1¼ Hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Tools
2. Special Tools and Equipment
   a. Container for radiator liquid
   b. Two drain pans
   c. One Set of Basic Tools available for the Ford Tractor Service Tool Board No. FT-47
   d. One Set of Special Tools available for the Ford Tractor Service Tool Board No. FT-46
   e. Overhead hoist
   f. Jack
   g. Transmission housing stand
   h. Engine stand

JOB PROCEDURE:

I. DRAINING THE TRACTOR

Step 1—Remove the radiator cap and drain the radiator at (A-Figure 1) and the block at (B-Figure 1).

Step 2—Remove the plug (A-Figure 2) from the crankcase. Drain the oil into a pan. Remove the oil stick (D-Figure 1).

Step 3—Remove the plug (B-Figure 2) from the transmission housing and drain the oil into a pan.

Step 4—Remove the two plugs (C- and D-Figure 2) from the center housing and drain the oil into a pan.

II. REMOVING THE HOOD

Step 1—Shut off the fuel at the filter bowl (C-Figure 1).

Step 2—Disconnect the fuel line from the carburetor at (D-Figure 3).

Step 3—Remove the air intake screen (C-Figure 3) and the connection (F-Insert-Figure 3) from the hood.

Step 4—Remove the two bolts (E-Figure 3) that hold the hood to the front axle support. (Right and left side.)

Step 5—Remove the two cap screws (A-Figure 3) on the right and left side, and the two bolts (B-Figure 3) that hold the hood to the instrument panel.

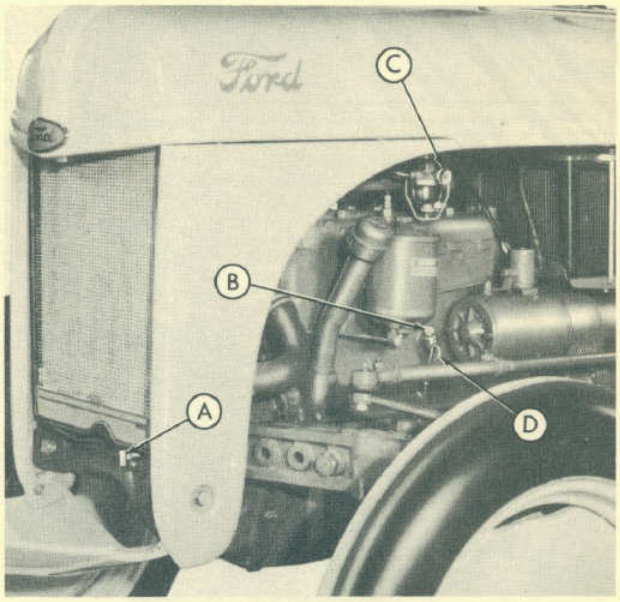

Fig. 1

Step 6—Remove the hood.

III. REMOVING THE RADIATOR

Step 1—Remove the two cap screws (A-Figure 4) that hold the radiator to the front axle support.

Step 2—Disconnect the radiator hoses (B-Figure 4) from the water pump and the head.

Step 3—Remove the radiator.

IV. REMOVING THE BATTERY AND TOOL BOX

Step 1—Remove the battery cover (C-Figure 4).

Step 2—Disconnect the battery cables from the battery posts.

Step 3—Remove the battery (D-Figure 4).

Step 4—Remove the tool box (E-Figure 4).

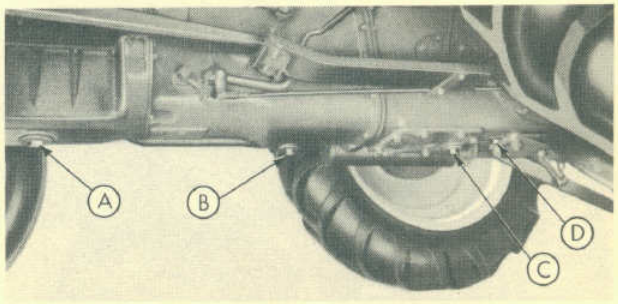

Fig. 2

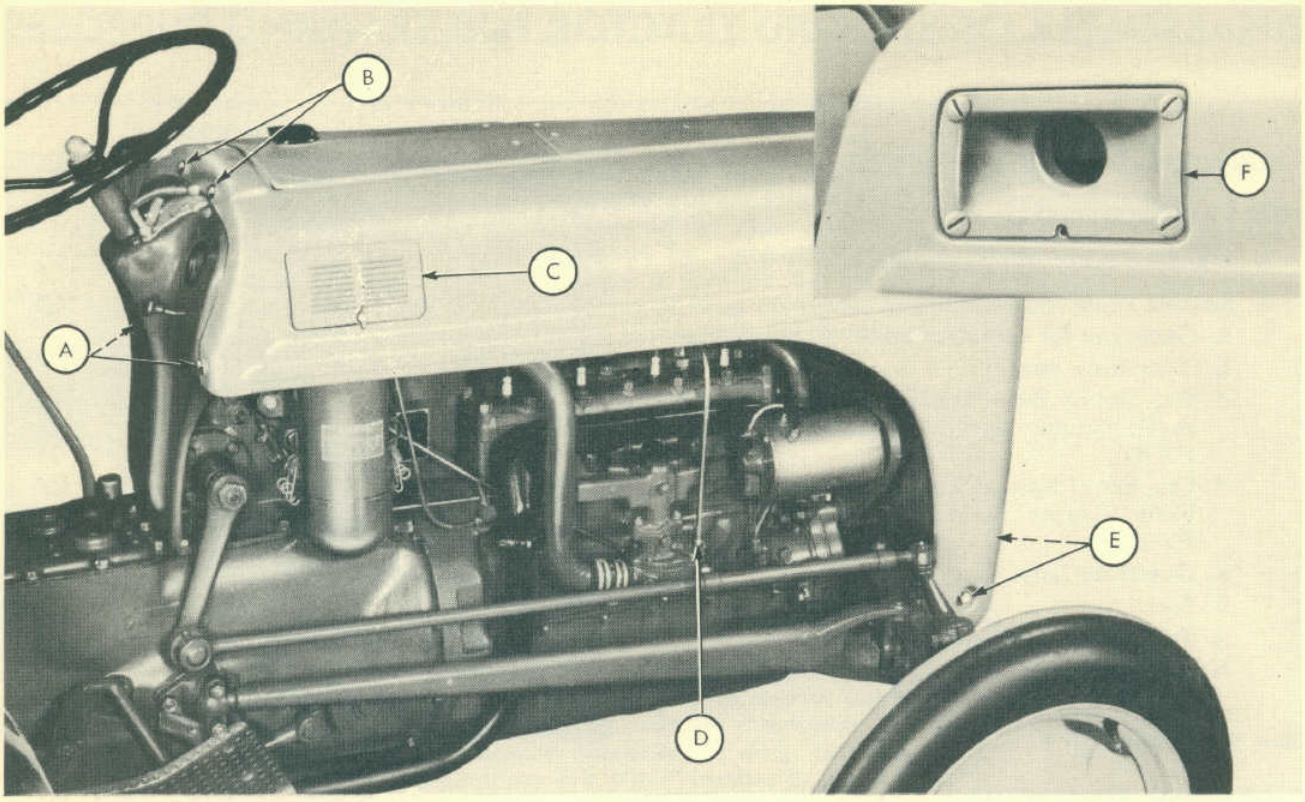

Fig. 3

V. REMOVING THE AIR CLEANER AND BATTERY RACK

Step 1—Loosen the air cleaner pipe hose connection from the carburetor at (D-Figure 5).

Step 2—Remove the two bolts (A-Figure 5) which hold the air cleaner to the battery rack.

Step 3—Remove the air cleaner.

Step 4—Remove the battery rack (B-Figure 5).

Step 5—Remove the fan (C-Figure 5) from the water pump pulley.

VI. REMOVING THE WIRING HARNESS

Step 1—Disconnect the four leads (A-Figure 6) from the distributor cap and unbolt clip (B-Figure 6) from the timing gear housing.

Step 2—Disconnect the lead from the coil (C-Figure 6).

Step 3—Disconnect the three leads (D-Figure 6) from the generator.

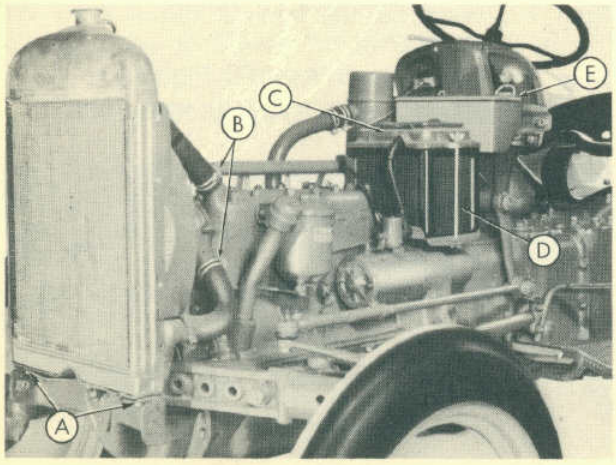

Fig. 4

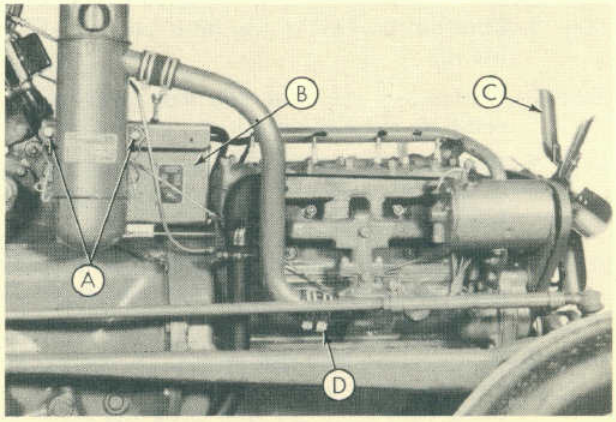

Fig. 5

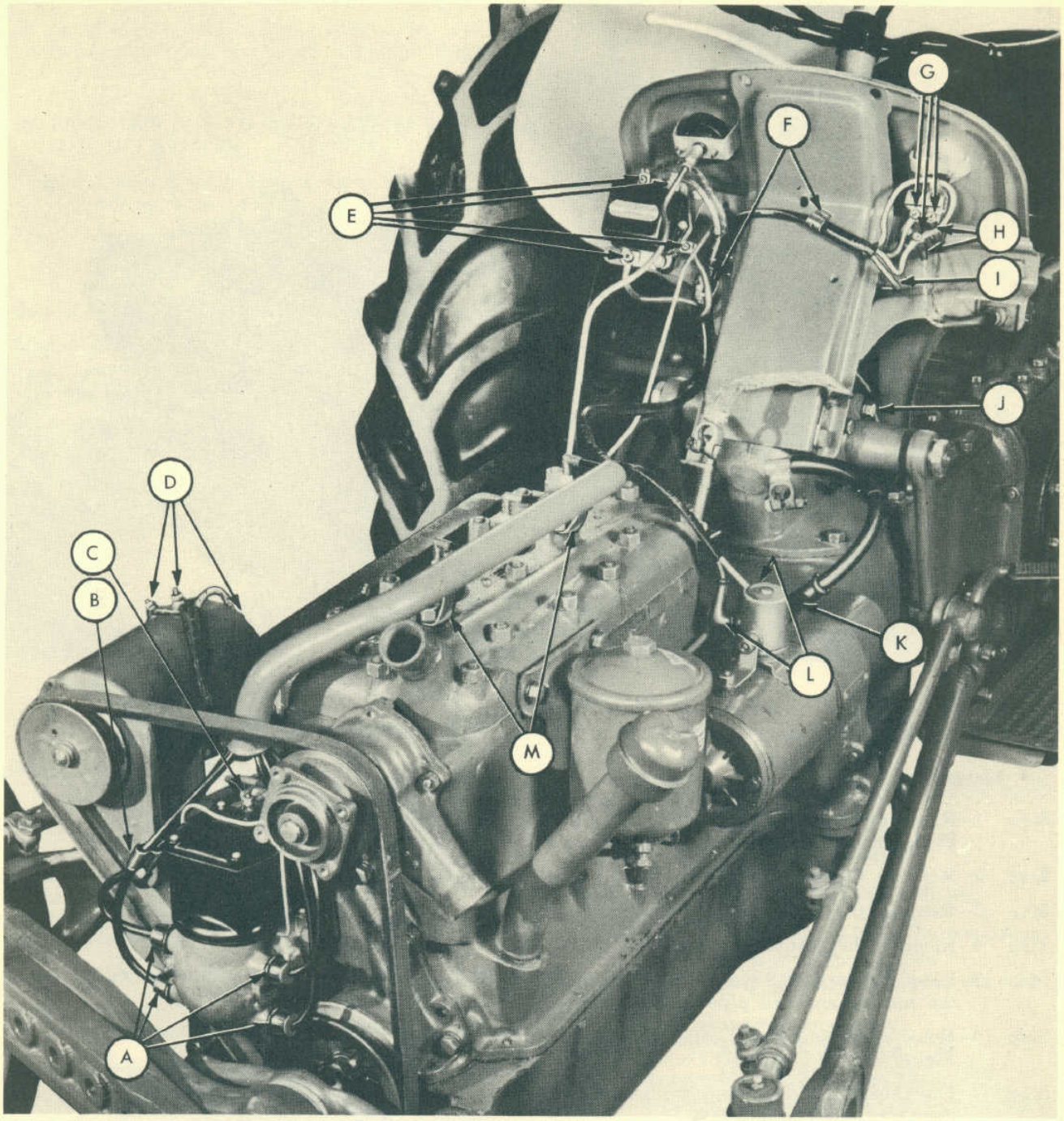

Fig. 6

Step 4—Disconnect the four spark plug leads and remove the two nuts (M-Figure 6) that hold the wiring conduit to the engine head.

Step 5—Disconnect the two leads (L-Figure 6) from the starter relay and remove the battery cable (K-Figure 6).

Step 6—Disconnect the four leads (E-Figure 6) from the voltage regulator.

Step 7—Remove the cable from the clips (F-Figure 6).

Step 8—Disconnect the three cable leads (G-Figure 6) from the resistor and the two starter switch leads (H-Figure 6).

Step 9—Disconnect the lead (I-Figure 6) from the starter button and remove the clip (J-Figure 6) from the left steering sector shaft housing.

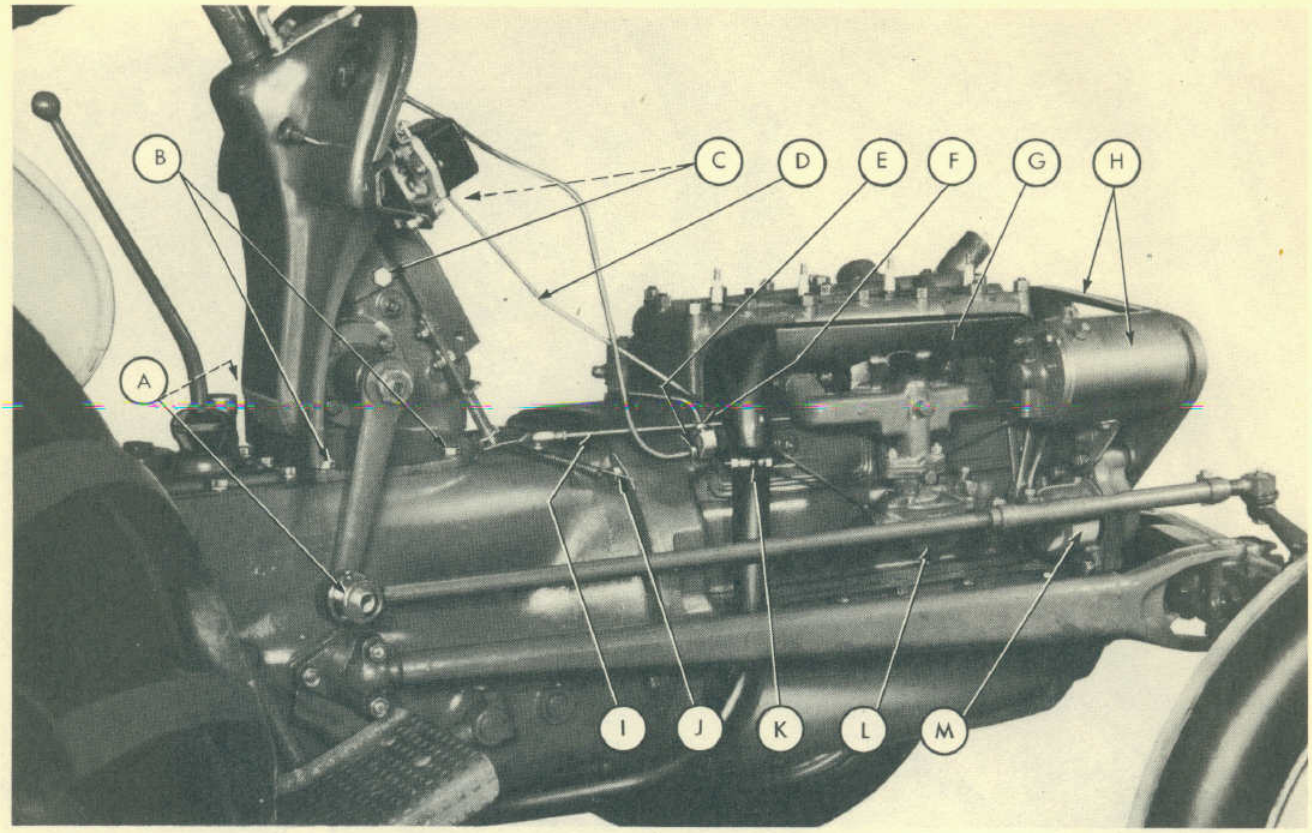

Fig. 7

Step 10—Remove the wiring harness.

VII. REMOVING THE ENGINE ACCESSORIES

Step 1—Remove the generator and fan belt (H-Figure 7).

Step 2—Remove throttle rod (I-Figure 7).

Step 3—Remove the choke rod (D-Figure 7).

Step 4—Remove the carburetor (L-Figure 7).

Step 5—Loosen clamp (K-Figure 7) and remove the muffler and tail pipe assembly.

Step 6—Remove the manifold and gaskets (G-Figure 7).

Step 7—Disconnect the oil line and remove the governor (M-Figure 7).

Step 8—Remove the water pump (B-Figure 8).

Step 9—Remove the distributor assembly (A-Figure 8).

Step 10—Remove the filler pipe (D-Figure 8).

Step 11—Remove the oil filter (C-Figure 8). Disconnect the oil line at junction. (F-Figure 7) on right side of block.

Step 12—Remove the starter and relay assembly (E-Figure 8).

VIII. REMOVING THE INSTRUMENT PANEL

Step 1—Disconnect the oil line at fitting (E-Figure 7.)

Step 2—Disconnect the governor compensating spring (J-Figure 7).

Step 3—Remove the two cap screws (C-Figure 7) that hold the instrument panel to the right and left side of the steering post housing.

Step 4—Pull the steering wheel as shown in Figure 9.

Step 5—Remove the instrument panel.

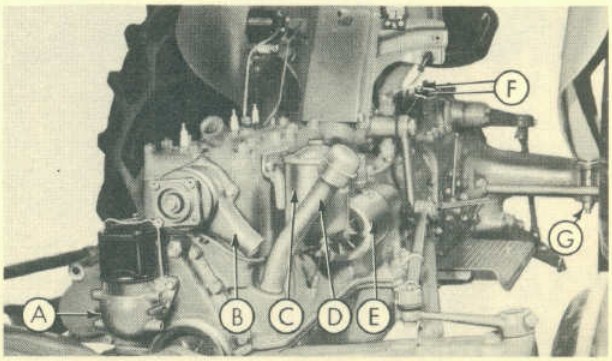

Fig. 8

NOTE: It may be necessary to remove the spring and clip assembly on the lower end of the throttle rod.

IX. REMOVING THE STEERING ASSEMBLY, SEAT, AND THE FENDERS

Step 1—Disconnect the tie rods from the right and left sector arms (A-Figure 7).

Step 2—Remove the two cap screws (B-Figure 7) on the right and left side that hold the steering housing to the transmission housing.

Step 3—Remove the steering assembly.

Step 4—Remove the two hex nuts (F-Figure 8) and remove the seat.

Step 5—Remove the bolts (G-Figure 8) which hold the right and left fenders in place and lift the fenders off.

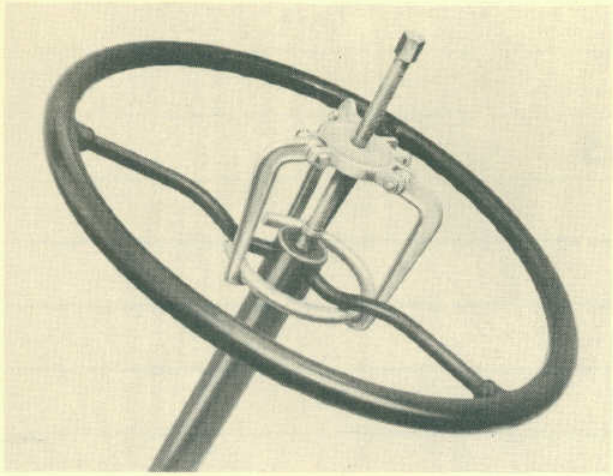

Fig. 9

X. REMOVING THE ENGINE

Step 1—Remove the spark plugs and washers.

Step 2—Install the engine lift plate and attach a hoist as shown in Figure 10.

Step 3—Support the transmission housing with a suitable jack.

Step 4—Disconnect the radius rods by removing the ball cap (D-Figure 10) from the right and left side.

Step 5—Raise the engine with the hoist sufficiently to remove the weight from the front wheels.

Step 6—Remove the bolts (B-Figure 10) that hold the front axle support plate to the pan. There are six of them.

Step 7—Roll the front axle assembly aside.

Step 8—Remove the two water pump studs (A-Figure 10). (Left side and bottom.)

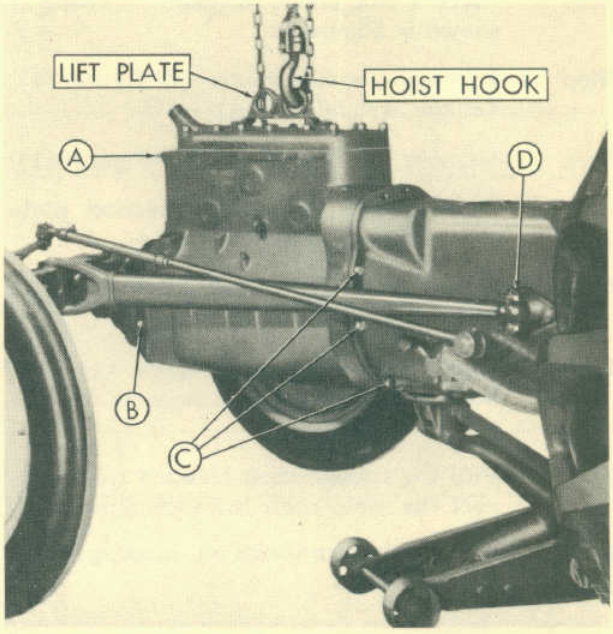

Fig. 10

Step 9—Remove the capscrews (C-Figure 10) that hold the engine to the transmission housing.

Step 10—Pull forward on the engine assembly to disconnect the main drive shaft from the clutch.

Step 11—Mount the engine in the engine stand.

XI. REMOVING THE TRANSMISSION

Step 1—Remove the gear shift assembly.

Step 2—Attach the lift plate to the transmission housing as shown in Figure 11.

Step 3—Attach the hoist and support the weight.

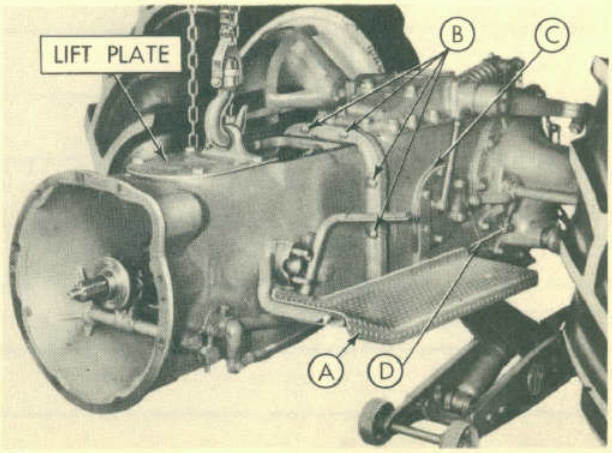

Fig. 11

Step 4—Place a jack under the center housing as shown in Figure 11.

Step 5—Remove the step plates (A-Figure 11). (Right and left sides.)

Step 6—Remove the brake rod (D-Figure 11).

Step 7—Remove the left side inspection plate and gasket (C-Figure 11).

Step 8—Remove the P.T.O. cap (A-Figure 12) and P.T.O. shaft.

Step 9—Remove the bolts (B-Figure 11) that hold the transmission housing to the center housing.

Step 10—Pull the transmission forward to disconnect the main shaft from the driveshaft.

Step 11—Mount the transmission housing on a suitable stand.

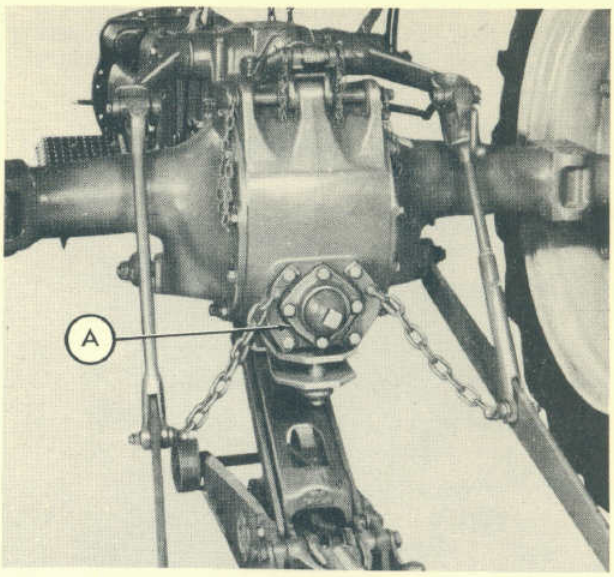

Fig. 12

NOTES

ENGINE AND CLUTCH ASSEMBLY

CONFERENCE OBJECTIVES:

1. To review the construction and operation of a four-cycle internal combustion engine.
2. To discuss the important phases of servicing and overhauling the engine and clutch assembly.

CONFERENCE TIME: ¾ Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual cast Slides:
   a. 2-1—8N Ford Tractor Engine
   b. 2-2—Valve Construction (Intake)
   c. 2-3—Valve Operation
   d. 2-4—Valve Stem Clearance
   e. 2-5—Valve Servicing Musts
   f. 2-6—The Camshaft Construction
   g. 2-7—Camshaft End Play
   h. 2-8—Servicing Rods, Pistons and Cylinders
   i. 2-9—Servicing the Crankshaft and Fly Wheel
   j. 2-10—Oil Pump
   k. 2-11—Engine Lubrication
   l. 2-12—Clutch Assembly
4. Rod and Piston Alignment Tool
5. Rod and Piston Assembly
6. Spring Clip Washer for Camshaft
7. Camshaft and Gear Assembly
8. Conference Guide No. 2—(One for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conference

1. You will recall that in the first conference, we stated that the objective of this service training program is to train service personnel in the latest methods and procedures for servicing and completely overhauling the 8N Ford Tractor. Thus far in our work we have disassembled the tractor for training purposes so that we may logically begin a planned procedure of training to accomplish our overall objective.

CHART 2-1

The Engine and Clutch

B. The subject of this conference

1. As we have indicated, the subject of this conference is the engine and clutch assembly. There is a definite reason for discussing these units first.

2. The complete training of service personnel must include the ABC's of operation as well as service and overhaul procedures. This program has, therefore, been organized to combine the ABC's of operation with the service and overhaul procedures. This is accomplished by starting with the generation of power and following this power through to its ultimate use in driving the tractor and operating implements.
3. Obviously enough, the generation of power occurs in the engine.

C. The objectives of this conference

1. To review the basic principles of four cycle internal combustion engine operation
2. To stress important phases of engine and clutch servicing

II. Basic Principles of Four Cycle Internal Combustion Engine Operation

A. Principal parts of such an engine

CHART 2-2

The Engine

1. The block
   a. The main body of the engine which permits the installation and attachment of the numerous units which go to make up the complete engine. Basically, in it we find machined openings for the cylinders and valves and the passages which permit a coolant to pass around the cylinder walls. Blocks are cast and then machined to meet specifications.
2. The piston
   a. It is a unit shaped to fit into the cylinders. The piston is constructed so that by the use of ring grooves and rings, it is snug enough to utilize all the downward pressure created by the burning gases in the cylinder, yet with sufficient space between it and the cylinder wall to permit lubrication.
3. The connecting rod
   a. In order to utilize the downward force exerted by the burning gases and to make the piston move up and down in the cylinder, it must be connected to something. In an engine, as we all know, the piston is connected to a crankshaft by means of a connecting rod. The connecting rod is fastened in pendulum fashion to the piston by the piston pin.
4. The crankshaft
   a. As we have indicated, each connecting rod is attached to the crankshaft
   b. The crankshaft serves to change the up and down motion of the piston into a rotary motion, an important step in the utilization of power
5. The fly wheel
   a. The fly wheel is attached to one end of the crankshaft. The rotation of the fly wheel on the crankshaft sets up a momentum which helps the crankshaft to move the pistons and also to turn additional shafts and gears.
6. The engine or cylinder head
   a. Thus far, we have a mechanical means of moving the pistons up and down in the cylinders of the block. As the piston moves upward in the cylinder, it pushes air out of the top of the cylinder. Some means must now be provided for placing a cap or cover over the cylinder to contain the gas vapor.

b. This is done with what is known as the engine or cylinder head.

c. The cylinder head is placed over the block, creating a chamber over each piston, into which combustible gases may be drawn and compressed. Ports in the side of the block permit the intake of those gases, and also the outlet or exhaust of those gases after they have been burned.

d. The head also contains four smaller holes, into which spark plugs, one for each combustion chamber, are installed. It is through the spark plug that an electrical spark is transmitted to the combustion chamber to ignite the compressed gas vapor.

7. The valves

a. The ports in the block, which permit the gas vapor to enter and leave the combustion chamber, must have "doors", that open and close at the proper time.

b. These "doors", as we know them, are called valves.

c. Each cylinder has two valves, an intake and an exhaust valve.

8. The camshaft

a. As previously indicated, means must be provided to open and close the intake and exhaust valves at the proper moment.

b. The intake valves must be opened to let the gas enter the combustion chamber and be closed while the gas is compressed and burned.

c. The exhaust valves must be opened to let the burned gas escape.

d. A camshaft provides the means for opening and closing the valves at the proper moment

B. Operation—the four strokes of a cycle

CHART 2-3

The Four Stroke Cycle

1. Intake stroke

a. The crankshaft is turned downward one-half of a complete circle, pulling the piston to the bottom of the cylinder

b. At the same time the camshaft has rotated and pushed the intake valve open allowing gas vapor to be drawn into the combustion chamber.

2. Compression stroke

a. As the crankshaft continues to rotate through the second half of its turn and starts upward, the piston is moved upward in the cylinder thus compressing and heating the gas vapor

b. The camshaft has now rotated so that both valves are closed

3. Combustion stroke

a. As the piston is moved to top dead center, the electrical spark ignites the compressed and heated gas vapor and the resulting cumbustion forces the piston to the bottom of the cylinder, rotating the crankshaft through 180 degrees.

b. Both the intake and exhaust valves are still closed.

4. Exhaust stroke

a. As the crankshaft rotates upward another 180 degrees, the piston again is moved upward pushing the burned gases to the top of the cylinder.

b. Just before the exhaust stroke begins, the camshaft has opened the exhaust valve thus permitting the burned gases to be forced out of the combustion chamber.

c. The piston is now ready to repeat the four strokes of the cycle—intake, compression, combustion and exhaust.

C. Summary of operation

1. The four stroke cycle applied to a four cylinder engine

CHART 2-4

Four Cylinder Engine Operation

a. In the four cylinder engine we apply the four stroke cycle to four pistons all connected to the same crankshaft. The movement of one piston will, therefore, effect the movement of the other three.

b. The throws on the crankshaft are placed so that the No. 1 and No. 4 pistons are at the top of their stroke when the No. 2 and No. 3 pistons are at the bottom of their stroke. Such an arrangement provides as nearly a continuous application of power to the rotation of the crankshaft and fly wheel as is possible in a 4 cylinder engine.

c. The firing order is so arranged that each of the four cylinders is performing one of the four strokes of the complete cycle at the same time.

(1) No. 1 piston going down on combustion.
(2) No. 2 going up on compression.
(3) No. 3 going up on exhaust.
(4) No. 4 going down on intake.

d. One piston is always making a combustion or power stroke. Successive power strokes continue to rotate the crankshaft. The momentum of the fly wheel serves to "smooth out" these successive power strokes into a nearly uniform rotation of the crankshaft.

III. 8N Ford Tractor Engine

A. Importance of servicing

VISUAL CAST SLIDE 2-1

The 8N Ford Tractor Engine

1. The entire operation of the 8N Ford Tractor and the implements designed for use with it are dependent on the efficient operation of the engine, its source of power

2. The 8N Ford Tractor engine is an L-type engine. It is designed to produce a given amount of power around which a tractor has been designed to utilize this power to its fullest advantage

3. In order to properly service and overhaul this engine, it is very important that the Ford Tractor service men be thoroughly familiar with its construction in terms of the engineering specifications that must be adhered to for efficient operation. Further, it is just as important that they know and are able to efficiently perform the recommended service and overhaul procedures established for its maintenance and repair

4. To this end we are now ready to consider these specifications and procedures

B. Servicing the valves

VISUAL CAST SLIDE 2-2

Valve Construction Intake

1. The valve assembly parts

a. Valve and valve stem

b. The valve guide bushings

c. The valve spring

d. Valve spring retainer

e. Valve bushing

f. Valve guide housing retainer

2. Construction and operation

a. The intake and exhaust valves are made of high chrome-nickel steel alloy, designed to withstand high temperatures

b. The valve assemblies are held in position in the block by valve guide retainers. The valve springs hold the valves in the closed position

VISUAL CAST SLIDE 2-3

Valve Operation

c. The opening and closing action is obtained through the cams on the camshaft which raise the push rods that in turn push upward on the valve stem, and compress the spring, opening the valve.

3. Causes of inefficient valve operation

CHART NO. 2-5

Valve Wear

a. Carbon—the result of combustion

(1) Causes increased temperatures in the combustion chamber which may result in warping and burning the valves

(2) Unburned carbon residue gums the valve stems and causes them to stick in the guide

(3) Deposits of hard carbon with sharp points get white hot and cause pre-ignition and pinging

(4) Fouls spark plugs, resulting in engine miss and wasted fuel

(5) Carbon particles will prevent valves from seating properly thus causing the valves and valve seats to become pitted and burned.

b. Improper seating due to carbon, weak valve springs, insufficient valve stem clearance, warpage and misalignment

(1) Causes burning and pitting especially on the exhaust valve due to blow by of intensely heated exhaust gases

c. Out of round valves caused by warped valve stems

(1) Causes burning and pitting due to blow by

(2) Causes loss of compression

d. Improper valve stem and guide clearance caused by wear and valve stem warpage

(1) Cause air and oil to be sucked past the intake valve stem and guide resulting in excessive oil consumption, excessive carbon formation, and diluted fuel vapor

(2) Causes blow by because the valve guide no longer serves its purpose of keeping the valve concentric with its seat

4. Valve repair

CHART 2-6

Valve Servicing

a. Repairing valve heads

(1) Both the exhaust and the intake valve should be ground at a 45° angle

(2) Scrap and replace any valve that cannot be entirely refaced with a definite margin maintained. A valve that is warped will require excessive grinding to obtain a true face. This generally results in a knife edge around part or all of the valve. Knife edges lead to breakage and to pre-ignition due to heat localizing at the edges

b. Refacing valve seats

(1) Both the exhaust and the intake valve seats are ground to a 45° angle

(2) The tendency is to generally grind the seat too wide. The seat width should not exceed 0.125 inches. If it is necessary to narrow the seat use a 30° stone. The seat should always be narrower than the valve face. Seats which are too wide tend to collect carbon. Seats which are too narrow prevent the valve head from rapidly dissipating its heat to the block

c. Checking valve stems and guides

(1) Always check valve stems and guides for wear. Scrap and replace valves and guides that exceed the specified wear limits

Intake —.004 clearance
Exhaust—.006 clearance

(2) Always regrind the seat when installing new guides to assure the guides being concentric to the seat

d. Valve springs

(1) Test all valve springs for uniform compressibility

(2) Unequal or cocked valve springs will nullify the precision that has gone into the valve job

(3) The valve springs in tractors 8N-1 to 42160 should test 37-40 lbs. @ 2⅛". Valve springs in tractors 8N-42161 and up should test 41-44 lbs. @ 1.80". Springs testing under 36 lbs. should be replaced.

e. Valve stem clearance

VISUAL CAST SLIDE 2-4

Valve Stem Clearance

(1) Clearance between the push rod and the end of the exhaust valve stem should be between .014 to .016 cold with a wear limit of .017.

(2) Clearance between the push rod and the end of the intake valve stem should be .010 to .012 cold with a wear limit of .013

(3) Valve stem clearance can be increased by grinding the end of the valve stem. Clearances that exceed the specified wear limits are corrected by installing new valves or reseating

f. Additional valve servicing "musts"

VISUAL CAST SLIDE 2-5

Valve Servicing Musts

(1) Always install a new head gasket when replacing the engine head after completing a valve job

(2) Uniformly tighten the head bolts to a torque value of 50 to 55 foot pounds

(3) Make a complete check of ignition system and correct spark plug gap

(4) Check ignition timing. It must be correct

(5) Adjust the carburetor to assure the correct air fuel ratio

C. Servicing the camshaft

1. Construction and operation

VISUAL CAST

SLIDE 2-6
The Camshaft Construction

a. The camshaft is cast from an alloy steel that is highly wear-resistant. The three hardened camshaft bearings rotate in the bearing bores in the block. These bearings are diamond bored, consequently no inserts are required.

b. The camshaft gear, made of cast aluminum, is attached to the forward end of the camshaft with four cap screws.

c. The camshaft is driven by the camshaft gear (timing gear) from the crankshaft gear. These two gears can be meshed at only one point if the engine is to be properly timed. One tooth on the crankshaft gear is marked with a "0". This tooth must be meshed with the tooth space on the camshaft gear marked with a "1".

d. The camshaft end thrust is controlled by the boss on the timing gear cover (cylinder front cover) contacting the front flange on the timing gear.

2. Service specification for efficient operation of the camshaft

a. Bearings

(1) The proper bearing clearance is .001 to .002 inches with a wear limit not to exceed .004 inches.

(2) A camshaft with worn, corroded, scored or discolored journals or journals that measure less than 1.795 should be replaced

b. Cams

(1) A camshaft with excessively corroded or scored cams should be replaced

c. Camshaft end play

VISUAL CAST SLIDE 2-7

Camshaft End Play

(1) Excessive end play between the camshaft gear and the timing gear cover produces noisy engine operation. Specifications permit end play of .0015 to .004, not to exceed .005

(2) Methods of removing camshaft end play

(a) Check end play by removing the timing gear side cover, and measuring the distance between the boss on the engine block and the timing gear

(b) Excessive end play may be removed by installing shims between the gear and the camshaft

(c) A spring clip washer may be installed between the timing gear cover and the gear

Show samples of the washer.

d. Camshaft gear

(1) Camshaft gear backlash should not exceed .004. A camshaft gear that has badly worn or chipped teeth should be replaced. If the gear backlash exceeds .004 replace it with an oversize gear

D. Servicing the rods, pistons and cylinders

1. Construction

VISUAL CAST SLIDE 2-8

Servicing Rods, Pistons and Cylinders

a. The pistons are constructed of light weight, strong, wear-resistant steel, having approximately the same rate of expansion as the cylinders and sleeves. This rate of expansion factor permits a closer piston fit, less oil consumption and longer life. The pistons are cadmium plated

b. Each piston is fitted with two compression rings and one oil control ring

c. The connecting rods are made of heat-treated carbon manganese forgings. The piston pin bushing is made of special bronze alloy. Both rods and pistons are accurately held to a specified weight to reduce vibration.

d. Each rod is connected to the piston by means of a closely fitted free floating piston pin. The piston pin is held in position by two lock springs

e. The lower end of the connecting rod is attached to a journal on the crankshaft. The connecting rod bearing inserts are the steel back, replaceable type, with each half of the bearing locked in position on the connecting rod. The special bearing alloy, which is bonded to the steel core, has a high structural strength

f. The piston operates within a replaceable steel cylinder sleeve which is installed in the cylinder bore. The wall thickness of this sleeve is .040. The wear surface of the sleeve is nitrate hardened to a depth of .004

2. Symptoms of inefficient engine operation related to the rods, pistons and cylinders

a. Engine overheating

(1) Rings fitted too tight
(2) Tight pistons
(3) Excessive clearance between cylinder and piston
(4) Scored cylinder sleeves or pistons
(5) Collapsed piston
(6) Insufficient ring gap clearance
(7) Improper seating of rings in the grooves causing rings to bind
(8) Slots on oil rings clogged
(9) Worn piston pins
(10) Scored or excessively worn connecting rod bearings
(11) Broken rings

b. Engine knock or slap

(1) Piston and rod out of alignment
(2) Worn connecting rod bearings
(3) Loose or broken connecting rod studs
(4) Piston pin or bushing worn
(5) Piston pin loose in the piston (one side or both)
(6) Piston out of round
(7) Worn cylinder sleeves

c. Compression loss

(1) Worn ring grooves (over width)
(2) Badly worn cylinder sleeves
(3) Barrel shaped pistons
(4) Rings badly worn
(5) Rings frozen in ring grooves
(6) Excessive ring gap clearance
(7) Insufficient ring gap clearance, causing buckling and breaking of rings
(8) Rods out of alignment

3. Specifications for efficient operation

a. Rings

(1) Ring gap clearance

(a) .012 to .017 measured in the cylinder in which the ring is to be fitted

(2) Ring side clearance on the groove
  (a) Compression ring .0015-.0035
  (b) Oil control ring .0010-.0025

(3) General
  (a) Ring gaps staggered
  (b) Marking on the ring ("top") should be to the top

b. Pistons
  (1) Piston and cylinder clearance
    (a) Fitted so as to have 6 to 10 lbs. pull with a .003-½" wide feeler gauge

c. Piston pins
  (1) Clearance in the piston .0001 to .0005
  (2) Clearance in the rod .0002 to .0005
  (3) Piston pins are available in .002 oversize

d. Connecting rod bearings
  (1) Clearance of the connecting rod bearing on the crankpin is .0013 to .0035 with a wear limit not to exceed .005

e. Rod and piston alignment

Demonstration—Rod and Piston Alignment

  (1) The perfect alignment of the rod, piston and pin is essential for perfect operation
  (2) Whenever new piston pins are installed alignment should be checked

E. Servicing the crankshaft and fly wheel

VISUAL CAST SLIDE 2-9

Servicing the Crankshaft and Fly Wheel

1. Construction

a. The cast alloy steel crankshaft is statically and dynamically balanced with the counterbalance weights cast as an integral part of the crankshaft. The bearing surfaces are finish ground and then receive two polishing operations. The crankshaft is drilled for oil passages to the main and connecting rod bearings

b. Three main bearings support the crankshaft. End thrust is controlled by a flanged center main bearing liner. All crankshaft bearing inserts are made of a special anti-friction alloy and are replaceable

c. The crankshaft oil seals are made of a woven asbestos packing material fitted into grooves in the oil pan and the engine block. The crankshaft rear oil seal retainer should be sealed with a suitable material to prevent oil leaks

d. The crankshaft gear is pressed onto the forward end of the crankshaft and locked with a Woodruff key

e. The carefully machined and statically and dynamically balanced cast iron flywheel is attached to the rear end of the crankshaft with four cap screws and two dowel pins. The fly wheel steel ring gear is preheated and shrunk on to the fly wheel

f. The oil pump housing is an integral part of the front main bearing cap

2. Specifications for efficient operation

   a. Main journals

      (1) Out of round not more than .0015

      (2) Tapered not more than .0015

      (3) Bearing clearance .001 to .003 with a wear limit of .005

   b. Crank pin journals

      (1) Out or round not more than .0015

      (2) Tapered not more than .001

      (3) Bearing clearance .0013 to .0035 with a wear limit of .005

   c. End play

      (1) .002 to .006 not to exceed .008

   d. Fly wheel run out should not exceed .005 measured ¼" from the beveled edge

F. Oil pump

   a. The oil pump is a gear type pump driven by the crankshaft gear. Pump pressure is regulated by a spring loaded plunger type by-pass valve, located on the top left side of the timing gear cover

   b. If the gears in the pump body are worn, chipped, or less than 0.560 wide they should be replaced

   c. If the shaft journal O.D. is less than 0.560 inches in diameter, a new shaft assembly should be installed.

   d. The drive gear shaft bushing should be replaced if worn to larger than a 0.566 inside diameter

   e. The oil pump screen is part of the crankcase oil drain plug assembly and should be cleaned at every oil change

VISUAL CAST SLIDE 2-10

Oil Pump

G. Engine lubrication

1. The oil pump draws oil through a screen in the bottom of the oil pan and circulates it through drilled holes in the upper part of the pump housing, to the oil passages in the block. The oil is forced under pressure from the main oil passages through the crankshaft main and connecting rod bearings, as well as the camshaft bearings

VISUAL CAST SLIDE 2-11

Engine Lubrication

IV. The Clutch

A. Construction and operation

1. If a driveshaft were connected directly to the fly wheel we could transmit power directly to the rear axle and wheels. However, that driveshaft would turn whenever the crankshaft was turning

2. To overcome this, the main drive gear shaft is splined to a clutch friction disc which is held in contact with the face of the fly wheel by a pressure plate and powerful springs. When the clutch is disengaged, the springs are compressed, moving the friction disc away from the fly wheel thus freeing the main drive gear shaft from the engine crankshaft

VISUAL CAST SLIDE 2-12

Clutch Assembly

B. Servicing the clutch assembly

1. Overhaul

a. Clutches requiring overhaul should be replaced with a factory re-built clutch or a new clutch assembly

2. Clutch repair and adjustment

a. Clutch release bearing

(1) Pre-lubricated bearing, and should never be washed out

b. Clutch pilot bearing

(1) Ball bearing type, carried in a recess in the fly wheel. It is lubricated before assembly with a short fiber grease of very high melting point. This bearing should be repacked whenever clutch repair is made

(2) Failure to use the type grease mentioned will result in grease melting into the clutch causing slippage, and failure of the bearing

c. Clutch pedal adjustment

(1) Clearance between the clutch release bearing and the clutch plate release fingers must be maintained at all times. The amount of free play in the clutch pedal maintains this clearance. Free play should be ¾ inch.

V. Conference Conclusion

A. Review any points that the group may want discussed concerning

1. Valves and camshaft
2. Rods, pistons and cylinders
3. Crankshaft and fly wheel
4. Lubrication system

B. Distribute service training materials

1. Conference Guide No. 1
2. Tell the group that the next conference topic will deal with the transmission and also the time it is scheduled to begin

NOTES

NOTES

SERVICING THE VALVES AND CAMSHAFT

TRAINING TIME: 1 Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Tools
2. Special Tools and Equipment
   a. One set of special tools for the Ford Tractor Service Tool Board No. FT 46.

JOB PROCEDURE:

I. REMOVING VALVE ASSEMBLIES

Step 1—Remove the head and gasket (A-Figure 1).

Step 2—Remove the two valve covers and gaskets (B-Figure 1).

Step 3—Mount the valve tool accessory (A-Figure 2) on the block, using the manifold studs.

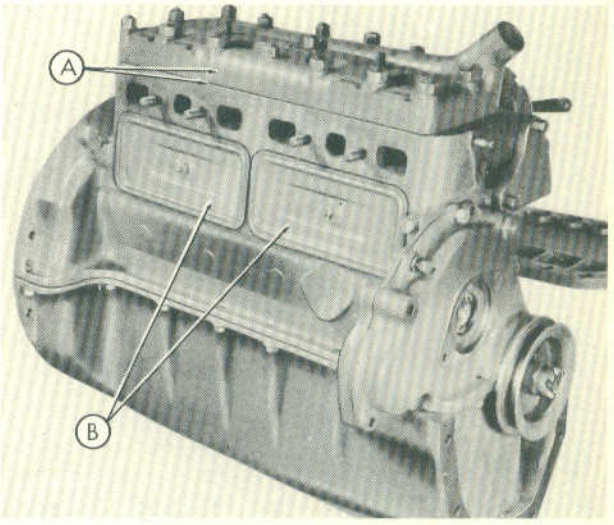

Fig. 1

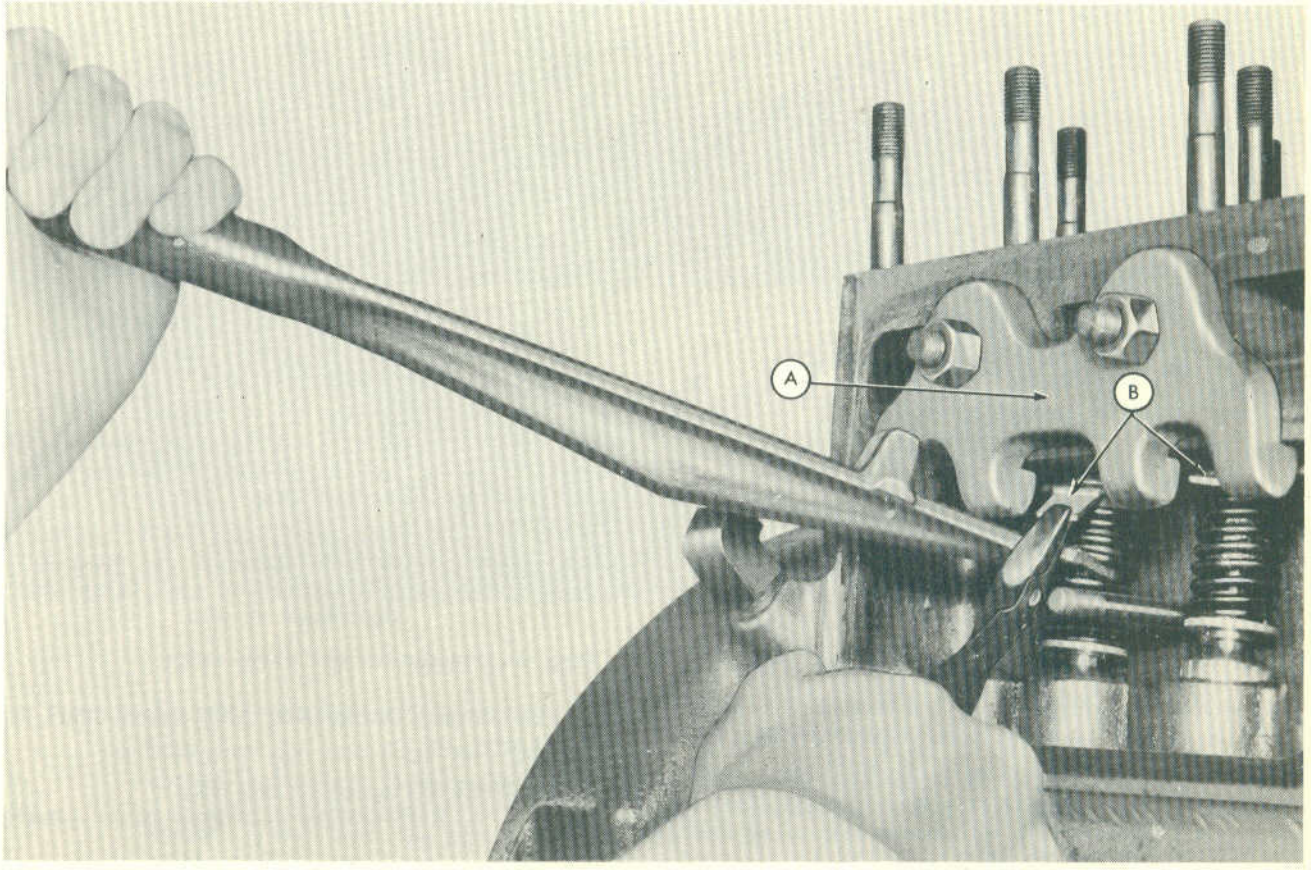

Fig. 2

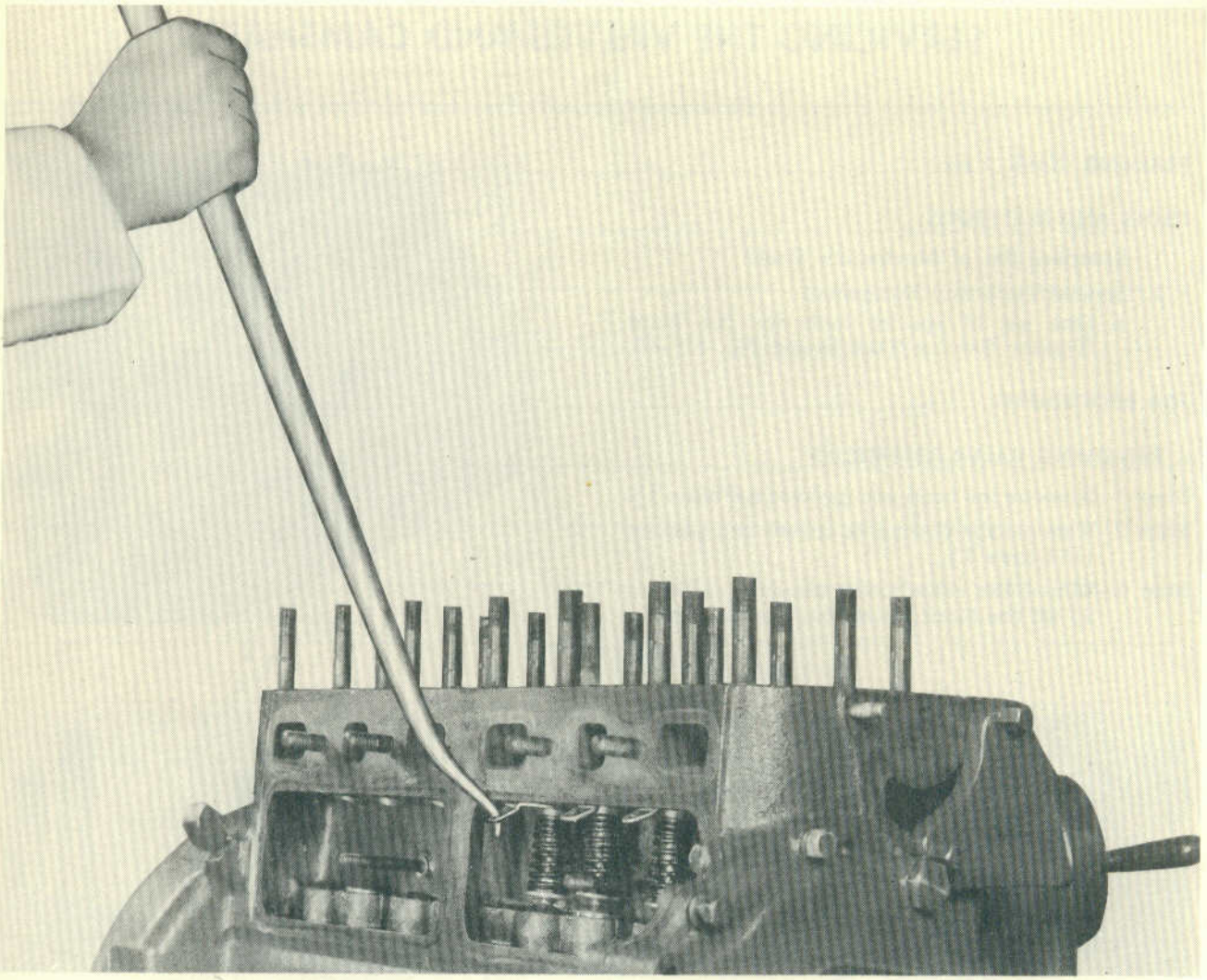

Fig. 3

Step 4—Turn the crankshaft until the valve to be removed is closed.

Step 5—Remove the valve guide retainers (B) as shown in Figure 2.

NOTE: If valve retainers are frozen, remove with the hook type remover as shown in Figure 3.

Step 6—Remove the valves and place them in the proper order on the stand.

Step 7—Disassemble a valve unit as shown in Figure 4.

Step 8—Check the valve stem thickness and guide clearance.

NOTE: a. Stem diameter (intake and exhaust) is .3105-.3115 with a wear limit of .004 on tractors 8N-1 to 42160. On tractors 8N-42161 and up intake is .3410-.3420; exhaust is .3405-.3415. Both have a wear limit of .004.

b. Clearance in the guide:

(1) Intake is .0025-.0045 (8N-1 to 42160). Intake is .0020-.0040 (8N-42161 and up). Both have a wear limit of .004.

(2) Exhaust is .0015-.0035 (8N-1 to 42160). Exhaust is .0025-.0045 (8N-42161 and up). Both have a wear limit of .006.

Step 9—Reassemble the valve unit.

II. REMOVING, CHECKING, AND REPLACING THE CAMSHAFT

Step 1—Check camshaft end play.

a. Remove the side gear cover (A-Figure 5).

NOTE: Measurement can be made through the governor opening. (For training purposes remove side gear cover.)

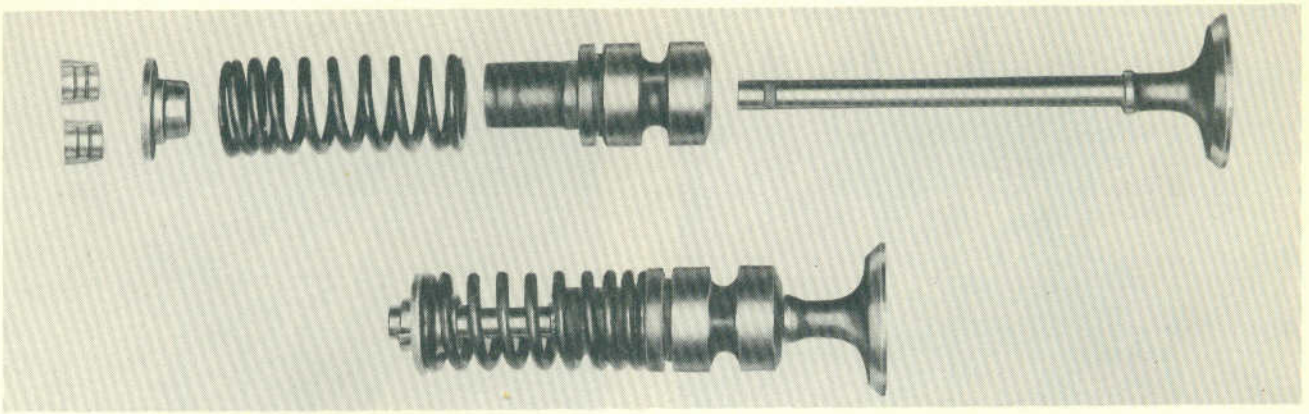

Fig. 4

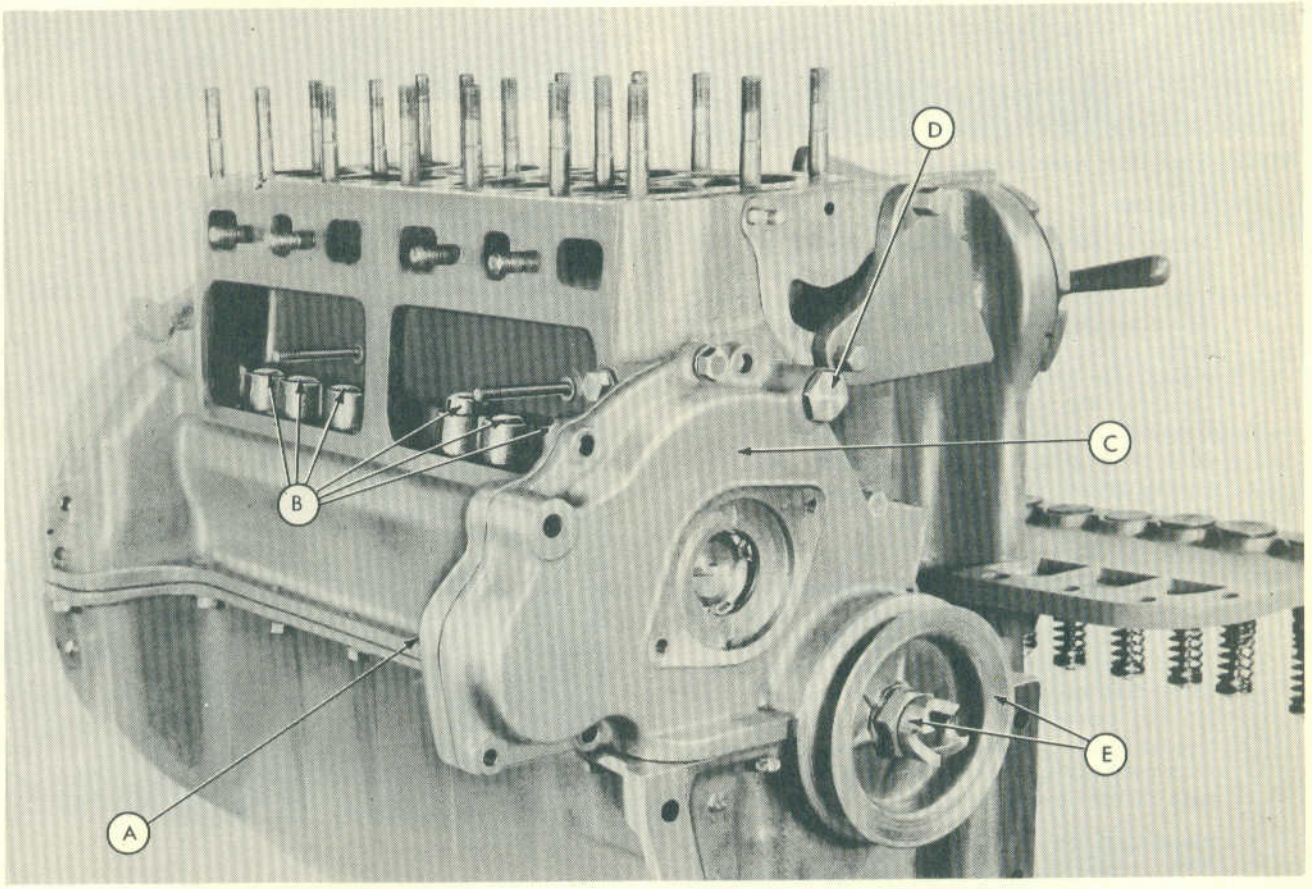

Fig. 5

b. Tap the camshaft forward.

c. Measure the camshaft end play as shown in Figure 6. If more than .005" end play exists, shims should be installed. A standard type thrust washer may be used to eliminate end play. This thrust washer is installed between the timing gear and the timing gear cover.

NOTE: Camshaft end play—.0015-.004 with a wear limit of .005.

Step 2—Remove the push rods (B-Figure 5) and place with corresponding valves as shown in Figure 7.

Step 3—Remove crankshaft ratchet and pulley assembly (E-Figure 5).

Step 4—Remove oil relief valve (D-Figure 5).

Step 5—Remove the timing gear cover (C-Figure 5).

Step 6—Install the crank ratchet and turn crankshaft until "0" on the crankshaft gear (A-Figure 7) is aligned with the mark on the camshaft gear (B-Figure 7). (This step will facilitate timing when reassembling.)

Step 7—Pull the camshaft out of the block as shown in Figure 8.

Step 8—Check the camshaft journals. If they measure less than 1.795″ renew the camshaft.

Step 9—Thoroughly clean and install the camshaft. Time the camshaft by aligning the marks as shown in Figure 7.

Step 10—Install the side gear cover.

III. GRINDING VALVES AND VALVE SEATS (DEMONSTRATION)

NOTE: This demonstration is optional.

A. Cleaning

Remove all carbon from the cylinder head, block, tops of pistons, valves and valve guides. The valve guides require very careful cleaning as carbon in the guide will deflect the grinding pilot, resulting in an inaccurate refacing operation. Clean all surfaces of the valve head, face and stem. Place the valves in a numbered rack, or otherwise mark them, to keep them in proper order. Be sure to replace each valve in its respective guide.

B. Refacing Valves

The use of precision valve grinding equipment is recommended for refacing. Refer to the manual provided by the manufacturer of the grinding equipment being used. After the valves and seats are refaced, "run in" the valves by hand using a fine grinding compound. Scrap and replace any valve that cannot be entirely refaced with a definite margin maintained.

C. Reseating Valve Seats

The intake and exhaust valves are faced on an angle of 45°. If the seats have to be narrowed use a 30° stone. Seats too wide tend to collect carbon. Seats too narrow prevent the valve head from rapidly dissipating its heat to the block. Grind each valve seat, using a suitable stone, pilot and motor, applying just enough pressure on the driving unit to overcome its vibrating action.

CAUTION: Too much pressure causes unnecessary friction. Make sure that the correct size pilot is used.

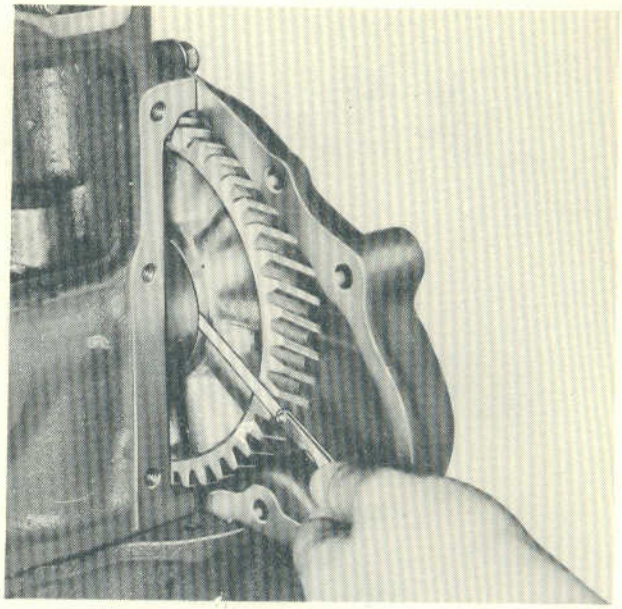

Fig. 6

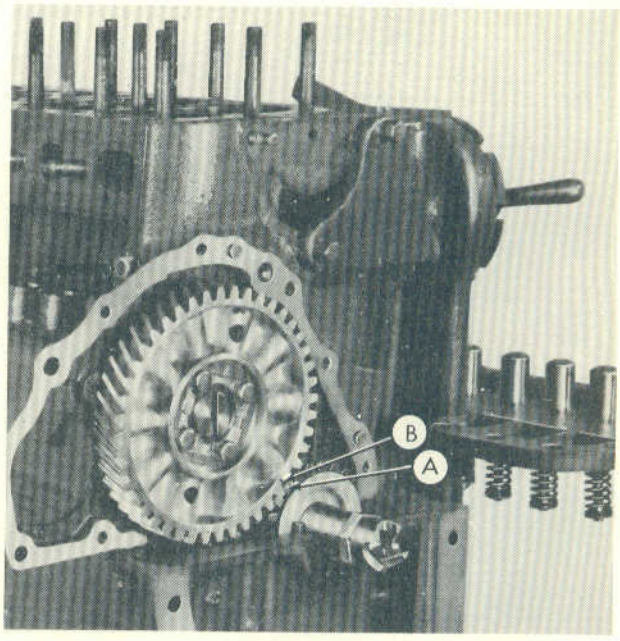

Fig. 7

For proper reseating instructions, refer to the manual provided with the equipment being used.

D. Testing Refaced Valves and Seats

To test refaced valves and seats for roundness and concentricity, spread a thin film of Prussian Blue on the valve face. Insert the stem in the guide from which the valve was originally removed. With hand pressure on the valve head, turn the valve one-quarter turn on its seat. Remove the valve

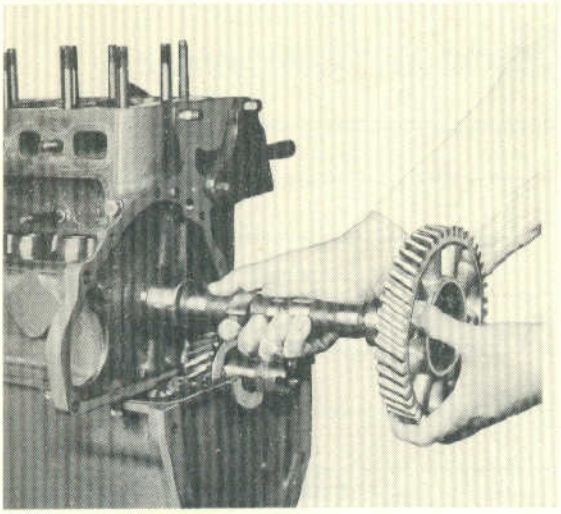

Fig. 8

and inspect the impression made on the valve face. Uneven removal of the Prussian Blue indicates an inaccurate valve grinding or reseating operation.

IV. INSTALLING VALVES

Step 1—Install push rods. Wash off in mineral spirits, wipe dry, and put a light coat of oil on. Be sure to replace with the corresponding valve.

Step 2—Install valve assemblies in the order removed. Be sure valve guide is positioned so that the valve replacement tool can be inserted in grooves on the valve guide.

Step 3—Install the valve guide retainers by compressing the valve spring as shown in Figure 2.

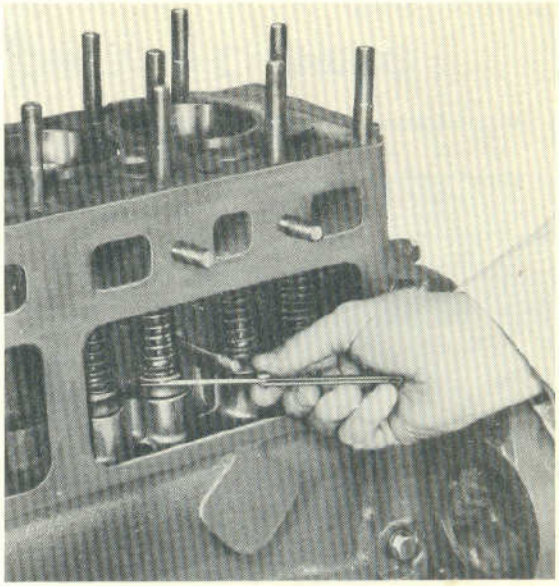

Fig. 9

Step 4—Check the valve stem clearance as shown in Figure 9.

NOTE: a. Intake valves—new .010-.012—wear limit .013.

b. Exhaust valves—new .014-.016—wear limit .017.

c. Excessive valve stem clearance may be corrected by reseating the valve, or by installing new valves and grinding the valve stem ends to the proper minimum clearance.

Step 5—Install the two valve covers.

Step 6—Install the side gear cover.

NOTES

NOTES

SERVICING THE RODS, PISTONS AND CYLINDERS

TRAINING TIME: ¾ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   b. 2" to 3" Micrometer

JOB PROCEDURE:

I. REMOVING THE RODS AND PISTONS

Step 1—Turn the engine on the stand so that the pan is up as shown in Figure 1.

Step 2—Remove the pan (A-Figure 1) and gasket.

Step 3—Remove the rod bearing caps and inserts (A-Figure 2).

Step 4—Remove the pistons and rods.

NOTE: Keep the bearing caps and inserts with the corresponding rod if not numbered.

NOTE: Pistons that are difficult to remove may be pushed or tapped out with a hammer handle.

II. SERVICING PISTON RINGS

Step 1—Remove the two compression rings (A-Figure 3) and the oil control ring (B-Figure 3).

Step 2—Check the compression ring gap.

a. Turn the engine upright on the stand so that the block is up.

b. Insert a compression ring in the cylinder bore within the area of piston travel. Be sure the top face of the ring is parallel to the face of the engine block.

c. Measure the ring gap as shown in Figure 4. It should measure .012 to .017". If the gap is too small, file the ring ends to meet the above specifications.

Step 3—Clean the ring grooves.

a. Hold the piston as shown in Figure 5.

b. Adjust the ring groove cleaner to the groove size and clean as shown in Figure 5.

III. REMOVING AND REPLACING PISTON PINS AND BUSHINGS

Step 1—Remove the two spring lock clips (D-Figure 3) from the sides of piston.

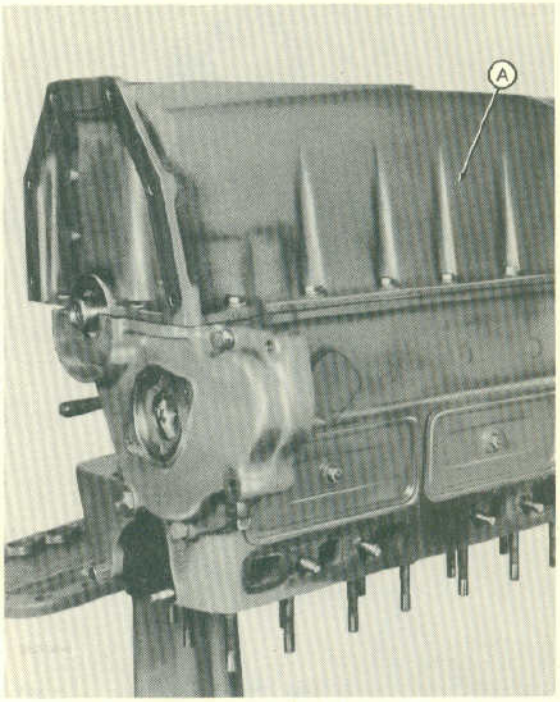

Fig. 1

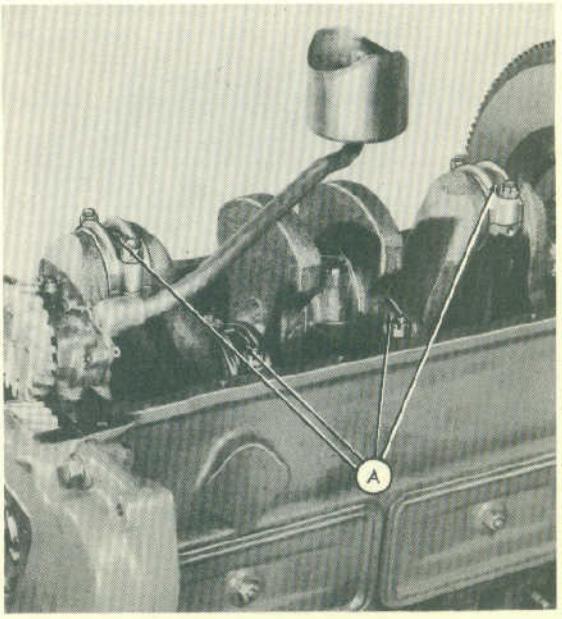

Fig. 2

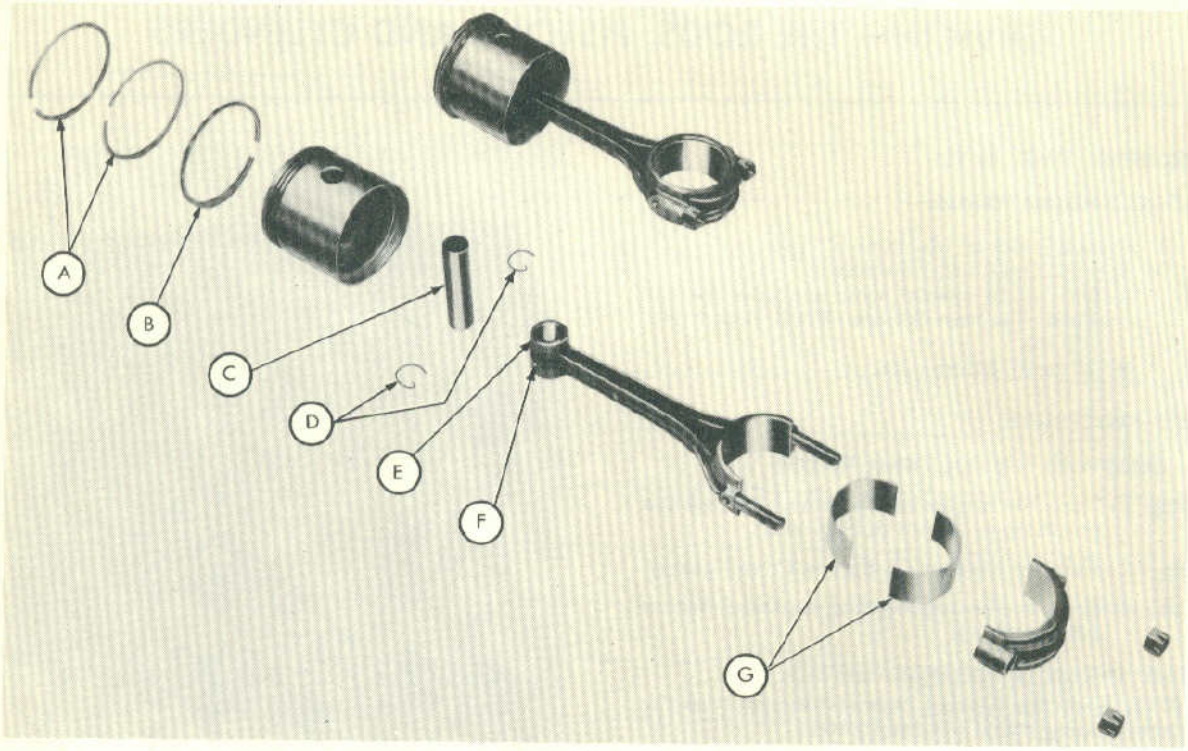

Fig. 3

Step 2—Push the piston pin (C-Figure 3) out. Note the position of the rod for correct installation.

NOTE: Steps 3, 4, 5 and 6 of Part III will not be performed in the shop but will be discussed by the instructor.

Step 3—Remove the piston pin bushing (E-Figure 3).

Step 4—Install new bushing.

Step 5—Drill the two oil holes (F-Figure 3) in the bushing after the bushing has been pressed into position.

Step 6—Ream the bushing for piston pin fit.

Step 7—Install new piston pins. New piston pins are available in standard, 0.001 oversize, 0.002" oversize.

NOTE: When both the piston and pin are clean and at the same temperature, the pins should be a thumb push fit in piston pin bores. The pin fit in the rod bushing is correct if the pin drops slowly through the bushing of its own weight.

Step 8—Install new spring clips.

IV. RENEWING THE ROD BEARING INSERTS

Step 1—Remove the old inserts (G-Figure 3).

Step 2—Replace with new bearing inserts.

NOTE: Bearing inserts are available in standard 0.001, 0.002, 0.005, 0.007, 0.010, and 0.020 undersize. To determine how much undersize the inserts should be, use a micrometer and check the diameter of the crankshaft rod journals.

V. CHECKING THE PISTON (STEEL) CLEARANCE. REMOVING AND INSTALLING CYLINDER SLEEVES—(DEMONSTRATION)

Step 1—Check the piston clearance in a cylinder bore.

a. Remove the rings from a piston.

b. Insert a ½" wide thickness gauge in the cylinder bore, long enough to cover the entire length of the piston.

c. Attach a tension scale to the feeler gauge.

d. Push the piston into the cylinder so that the side of the piston, which is 90° from the piston pin hole, is against the thickness gauge.

e. Withdraw the gauge and observe the tension scale reading.

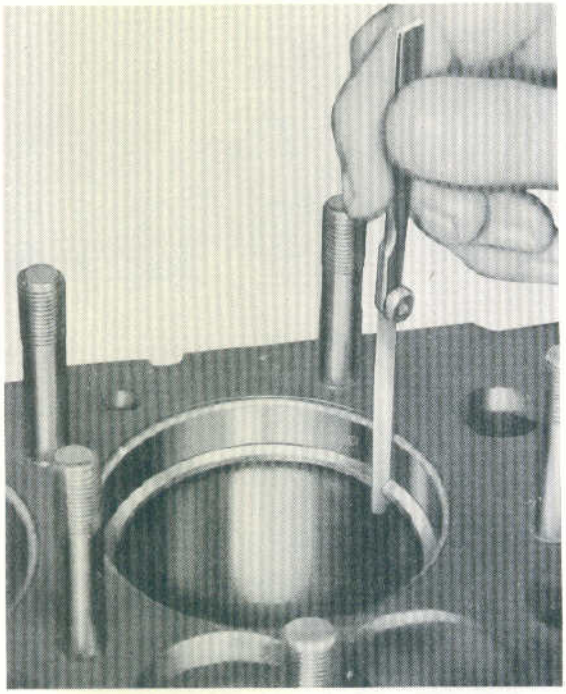

Fig. 4

CYLINDER BORE AND PISTON COMBINATIONS	STEEL PISTON	
	GAUGE THICKNESS	PULL POUNDS
New Steel Sleeve– New Piston (Steel)	0.003	5-8
Worn Steel Sleeve– New Piston (Steel)	0.004	5-8
Worn Steel Sleeve– Worn Piston (Steel)	0.005	5-8

DIMENSIONS FOR FITTING STEEL PISTON IN CYLINDER BORE

Step 2–Remove the cylinder sleeve.

a. Start separating the sleeve from the cylinder wall as shown in Figure 6.

b. Complete the separation of the sleeve from the cylinder wall as shown in Figure 7.

c. Pull the crushed sleeve from the cylinder wall.

Step 3–Install new cylinder sleeve as shown in Figure 8.

VI. INSTALLING RODS AND PISTONS

NOTE: For training, perform as Part VI of Job Plan 4.

Step 1–Install rings on the pistons.

a. Thoroughly clean the pistons and rings.

b. Install the oil control ring.

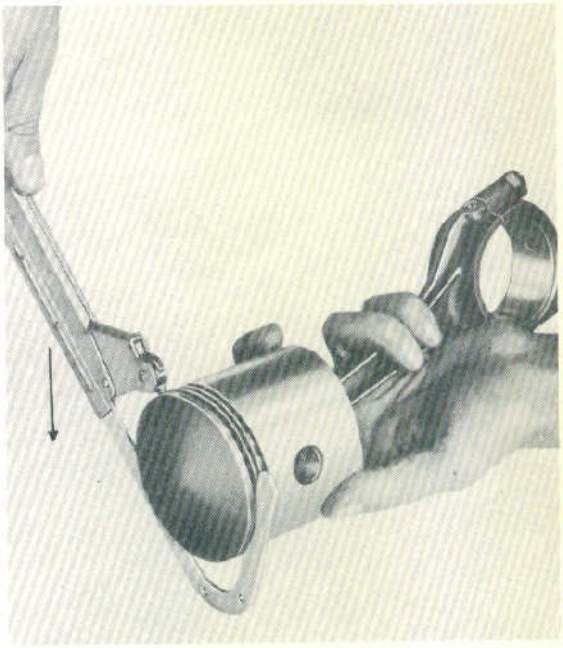

Fig. 5

Fig. 6

c. Install the compression rings. New rings are marked "Top" and should be installed with that side up.

d. Check the ring side clearance.

e. Stagger the ring gap spacing.

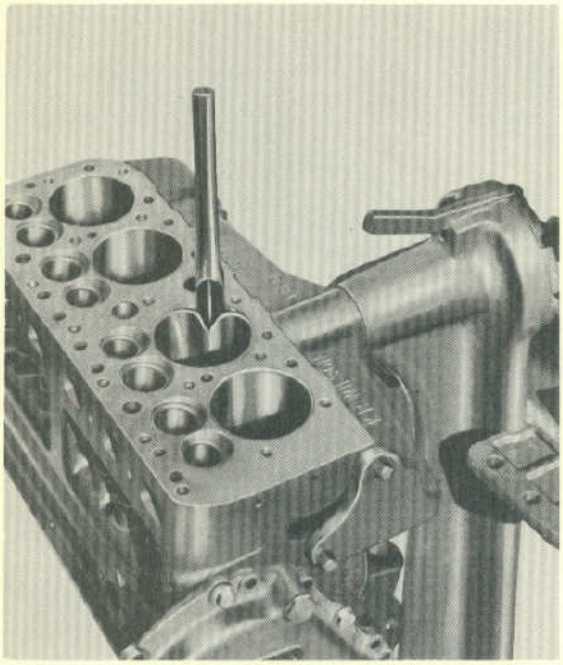

Fig. 7

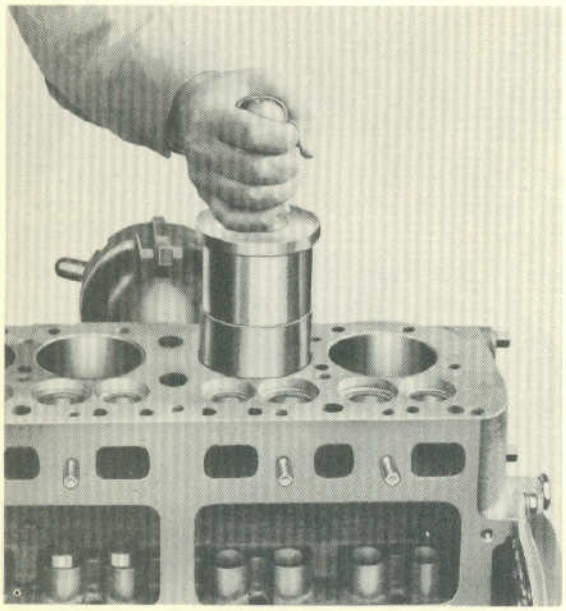

Fig. 8

NOTE: If ring side clearance exceeds 0.004 at any point around ring groove it is advisable to renew the piston.

Step 2—Position the engine on the stand with the block up. This eliminates the possibility of nuts falling into the block when attaching the connecting rods.

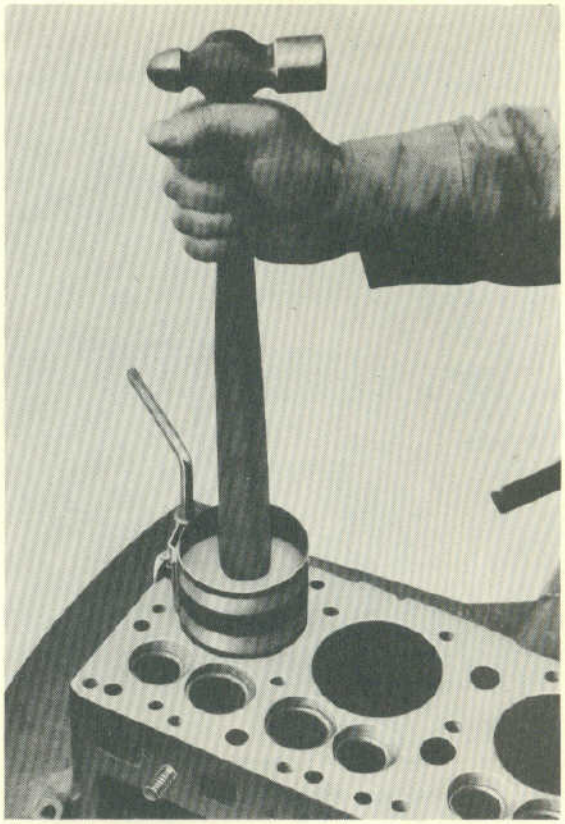

Fig. 9

Step 3—Insert the rods and the pistons in the cylinders. Lubricate each piston with a light coat of oil before inserting it in the cylinder.

Step 4—With the ring compressor attached as shown in Figure 9, tap the piston into position. Be sure that the crankshaft is in the proper position.

Step 5—Replace the matching rod bearing caps on their respective rods.

Step 6—Tighten the rod bearing cap nuts to a torque value of 35 to 40 ft. lbs. Check crankshaft rotation for binding.

Step 7—Install the pan gasket, pan, oil cap and screen.

Step 8—Install the crankshaft pulley.

Step 9—Install the head gasket and head. The head nuts should be tightened to a torque value of 50 to 55 foot pounds.

Step 10—Install the engine lift bracket.

SERVICING THE CRANKSHAFT, CLUTCH, FLY WHEEL ASSEMBLY AND OIL PUMP

TRAINING TIME: 1¾ Hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Service Tool Board #FT 46
   b. Torque Wrench
   c. 2" to 3" Micrometer
   d. Stub Shaft (Clutch)
   e. Feeler Pull Gauge
   f. #20 Soft Annealed Wire
   g. Oil Can
   h. Arbor Press

JOB PROCEDURE:

I. REMOVING THE CRANKSHAFT

Step 1—Remove the clutch assembly by removing the six cap screws (A-Figure 1). Grasp both the friction plate and clutch assembly when removing.

Step 2—Remove the flywheel by removing the four cap screws (A-Figure 2) and tapping the face of the flywheel near the outer edge with a soft face mallet.

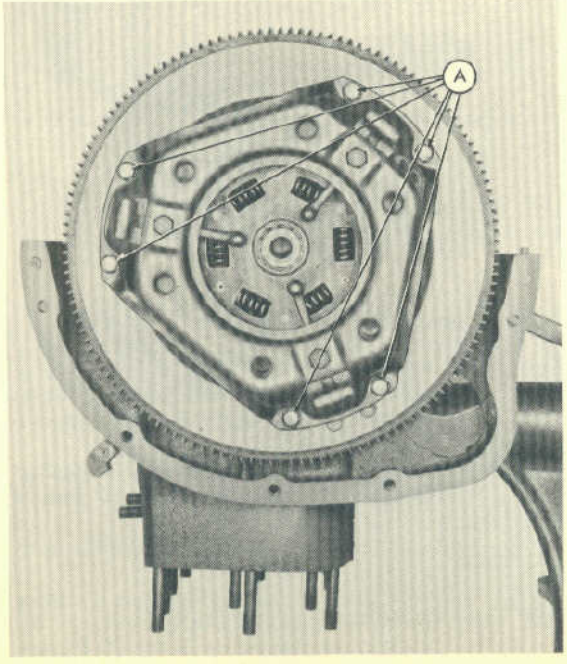

Fig. 1

Step 3—Check the crankshaft for end play as shown in Figure 3. End play should be from .002 to .006 with a wear limit of .008.

NOTE: End play is controlled by the side flanges on the main center bearing. If the end play is in excess of above limits, the center bearing should be replaced as explained under Part IV, Step 1, of this Job Plan.

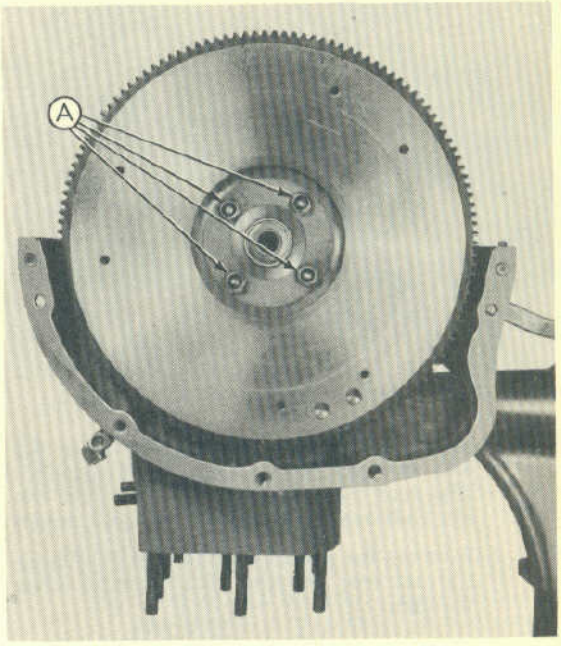

Fig. 2

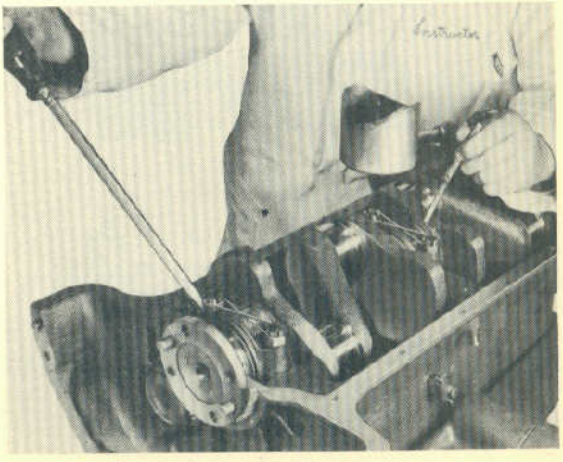

Fig. 3

SERVICING THE CRANKSHAFT, CLUTCH, FLY WHEEL ASSEMBLY AND OIL PUMP

Step 4—Remove the safety wire from the nuts on the main bearing caps (A-Figure 4).

Step 5—Remove the front main bearing cap and oil pump assembly (C-Figure 4).

Step 6—Remove the center and rear main bearing caps (B-Figure 4).

Step 7—Remove the crankshaft.

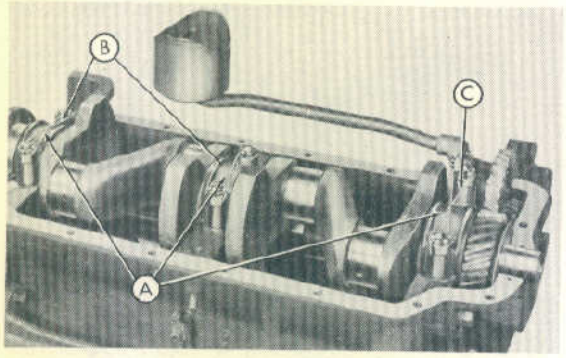

Fig. 4

II. RENEWING THE CRANKSHAFT OIL SEALS

Step 1—Remove the upper front (D-Figure 5) and rear oil seal halves, (A-Figure 5). The rear oil seal is in the block and the front oil seal is in the timing gear cover.

Step 2—Remove the lower front oil seal (C-Figure 5) and rear oil seal (B-Figure 5) from the pan.

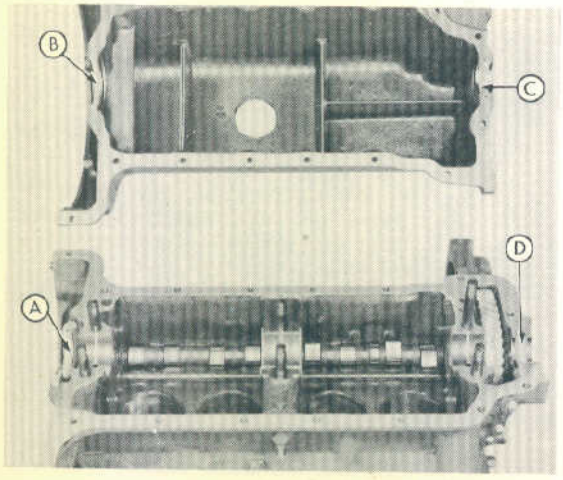

Fig. 5

Step 3—Install new oil seals.

NOTE: The crankshaft oil seals are of the two-piece molded packing ring type. New seals should be soaked in oil several hours before being installed.

III. CHECKING CRANKSHAFT JOURNALS AND REPLACING THE BEARING SHELLS

Step 1—Check the diameter of both the main and connecting rod journals.

NOTE: The main journals should be 2.248—2.249 diameter; the connecting rod journals should be 2.0935—2.0945 diameter. If the crankshaft main or the connecting rod journals are out of round more than 0.0015 or are tapered more than 0.001, the shaft should be reconditioned or renewed. If the journals are worn evenly and are not out of round or tapered more than the above mentioned tolerances, undersize bearings may be installed, providing the main or the rod bearing clearance does not exceed 0.005.

Step 2—Replace all bearing shells in both the engine block and the bearing caps which do not conform to the proper tolerances. Special attention should be given the center main bearing. If the crankshaft was found to have excessive end play when checked as per Step 3, Part I, of this Job Plan, replace the center bearing shells at this time.

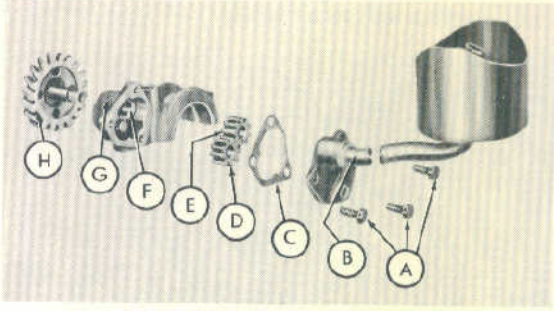

Fig. 6

IV. CHECKING THE OIL PUMP

Step 1—Disassemble The Unit

a. Remove the safety wire from the three cap screws (A-Figure 6) and remove the cap screws.

b. Remove the cover and tube assembly (B-Figure 6) and the gasket (C-Figure 6).

c. Lift the driven gear (D-Figure 6) from the pump.

d. Press the drive gear (E-Figure 6) from the driven gear and shaft (H-Figure 6) and inspect the pump body (G-Figure 6) for wear or cracks.

e. Inspect the oil pump body bushing (F-Figure 6). If the inside diameter exceeds 0.566 inch, or the outside diameter of the drive gear shaft is less than 0.560 inch, replace the bushing or shaft.

NOTE: If the bushing is replaced it must be reamed to .001 inch of the shaft diameter. Replace the drive gear (E-Figure 6) if it is less than 0.560 inch long or if the teeth are worn, chipped, or broken.

Step 2—Assemble the oil pump.

a. Press the gear and shaft assembly into the oil pump body until the end of the shaft is flush with the outside of the pump body.

b. Press the drive gear on the drive gear shaft, making sure the flat in the gear is in line with the flat side of the shaft.

c. Replace the driven gear on the stub shaft.

d. Replace the cover and tube assembly.

e. Safety wire the cap screws.

V. INSTALLING THE CRANKSHAFT

Step 1—Position the crankshaft in the engine block.

Step 2—Time the crankshaft gear with the camshaft gear.

Step 3—Replace the main bearing caps.

Step 4—Tighten the nuts on the stud bolts holding the main bearing caps to a torque value of 75 to 80 foot pounds (Figure 7). Check crankshaft rotation for binding. Secure the nuts with safety wire.

Step 5—Install the timing gear gasket, the cover, and the oil relief valve.

Step 6—Install the flywheel. Tighten the cap screws securely.

Step 7—Install the clutch assembly.

a. Position the clutch plate (springs out) and clutch cover assembly against the flywheel. Start the cap screws.

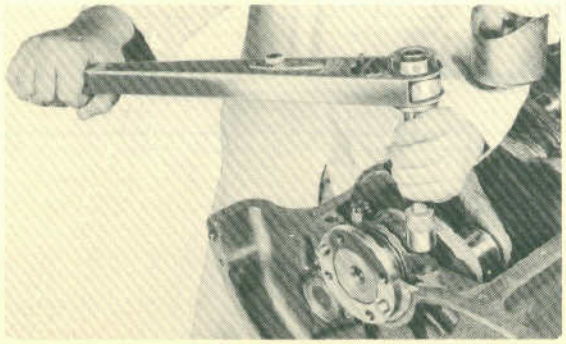

Fig. 7

b. Align the clutch plate by inserting the stub clutch shaft as shown in Figure 8.

c. Tighten the cap screws securely.

VI. INSTALLING THE RODS AND THE PISTONS (SEE PART VI OF JOB PLAN 3)

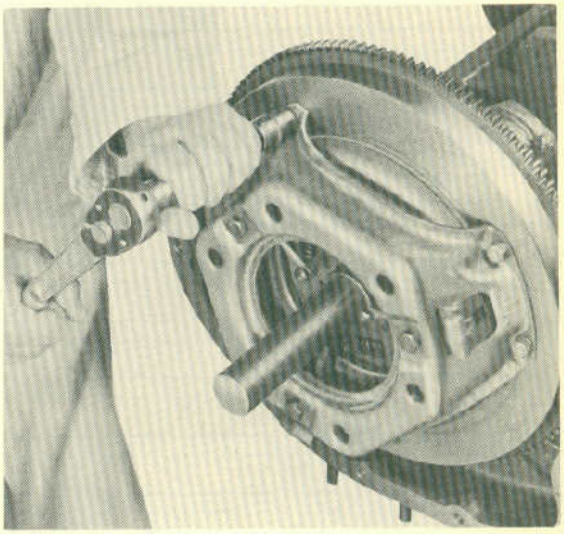

Fig. 8

VII. RENEWING THE FLYWHEEL RING GEAR—(DEMONSTRATION)

NOTE: This demonstration is optional.

Step 1—Remove the ring gear.

a. Drill a $^{11}/_{32}$ inch hole nearly through the flywheel ring gear on the engine side of the gear.

b. Split the ring gear at the drilled hole with a chisel, and lift it off of the flywheel.

Step 2—Install the new ring gear.

a. Clean the ring gear recess on the flywheel.

b. Heat the ring gear evenly to 360°F, and place it on the cold flywheel, making sure it is seated in the recess of the flywheel.

c. Allow to cool before installing the flywheel.

NOTES

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Prepared by the Service Department

DEARBORN MOTORS CORPORATION
DETROIT 3, MICHIGAN

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TRANSMISSION ASSEMBLY

CONFERENCE OBJECTIVES:

1. To review the construction and operation of the 8N Ford Tractor transmission
2. To discuss service problems related to the transmission

CONFERENCE TIME: 1 Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 3-1—Transmission—Main and Countershaft Assembly
   b. 3-2—Main Drive Gear
   c. 3-3—Main Shaft, Countershaft, and Main Drive Gear
   d. 3-4—Reverse Idler Gear Assembly
   e. 3-5—Transmission Shift Assembly
   f. 3-6—Transmission Bearing Adjustment
   g. 3-7—Operating Problems
   h. 3-7—PTO Shifter Assembly
4. PTO Shaft—disassembled
5. Conference Guide No. 3 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conference

1. In our previous conference we discussed in part, the engine being a means of generating power that can be put to work rotating a shaft. Also, we discussed that by means of the clutch assembly we can stop the rotation of this shaft at will

2. Mechanically, the power that the engine has generated could be transferred by direct drive to the rear wheels of the tractor by means of a long drive shaft and bevel gears. But this would provide only one forward speed and greatly limit the usefulness of the tractor

B. Usefulness of the tractor

CHART 3-1
The Transmission

1. The usefulness of the tractor is dependent on its ability to use the power generated by the engine at various speeds, and directions. To give the various speeds desired as well as enable the tractor to go forward or backward, the transmission is installed between the clutch and final drive

C. The objectives of this conference

1. To review the construction and operation of the 8N Ford Tractor transmission

2. To discuss service problems related to the transmission

II. The 8N Ford Tractor Transmission

A. Construction and operation

1. Basic construction principles of any transmission

CHART 3-2

Basic Transmission

a. *Main drive gear*—attached to the clutch assembly and always rotating when the clutch is engaged

b. *The countershaft*—with a fixed gear in constant mesh with the main drive gear, on which is mounted various size gears

c. *The main shaft*—on which are mounted gears of various size in mesh or which can be made to mesh with the gears on the countershaft. The main shaft is splined directly to the final drive

d. *Third set of gears*—to produce reverse rotation of the main shaft

e. *Shifting mechanisms*—the mechanical device for meshing the selected gears on the main shaft with those of the countershaft or with the reverse gears

3. Construction and operation of the 8N Ford Tractor Transmission

a. The main shaft and countershaft

VISUAL CAST SLIDE 3-1

Transmission—Main and Countershaft Assembly

(1) In discussing the construction and operation of the 8N Ford Tractor transmission, let us start with the countershaft and main shaft assemblies

(2) The countershaft consists of a shaft on which are mounted various sized helical type gears. Some of these gears are splined or fixed to the shaft, and others idle on the shaft until engaged to the shaft by means of a sliding coupling which is splined to the connector.

(a) The large forward gear, the countershaft gear, is splined to the shaft. As we shall see later, this is the gear that is in constant mesh with the main drive gear and drives the transmission assembly

(b) Back of the countershaft gear is the countershaft fourth gear which idles on the countershaft. As an integral part of this gear, there is the smaller spur gear. This fourth gear is meshed with its mating gear of the same size which is splined to the mainshaft. This gear is the main shaft fourth gear

(c) Back of the countershaft fourth gear is the sliding coupling which is splined to the connector, which in turn is splined to the countershaft. It turns with the countershaft. This coupling, when moved forward, locks the idling countershaft fourth gear to the countershaft and thereby drives the main shaft in fourth gear

(d) Back of the countershaft sliding coupling is the countershaft second gear which idles on the countershaft. It is in mesh with the larger main shaft second gear which is splined to the main shaft. When the coupling is moved rearward, the countershaft second gear becomes locked to the countershaft and turns the main shaft in second gear

(e) Back of the countershaft second gear is located the countershaft third gear. This gear is an integral part of the countershaft. It is meshed with a larger idling gear on the main shaft, the main shaft third gear

(f) Back of the main shaft third gear is the main shaft sliding coupling which is splined to the connector, which in turn is splined to the main shaft. When this coupling is moved forward the idling main shaft third gear becomes locked to the main shaft and because it is meshed with the countershaft third gear the main shaft is rotated in third gear

(g) The gear at the rearward end of the countershaft is the first gear. It is an integral part of the countershaft. This gear is meshed with the large idling main shaft first gear, when the main shaft sliding coupling is moved rearward the main shaft first gear becomes locked to the main shaft and the main shaft is then rotated in first gear

B. The main drive gear

1. We are now ready to consider transmitting the rotating force of the crankshaft to the transmission. This is done through the main drive gear. The main drive gear and shaft are machined as a unit. This unit is held in position by the bearing retainer. The forward end of the main drive gear (shaft) is splined to the clutch friction plate. So, whenever the clutch is engaged the main drive gear rotates

VISUAL CAST SLIDE 3-2

Main Drive Gear

2. The inside diameter of the main drive gear forms the bearing race for the roller bearing at the forward end of the main shaft, and is meshed with the countershaft gear, directly driving the countershaft whenever the clutch is engaged. NOTE: Select a trainee to trace flow of power on visual cast slide 3-3.

VISUAL CAST SLIDE 3-3

Main Shaft, Counter-Shaft and Drive Gear

C. The reverse idler gear assembly

1. So far, we have considered only the four forward speeds. As we know, to reverse the rotation of the main shaft it is necessary to introduce a third set of gears

VISUAL CAST SLIDE 3-4

Reverse Idler Gear Assembly

2. The reverse idler gear assembly

a. Principal parts

(1) The shaft
(2) The reverse idler gear and bushing assembly
(3) The driven gear
(4) The shift coupling
(5) Thrust washers

b. Operation

(1) The driven gear, which idles on the reverse idler gear bushing assembly, is in constant mesh with the countershaft third gear

(2) The reverse idler gear is in constant mesh with the main shaft second gear

(3) The shifting coupling is splined to the reverse idler gear and bushing assembly

(4) When the shifting coupling is moved forward the idling driven gear becomes locked to the reverse idler gear and the complete assembly is rotated by the counter-

shaft third gear. The reverse idler gear is meshed with the main shaft second gear so the rotation of the reverse idler assembly reverses the rotation of the main shaft thus turning the wheels in reverse

D. The transmission shift assembly

VISUAL CAST SLIDE 3-5

Transmission Shift Assembly

1. As we have seen up to this point the movement of the sliding coupling on all three transmission shafts determines the gear in which the tractor is operating. These sliding couplings are moved mechanically
2. Parts of the shift assembly
   a. Shifter forks that fit over each sliding coupling
   b. Shifter rails on which the shift forks are mounted
   c. Shift plates that move the two lower rails forward or backward
   d. The shift lever that moves the shift plates and the upper shift rail
3. Shifting operation
   a. For training purposes the operation of the shifting mechanism can best be explained by using the actual transmission. Your instructor will make the explanation during the shop period following this conference

E. Servicing the transmission

1. Lubrication
   a. The transmission assembly operates in a bath of oil, the same oil that lubricates the differential assembly and operates the hydraulic system
   b. This oil is SAE 90 for summer and SAE 80 for winter. Heavy duty motor oil, SAE 50HD, may be used in summer and SAE 30HD, in the winter
2. Bearing adjustment

VISUAL CAST SLIDE 3-6

Transmission Bearing Adjustment

   a. The pre-load on the main shaft and the countershaft is established by metal shim packs placed between the main shaft rear bearing retainer and the transmission housing and the PTO shifter assembly and transmission housing.
      (1) Countershaft—15 to 30 inch pounds
      (2) Main Shaft—20 to 35 inch pounds
3. Operating problems and cause

VISUAL CAST SLIDE 3-7

Operating Problems

   a. Difficult shifting
      (1) Burrs or faulty splines on the sliding coupling or on the idling gears drive teeth
      (2) Close tolerances held in the manufacture of the gears to prevent them from jumping out of gear
      (3) Radii on the slots in the selector plate have been removed. This makes it difficult to know when the gear shift lever is in position to shift
         (a) An automatic means of centering is being developed
      (4) Excessive pre-loading of the main and countershaft
   b. Locking in gear
      (1) Fourth gear "freezing" to the hub of the connector due to insufficient lubrication
         (a) Oil grooves are now provided in both ends of the fourth gear and in the inside diameter

(2) The reverse idler gear "freezing" for the same reason as the fourth gear

(3) Set screw that secures the fork to the shift rail working loose causing the shift rail to move instead of the fork

(4) Faulty drive teeth on the idler gears and splines on the coupling causing them to freeze together

c. Jumping out of gear

(1) Negative lead on spur teeth of gear

(a) Correct by replacing the gear and the sliding coupling

(2) Sprung shift lever or shift fork that failed to completely mesh the coupling and idling gear

(3) Not shifting all the way into gear due to insufficient overshift

(a) A little overshift is desirable in all gears. The position of the shift cover on the transmission is a determining factor in the amount of overshift for a given gear. The amount of overshift should be equalized. This can be done by re-positioning the shift cover toward the gear that has no overshift

(4) Sloppy fit in the sliding couplings

(5) Recess for the detent balls in the shift are mislocated

d. Noisy

(1) Insufficient bearing pre-load

(2) Excessive bearing pre-load

(3) Faulty or broken teeth on the transmission gears

(4) Improper fit of the gears on the shafts

III. PTO Shifter Assembly

A. Function

1. Provides a means of engaging and disengaging the power take-off shaft with the transmission countershaft

B. Construction and operation

VISUAL CAST SLIDE 3-8

PTO Shifter Assembly

1. The PTO shifter assembly consists of a

a. Bearing support, which contains the race for the rear countershaft bearing. This support is attached to the transmission housing with four cap screws. A metal shim pack is installed between the support and transmission housing. The number and thickness of these shims determines the bearing pre-load on the countershaft

b. Clutch sleeve internally splined to the PTO shaft, and also splined at the forward end to engage the PTO clutch hub on the countershaft

c. The PTO shaft bearing is held in position in the bearing support by two snap rings

d. Shifter rail and stop, when moved forward, slides the sleeve forward engaging the PTO hub on the countershaft, thereby rotating the PTO shaft. It is held in position by means of a detent ball and spring

C. Servicing the PTO shifter assembly

NOTE: The complete procedure for servicing the PTO shifter assembly is outlined in Service Training Job Plan No. 5.

IV. PTO Shaft

Discuss the PTO Shaft using a disassembled PTO Shaft to illustrate its construction and servicing

A. Function
   1. To furnish a direct drive from the transmission countershaft to the rear of the center housing for attaching a belt pulley or power driven equipment

B. Construction
   1. The PTO shaft assembly consists of a shaft and sleeve assembly with a 1⅛" splined end
   2. The PTO shaft is supported in the PTO cover by a ball type bearing. This bearing is secured to the shaft by the PTO sleeve which is preheated and shrunk on the PTO shaft.
   3. A grease seal, pressed into the PTO cover, prevents oil from leaking from the rear of the center housing
   4. The PTO cover cap, covers the rear end of the shaft when not attached to the pulley or power driven equipment

C. Servicing the PTO shaft assembly
   1. Disassembly
      a. Remove the PTO cover cap
      b. Remove the outer snap ring from the PTO cover
      c. Attach a puller to the PTO cover and pull the cover assembly from the PTO shaft assembly
         (1) The cover when removed will contain the oil seal and inner snap ring
         (2) The shaft assembly will contain the PTO shaft bearing and PTO sleeve
      d. To remove the bearing from the shaft assembly
         (1) Split the PTO sleeve with a cold chisel and remove from the shaft assembly
         (2) Pull the bearing from the shaft
      e. To remove the oil seal from the cover
         (1) Remove the inner snap ring
         (2) Drive the oil seal from the cover
   2. Assembly
      a. Reverse the disassembly procedure noting the following precautions
         (1) The PTO sleeve must be preheated to install on the PTO shaft
         (2) The oil seal is pressed into the cover. Be sure to use a tool that applies pressure evenly to the oil seal

V. Conference Conclusion

A. Summary
   1 In this conference we have discussed the construction and operation of the 8N Ford Tractor transmission
   2. We have also discussed service problems related to the transmission
   3. Following this conference we will go to the shops and perform the various service jobs on the transmission

B. Distribute the training material
   1. Conference Guide No. 3

C. Tell the group that the next conference topic will deal with the differential, rear axle and brakes, and the time that that conference is scheduled to begin

TRANSMISSION ASSEMBLY OVERHAUL

TRAINING TIME: 3½ Hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Tractor Service Tool Board #FT 47
   b. One set of special tools available for the Ford Tractor Service Tool Board #FT 46
   c. Hoist
   d. Jack
   e. Transmission Housing Stand
   f. Arbor Press
   g. Sleeves for Installing Bushings

JOB PROCEDURE:

I. DISASSEMBLING THE GEARSHIFT UNIT

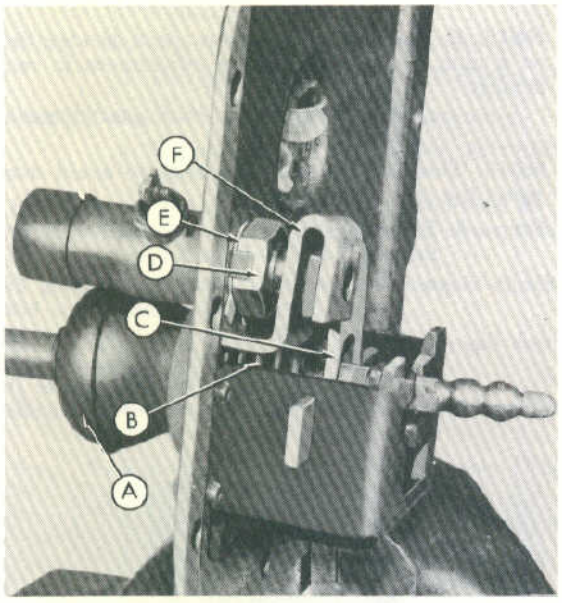

Fig. 1

Step 1—Slide the shift lever rubber (A-Figure 1) up on the lever.

Step 2—Remove the starter switch by removing the 1 1/16" brass nut (D-Figure 1) and the lockwasher (E-Figure 1).

Step 3—Remove the safety latch (F-Figure 1).

Step 4—Compress the spring as shown in Figure 2 and remove the spring retainer.

Step 5—Pull up on the gear shift lever and lift it out of the cover assembly.

Step 6—Remove the spring (B-Figure 1).

Step 7—Tilt the shifter lock plate (C-Figure 1) and remove it from the guide support.

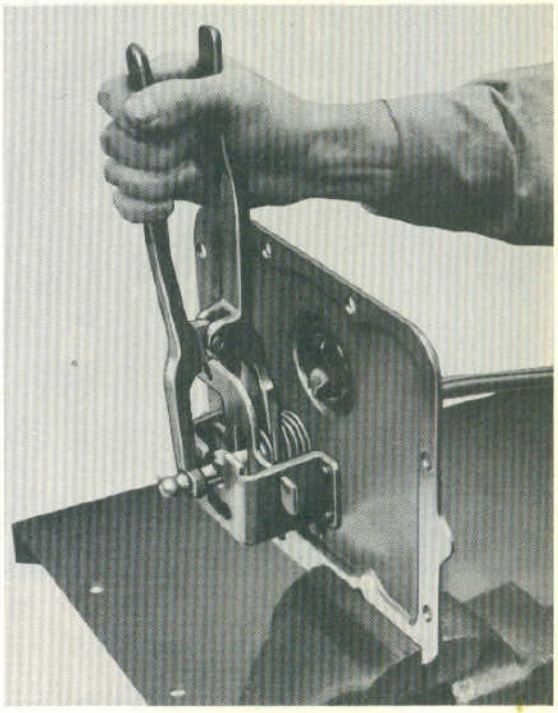

Fig. 2

II. REASSEMBLING THE GEARSHIFT UNIT (REVERSE THE DISASSEMBLY PROCEDURE.)

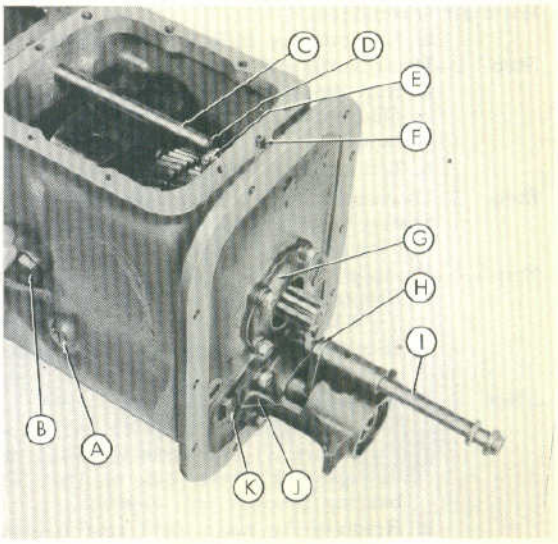

Fig. 3

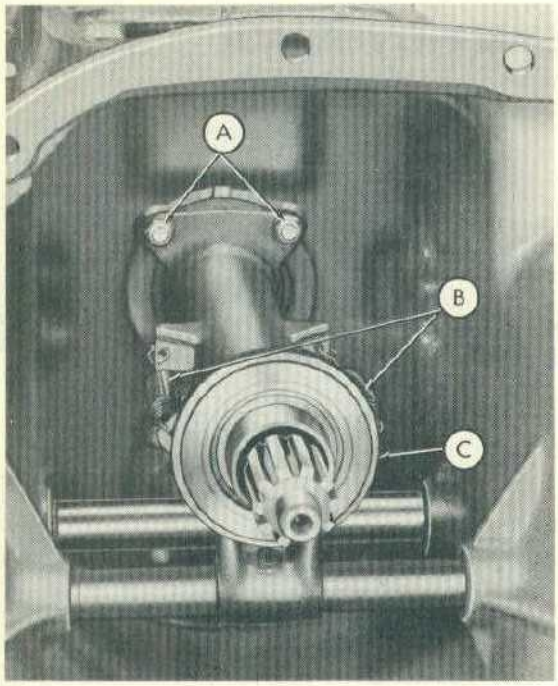

Fig. 4

III. DISASSEMBLING THE TRANSMISSION

Step 1—Remove the top shift fork.

a. Loosen the locknut on the fork screw (E-Figure 3) and back off the screw until the shaft (C-Figure 3) is free to slide out the rear of transmission housing.

b. Remove the shifter rod fork spring (F-Figure 3).

NOTE: Remove the steel ball from the casting after the shaft is removed.

c. Lift out the shift fork (D-Figure 3).

Step 2—Remove the shift plates.

a. Remove the hex head pivot screws (B-Figure 3) from both sides of the housing.

b. Lift out the shift plates.

Step 3—Disconnect the clutch release bearing retaining springs (B-Figure 4) and remove bearing (C-Figure 4).

Step 4—Remove the main drive gear and shaft.

a. Remove the four cap screws (A-Figure 4).

b. Remove the shaft and bearing retainer as a unit.

Step 5—Remove the main shaft.

a. Remove the PTO shift rail stop (H-Figure 3) and slide the shift rail (I-Figure 3) rearward so that the bearing retainer will clear.

b. Remove the main shaft rear bearing retainer (G-Figure 3) and the shims.

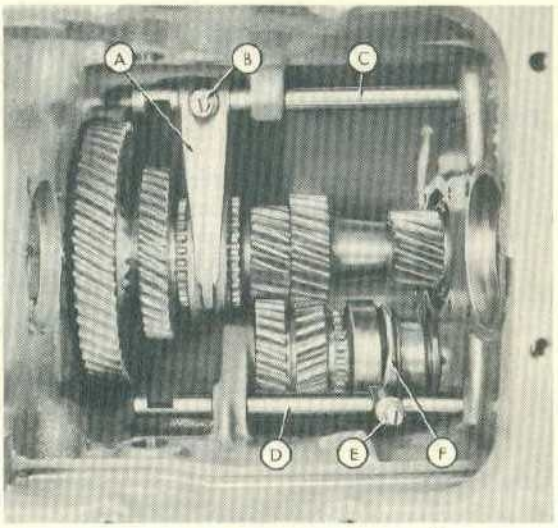

Fig. 5

NOTE: Be sure the metal shim pack is identified as a unit. This will facilitate adjustment in reassembly.

c. Remove the main shaft gear cluster as a unit.

NOTE: This should be done slowly to avoid damaging the gear teeth.

Step 6—Remove the two lower shift rails and forks. (C and D-Figure 5).

a. Remove the interlock screw plug (A-Figure 3) and the spring from both sides of the housing.

b. Loosen the locknuts (B and E-Figure 5) on the shift forks and release the screws until the shafts are free to slide out of the forks.

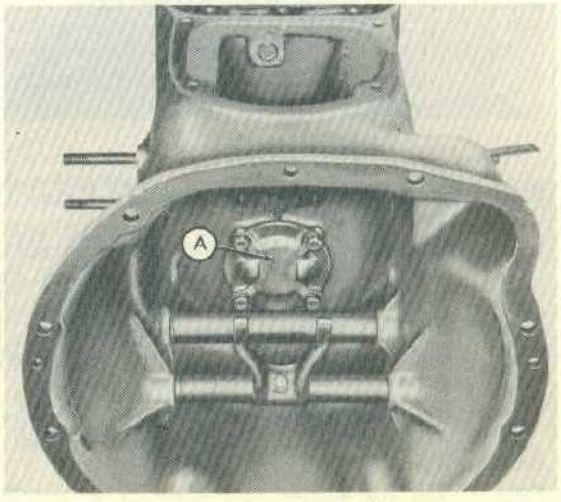

Fig. 6

Fig. 7

c. Slide the shafts out of the rear of the transmission housing.

NOTE: The detent balls can now be removed.

d. Remove the forks (A and F-Figure 5).

Step 7—Remove the countershaft assembly.

a. Remove the PTO shifter assembly (J-Figure 3).

NOTE: Keep the metal shim pack identified as a unit. This will facilitate adjustment upon reassembly.

a. Remove the countershaft gear cluster as a unit.

NOTE: This should be done slowly to avoid damaging the teeth.

Step 8—Remove the countershaft front bearing retainer (A-Figure 6).

Step 9—Remove the reverse idler assembly (Figure 7).

a. Pull the shaft K-Figure 3) rearward.

b. Remove the reverse idler assembly.

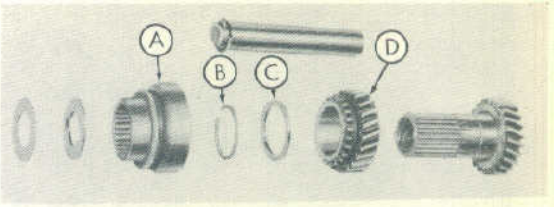

Fig. 8

Step 10—Remove the washer and spacer (A-Figure 7).

IV. SERVICING THE REVERSE IDLER GEAR ASSEMBLY

Step 1—Disassemble the unit.

a. Remove the coupling (A-Figure 8).

b. Remove the snap ring (B-Figure 8).

c. Remove the thrust washer (C-Figure 8).

d. Remove the driver gear (D-Figure 8).

Step 2—Remove and install the reverse idler gear bushings.

NOTE: When using new tractors in training, do not perform this job.

a. Place the gear and bushing assembly on an arbor press and with a proper size pilot tool press out the bushings.

b. Install new bushings by using pilot tools and arbor press.

c. Line ream the new bushings.

Step 3—Assemble the unit.

a. Reverse the disassembly steps.

b. Install in the transmission housing.

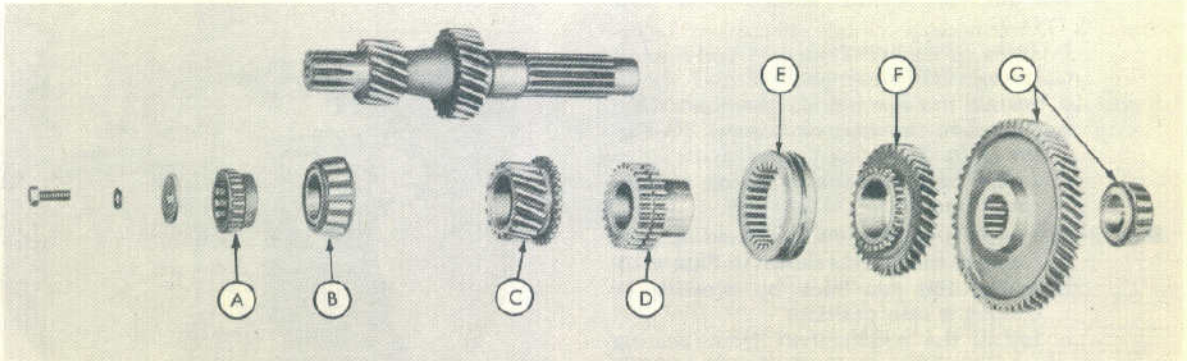

Fig. 9

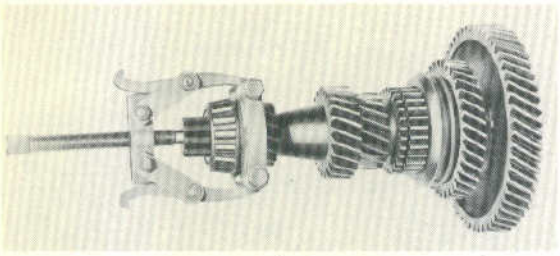

Fig. 10

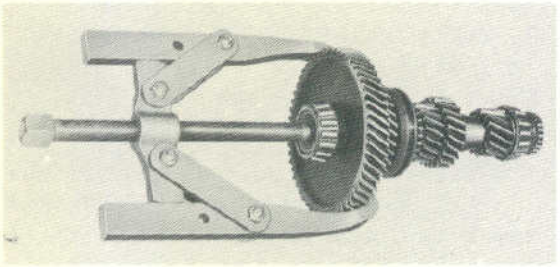

Fig. 11

V. SERVICING THE COUNTERSHAFT ASSEMBLY

Step 1—Disassemble the unit.

a. Remove the PTO hub (A-Figure 9) by removing the cap screw, lockwasher and flat washer that secure it.
b. Remove the rear roller bearing (B-Figure 9), as shown in Figure 10.
c. Remove the front bearing and countershaft gear (55T) (G-Figure 9) as shown in Figure 11.
d. Slide the countershaft fourth gear (36T) (F-Figure 9) from the shaft.
e. Remove the sliding coupling (E-Figure 9).
f. Remove the countershaft connector (D-Figure 9) as shown in Figure 12.
g. Remove the countershaft second gear (C-Figure 9).

Step 2—Assemble the countershaft. (See Figure 9).

a. Install the countershaft second gear (C).
b. Install the countershaft connector (D).
c. Install the sliding coupling (E).
d. Install the countershaft fourth gear (F).
e. Press the countershaft gear (G-Figure 9) and bearing on the shaft.
f. Install the rear roller bearing (B-Figure 9) and the PTO hub (A).

Step 3—Renew the countershaft front bearing race.

a. Remove the race as shown in Figure 13.
b. Install the new race by pressing or driving it into position.
c. Install the countershaft front bearing retainer. Be sure the gasket is in position.

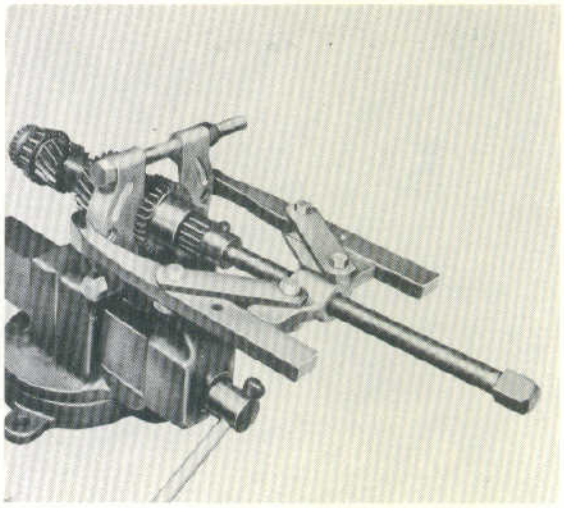

Fig. 12

Step 4—Install the countershaft assembly in the transmission housing.

VI. SERVICING THE PTO SHIFTER ASSEMBLY

Step 1—Disassemble the shifter assembly.

a. Remove the shift rail, interlock ball and spring (A-Figure 14).
b. Remove the snap ring (B-Figure 14) from the rear of bearing support.
c. Lift out the bearing (C-Figure 14).
d. Remove the snap ring (D-Figure 14) which is located in front of the rear bearing.
e. Remove the clutch sleeve (E-Figure 14) from the bearing support
f. Remove the front bearing race as shown in Figure 15.

Step 2—Assemble the PTO shifter.

a. Reverse the disassembly procedure.

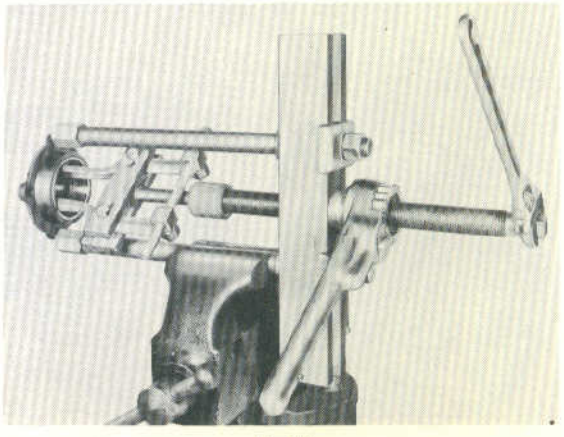

Fig. 13

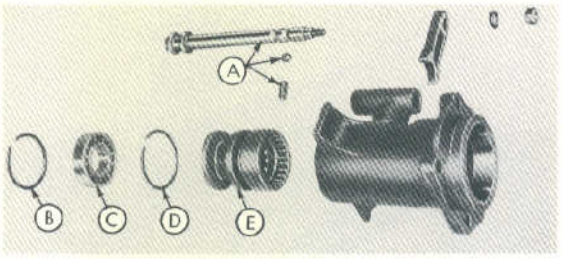

Fig. 14

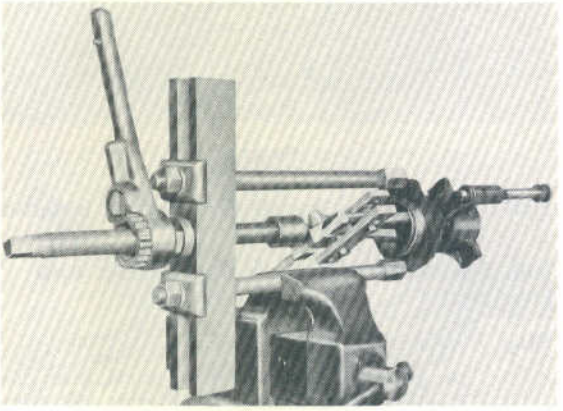

Fig. 15

NOTE: The eraser end of a lead pencil may be used to hold the interlock ball spring in place when installing the shift rail in the housing.

Step 3—Install the shifter assembly on transmission housing. See Figures 3 and 16.

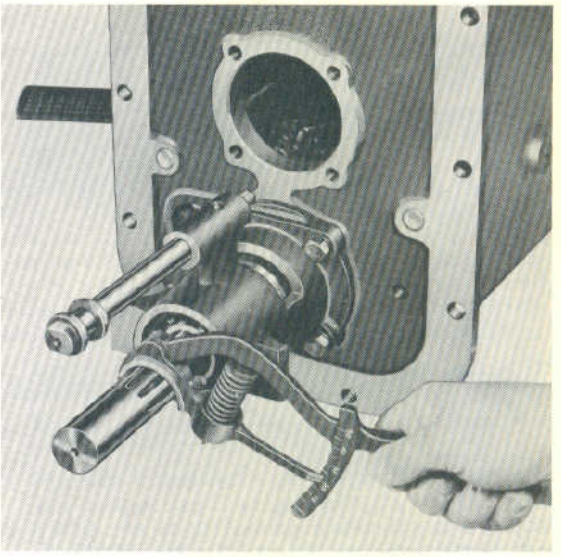

Fig. 16

Step 4—Check the countershaft bearing adjustment as shown in Figure 16. (Stub shaft inserted or the PTO shaft may be used if properly supported.)

NOTE: Be sure the proper number of shims are installed. The correct torque for bearing adjustment is 15 to 30 inch lbs.

NOTE: Install the two lower shift rails and forks. Insert the detent balls and secure with the springs and the interlock screw plugs.

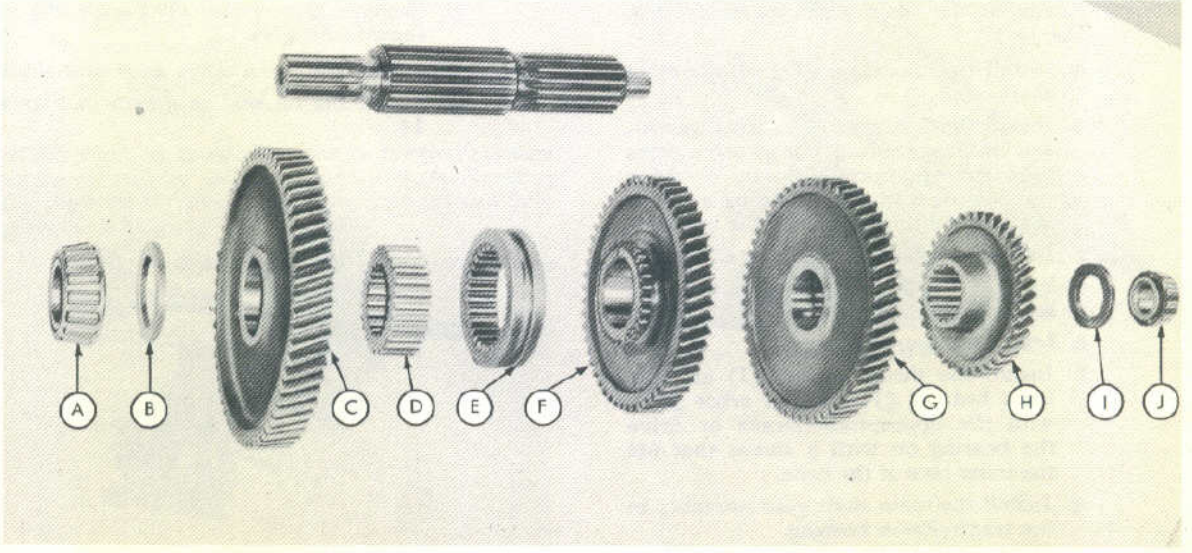

Fig. 17

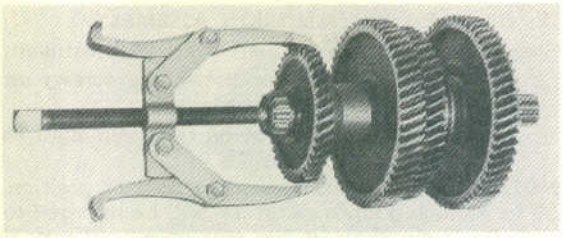

Fig. 18

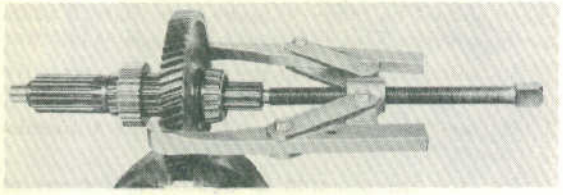

Fig. 19

VII. SERVICING THE MAIN SHAFT ASSEMBLY

Step 1—Disassemble the unit.

a. Pull the front bearing (J-Figure 17), thrust washer (I-Figure 17) and the fourth gear (H-Figure 17) as a unit. See Figure 18.

b. Remove the second gear (G-Figure 17).

c. Remove the third gear (F-Figure 17).

d. Remove the sliding coupling (E-Figure 17).

e. Pull the first gear (C-Figure 17), thrust washer (B-Figure 17), and the rear bearing (A-Figure 17) as a unit. See Figure 19.

f. Remove the connector (D-Figure 17).

Step 2—Assemble the main shaft assembly. See Figure 17.

a. Install the connector (D) on the main shaft.

b. Install the first gear (C) thrust washer, and the rear bearing. Use an arbor press with the appropriate sleeve, or drive the bearing into position using a sleeve that fits the inner race of the cone.

c. Install the sliding coupling (E).

d. Install the third gear (F) and the second gear (G).

e. Install the fourth gear (H).

f. Install the thrust washer (I) and the front bearing (J). Use an arbor press with the appropriate sleeve or drive the bearing on with a sleeve that fits the inner race of the cone.

g. Install the main shaft gear assembly in the transmission housing.

h. Install the rear bearing retainer.

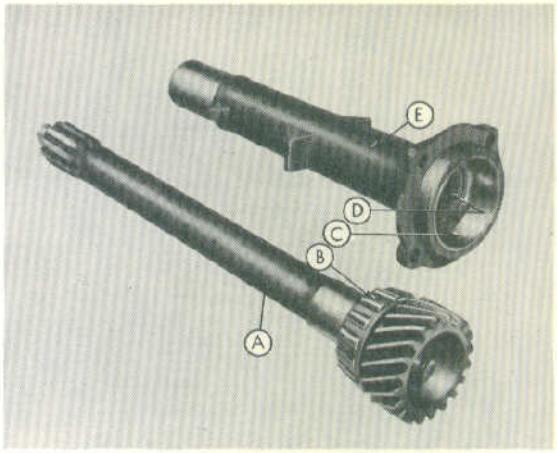

Fig. 20

NOTE: Be sure the metal shim pack is installed.

VIII. SERVICING THE MAIN DRIVE GEAR AND SHAFT

Step 1—Disassemble the unit.

a. Remove the main drive shaft, gear, and bearing assembly (A-Figure 20) from the retainer (E-Figure 20).

b. For training purposes, when using a tractor in which the main drive gear bearing is undamaged, *do not* remove the bearing. Remove the bearing (B-Figure 20) from the main drive shaft as shown in Figure 21.

c. Remove the bearing cup (C-Figure 20) as shown in Figure 22.

d. Remove the oil seal (D-Figure 20) as shown in Figure 23.

Step 2—Assemble the main drive gear and shaft.

a. Install the oil seal as shown in Figure 24.

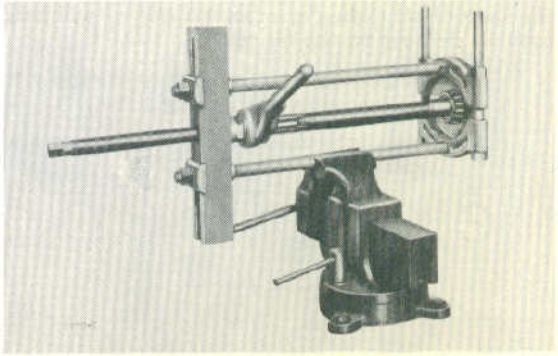

Fig. 21

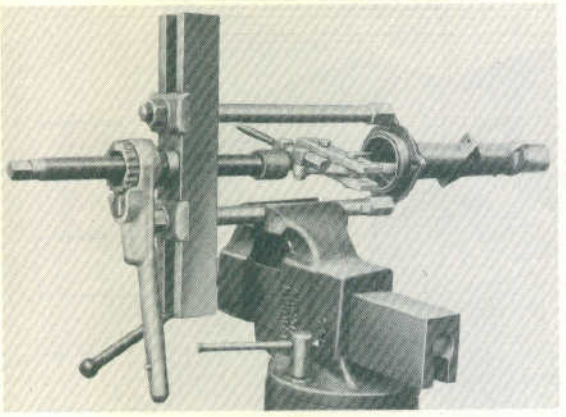

Fig. 22

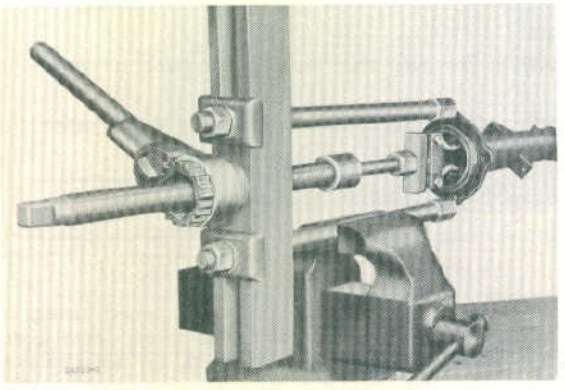

Fig. 23

b. Install the bearing cup by pressing it into position or by driving it with a tool that applies even pressure.

c. Install the bearing with a sleeve and arbor press.

d. Insert the main drive shaft in the retainer.

NOTE: Caution should be used to prevent damage to the oil seal by spline end of the shaft. Rotating the shaft slowly when it is being inserted will help prevent damage to the oil seal.

e. Install the main drive gear assembly to the transmission housing.

f. Install the clutch throw-out bearing and spring.

IX. COMPLETE TRANSMISSION ASSEMBLY

Step 1—Check the main shaft bearing adjustment.

a. Securely tighten the 4 cap screws on the rear bearing retainer.

b. Check the torque on the main shaft as shown in Figure 25.

NOTE: With the transmission in neutral position, 20 to 35 inch pounds of torque will be required to turn the main shaft at the rear or output end, if bearing adjustment is correct. If it has been necessary to replace any transmission gears, a careful check should be made to make sure that all gears mesh properly. This check may be made as follows:

1. Install a stub shaft or the PTO shaft, properly supported, in the PTO shift assembly.
2. Engage the power take-off with the transmission.
3. Put the transmission in neutral and measure the torque required to turn the PTO shaft. (With the shaft turning uniformly, the torque should be from 30 to 60 inch pounds. If the torque is higher than 60 inch pounds, one or more of the gears are binding at the teeth or on the hub shoulders.)

Step 2—Install the PTO clutch rail stop, lockwasher and nut.

Step 3—Install the shift plates.

Step 4—Install the top shift fork and rail.

Step 5—Install the detent ball and spring.

Step 6—Install the gear shift lever assembly.

NOTE: Omit Step 6 until the transmission assembly is reassembled to the tractor.

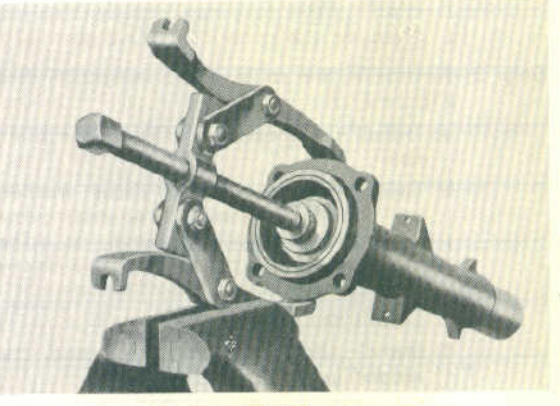

Fig. 24

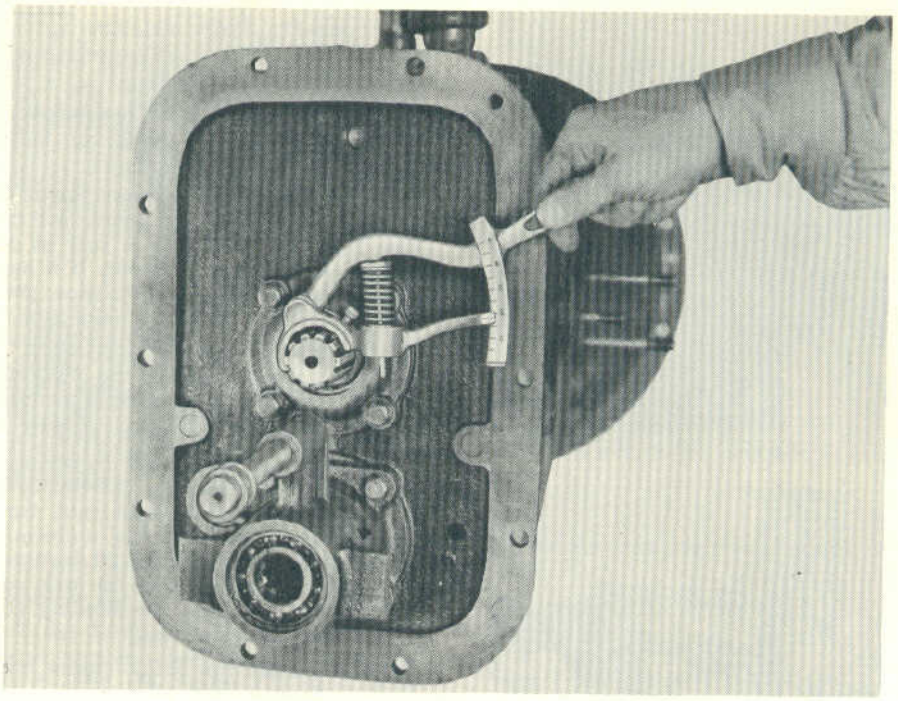

Fig. 25

NOTES

NOTES

FINAL DRIVE AND BRAKES

CONFERENCE OBJECTIVES:

1. To review the construction and operation of the 8N Ford Tractor final drive and brakes
2. To discuss service problems related to the final drive and to the brakes

CONFERENCE TIME: ¾ Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 4-1 Drive Shaft
   b. 4-2 Drive Pinion
   c. 4-3 Ring Gear and Differential
   d. 4-4 Lubrication
   e. 4-5 Rear Axle and Brake Assembly
4. Conference Guide No. 4 (one for each trained)

CONFERENCE PROCEDURE:

I. INTRODUCTION

A. In the last conference we discussed how the power generated by the engine is utilized at various speeds, and how a forward and backward motion is obtained by means of the transmission

CHART 4-1
Final Drive

B. Up to this point, that power is transmitted rearward in a straight line parallel to the sides of the tractor. The power must now be turned at right angles to the drive shaft, and then transmitted to the traction wheels. To do this, we add the final drive to the tractor

C. Objectives of this conference

1. To review the construction and operation of the final drive and the brakes
2. To discuss service problems related to the final drive and to the brakes

II. THE FINAL DRIVE

CHART 4-2
Basic Parts of the Final Drive

A. Basic Parts

1. The drive shaft
   a. It is the hollow steel tube splined at both ends, that joins the transmission main shaft with the pinion gear

2. The pinion gear
   a. The assembly can now be rotated by turning the drive shaft. However, its rotation is still at right angles to the center line of the rear axle
   b. To get the rotary motion of the wheels we must provide a means of transmitting the power "around a corner"

3. The ring gear
   a. The ring gear is the means by which the power is carried "around the corner"
   b. The teeth on the ring gear are beveled to match those of the pinion. Therefore, as the pinion turns, so does the ring gear. The ring gear is now rotating in a plane parallel to that of the rear wheels
   c. At this point we could attach an axle to the ring gear, and then attach wheels to the axle. The tractor could now be moved and we could have forward and backward motion in a straight line. However, this arrangement would not permit turning. As a turn is made, one drive wheel must act as a pivot. As we visualize a turn, two arcs are made with two different radii. This necessitates that the one wheel must travel farther and faster. The axle must therefore be in two parts and another set of gears installed to permit one rear wheel to rotate faster than the other when necessary

4. The differential and axles

CHART 4-3

Basic Differential

   a. Basic construction and operation
      (1) The differential consists of four pinion and two side bevel gears
      (2) If we were to rotate one bevel gear away from us we would find that the pinions would rotate in opposite directions, and because they are meshed with the other bevel gear it would rotate in a direction opposite to that of the bevel gear we are turning
      (3) If we rotate both bevel gears together in the same direction, the pinions remain stationary and the whole gear assembly rotates in the same direction
      (4) If we now hold one side gear and turn the pinions end over end, the pinions will travel around the teeth of the non-rotating bevel gear as if on a track. Since the pinions are meshed with the other bevel gear it will rotate in the same direction as the pinions
      (5) If we now put an axle with splines in each bevel gear and mount wheels on the axles, we can visualize the action of the differential in driving the wheels
      (6) By turning both axles we turn both bevel gears, and the entire assembly moves as if the axle ran straight through the assembly. Now, instead of turning the axle to turn the differential, let us turn the differential to turn the axles. This is what happens when the tractor is driven by the engine
      (7) The differential gears are encased in a case which is riveted to the ring gear. The ring gear, therefore, turns the differential pinion which turn the side gears splined to the axles

III. Servicing The Final Drive

A. Drive shaft

VISUAL CAST SLIDE 4-1

Drive Shaft

1. Construction

   a. The drive shaft is made of heavy steel tubing. Splined sections are welded to both ends

   b. The forward end fits over the splined end of the transmission main shaft; the rear end fits over the splined end of the pinion

2. Servicing

   a. Tolerances for efficient operation

      (1) When the drive shaft is installed, it should slide freely over the splined ends of the main shaft and pinion. When installed it should be possible to move the drive shaft forward or rearward slightly

   c. Service problems

      (1) Breakage

         (a) The most prevalent cause of breakage is due to a misaligned center housing, resulting in a binding of the drive shaft which causes metal fatigue

         (b) The removal of all burrs and checking for freeness of movement of the drive shaft will aid in eliminating binding

         (c) In some cases where binding still occurs due to a misaligned center housing, it will be necessary to replace the housing

VISUAL CAST SLIDE 4-2

The Drive Pinion

B. The drive pinion

1. Construction

   a. Pinion—splined at one end to fit the drive shaft with the rear end machined to fit the pilot bearing inner race.

   b. The pinion is mounted on two tapered roller bearing mounted in a sleeve and cup assembly

   c. A thrust washer is in front of the forward bearing. Two lock nuts, when drawn up on the pinion, establish the amount of bearing pre-load in the pinion sleeve assembly

   d. The drive pinion assembly is secured to the center housing with six cap screws and lockwashers

2. Servicing the drive pinion

   a. Complete procedure for servicing the drive pinion is covered in Service Training Job Plan No. 6, however, several points may be stressed at this time

      (1) Lubrication of the drive pinion is provided by the splash system, utilizing the oil in the center housing

(2) Bearing adjustment should be such that 12 to 16 inch pounds is required to turn the pinion

(3) If the pinion gear is worn so that it requires replacement, the ring gear assembly should also be replaced. It is important that the pinion and ring gear mesh perfectly

C. The ring gear and differential

VISUAL CAST SLIDE 4-3

Ring Gear and Differential

1. Construction

a. The ring gear is riveted to the left section of the differential case

b. The differential spider, fitted with the four pinion gears is mounted between the two case sections. Thrust washers are placed between each pinion gear and the case

c. The beveled side gears (rear axle shaft differential gears) are fitted within each case section and when the two sections are fastened together with the eight cap screws these side gears are in mesh with the four pinion gears. Both side gears have the thrust washer between the back face of the gear and the shoulder in the differential case

d. The ring gear and differential assembly is supported by large tapered roller bearings (differential bearings). The bearing cups for these bearings are located in the rear axle housings

2. Servicing the differential

a. The complete procedure for servicing the differential is covered in Servicing Training Job Plan No. 9. However, the following points may be stressed at this time

(1) Replacement of the differential assembly

(a) Replace the ring gear assembly if it has chipped or missing teeth

(b) Differential bearings that bind when turned by hand should be replaced

(c) The differential spider should be replaced if the diameters are excessively worn at the differential pinion gear bearing surfaces

(d) Differential pinion gears should be replaced if they have chipped, pitted or missing teeth, or if the inside diameter is excessively worn. Worn thrust washers also should be replaced

(e) Differential side gears that have worn, chipped or broken teeth should be replaced. If excessive back lash is noted by inserting a new axle shaft in the differential side gear, the side gear should be replaced

(2) Lubrication

(a) The oil in the center housing lubricates the differential and ring gear assembly. An oil trough assembly is riveted to the inside of the center housing that aids in distributing oil to the assembly

(b) The thrust block, attached to the left axle housing is designed so that it will arrest the deflection created by the pinion turning the ring gear and also aid in the distribution of oil to the differential assembly

VISUAL CAST SLIDE 4-4

Lubrication

VISUAL CAST SLIDE 4-5

Rear Axle and Brake Assembly

D. The rear axle assembly

1. Construction

a. Rear axle housing

(1) A heavy malleable iron or cast steel assembly which is attached to the center housing with cap screws

(2) The differential bearing cup is fitted into a milled recess in the inner end of the axle housing. A standard gasket is used between the axle housing and center housing

b. Axle shaft

(1) The rear axle is the semi-floating type. The inner ends of the axles are splined to the differential side bevel gears, providing an axle ratio of 6.6 to 1. The outer rear axle bearing is pressed on to the axle. It is supported by a bearing cup retainer which is bolted to the outer end of the axle housing. Metal shims between the bearing cup retainer, and brake dust seal assembly provide the means for adjusting the axle bearings

c. Rear axle oil seal assembly

(1) The oil seal is pressed into the oil seal retainer. This assembly together with the brake support plate assembly is attached to the rear axle bearing cup retainer with two cap screws. The whole bearing retainer assembly is attached to the rear axle housing with four bolts

d. Brake shoe assembly

(1) The two self energizing brake shoes are held in position on the brake support plate by strong steel coil springs

(2) The right brake has a retracting spring and a brake adjusting spring. The left brake has three springs—the retracting spring, a secondary retracting spring and the brake adjusting spring

e. The rear axle hub

(1) The rear axle hub is attached to the outer end of the rear axle shaft by means of tapered splines and the rear axle nut

f. The brake drum

(1) The brake drum is attached to the rear axle hub with four countersunk screws

g. The brake actuating camshaft

(1) This shaft has a ball end on the inner end, and fits into a hole in the axle housing

(2) The outward end fits between the movable ends of the brake shoes, and is inserted into position at the time the brake and bearing cup retainer assembly are installed on the axle

2. Servicing the rear axle assembly

a. Lubrication

(1) The rear axle assembly is lubricated by the oil from the center housing

b. Differential bearing pre-load

(1) It is important that a standard sized gasket (2N 4035) be used between the axle housing and center housing to provide the correct bearing pre-load on the differential bearings

c. Axle bearing adjustment

(1) The adjustment on the rear axle outer bearing is determined by the amount of clearance between the inner ends of the axle shafts. Clearance should be .002 to .006

(2) The clearance is established by the number of metal shims between the dust seal and bearing cup retainer assembly

(3) To make this adjustment, jack the tractor up and remove both rear wheels. Remove shims until the shafts rotate in the same direction when rotating one of the brake drums. This indicates that the shafts are butting together. By adding shims of .005 thickness until the shafts rotate in opposite directions will assure .002 to .006 clearance

(4) Excessive clearance permits the shaft and hub assembly to move in and out and tends to increase wear on the rear axle oil seal and bearing race

d. Rear axle nut adjustment

(1) The rear axle nut holds the axle hub onto the tapered splines of the axle shaft. The hub must be tight on the shaft. If it is not, excessive wear on the axle shaft and hub splines result, eventually making it impossible to keep the hub tight. A loose hub causes abnormal wear on the oil seal resulting in oil leakage

(2) The rear axle nut should be drawn up to 450 foot pounds torque. It is advisable to make this adjustment, drive the tractor for a short time and then re-tighten

e. Oil seal

(1) Oil seals that have been damaged due to loose hubs or incorrect axle bearing adjustment, should be replaced. The oil seal should be soaked in oil until soft before installing in the retainer

f. Brakes—adjustment

(1) Both brakes should be adjusted equally and the brake pedals equalized in the applied position

g. Brake relining

(1) Following this conference, the important points of brake relining will be covered in a demonstration by your instructor

IV. Conference Conclusion

A. Review and answer group questions regarding the final drive, and brakes

1. Drive shaft
2. Pinion
3. Ring gear and differential
4. Rear axle assembly
5. Brakes

B. Distribute the service training material

1. Conference Guide No. 4, one for each trainee

C. Tell the group that the next conference will deal with the steering and front axle assembly and the time it is scheduled to begin

SERVICING THE DRIVING PINION

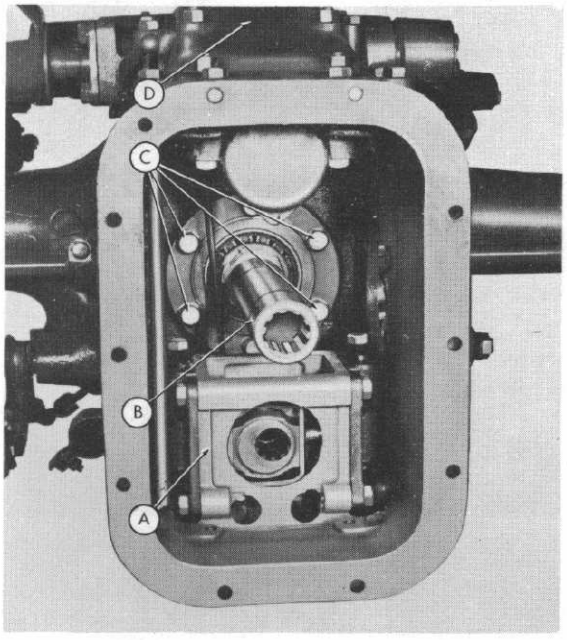

Fig. 1

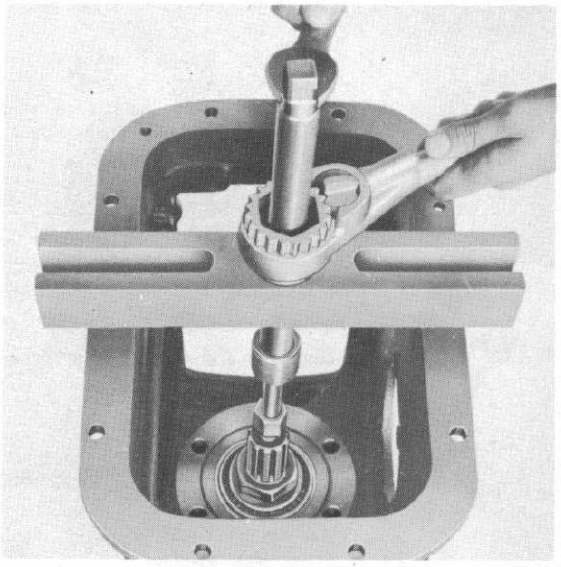

Fig. 2

TRAINING TIME: 1½ hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 46
   c. Jack

JOB PROCEDURE:

I. REMOVING THE PINION ASSEMBLY

Step 1—Remove the drive shaft (B-Figure 1).

Step 2—Remove the hydraulic lift cover assembly (D-Figure 1).

Step 3—Remove the hydraulic pump (A-Figure 1).

Step 4—Remove the six pinion carrier cap screws (C-Figure 1).

Step 5—Pull the pinion and bearing carrier out as shown in Figure 2.

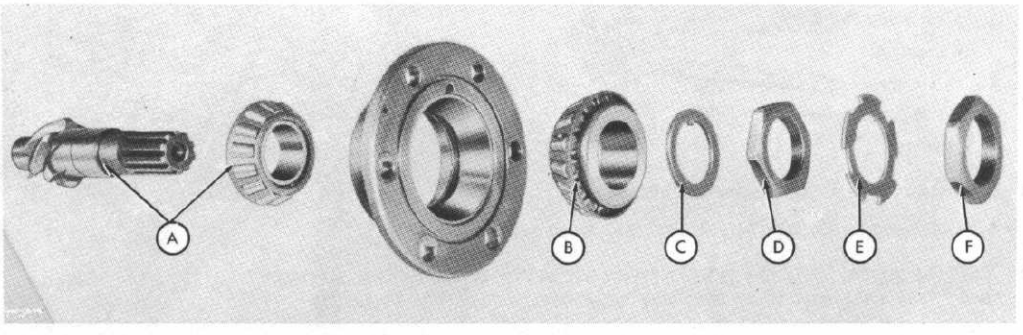

Fig. 3

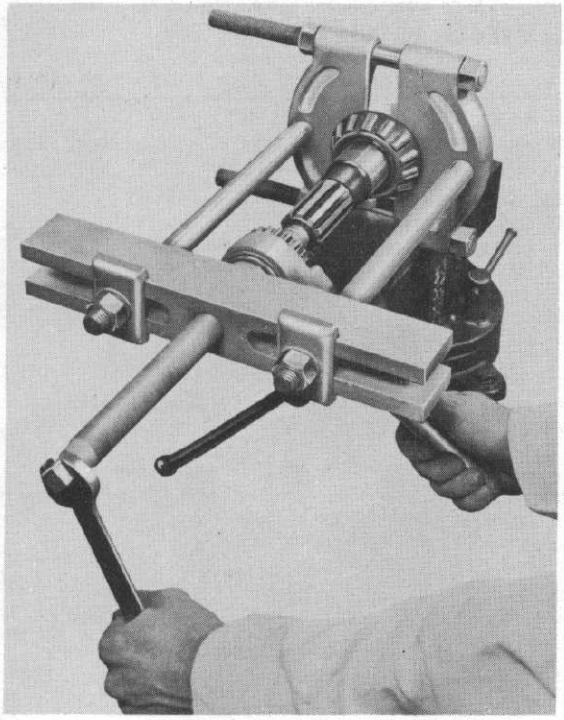

Fig. 4

II. DISASSEMBLING THE PINION UNIT

Step 1—Straighten the tabs on the lockwasher (E-Figure 3).

Step 2—Remove the outer locknut (F-Figure 3), lockwasher (E-Figure 3), and the inner locknut (D-Figure 3).

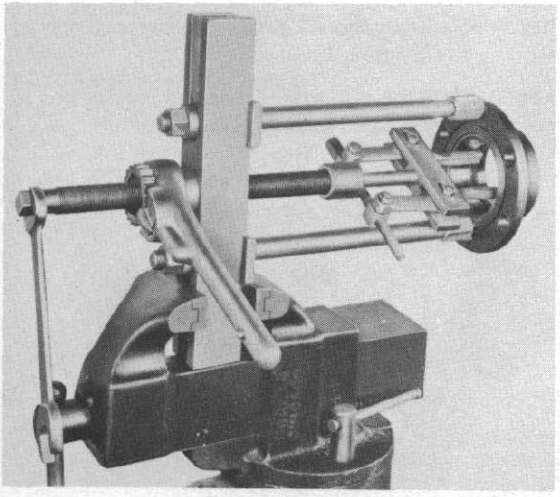

Fig. 5

Fig. 6

Step 3—Remove the thrust washer (C-Figure 3).

Step 4—Remove the pinion and rear bearing assembly (A-Figure 3). Be sure to catch the forward bearing (B-Figure 3) as the pinion and rear bearing are removed.

Step 5—Remove the rear bearing from the pinion as shown in Figure 4.

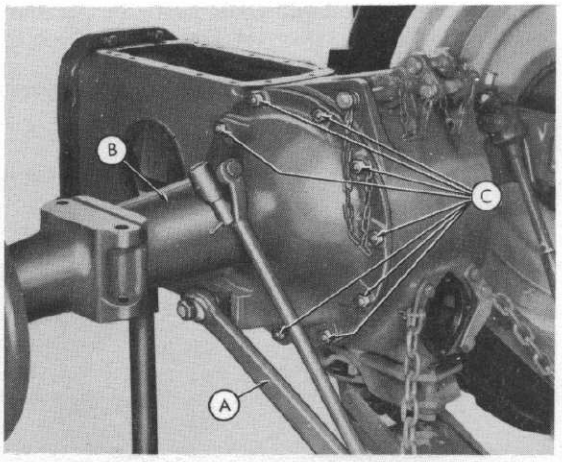

Fig. 7

Step 6—Remove the bearing cups in the sleeve assembly as shown in Figure 5.

III. ASSEMBLING THE PINION

Step 1—Thoroughly clean all parts.

Step 2—Install the rear bearing on the pinion using a sleeve and arbor press.

Step 3—Install the bearing cups.

Step 4—Install the pinion and rear bearing assembly in the sleeve assembly.

Step 5—Install the front bearing.

Step 6—Install the thrust washer.

Step 7—Install the inner locknut, the lockwasher and the outer locknut.

Step 8—Adjust the bearing as shown in Figure 6.

a. Tighten the locknuts until a torque of 12 to 16 inch pounds is required to turn the pinion.

b. Bend the tabs on the lockwasher to lock the locknuts.

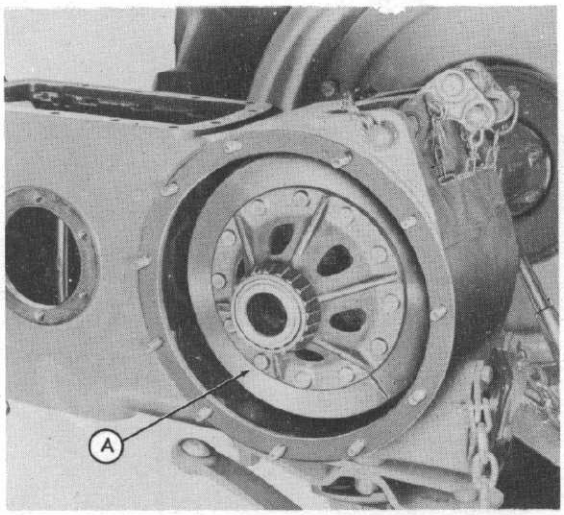

Fig. 8

IV. REMOVING AND REPLACING THE REAR PINION BEARING

Step 1—Remove the left rear wheel as shown in Figure 7, and the right rear wheel.

Step 2—Remove the left axle housing and axle assembly (B-Figure 7) from the center housing as a unit.

a. Remove the left lower link (A-Figure 7.

b. Remove the hex head nuts from the studs (C-Figure 7) that hold the axle housing to the center housing.

c. Remove the axle housing and gasket from the center housing.

Step 3—Remove the differential (A-Figure 8) as a unit.

Step 4—Remove the rear pinion bearing as shown in Figure 9, using the tools shown in the inset of Figure 9.

Step 5—Replace the rear pinion bearing (with the beveled edge of the race rearward) as shown in Figure 10. Use the tools shown in the inset Figure 10.

V. INSTALLING THE PINION GEAR

Step 1—Align the dowel pin in the sleeve and bearing cup assembly with the hole in the housing.

Step 2—Attach the puller rods as shown in Figure 11.

Step 3—Press the pinion and bearing assembly into position as shown in Figure 11.

Step 4—Remove the puller.

Step 5—Replace the six cap screws and lockwashers that hold the pinion carrier assembly in the center housing.

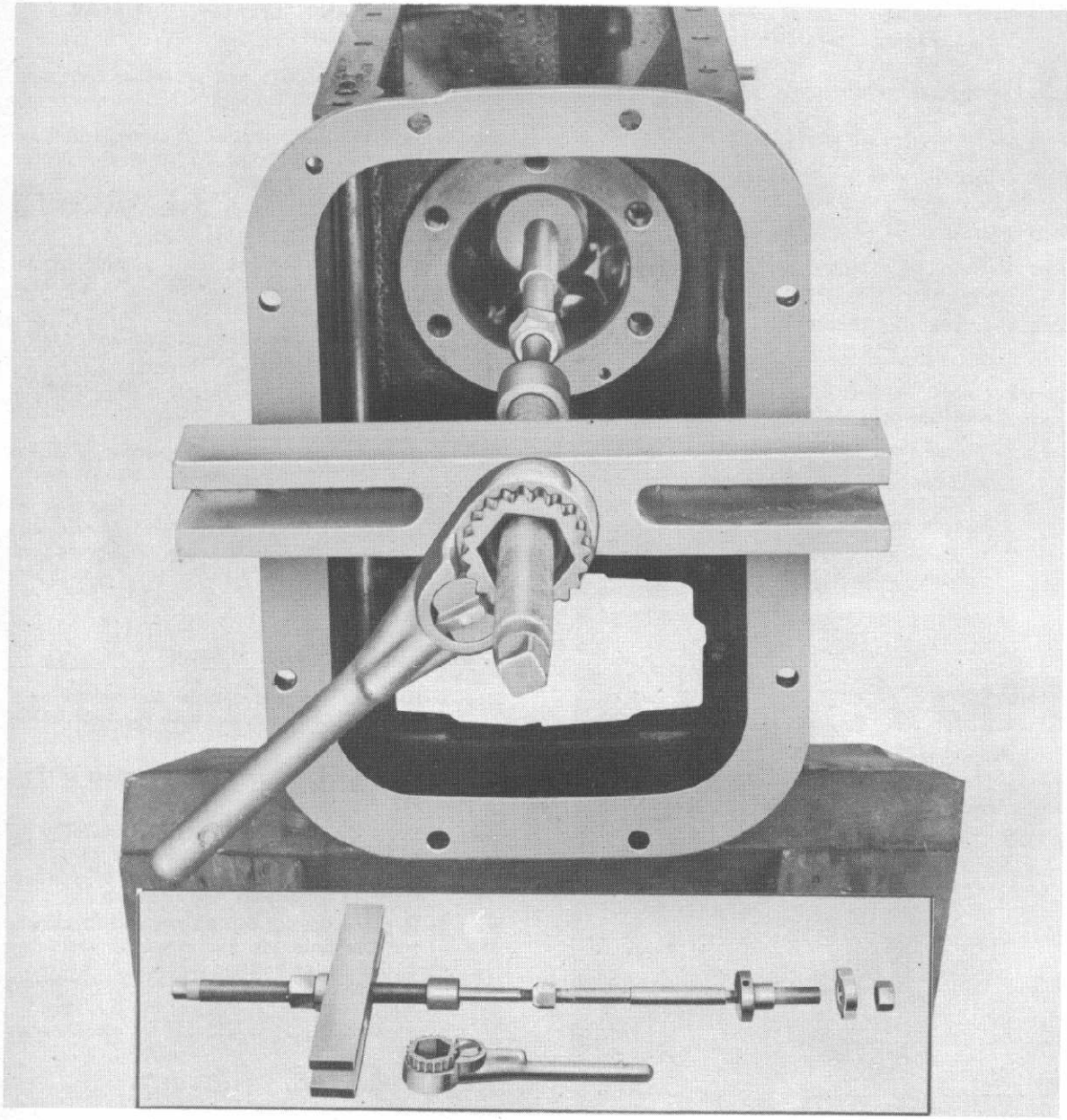

Fig. 9

NOTES

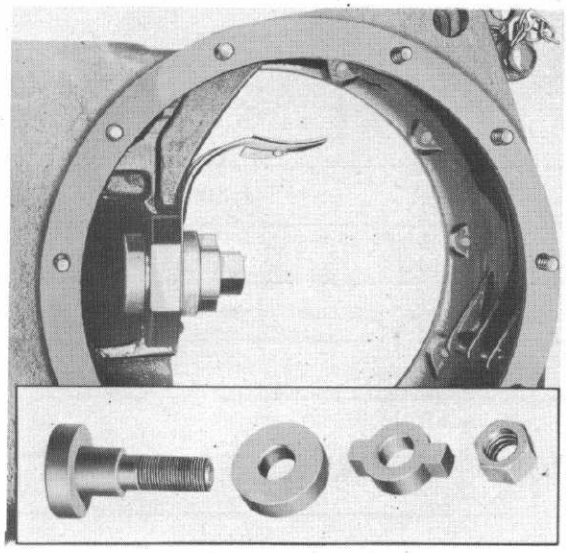

Fig. 10

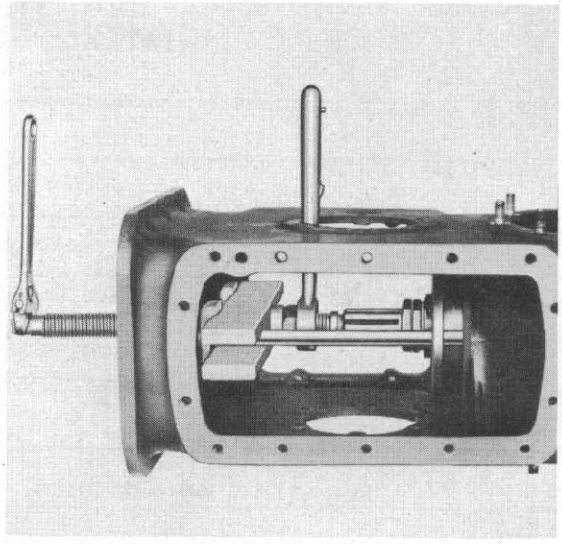

Fig. 11

NOTES

NOTES

SERVICING THE DIFFERENTIAL

TRAINING TIME: 1 hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   c. No. 20 Soft Annealed Wire
   d. Jack

JOB PROCEDURE:

I. REMOVING THE DIFFERENTIAL

(Performed in Part IV, Job Plan No. 6)

II. DISASSEMBLING THE DIFFERENTIAL

Step 1—Remove the differential bearings as shown in Figure 1.

Step 2—Remove the wire (A-Figure 1) from the eight differential case cap screws and remove the cap screws (B-Figure 1).

NOTE: A rod or bar may be used to hold the differential housing when removing and installing these cap screws, if a vise is not available.

Step 3—Separate the two parts of the differential case as shown in Figure 2.

Step 4—Remove the spider (C-Figure 2), the differential pinions (D-Figure 2), and the thrust washers (E-Figure 2).

Step 5—Remove the axle shaft differential gears (B-Figure 2) and thrust washers (A-Figure 2).

III. ASSEMBLING THE DIFFERENTIAL

Step 1—Clean all of the parts thoroughly.

Step 2—Install the differential side gears and thrust washers. Be sure thrust washers are seated in the recess.

Step 3—Install the spider, the pinions and thrust washer.

Step 4—Reassemble the differential case parts so that the numbers stamped on the two parts are aligned.

Step 5—Replace and wire the eight cap screws.

Step 6—Install the differential bearing. Use a sleeve that will fit the inner race and drive it into position.

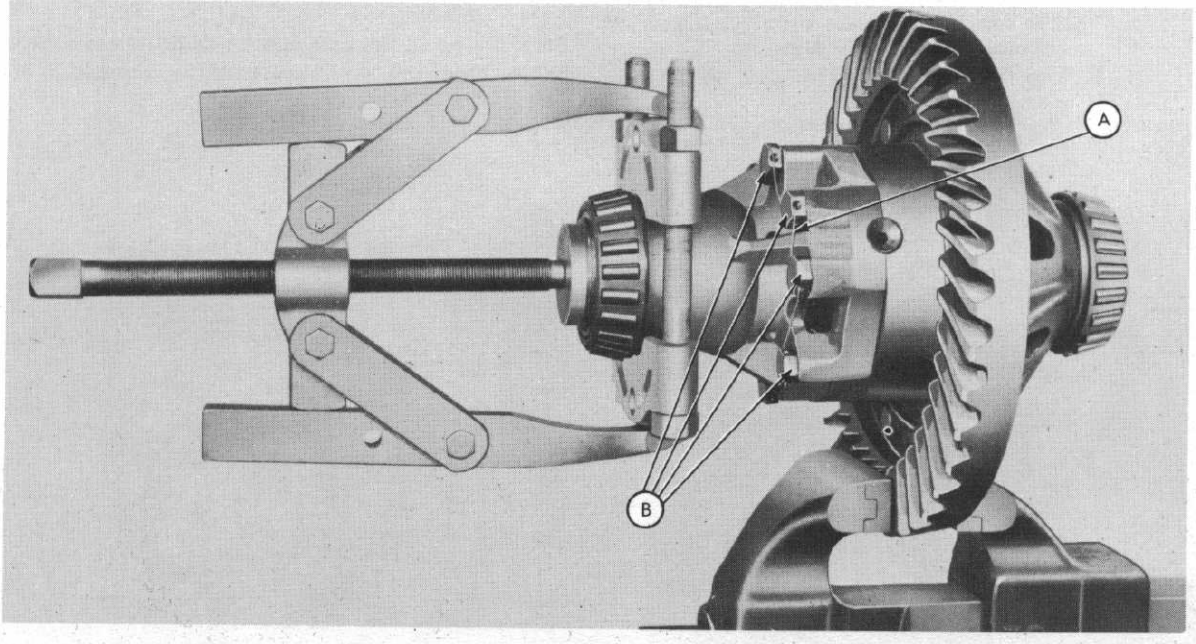

Fig. 1

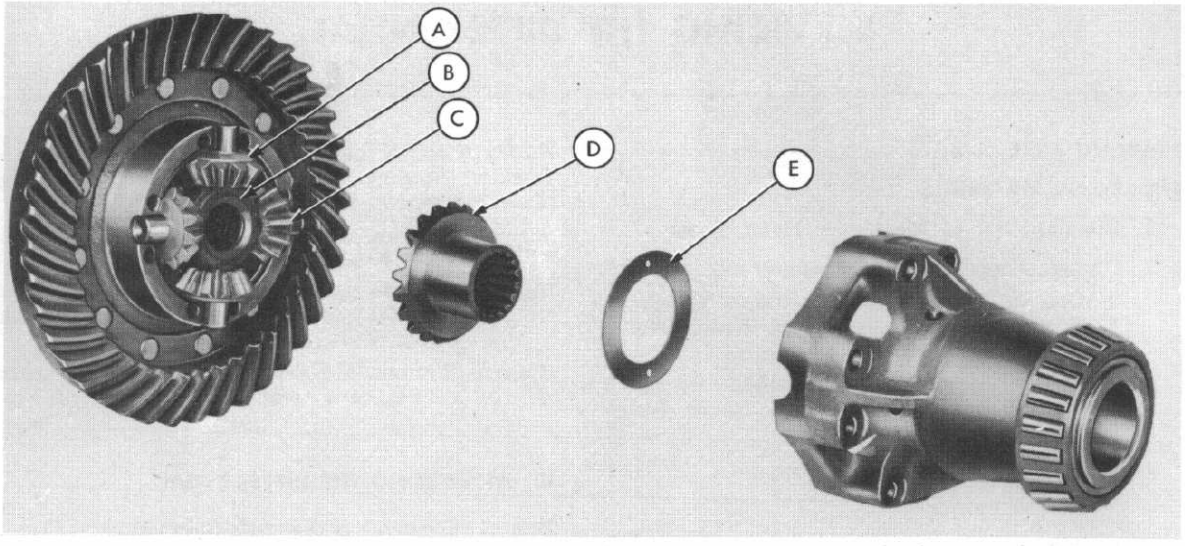

Fig. 2

Step 7—Wire the eight cap screws as shown in Figure 3.

Step 8—*Thoroughly* clean the center housing and install the differential assembly.

IV. REMOVING AND REPLACING THE DIFFERENTIAL BEARING CUP

Step 1—Remove the axle and brake drum assembly from the axle housing.

a. Remove the two cap screws, the four nuts, and the lockwashers (A-Figure 4) that secure the brake drum and axle assembly to the axle housing.

b. Tap the axle shaft (D-Figure 4) with a soft face mallet and drive it out of the axle housing.

c. Remove the brake camshaft (B-Figure 4).

Step 2—Remove the old bearing cup (C-Figure 4) as shown in Figure 5.

Step 3—Install the bearing cup by using a tool that will apply even pressure on the cup and press it into place.

Step 4—Bolt the axle housing to the center housing.

Step 5—Install the lower lift link on the axle housing.

Step 6—Install the axle and brake drum assembly.

NOTE: Omit this step until after the completion of Job Plan No. 8.

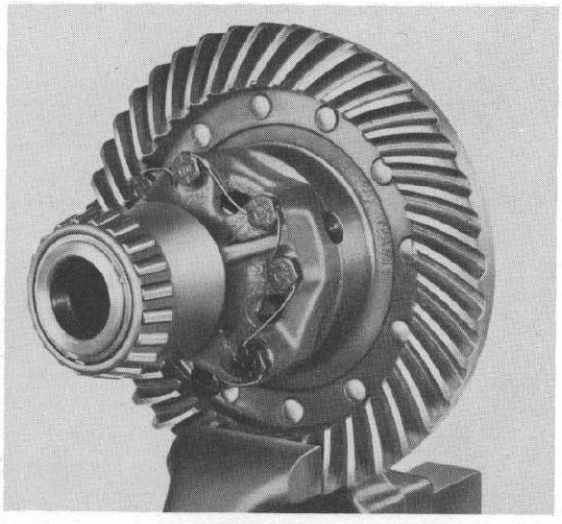

Fig. 3

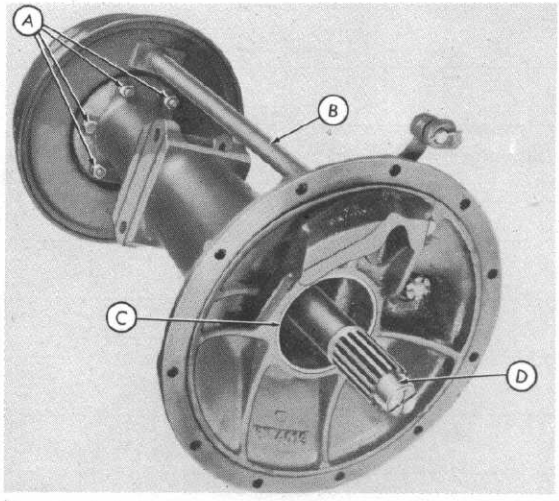

Fig. 4

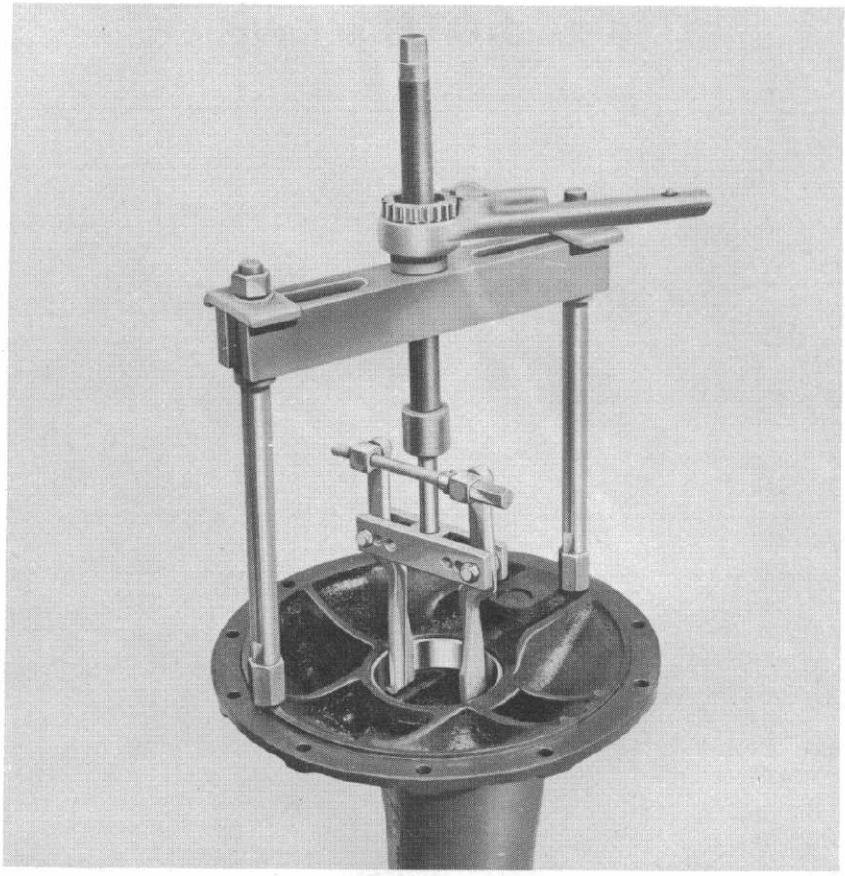

Fig. 5

NOTES

NOTES

SERVICING THE REAR AXLE

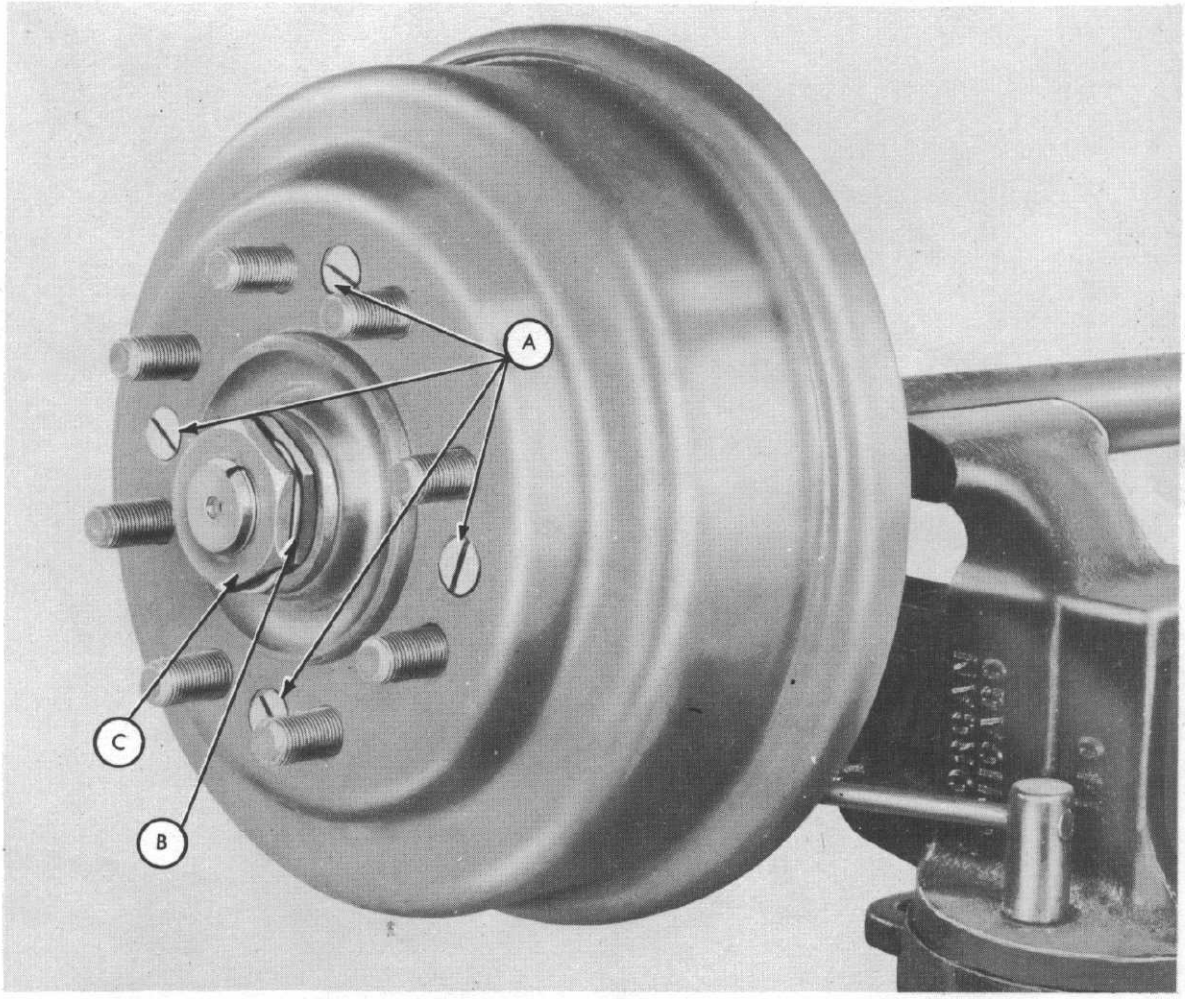

Fig. 1

TRAINING TIME: 1 hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   c. Jack

JOB PROCEDURE:

I. DISASSEMBLING THE REAR AXLE

NOTE: In Service Training Job Plan No. 7, the left rear axle and brake assembly was removed as a unit.

Step 1—Position the rear axle and brake assembly in a vise as shown in Figure 1.

Step 2—Remove the brake drum by removing the four (4) flat head screws (A-Figure 1).

Step 3—Remove the rear axle nut snap ring (B-Figure 1) and axle nut (C-Figure 1).

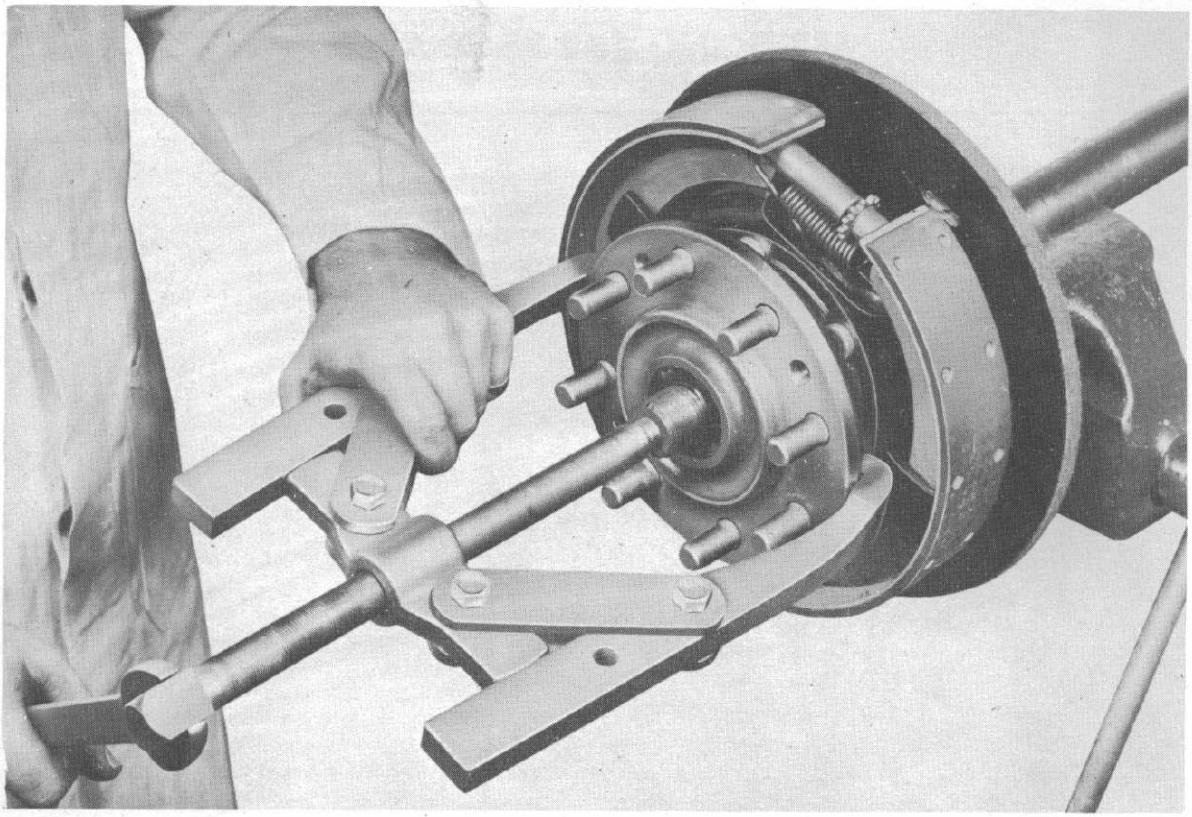

Fig. 2

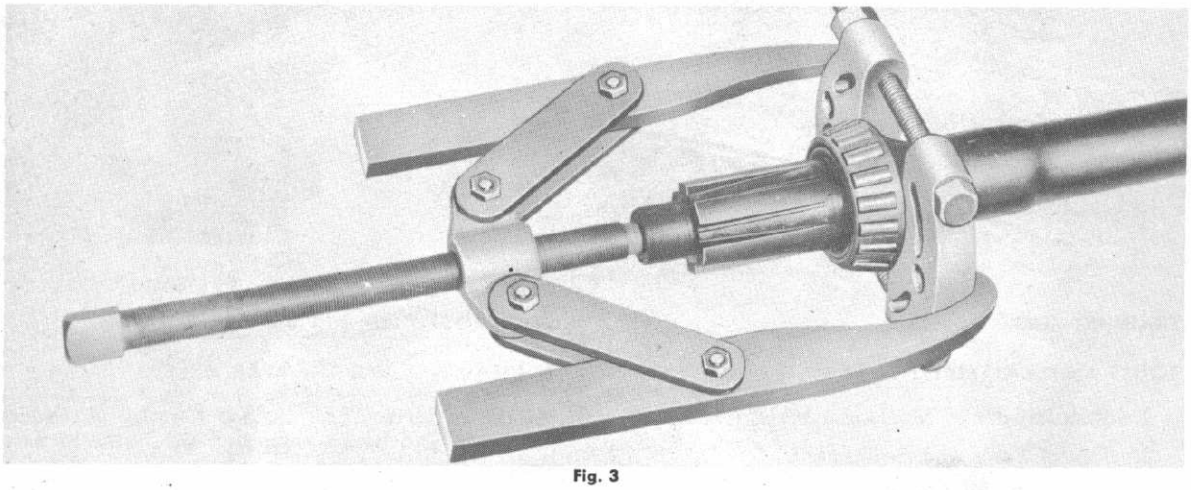

Fig. 3

Step 4—Remove the thrust washer.

Step 5—Remove the axle hub as shown in Figure 2.

Step 6—Remove the brake assembly.

II. RENEWING THE REAR AXLE BEARING (OUTER)

Step 1—Remove the bearing as shown in Figure 3.

Step 2—Install the bearing as shown in Fig. 4, or with an arbor press.

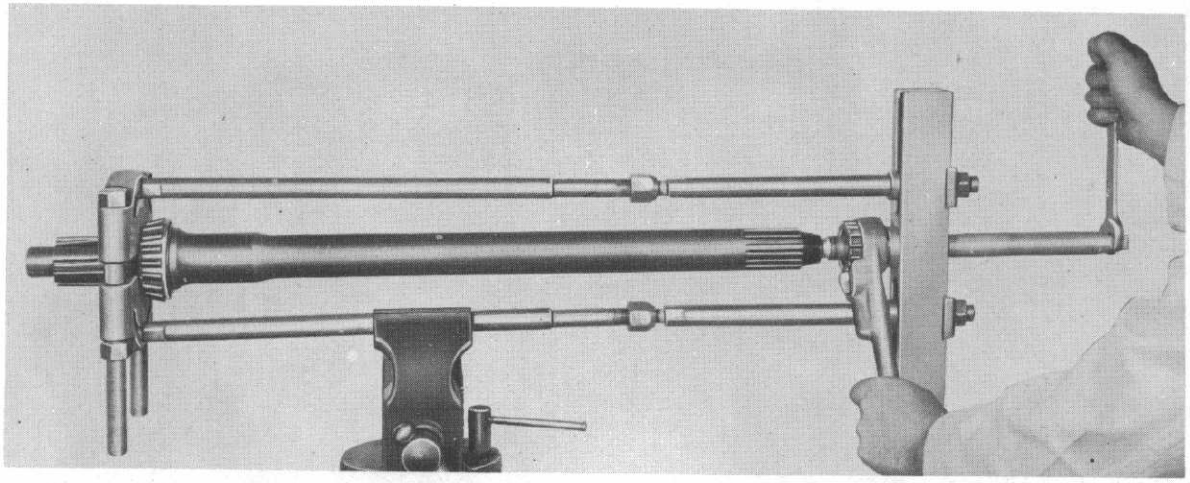

Fig. 4

III. SERVICING THE REAR AXLE BEARING CUP (OUTER) AND OIL SEAL ASSEMBLY

Step 1—Remove the two cap screws (E-Figure 5) that hold the oil seal assembly (D-Figure 5) to the rear axle shaft bearing retainer and cup assembly (A-Figure 5).

Step 2—Remove the oil seal assembly (D-Figure 5).

a. With a soft face mallet drive the long bolts (C-Figure 5) out of the retainer and seal assembly.

Step 3—Drive the old oil seal from the retainer and replace with a new oil seal.

NOTE: It is recommended that the oil seal be soaked in oil until soft before installing.

Step 4—Remove the bearing cup (B-Figure 5) as shown in Figure 6.

Step 5—Install the bearing cup in the retainer by using a tool that will apply equal pressure to the cup and drive it into the retainer. Seat the bearing cup with a drift punch and hammer.

Step 6—Attach the oil seal assembly to the brake support plate and bearing retainer.

IV. REASSEMBLING THE REAR AXLE UNIT

Step 1—Install the adjusting shims and the dust seal on the brake assembly.

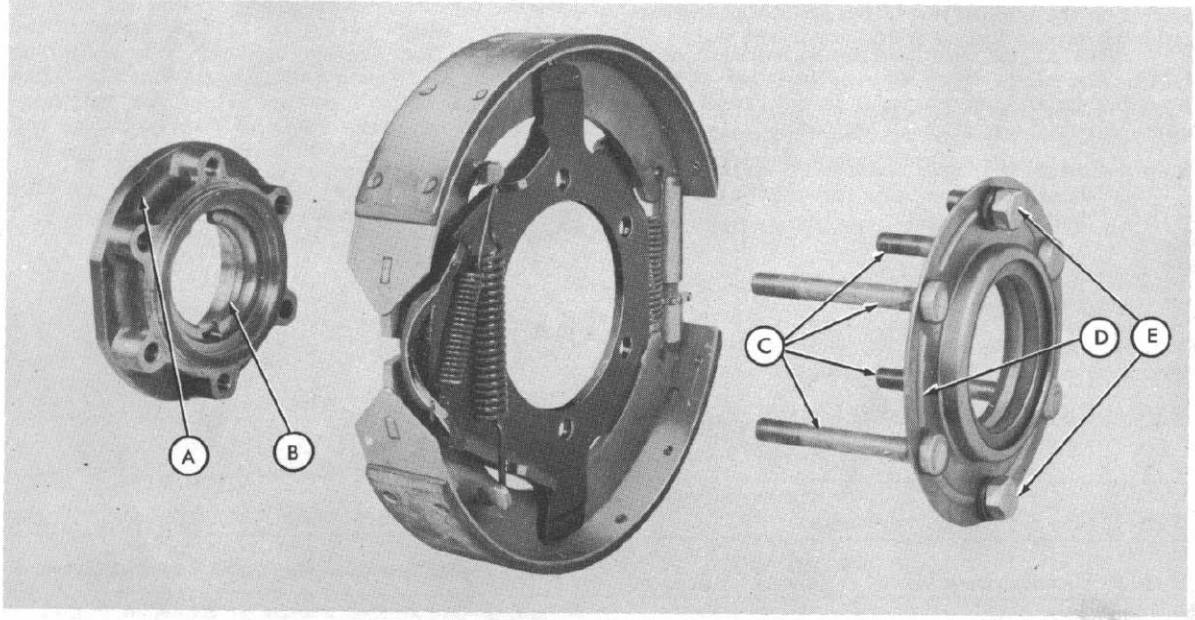

Fig. 5

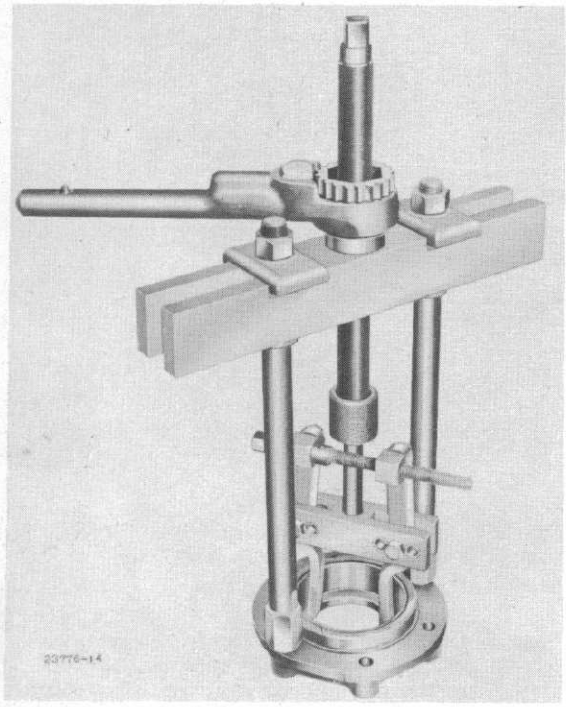

Fig. 6

Step 2—Install the brake assembly on the axle.

Stpe 3—Install the axle hub, thrust washer and nut on the axle shaft.

NOTE: Do not apply the recommended torque (450 lbs.) to the wheel nut until the wheel is installed on the tractor. Install the locknut snap ring after the proper torque is applied to the nut.

NOTE: The brake drum may be installed at this time, but for training purposes do not install until after Service Training Job Plan No. 9.

Step 4—Insert the axle assembly in the axle housing and securely fasten with the four bolts.

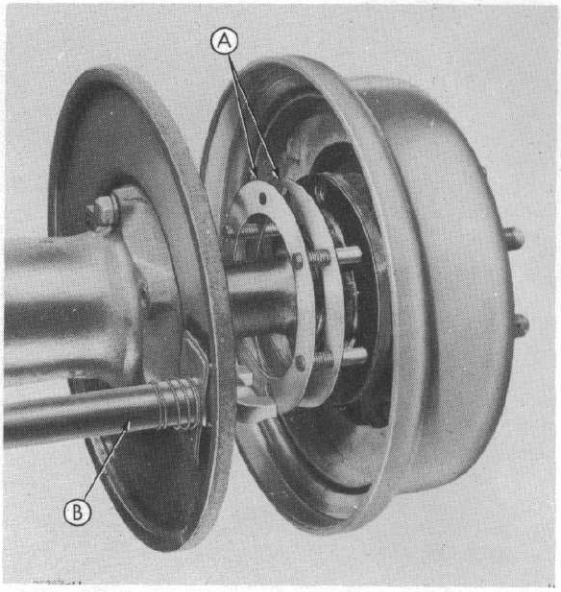

Fig. 7

NOTE: Be sure to install the left brake actuating camshaft (B-Figure 7).

Step 5—Check the rear axle bearing adjustment.

a. Remove both wheels and turn either axle hub. If both axle shafts rotate in the same direction, the bearing adjustment is too tight. The bearing adjustment is correct if axle shafts rotate in the opposite directions.

NOTE: Correct bearing adjustment is obtained by removing shims (A-Figure 7) from between the right or left hand bearing retainer and axle housing until both shafts rotate in the same direction. Then add shims of .005 thickness until shafts start turning in the opposite directions. This procedure will hold end play from .002 to .006.

Step 6—Replace the cap screws that secure the bearing retainer to the axle housing.

NOTES

SERVICING THE BRAKES

TRAINING TIME: 1 hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   b. Jack

JOB PROCEDURE:

I. REMOVING THE BRAKE SHOES

Step 1—Remove the wheel and brake drum.

NOTE: For training purposes the above parts were not installed at the completion of Job Plan No. 8.

Step 2—Remove the brake shoe retracting spring (B-Figure 1) and the secondary spring (A-Figure 1).

NOTE: The above step deals with the left brake. The right brake does not have a secondary spring.

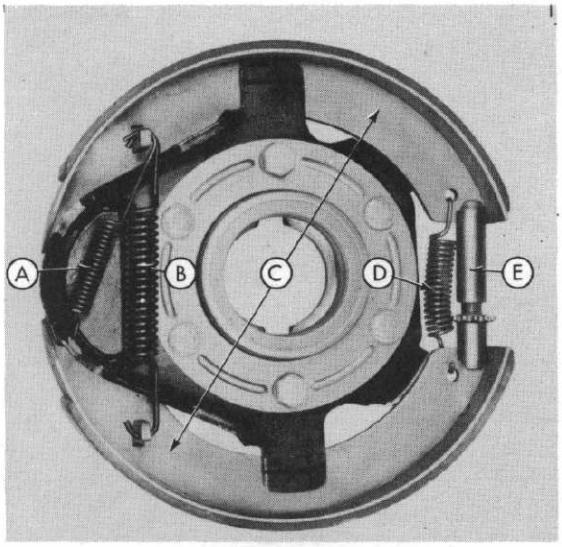

Fig. 1

Step 3—Remove the brake shoes (C-Figure 1).

Step 4—Remove the adjusting spring (D-Figure 1) and the adjusting screw assembly (E-Figure 1).

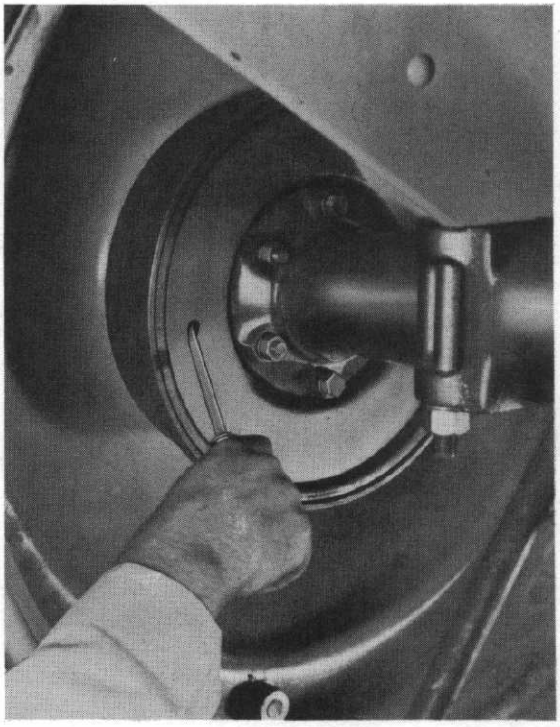

Fig. 2

II. RELINING BRAKES—(DEMONSTRATION)

NOTE: This demonstration is optional. For proper relining instructions, refer to the manual provided with the equipment being used.

III. INSTALLING THE BRAKE SHOES

Step 1—Attach the adjusting spring and adjusting screw assembly to the brake shoes.

Step 2—Position the brake shoes on the brake assembly and install the secondary spring.

Step 3—Install the brake shoe retracting spring.

Step 4—Install the brake drum.

Step 5—Install the rear wheel.

IV. ADJUSTING THE BRAKES

Step 1—Jack up the rear wheels.

Step 2—Remove the adjusting screw cover.

Step 3—Turn the notched adjusting screw (Figure 2) toward the rear of the tractor until the wheel can no longer be turned. Then turn the adjusting screw in the opposite direction until just a slight drag can be felt in turning the wheel. (Adjust both wheels.)

Step 4—Re-install the adjusting screw cover.

Step 5—Adjust the left brake clevis to equalize the brake pedals while in the applied position.

NOTE: Do not perform the above step until the transmission housing is assembled to the center housing (Job Plan 10).

NOTES

PARTIAL ASSEMBLY OF THE TRACTOR

TRAINING TIME: ½ hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   c. Hoist
   d. Two Jacks
   e. Two Drift Dowel Pins

JOB PROCEDURE:

I. ATTACHING THE TRANSMISSION TO THE CENTER HOUSING

Step 1—Position the drive shaft on the pinion.

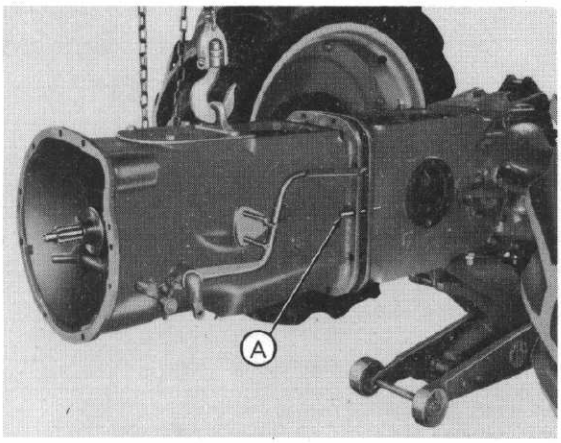

Fig. 1

Step 2—Install the gasket on the center housing. Use a light coat of grease to hold the gasket in position.

Step 3—Insert a drift pin (A-Figure 1) in each side of the transmission and center housing to align the holes.

Step 4—Start the splined end of the main shaft in the drive shaft and push rearward on the transmission.

Step 5—Bolt the transmission housing to the center housing.

Step 6—Place a jack under the forward end of the transmission housing.

Step 7—Remove the hoist and lift plate.

II. ATTACHING THE ENGINE TO THE TRANSMISSION HOUSING

Step 1—Attach the hoist to the engine lift plate and remove the engine from the engine stand.

Step 2—Position the engine so that the main drive gear shaft will align with the female spline in the clutch assembly. It may be necessary to turn the engine crankshaft to get the splines to align.

Step 3—Push rearward on the engine and attach it to the transmission housing with cap screws.

NOTE: For training purposes do not tighten the two top cap screws as the battery box will be installed later.

III. ATTACHING THE FRONT AXLE ASSEMBLY

Step 1—Bolt the front axle support plate to the engine pan.

IV. COMPLETING THE ASSEMBLY

Step 1—Install the gear shift assembly on the transmission housing.

Step 2—Install the crank case filter pipe.

Step 3—Install the brake rod. (Adjust the brake rod clevis to equalize brake pedals.)

Step 4—Install the manifold, muffler and tail pipe.

Step 5—Install the inspection plate on the left side of the center housing.

Step 6—Place the steps in position. Secure the left one but do not fasten the right one at the rear.

Step 7—Bolt the radius rods in position.

Step 8—Install the engine oil pan and transmission housing drain plugs.

NOTES

Prepared by the Service Department
DEARBORN MOTORS CORPORATION
DETROIT 3, MICHIGAN

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STEERING ASSEMBLY, FRONT AXLE, WHEELS AND TIRES

CONFERENCE OBJECTIVES:

1. To review the construction and operation of the front axle, and the steering assembly.
2. To discuss service problems related to the front axle, the steering assembly, and the wheels.
3. To discuss liquid weighting of tires.

CONFERENCE TIME: ¾ Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 5-1—Front Axle Assembly
   b. 5-2—Spindle and Wheel Assembly
   c. 5-3—Installation of Spindle Bushings
   d. 5-4—Steering Assembly
   e. 5-5—Liquid Weighting Tires
4. Steering Gear Assembly
5. Front Axle Pin and Bushing
6. Conference Guide No. 5 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

CHART 5-1
Steering, front axle, wheels and tires

A. Tie in with previous conferences

1. Previous conferences have dealt with (1) the generation of power (2) utilization of this power at various speeds, (3) the transfer of this power to the rear wheels.
2. In this conference we propose to follow this flow of power one step further toward its utilization by discussing
   a. The means of controlling the direction of tractor travel and
   b. Getting maximum traction by liquid weighting of the tires

B. Conference objectives

1. To review the construction and operation of the front axle and steering assembly.
2. To discuss service problems related to the front axle, steering assembly, and wheels
3. To discuss the procedure for liquid weighting tires

II. Front Axle Assembly

VISUAL CAST SLIDE 5-1
Front Axle Assembly

A. Construction

1. The front axle is a three piece unit consisting of:
   a. Center axle assembly
      (1) On the 8N Ford Tractor the radius rods are attached to this section.

b. The right and left hand axle assemblies

(1) These assemblies are bolted to the center assembly, and may be positioned so as to obtain varying wheel widths of from 48 to 68 inches in four inch spacings. (By reversing the front wheels a 76 inch spacing can be obtained.)

c. The spindle housing

(1) The spindle assemblies are supported by the right and left hand axle assemblies. The spindle housing is an integral part of the axle. This housing contains two split bushings which are pressed into the housing

2. Front axle support plate
   a. It is bolted to the engine pan and supports the front axle center assembly by means of an axle pin

3. Radius rods
   a. These rods are pinned to the front axle center assembly and attached to the transmission housing by means of a ball and socket

4. Front axle spindles
   a. Spindles are inserted into the right and left hand axle assemblies. The spindle bearings support the front weight of the tractor; the spindle bushings maintain alignment of the spindle in the spindle housing

VISUAL CAST SLIDE 5-2

Spindle and Wheel Assembly

5. Front axle spindle arms
   a. The right and left spindle arms are attached to the spindles with a woodruff key and a machine bolt which clamps the arm onto the spindle
   b. A rubber composition dust seal is located between the spindle arm and the spindle housing

6. Front wheels
   a. The front wheels are made of steel discs to which are attached drop center rims designed for a 4 x 19 inch pneumatic tire
   b. Two tapered roller bearings support the wheel on the spindle. A dust seal pressed into the wheel hub from the inside, prevents dust and dirt from entering the front wheel bearings and spindle

B. Servicing the front axle assembly and front wheels

NOTE: The procedure for completely servicing the front axle assembly and the front tires is covered in Service Training Job Plan No. 15. However, some of the important service problems will be discussed in this conference.

1. Front wheel hub
   a. Lubrication
      (1) The front wheel bearings and hub should be periodically packed with a good grade of fiber bearing grease
   b. Dust seal
      (1) Replace the seal if it does not fit tight against the shoulder in the spindle
   c. Bearing adjustment
      (1) Adjust the bearing by turning the nut on the axle until the front wheel is locked. Then back the nut off one eighth of a turn, or until there is just a slight drag.

2. Spindle bushings

VISUAL CAST SLIDE 5-3

Spindle Bushing Replacement

a. Spindle bushings are made of steel and are split. They are pre-sized and need not be line reamed after installation.

b. When removing the spindle bushings, drive them out of the spindle housing one at a time. When installing them both bushings are pressed into the spindle at the same time with a piloted, draw-in bushing installing tool.

c. The spindle is lubricated by pressure gun grease and should be lubricated every 10 hours of operation

3. Front axle pin

Show front Axle Pin and Bushing

a. The axle pin fits snugly in the axle pin bushing located in the front axle center assembly. The fit is a "push" fit. Excessive wear at this point is normally corrected by replacing the bushing, and the axle pin

b. In replacing the axle pin bushing the split part of the bushing should be at the top

III. Steering Assembly

VISUAL CAST SLIDE 5-4

Steering Assembly

A. Construction and operation

1. The steering assembly includes the steering gear, steering wheel, sector shafts, steering arms, and steering drag links.

2. The steering gear is the re-circulating ball bearing worm and nut type

3. Rotation of the steering tube shaft moves the ball nut along the worm. The left sector, which engages the rack on the ball nut, is thereby rotated through an arc by the movement of the ball nut. The right sector engages the left sector and rotates the same number of degrees in the opposite direction

4. Steering arms which are splined to the outer ends of the sector shafts transfer this movement to the spindle arms through the drag links

B. Servicing the steering assembly

NOTE: The procedure for servicing the steering assembly is covered in Service Training Job Plan No. 11. However, the following parts will be discussed in this conference.

1. Steering shaft bearing adjustment

a. Method of checking

(1) Disconnect the drag links and loosen the sector mesh adjustment

(2) Attach a pull scale to the outer rim of the steering wheel. Adjustment is correct if a pull of 1½ pounds is required to pull the wheel through center or to the straight forward position

b. Method of adjusting

(1) A metal shim pack is located between the steering tube and steering gear housing. Remove or install shims as needed

2. Sector mesh adjustment

a. Improperly adjusted sectors cause back lash in the steering sector gears, and a resultant lag in the movement of the front wheels when steering

b. Method of checking and adjusting sector mesh

(1) Disconnect the drag links, hold the steering wheel in one position, grasp the left sector shaft arm and attempt to move it. If any movement is noted there is excessive back lash between the sector gear and ball nut.

(2) Adjust by removing the four cap screws from the sector shaft housing and turning the housing counterclockwise, until all movement in the sector arm has been eliminated. Normally, this should be done with the steering gear arms in the straight forward position

(3) After the left sector mesh adjustment has been made, check the right side in a similar manner, except if back lash is present, the sector shaft housing is turned clockwise to remove the back lash

c. Causes that make it difficult to remove all sector gear back lash

(1) Worn sector gears

(2) Bottoming sector gears

(3) Loose fitting sector shafts in the sector shaft housings due to worn sector shaft bushings

3. Ball nut and steering tube shaft

a. This assembly is removed as a unit and should be replaced as such

4. Lubrication

a. The steering assembly housing serves as a reservoir for oil which lubricates the steering gear unit

(1) Use one pint of heavy duty motor oil SAE 50 HD or straight mineral oil SAE 90

(2) This oil should be changed every 200 hrs. of operation

b. The steering drag link joints, one at spindle arms, and one at sector steering arms, should be lubricated every 10 hours with pressure gun grease

IV. Liquid Weighting Tires

A. Introduction

1. Up to this point in our conferences we have discussed and performed service jobs dealing with the generation of power to the mechanical means of steering that power in useful directions

2. While it is true that the potential power we have at our disposal is derived from the engine, the power we actually utilize is dependent upon the traction of the tractor drive wheels

3. In one of the evening programs, you were told about tractor tires. As a part of this conference we would like to demonstrate how to properly liquid weight the tires to get the most in tire traction.

VISUAL CAST SLIDE 5-5

Liquid Weighting Tires

B. What liquid weighting is

1. Liquid weighting is actually the inflation of a tire with a liquid as well as with air (for 90% fill) for the purpose of adding weight

C. What solution is best

1. Experience has shown that a solution that will not freeze and at the same time will give maximum weight is desirable. By adding 5 lbs. of calcium chloride to a gallon of water, we have a type of solution that meets all requirements. To prevent formation of crystals a handful of lime is added to 50 gal. of the solution.

D. Liquid weighting procedure

1. The complete procedure for liquid weighting the 8N Ford Tractor tires is covered in Service Training Job Plan No. 13. This procedure will be demonstrated to you during the shop work to be performed following this conference

V. Conference Summary

A. Review the main parts of conference dealing with servicing the

1. Front axle
2. Steering assembly
3. Tires

B. Distribution of training materials

1. Distribute conference guide No. 5
2. Tell the group that the next conference topic will deal with the non-electrical engine accessories and also the time that the conference is scheduled to begin.

NOTES

SERVICING THE STEERING ASSEMBLY

TRAINING TIME: 1¼ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. Spring Scale
   c. One quart can

JOB PROCEDURE:

I. DISASSEMBLING THE STEERING UNIT (WITH UNIT REMOVED FROM THE TRACTOR)

Step 1—Drain the oil by removing the oil plug (A-Figure 1).

Step 2—Pull both steering arms off of the sector shafts as shown in Figure 2 and remove the felt washers.

Step 3—Unscrew the cap screws (C-Figure 1) that hold the sector shaft housings and washers to the gear case.

Step 4—Remove both washers, sector gears and housings from the sides of the gear case.

NOTE: Due to the eccentric fit of the sector gear housing in the side of the gear case it will facilitate removal to turn the right sector gear housing counter clockwise to free it. Free the left sector gear housing by turning it *clockwise.*

a. Remove the right sector gear housing.

b. Remove the left sector gear housing.

Step 5—Remove the cover and tube assembly cap screws (B-Figure 1) and lift the assembly off of the gear case.

CAUTION: Do not turn the wormshaft if the ball nut is near either end of the worm because the ball retainers will be damaged.

II. REPLACING THE LOWER BEARING CUP

Step 1—Remove the welsh plug from the bottom of the steering housing.

Step 2—Drive the bearing cup (A-Figure 3) out of the housing, using a punch.

Step 3—Replace the bearing cup by driving it in from inside the housing.

Step 4—Replace the welsh plug.

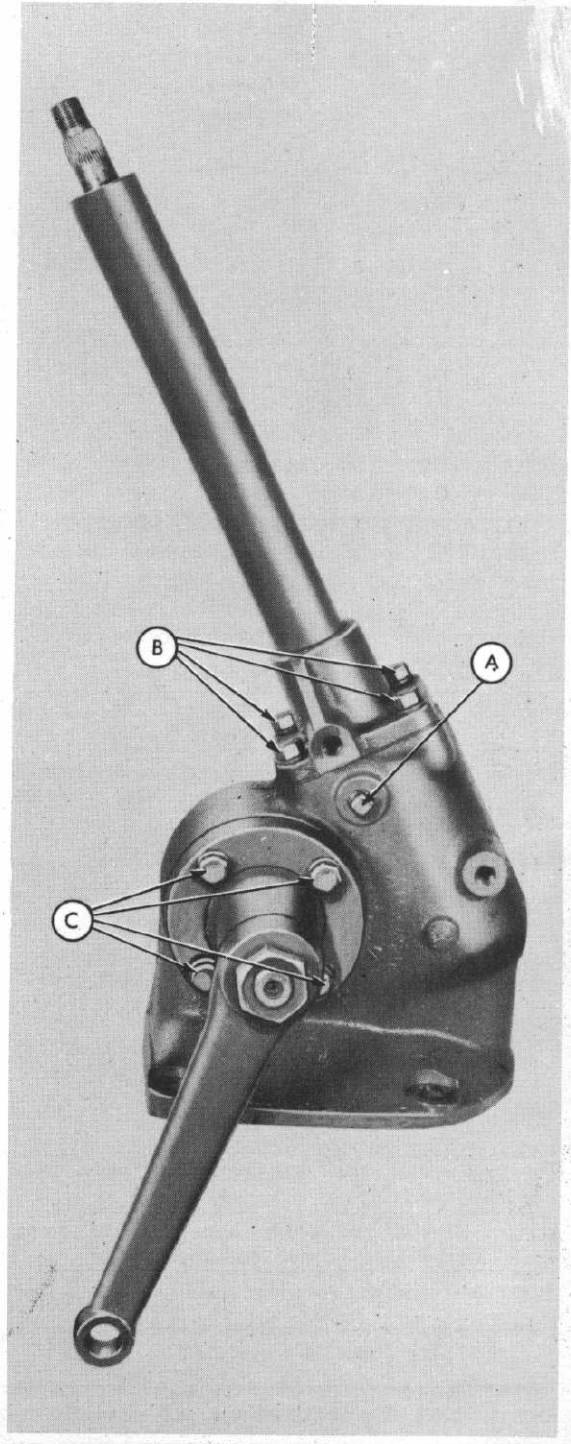

Fig. 1

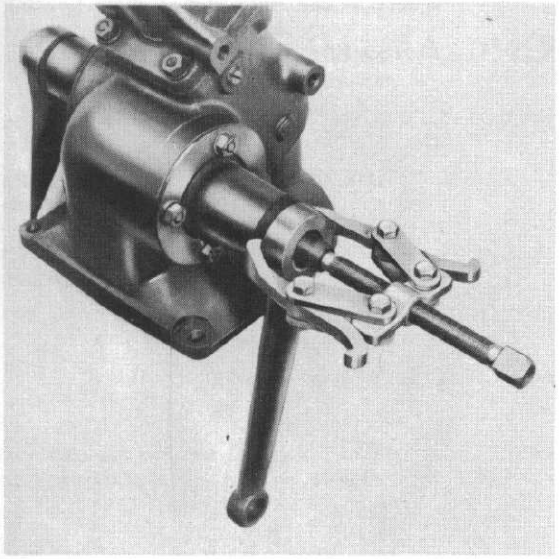

Fig. 2

III. REPLACING THE SECTOR SHAFT HOUSING BUSHING

NOTE: When new tractors are used for training, this part of the job plan will be omitted but the procedure will be discussed by the instructor.

Step 1—Drive the bushings from the housings.

Step 2—Press the inner bushings into the housing ⅛ inch below the face of the hub.

Step 3—Install the outer bushings flush or slightly below the bottom of the oil seal counterbores.

Step 4—Ream the bushings to 1.125-1.126.

IV. REASSEMBLING AND ADJUSTING THE STEERING UNIT

Step 1—Install the steering shaft lower bearing (B-Figure 3).

Step 2—Install the shaft and ball nut assembly with the nut (C-Figure 4) positioned at approximately the center of the worm.

Step 3—Install the top bearing (C-Figure 3).

Step 4—Position the shims (B-Figure 4) and install the steering tube and cover assembly.

Step 5—Install the lockwashers and cap screws (B-Figure 1) and tighten securely.

Step 6—Install the steering housing on the tractor.

Step 7—Adjust the wormshaft (A-Figure 4) end play (bearing adjustment).

NOTE: To properly perform the above, it is necessary to have the sector shafts and housings removed.

a. Adjust the bearings to a slight pre-load by removing shims (B-Figure 4) from the top face of the gear housing.

b. With a spring scale as shown in Figure 5, check the amount of pull required to rotate the steering wheel through center or straight forward position. (Should be 1½ lbs.)

Step 8—Center the ball nut on the shaft as shown in Figure 3.

Step 9—Install the left sector shaft assembly (three large and five small teeth).

NOTE: The notch on the sector shaft housing flange should be down.

a. The center tooth of the three large sector teeth is meshed with the center space of the teeth on the ball nut (D-Figure 3).

Step 10—Adjust the sector mesh (left).

a. Install the felt dust seal.

b. Install the left sector arm.

c. With the steering wheel installed hold the steering shaft rigid and turn the sector shaft housing and metal gasket counter clockwise as far as possible by hand.

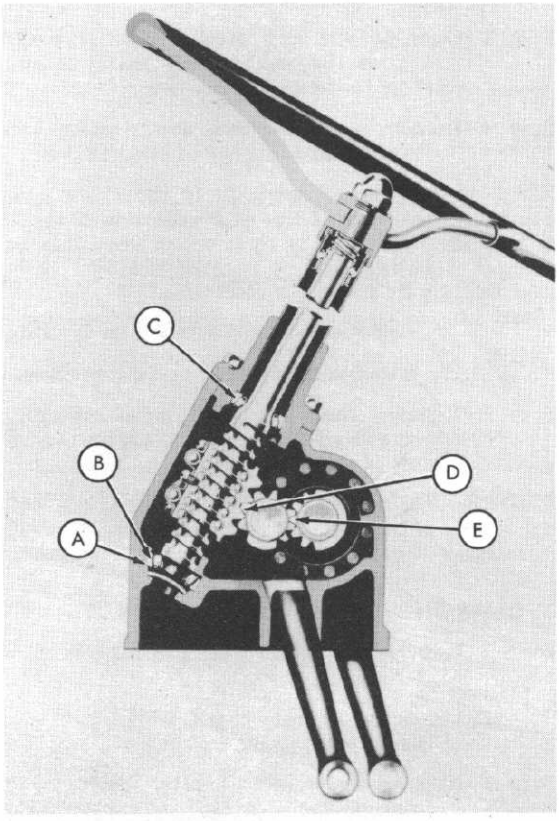

Fig. 3

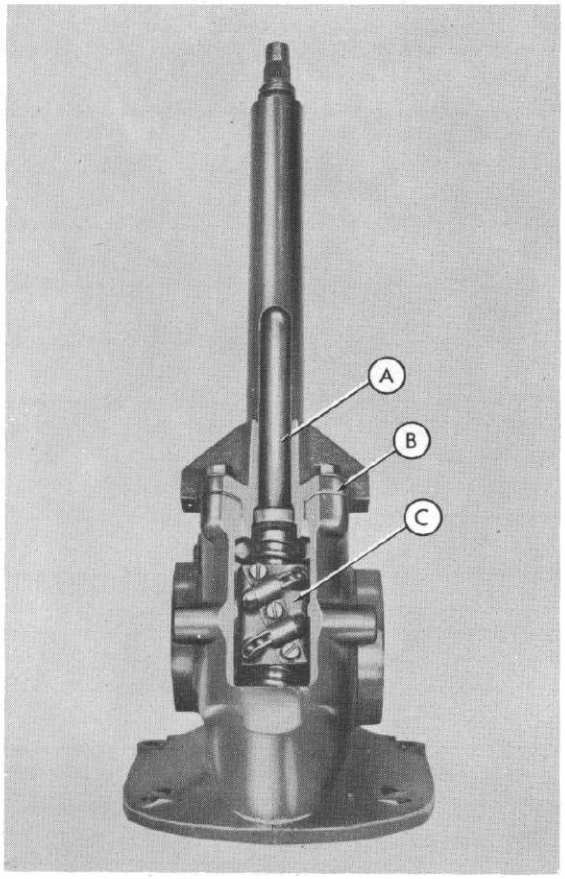

Fig. 4

d. Check to see that there is no backlash.

e. Install the side washer and cap screws.

Step 11—Install the right sector shaft assembly.

NOTE: The notch on the sector shaft housing flange should be down.

a. Mesh the center tooth of the sector with the third tooth space on the left sector gear (counting from the solid section of the gear located on the bottom (E-Figure 3).

b. Rotate the right sector shaft housing in a clockwise direction and follow the procedure established in Step 10 for checking backlash.

Step 12—Check the steering adjustment (drag links disconnected).

a. With a spring scale hooked to the rim of the steering wheel rotate the steering wheel through mid or straight forward position. A pull of not less than 2½ lbs. or more than 6 lbs. is correct.

Step 13—Properly position the steering arms and secure with nuts and lockwashers.

Step 14—Fill the gear housing with oil.

Step 15—Install the instrument panel.

NOTE: It may be necessary to remove the clip and bracket on the lower end of the throttle rod to install the instrument panel.

Step 16—Install the steering wheel.

Step 17—Connect the oil pressure line from the gauge on the instrument panel to the block.

Step 18—Attach the drag links to the steering arms.

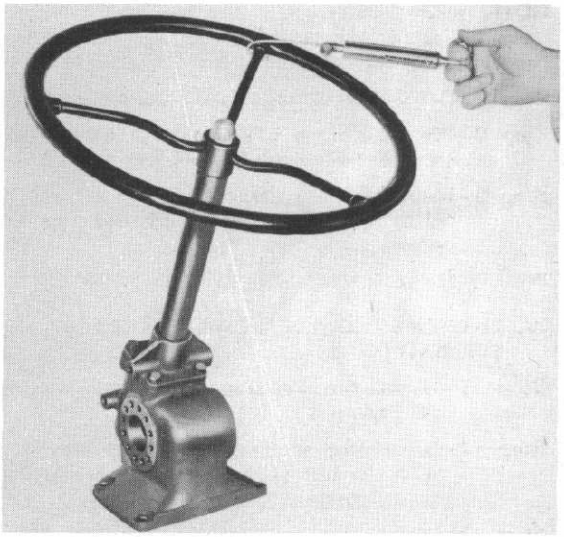

Fig. 5

NOTES

SERVICING THE FRONT AXLE

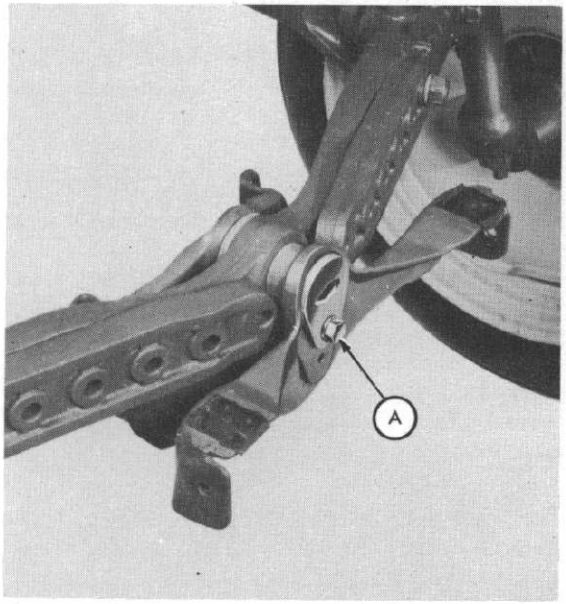

Fig. 1

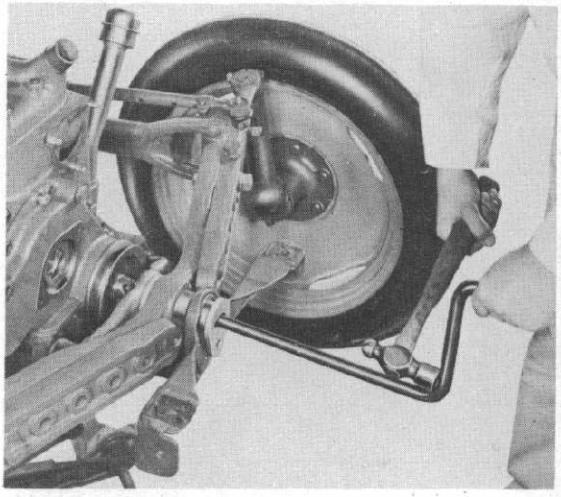

Fig. 2

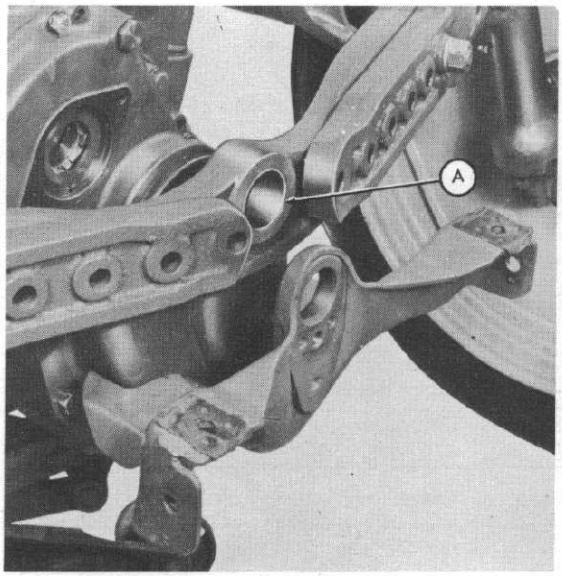

Fig. 3

TRAINING TIME: 1 Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Special Tools and Equipment
   a. One set of basic tools available for the Ford Tractor Service Tool Board No. FT 47
   b. Jack
   c. Sleeve (for installing bearings)
   d. Bearing grease

JOB PROCEDURE:

I. REPLACING THE AXLE PIN BUSHING (HOOD, RADIATOR, AND ENGINE ACCESSORIES REMOVED)

Step 1—Place a jack under the oil pan and take the weight off of the front axle.

Step 2—Remove the cap screw (A-Figure 1) that holds the axle pin in position.

Step 3—Remove the axle pin as shown in Figure 2.

Step 4—Slowly release the jack permitting the engine to lower below the axle.

Step 5—Drive out the old bushing (A-Figure 3).

Step 6—Install a new bushing.

Step 7—Jack the engine up to align the axle support with the axle pin in the axle.

Step 8—Install the front axle pin, spacer and washers.

Step 9—Install the cap screw that secures the front axle pin.

IA. REPLACING THE AXLE PIN BUSHING (HOOD, RADIATOR AND ALL ACCESSORIES ON THE TRACTOR)

Step 1—Remove the radiator grill.

Step 2—Remove the front hood bolts and block up under the hood as shown in Figure 4.

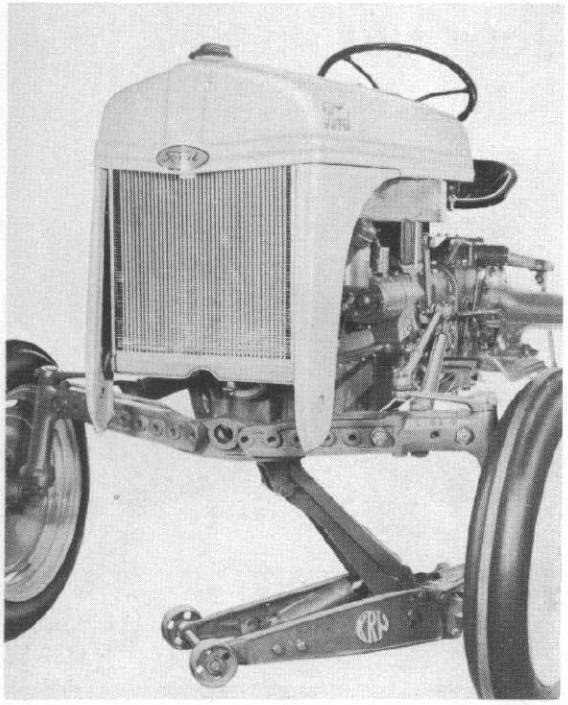

Fig. 4

Step 3—Hold up the front end of the engine with a jack under the oil pan and unbolt the axle support.

Step 4—Remove the two bottom radiator bolts and raise the engine and radiator high enough to permit removal of the axle center pin.

Step 5—Remove the pin, using the hand crank as shown in Figure 5.

Step 6—Raise the engine to allow clearance to remove the bushing.

Step 7—Drive out the old bushing.

Step 8—Install a new bushing.

Step 9—Lower the engine and attach the front axle support to the front axle by installing the front axle pin.

Step 10—Align the front axle support with the engine pan and securely bolt.

Step 11—Reassemble by reversing Steps 1 through 4

II. REPLACING THE SPINDLE BUSHING

Step 1—Jack up the left front wheel and remove the wheel from the hub as shown in Figure 6.

Step 2—Remove bolt (A-Figure 6) from the axle end of the steering arm.

Step 3—Remove the steering arm (F-Figure 7) from the top of the wheel spindle E-Figure 7).

Step 4—Remove the woodruff key (D-Figure 7) and dust seal (C-Figure 7).

Step 5—Remove the spindle and hub assembly.

Step 6—Remove the spindle housing and axle assembly (A-Figure 7) by removing the two bolts (B-Figure 7).

NOTE: Removal from the tractor is optional. However, the removal and replacement of the bushings is made easier by securing the assembly in a vise as shown in Figure 8.

Step 7—Remove the bushings by driving them out.

Step 8—Install the bushings using a piloted tool as shown in Insert Figure 8.

NOTE: New bushings are pre-sized and are not reamed after installation.

Step 9—Install the front axle assembly to the center axle.

Step 10—Install the spindle and hub assembly.

Step 11—Install the dust seal and woodruff key.

Step 12—Attach the steering arm to the top of the spindle.

Step 13—Mount the wheel.

III. REPLACING THE FRONT WHEEL BEARINGS

Step 1—Remove the hub cap.

Step 2—Remove the cotter pin and the wheel adjusting nut (A-Insert Figure 9)..

Step 3—Pull the hub outward until the outer roller bearing is near the end of the spindle and remove the bearing from the hub.

Step 4—Remove the hub and wheel assembly.

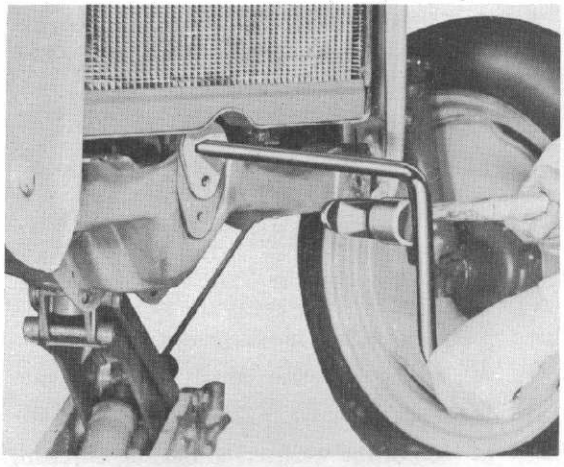

Fig. 5

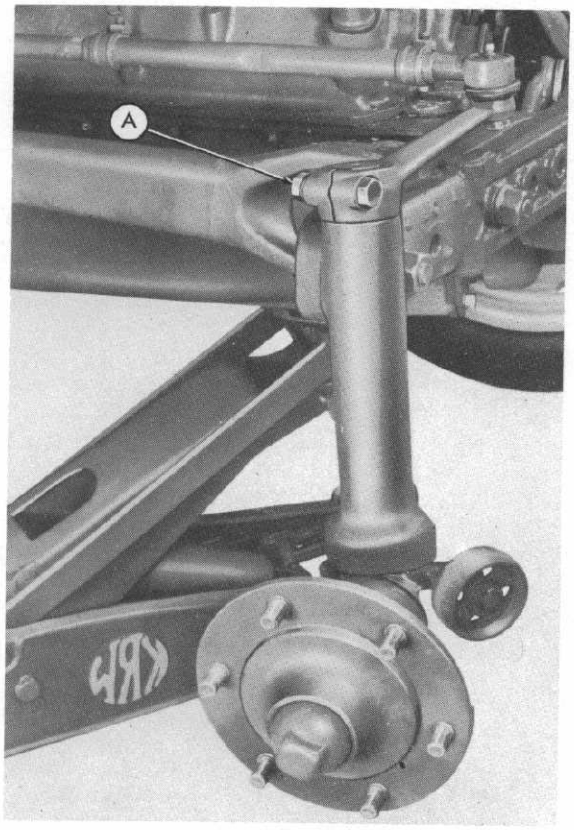

Fig. 6

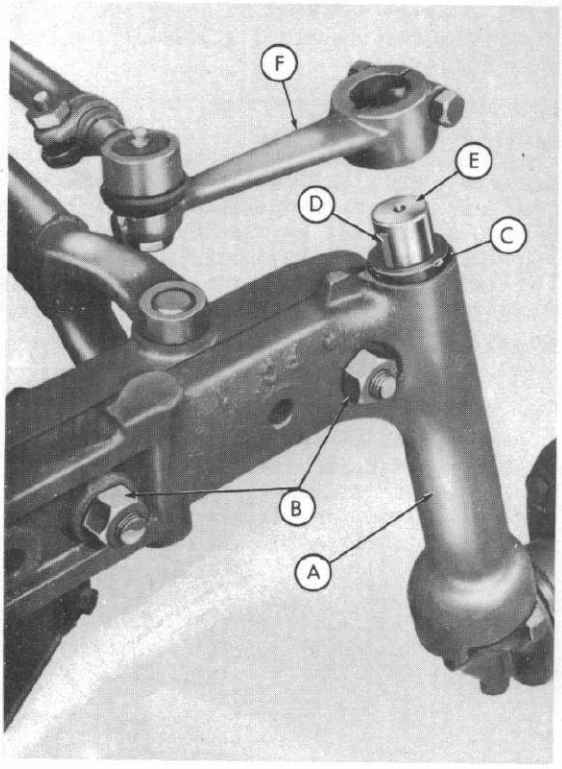

Fig. 7

Step 5—Drive the dust seal (A-Figure 9), rear bearing (B-Figure 9) and the bearing cup (C-Figure 9) out of the hub.

Step 6—Clean the spindle and hub, and examine the bearing races.

NOTE: The bearing cups should be renewed if new bearings are installed.

a. Pull the outer bearing cups as shown in Figure 10.

b. Bearing cups are installed by driving them into place with a sleeve and hammer.

Step 7—Pack the inner bearing with grease and install the bearing and seal.

NOTE: Be sure the seal is seated against the shoulder in the hub.

Step 8—Repack the hub and inner bearing.

Step 9—Install the hub assembly on the spindle.

Step 10—Pack the outer bearing and install.

Step 11—Install the washer and bearing adjusting nut.

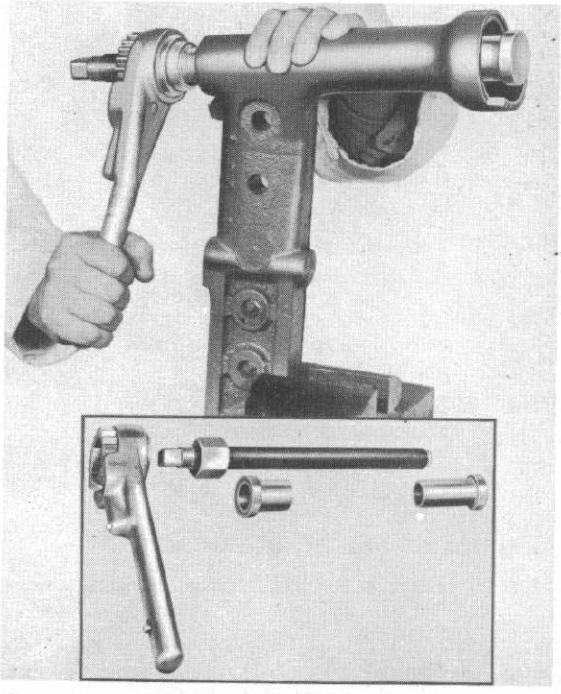

Fig. 8

NOTE: Draw the adjusting nut up tight and back off approximately ⅛ turn. The wheel should drag slightly.

Step 11—Replace the cotter pin and hub cap.

IV. ADJUSTING THE TOE-IN

NOTE: Correct toe-in is established when the distance from center to center on the front side of the tires is from 0 to ¼" less than the distance from center to center on the rear side of the front tires. Toe-in is adjusted by varying the length of the drag links.

Step 1—Loosen the turnbuckle nuts (A-Figure 11).

Step 2—Turn the turnbuckle (B-Figure 11) to shorten or lengthen the drag links.

NOTE: The wheels may be aligned approximately by adjusting the drag links until the spindle arms (C-Figure 11) are centered over the axle reference marks (D-Figure 11).

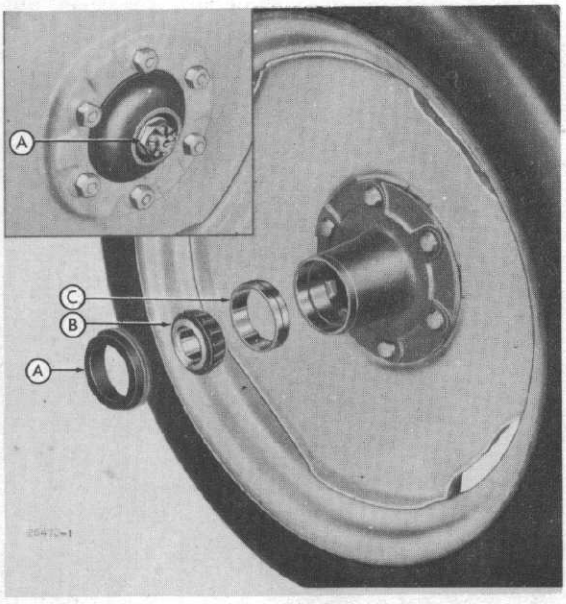

Fig. 9

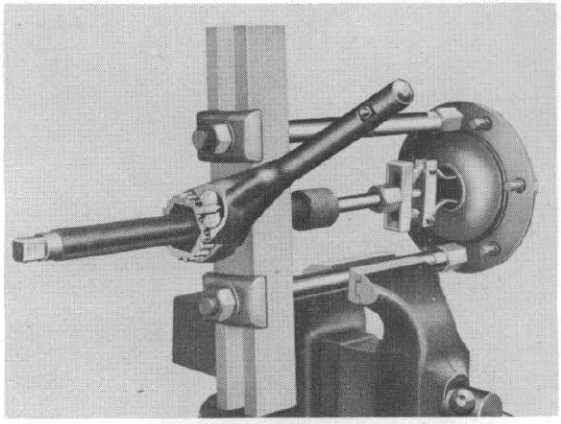

Fig. 10

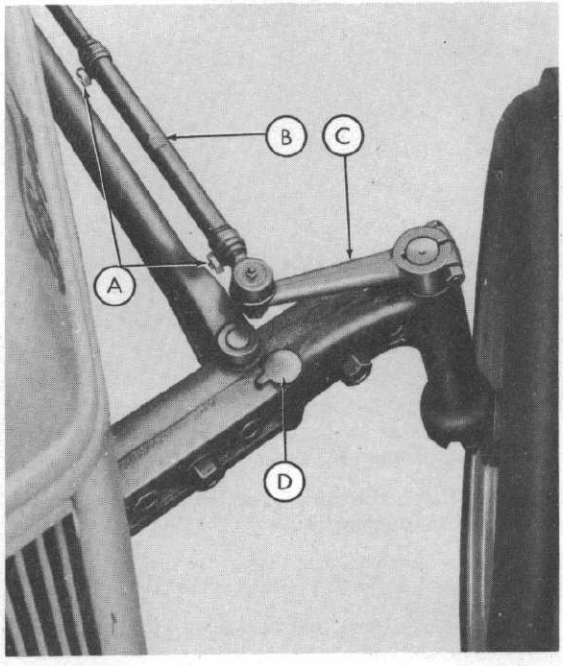

Fig. 11

NOTES

LIQUID WEIGHTING THE TIRES

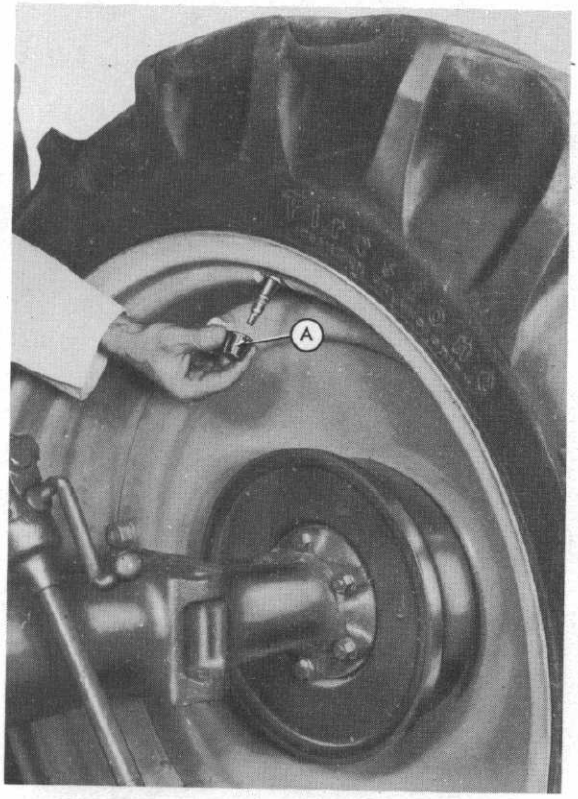

Fig. 1

TRAINING TIME: 1 Hr.

TOOLS AND MATERIALS:

1. Jack
2. Electric Liquid Weighting Pump Assembly
3. 55 Gal. Steel Barrel
4. Calcium Chloride and Water Solution
5. Hydrate of Lime
6. Air Liquid Pressure Gauge
7. One Gallon Pail

JOB PROCEDURE:

I. FILLING THE TIRES WITH LIQUID

Step 1—Make the calcium chloride anti-freeze solution.

a. Fill the barrel with the correct amount of clean water. (ALWAYS PUT WATER IN THE BARREL FIRST.)

NOTE: Ultimate protection good to —60° F, is obtained by mixing 5 lbs. of calcium chloride per gallon of water. This formula makes 1.25 gal. of solution. Never put in more than 5 lbs. of calcium chloride per gallon of water. The liquid capacities of the standard rear tires on the Ford tractor are as follows: Stem Level Full—24.0 gal.; 90% full—28.4 gal.; 100% full—31.5 gal.

CAUTION: Toxic fumes and intense heat caused by putting calcium chloride into the water may be injurious to operator.

Step 2—Pour the calcium chloride slowly into the water. Add 1 lb. of hydrate of lime per 100 lbs. of calcium chloride to prevent caking.

Step 3—Use a wood mixing paddle about 4 inches wide and 5 ft. long and mix thoroughly. Allow the solution to cool until one's hand can be held comfortably against the side of the barrel.

Step 4—Wash the strainer on the inlet hose with clear water to make certain it is clean.

Step 5—Remove the tractor fenders (if the wheels are standard mounted).

Step 6—Jack up the wheel on which the tire to be filled is mounted. Turn the wheel until the valve is at top center as shown in Figure 1.

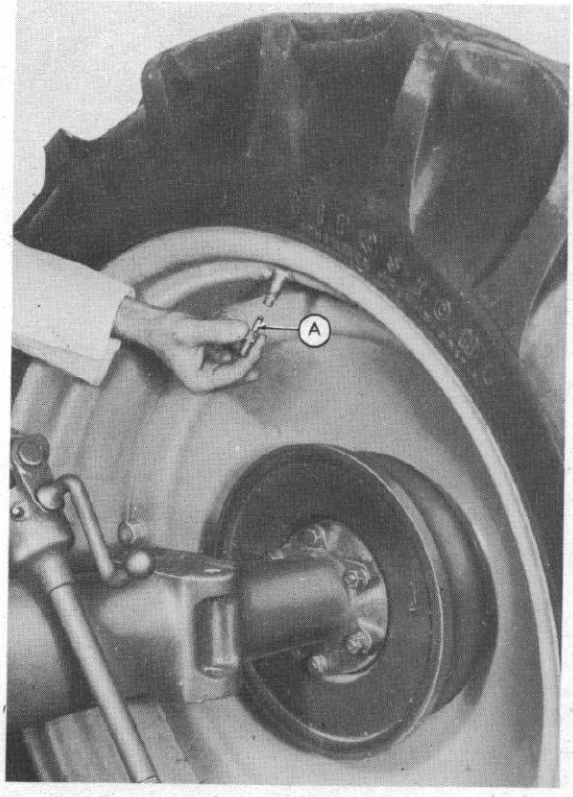

Fig. 2

Step 7—Remove the valve mounting cone (A-Figure 1).

Step 8—Remove the core housing (A-Figure 2).

Step 9—Install part "A" of the liquid-weighting adaptor to the tube valve stem as shown in Figure 3, and tighten firmly by hand.

Step 10—Install part "C" of the liquid-weighting adaptor to part "A" and attach the hose (15 ft.) from the pump to part "C" as shown in Figure 4.

Step 11—Insert the bleeder tube as shown in Figure 4.

NOTE: Push in the bleeder tube until it hits the top of the tire. Withdraw it ½ the width of the cross section of the tire for 90% fill.

Step 12—Connect the overflow hose (B-Figure 5) and the inlet hose (C-Figure 5) to the pump and place the opposite ends in the barrel as shown in Figure 5.

Step 13—Attach a small hose to the end of the bleeder tube and place the other end of the hose in an empty pail to catch any excess solution.

Step 14—With the pump control valve in "off" position, start the electric motor.

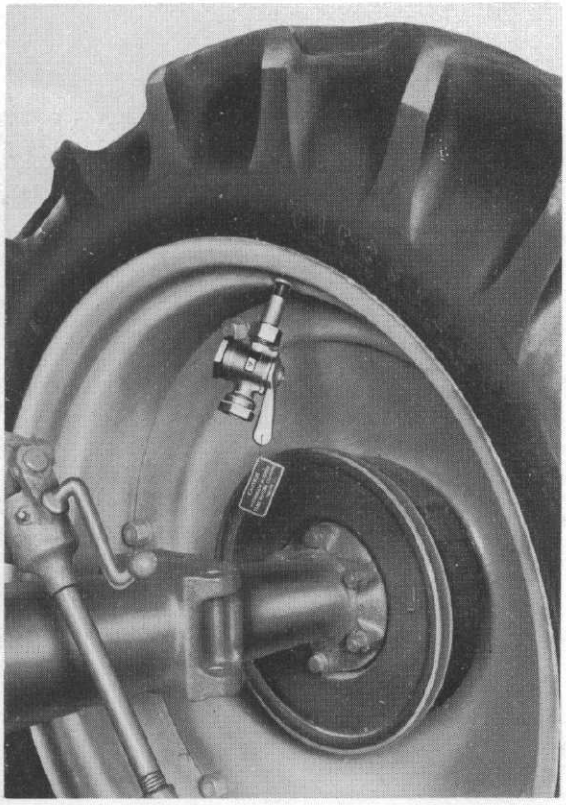

Fig. 3

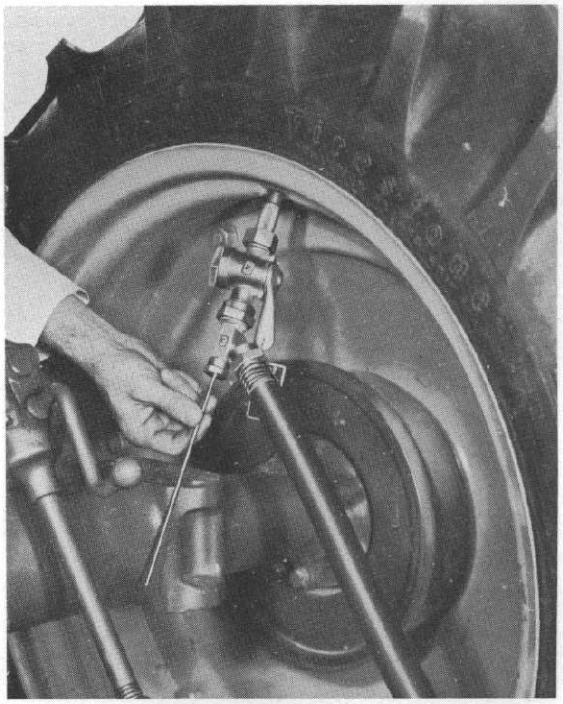

Fig. 4

NOTE: Be sure the ground plug on the electric power line plug is attached to adequate ground.

Step 15—Slowly turn the pump valve handle (A-Figure 5) to the "FILL" position and continue pumping the solution into the tire until a steady stream of solution runs out of the bleeder tube.

Step 16—Turn the pump valve handle to the "off" position.

Step 17—Stop the pump by removing the power line plug from the power source.

Step 18—Push the bleeder tube (A-Figure 6) up in the tube above the level of the liquid to release the air pressure from the air space.

Step 19—Remove the bleeder tube and at the same time close the valve (C-Figure 6) to prevent the liquid from escaping.

Step 20—Empty the pump hose by starting the pump motor and turning the pump valve handle to "EMPTY" for about one minute.

Step 21—Disconnect the hose from the adaptor (B-Figure 6) and remove the part "C" from part "A" of the adaptor.

Step 22—Install the core housing into part "B" of the adaptor as shown in Figure 7.

Step 23—Install part "B" (with the core housing attached) to part "A" of the adaptor as shown in Figure 8.

Step 24—Open the adaptor valve (A-Figure 9) to permit the core housing to enter the valve stem and screw in the core housing as shown in Figure 9.

Step 25—Pull the plunger in part "B". Close the adaptor valve and remove part "B".

Step 26—Open the adaptor valve slowly and check for any leakage from the valve.

Step 27—Remove the part "A" of the adaptor.

Step 28—Install the valve mounting cone.

Step 29—Rotate the wheel placing the valve stem on the lower side of the wheel and remove the jack.

Step 30—Inflate the tire to 12 lbs. pressure as shown in Figure 10.

NOTE: Inflate slowly to avoid getting over 12 lbs. of pressure.

Step 31—Install the valve cap.

NOTE: After completion of liquid weighting, install the fenders.

II. EMPTYING LIQUID FROM THE REAR TIRES

Step 1—Jack up the tire to be emptied.

Step 2—Remove the Valve mounting cone.

Step 3—Attach part "A" of the adaptor to the valve stem.

Step 4—Remove the core housing from the valve stem.

a. Attach part "B" to part "A" of the adaptor. Push the plunger in and at same time open the adaptor valve allowing passage of the plunger.

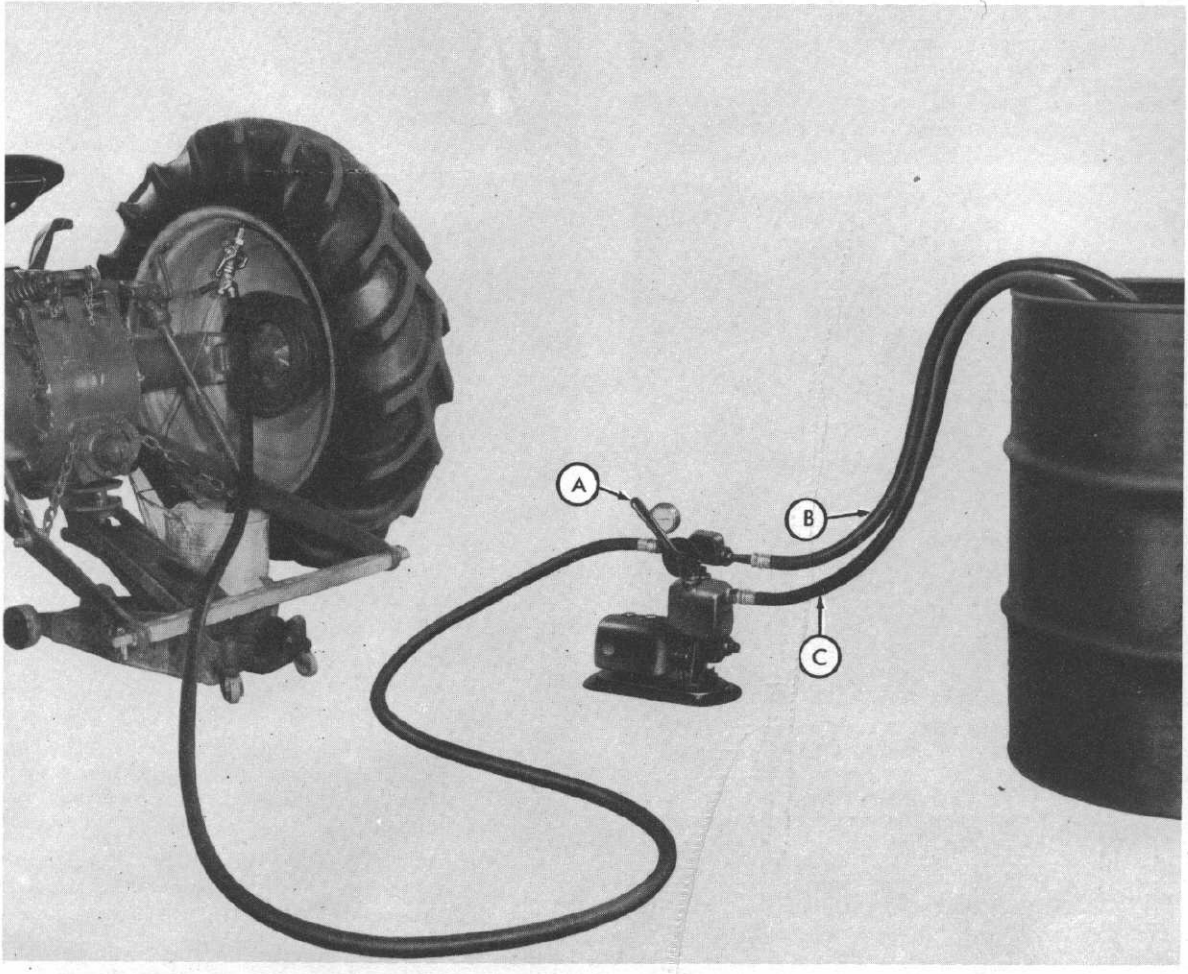

Fig. 5

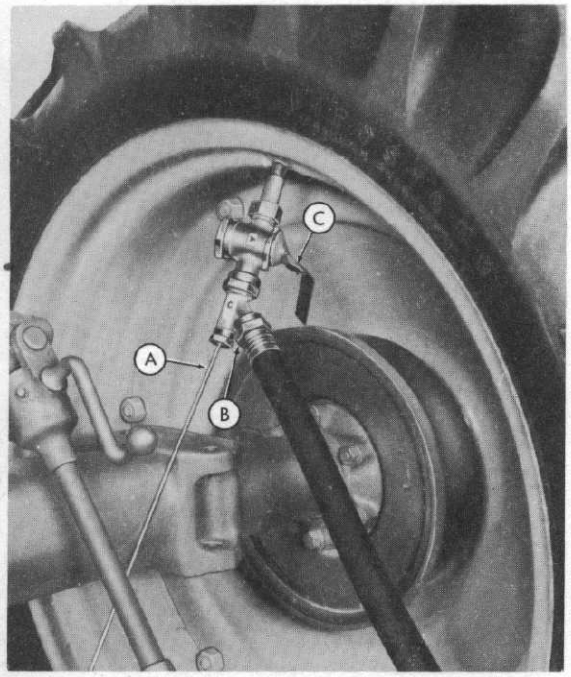

Fig. 6

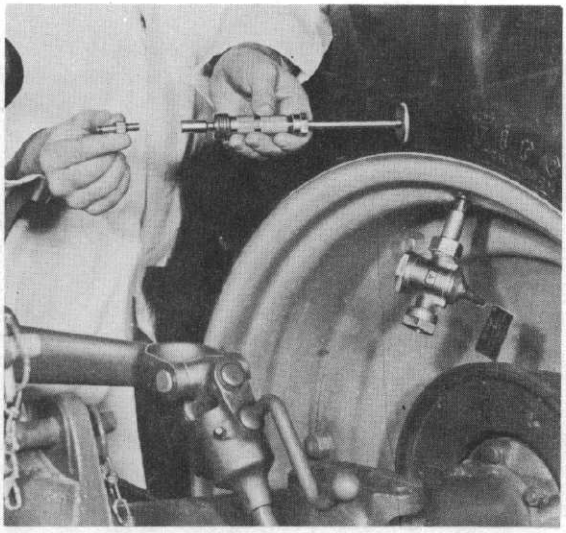

Fig. 7

b. Turn the plunger counter clockwise to unscrew the core housing as shown in Figure 11.

c. Pull the plunger rearward and at the same time close the adaptor valve to prevent the solution from escaping.

d. Remove part "B" from part "A" of the adaptor as shown in Figure 12.

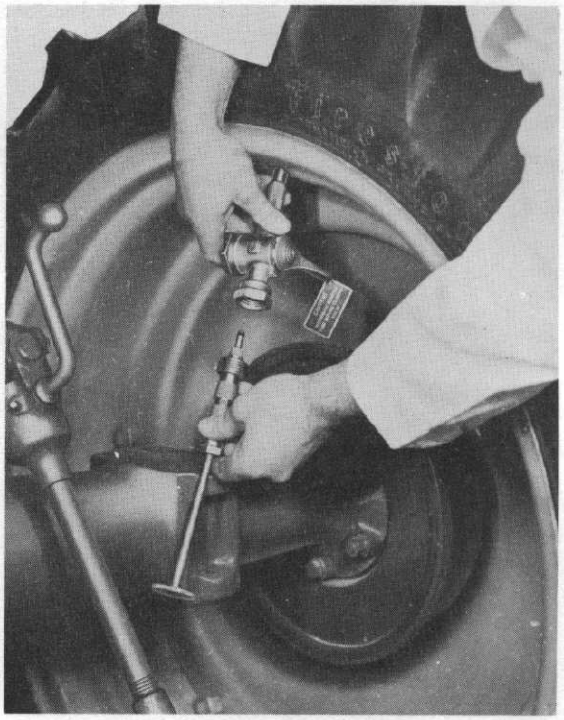

Fig. 8

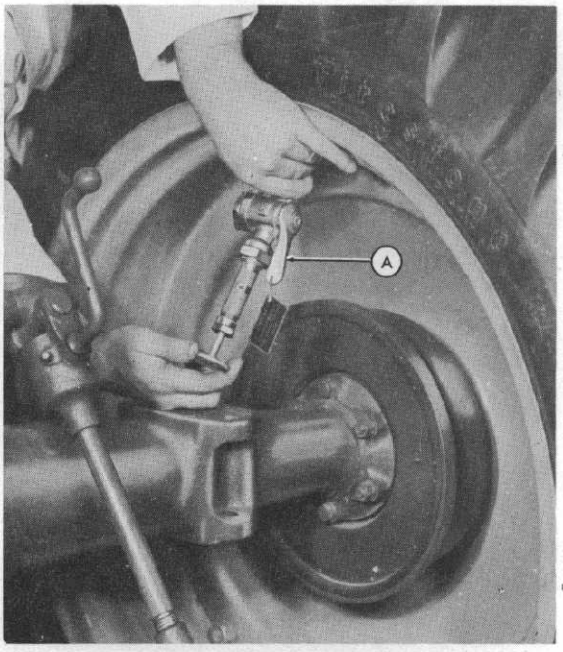

Fig. 9

e. Remove the core housing from part "B" of the adaptor as shown in Figure 13.

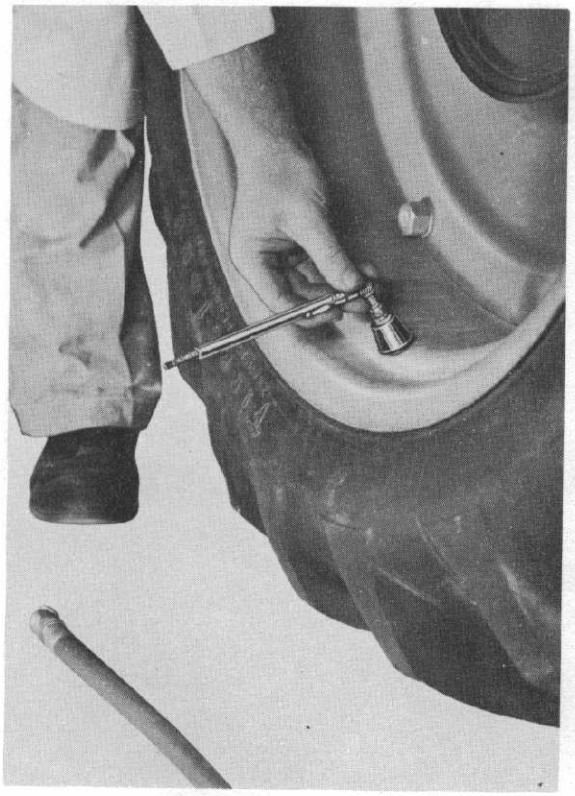

Fig. 10

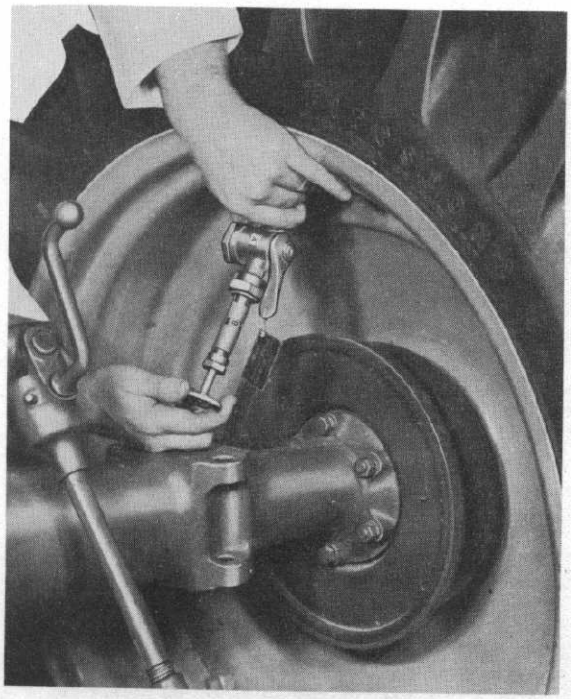

Fig. 11

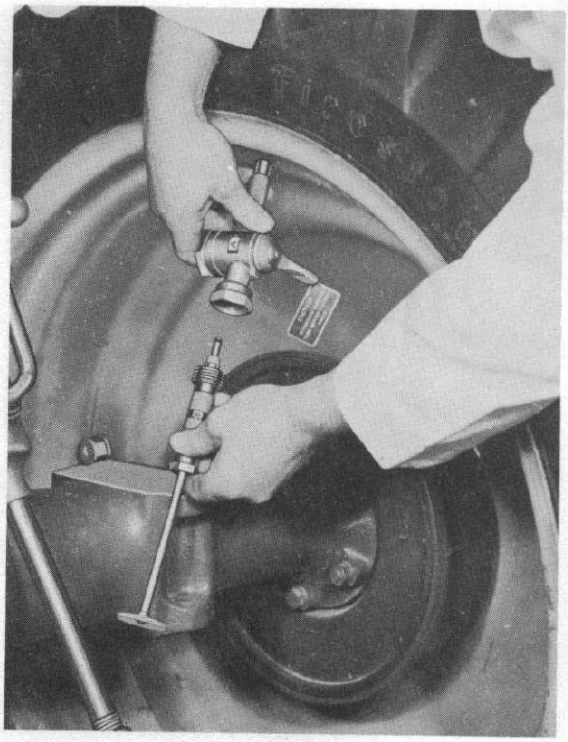

Fig. 12

Step 5—Rotate the wheel until the valve is in its lowest position as shown in Figure 14.

Step 6—Attach the pump hose to part "A" of the adaptor as shown in Figure 15.

Step 7—Turn the adaptor valve (A-Figure 15) to open.

Step 8—Start the pump motor.

Step 9—Turn the pump valve handle (B-Figure 15) to "empty". This will permit the solution to pass through the pump and into the barrel.

NOTE: During the above operation, keep the tire valve pushed back into the rim to allow air to enter. The air passing through the rim hole prevents the tire from collapsing.

Step 10—Turn the pump valve handle to "off" when the vacuum gauge (C-Figure 15) registers about 28 inches for a period of 30 seconds, and no more air or solution comes from the tire.

Step 11—Turn the part "A" adaptor valve to "close".

Step 12—Disconnect the motor.

Step 13—Remove the pump hose from part "A" of the adaptor.

Step 14—Remove part "A" of the adaptor.

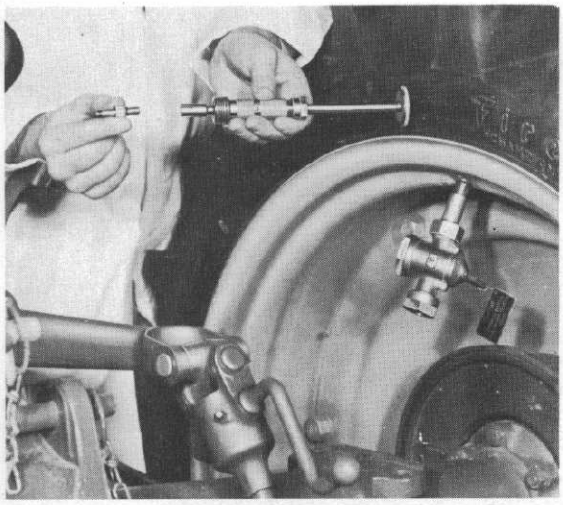

Fig. 13

NOTE: Hold the valve stem during removal of the adaptor to prevent it from being pulled inside the rim.

Step 15—Install the valve mounting cone.

Step 16—Install the core housing.

Step 17—Inflate the tire to 12 lbs. pressure.

Step 18—Install the valve cap.

Step 19—Remove the jack.

III. FRONT TIRES

When liquid weighting front tires, the following table shows the capacity required:

TIRE SIZE	LIQUID CAPACITY (GAL.) STEM LEVEL FULL
4.00—19	2.50
6.00—16	5.76

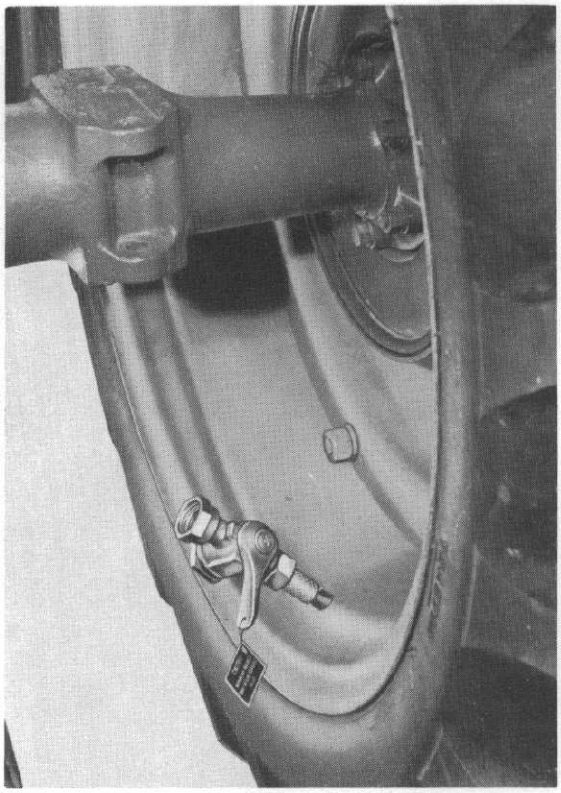

Fig. 14

A small wheel valve bushing as shown in Figure 16 is used with the part "A" of the adaptor for liquid weighting the front wheels. The tire is filled to valve stem level. The same procedure is followed in emptying as with the rear tires in Part II of this job plan.

NOTES

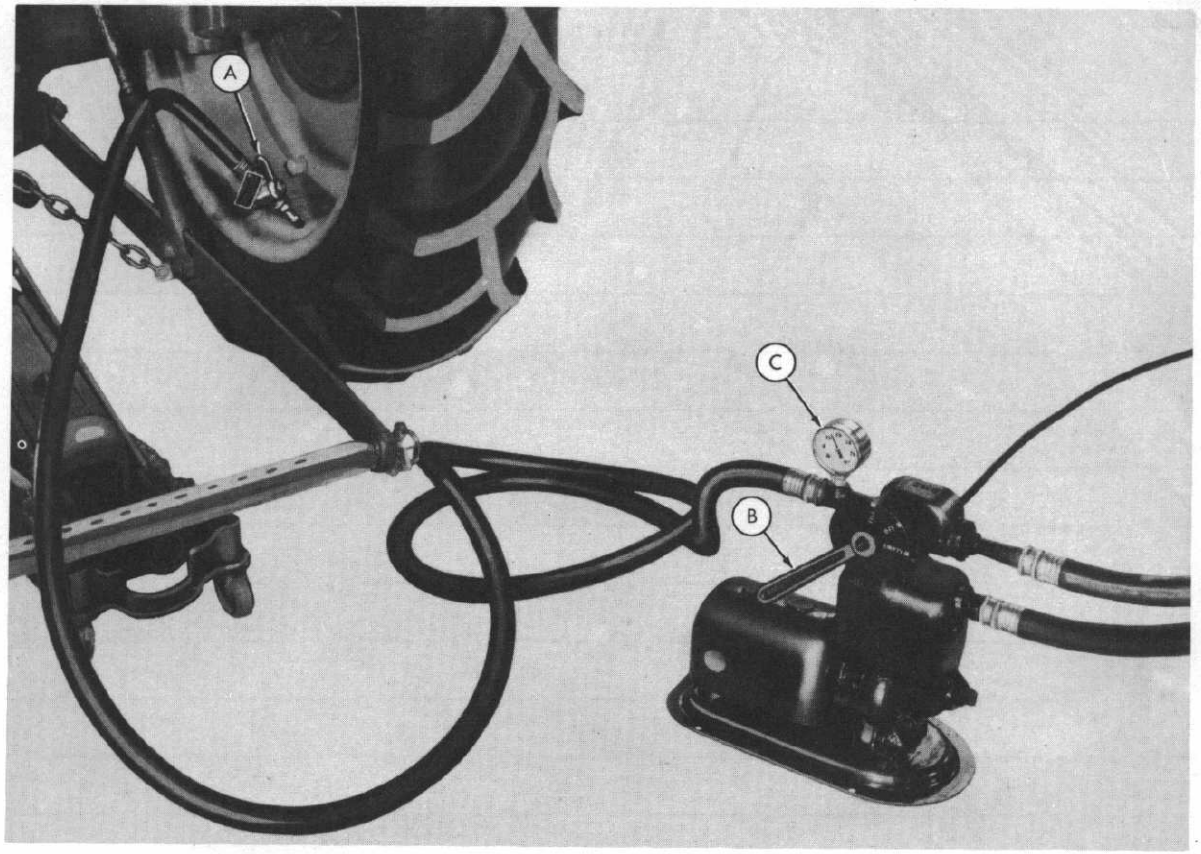

Fig. 15

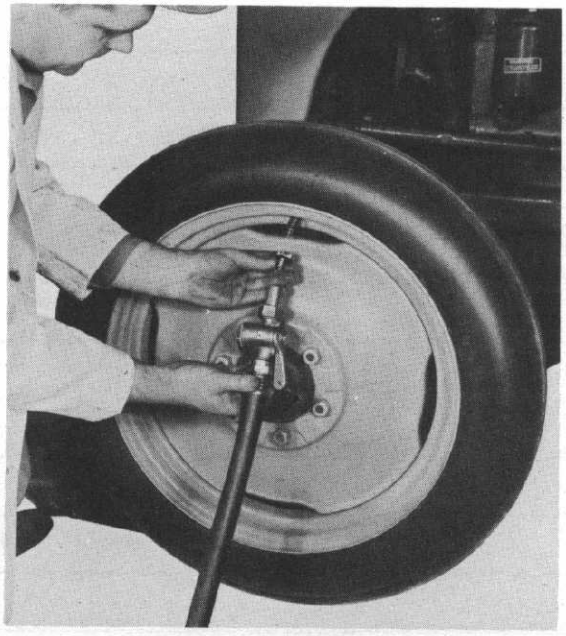

Fig. 16

NOTES

NOTES

ENGINE ACCESSORIES (NON-ELECTRICAL)

CONFERENCE OBJECTIVES:

1. To review the construction and operation of the non-electrical engine accessories
2. To discuss service problems related to these accessories

CONFERENCE TIME: ¾ Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 6-1—The Manifold
   b. 6-2—The Carburetor
   c. 6-3A—The Air Cleaner 3B—The Governor
   d. 6-4—Governor—Shaft, Gear and Fly Ball Assembly
   e. 6-5—Governor—Body and Lever Assembly
   f. 6-6—Governor Operation
   g. 6-7—Checking Race Travel
   h. 6-8—Checking Governor Arm Adjustment
   i. 6-9—The Oil Filter
   j. 6-10—The Cooling System
   k. 6-11—The Water Pump
4. Manifold and Steel Balls for Checking Passages
5. Sound Slide Film—"A Guy's Gotta Breathe" (Servicing The Air Cleaner)
6. Cut-a-way Model of the Oil Filter
7. Cut-a-way Model of the Air Cleaner
8. Cut-a-way Model of the Carburetor
9. Cut-a-way Model of the Governor
10. Cut-a-way Model of the Water Pump
11. Conference Guide No. 6 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conferences

1. Up to this point in the program we have traced the flow of power from its source back to the tractor wheels, and have discussed a method of directing that power by means of the steering mechanism
2. We have assumed, theoretically, that we were getting power from the engine. It is true, that the basic engine that we discussed in Conference 2, is the potential source of power. However, in order that the engine may efficiently operate, accessories must be attached to that basic engine. For training purposes these accessories are classified into two groups; the non-electrical and the electrical accessories

CHART 6-1

Engine Accessories (Non-Electrical)

3. In this conference we will discuss the construction and operation, together with service problems related to the non-electrical engine accessories which consist of the
   a. Manifold
   b. Carburetor
   c. Air Cleaner
   d. Governor
   e. Oil filter and breather cap
   f. Cooling system, including:
      (1) Water pump
      (2) Fan
      (3) Radiator and thermostat

II. The Manifold

VISUAL CAST
SLIDE 6-1
The Manifold

A. Function

1. To distribute the fuel and air mixture uniformly to the four combustion chambers. It is also designed to pre-heat the fuel and air mixture before it enters the combustion chamber. This pre-heating is essential in order to insure complete vaporization of the mixture

B. Servicing

1. Manifold gaskets

   a. If, for any reason, the manifold is removed a new manifold gasket must be installed. These gaskets must be tight. Air leaks between the manifold and the engine block will cause erratic engine operation and prevent the carburetor from functioning properly even though it be correctly adjusted

   b. Air passages that are blocked due to a faulty core in casting, will cause a definite loss of engine power

      (1) These air passages may be checked by running a steel ball through the passages. A manifold which has blocked passages must be replaced

Demonstration
Checking Manifold Air Passages

III. The Carburetor

A. Function

1. The fuel and air mixture that enters the combustion chambers in the engine must be correctly proportioned and mixed. The proportioning and mixing of liquid fuel and air is called carburetion, and is performed by the carburetor

B. Construction and operation

VISUAL CAST
SLIDE 6-2
The Carburetor

1. The carburetor used on the 8N Ford Tractor is a Marvel Schebler up-draft type carburetor. The throttle control is located on the steering shaft tube. The choke control is on the right hand side of the instrument panel

2. The fuel supply is contained in a ten gallon tank located above the carburetor, utilizing a gravity feed to supply the carburetor with liquid fuel. This fuel supply enters the carburetor through an elbow which is equipped with a strainer

3. During each intake stroke of the pistons, air is drawn into the carburetor, and in so doing, rushes past a jet filled with liquid fuel. The velocity of the inrushing air is increased as it is drawn through the venturi tube (a tube with a restricted passage). This increase of velocity lifts the liquid gas out of the main jet atomizing the gas instantly and mixing the fine fuel particles with the air. This mixture of gas and air is drawn into the manifold and on into the combustion chamber. The throttle valve is located above the main jet. It controls the amount of air and fuel mixture entering the engine, thereby controlling the speed of the engine

4. The choke valve is located in the air intake passage and controls the quantity of air entering the carburetor. The poppet valve is designed to prevent overflooding or smothering the engine. The float controls the quantity of fuel entering the carburetor.

C. Servicing the carburetor

1. The complete procedure for cleaning and adjusting the carburetor is covered in Service Training Job Plan #15

(NOTE TO THE INSTRUCTOR: Discuss any questions the group may ask concerning the carburetor)

IV. The Air Cleaner

VISUAL CAST SLIDE 6-3A

The Air Cleaner

A. Introduction

1. The importance of a sufficient amount of clean air entering the carburetor cannot be overstressed to owners. The mechanical operation of the air cleaner is not difficult to understand, but the importance of servicing the air cleaner properly and completely is often overlooked

2. To aid in carrying this story directly to the Dearborn dealers and to tractor owners, Dearborn Motors Corporation presents a sound slide film entitled "A Guy's Gotta Breathe" (Servicing the Air Cleaner)

Show Sound Slide Film

"A Guy's Gotta Breathe" (Servicing the Air Cleaner)

B. Show the sound slide film

C. Answer any questions the group may have regarding the air cleaner

V. THE GOVERNOR

VISUAL CAST SLIDE 6-3B

The Governor

A. Function

1. The throttle valve, we have noted, controls the speed of the engine by regulating the flow of fuel and air mixture that enters the combustion chambers. At a given throttle setting and a given pounds pull, the forward speed of the tractor will remain constant. However, if the pounds pull were increased without increasing the throttle valve opening, the tractor speed would decrease. If we decreased the pounds pull, without changing the throttle setting, our tractor speed would increase. In other words, the tractor engine would tend to "race" or "choke down" depending on the pull. Manually the operator could compensate for this by constantly changing the throttle setting. However, this is not practical, so a Novi, fly ball type variable speed governor is attached to the engine, to automatically control (within limits) the engine speed so that the tractor will maintain a constant forward speed

B. Construction

1. Major parts of the governor

a. The shaft, gear and fly ball assembly

(1) Governor drive gear
   (a) Pressed on the drive shaft
   (b) Meshes with the camshaft gear.

(2) Ball bearing base and lower bearing race assembly
   (a) Pressed on the drive shaft

(3) Fly balls

(4) Upper race
   (a) Fabricated with a smooth concave surface, and designed to slide freely on the drive shaft

(5) Thrust bearing

(6) Governor fork bearing base

(7) Shims
   (a) Control the maximum movement of the upper race on the shaft

(8) Washer and lock ring

VISUAL CAST SLIDE 6-4

Governor—Shaft, Gear and Fly Ball Assembly

b. Body and lever assembly

(1) Body
   (a) The governor body contains the needle bearing for the lever shaft and the bushing for the drive shaft; dust seal for the lever shaft needle bearing; and the tapped port for installing the oil line elbow.

(2) Governor lever (manual)
   (a) Fits over the governor lever assembly
   (b) It is this lever to which the throttle rod is connected

(3) Governor lever assembly
   (a) Held in position in the governor body by the fork pinned to the lever shaft
   (b) The governor lever is connected to the carburetor throttle valve

(4) Governor lever spring
   (a) Connects the two governor levers

VISUAL CAST SLIDE 6-5

Governor—Body and Lever Assembly

C. Operation of the governor

1. When the throttle control rod is moved, it actuates the governor lever (manual) which increases the tension on the governor spring. The governor spring moves the governor lever assembly opening the carburetor throttle. When the engine speed is increased, the balls inside the governor tend to close the throttle. The governor operation is to maintain a balance between these two forces. The spring opening the throttle allows more fuel to the engine, increasing the engine speed. As the engine speed increases, the speed of the governor drive shaft also increases, and gives more inertia or centrifugal force to the governor balls. This greater force in the balls overcomes or equals the tension of the governor spring, thus closing the throttle until a balance

VISUAL CAST SLIDE 6-6

Governor Operation

is achieved by the force of the balls tending to close the throttle and the spring trying to open the throttle. As long as the load on the engine remains the same, the forces are balanced, and the engine will operate at a constant speed

2. When a plow enters the ground, or any load is transmitted to the engine causing the engine speed to decrease, the force of the governor balls will decrease. The tension of the governor spring will then instantaneously open the throttle to prevent an appreciable loss in speed. This instantaneous opening of the throttle gives the engine more fuel, preventing any appreciable decrease of the engine speed. When the engine speed increases, the force is restored to the governor balls, and they then counteract the tendency of the governor spring to continue opening the throttle and restores the balance, thus preventing the engine from overspeeding
3. When the control rod is moved to open the throttle, it increases the tension on the spring and thus makes the spring stronger and requires the engine to run faster to build up sufficient centrifugal force in the governor balls to counteract or balance this increased strength or tension that was put into the spring as the throttle was opened. Any wear on the governor spring will reduce its tension or strength and, thereby, reduce the ability to counteract the governor balls. This reduced spring tension may then not have sufficient strength to counteract the force of the governor balls preventing the engine from reaching top RPM. The governor regulates the engine speed from 700 RPM to 2200 RPM

D. Servicing the governor

(NOTE: The complete procedure for servicing the governor is outlined in Service Training Job Plan #14, however, we will discuss at this time some of the common causes of improper governor action)

1. Causes of improper governor action
   a. Sludge and dirt
      (1) Sludge and dirt accumulating in the governor body will cause a sluggish action of the governor
         (a) This condition can be remedied by removing the governor and thoroughly washing it in kerosene or gas. Inspect all parts for freedom of movement, lubricate thoroughly with engine oil and reinstall
   b. Worn races
      (1) Grooves worn in the upper and lower races may prevent a free outward movement of the fly balls. This would cause the engine to race when the load is decreased
         (a) Races that are grooved or balls that have flat spots worn on them should be replaced
   c. Loose linkage
      (1) Looseness in the linkage between the throttle and governor lever (manual) or the governor lever and throttle valve, result in a loss of governor control. A governor lever spring that has lost its tension or has wear in the end of the spring and in the eyes in which the spring is hooked will also result in the loss of governor control
         (a) The governor control rod and governor-to-carburetor rod are both equipped with adjustable ends so that any looseness in linkage may be corrected
         (b) A weak or worn spring should be replaced

d. Worn drive shaft
   (1) A governor drive shaft that is worn or pitted, preventing the free movement of the race assembly, will cause erratic governor operation
      (a) A fine grade of emery paper may be used to remove corrosion or pitted edges

e. Worn governor spring
   (1) A governor spring that is badly worn at the ends, and has lost its tension will prevent the engine from operating at maximum speed

f. Incorrect number of spacers
   (1) An incorrect number of spacers between the lock ring and the governor fork bearing base will either prevent the balls from extending to their maximum radius or permit them to go too far and strike the governor body
      (a) The correct thickness of spacers can be determined by checking the assembly on the governor gauge
      (b) Correct travel of the race should permit the balls to move $1/16''$ over the outer edge of the race. This represents a clearance of 0.220" to 0.230" between the washer and fork base

VISUAL CAST SLIDE 6-7

Checking Race Travel

g. Incorrect governor arm adjustment
   (1) The manually controlled governor lever and the governor lever must be set so that with the throttle wide open, the governor lever is opening the throttle valve in the carburetor to its maximum
      (a) The correct relationship of the two governor levers can be determined by checking on the governor gauge

VISUAL CAST SLIDE 6-8

Checking Governor Arm Adjustment

E. Answer any questions the group may have regarding the governor

VI. THE OIL FILTER

VISUAL CAST SLIDE 6-9

The Oil Filter

A. Function

1. To remove particles of dirt and other foreign elements from the oil that would be harmful to the engine if allowed to circulate indefinitely in the oil

B. Operation

1. In our discussion of the engine we noted that the oil in the crank case is pumped through passages in the block to lubricate the various moving parts. At the right side near the rear of the block there is a hole tapped into the main oil passage in the block. A tube connects this hole with the oil filter. Oil under pressure passes through the tube to the outer shell of the oil filter
2. A filter cartridge is located between the outer shell and the inner chamber of the oil filter. The oil passes through the holes of the outer shell, then through the filter which removes foreign materials. The filtered oil then is discharged to the center tube
3. The filtered oil in the center perforated tube passes through the bottom of the filter and through the oil line to the governor. The oil, thus returning to the crank case serves the important function of lubricating the governor on its return

C. Servicing the oil filter

1. Changing the filter cartridge
   a. When the cartridge becomes clogged with dirt it ceases to function and should be replaced
   b. A new cartridge should be installed at each oil change, or whenever the oil looks dirty on the dip stick. The new gaskets that come with each new filter should be installed
   c. It is important that the oil lines from the block to the filter, and from the filter to the governor, be checked periodically for blocking. If these lines are blocked the function of the oil filter will be nullified

Use the Cutaway Model In Discussing Servicing the Oil Filter

D. The breather cap

1. In connection with proper lubrication of the engine, it is important that the breather cap in the oil filter pipe be clean, so that the air pressure in the crank case can be equalized with the outside air pressure and eliminate back pressure
2. The breather cap should be cleaned every 10 hours of operation by washing in kerosene or gasoline

VII. THE COOLING SYSTEM

A. Introduction

1. An internal combustion engine is really a heat engine. In its operation, it generates a sufficient amount of heat to damage the internal working parts of the engine if the excess heat is not dissipated
2. The 8N Ford Tractor engine is equipped with a water circulating system to control the engine temperature

B. Construction and operation

1. The cooling system consists of:
   a. The radiator which is connected to the cylinder head and the block by means of hoses
   b. The block and head contains cored water passages, that surround the full length of the cylinder walls, and the valves
   c. The water pump circulates the water from the radiator through the water jacket in the engine and back to the radiator
   d. The fan is connected to the water pump and aids in cooling the water in the radiator by drawing air through the radiator
   e. The thermostat is located in the upper radiator hose and is set to open when the water has reached a temperature of 160 to 195°F

VISUAL CAST SLIDE 6-10

The Cooling System

2. Summary of the operating cycle
   a. If we were to start a cold engine, the cooling system would keep the engine cold, cutting down on the efficient operation of the engine
   b. As we start a cold engine, the thermostat is closed preventing the water from circulating through the cooling system. As the water in the jackets around the engine becomes heated to 160° the thermostat begins to open permitting the water pump to move the water from the cylinder jackets to the top of the radiator. The fan cools the hot water in the radiator, and the circulating cycle becomes a continuous process while the engine is operating

C. Servicing the cooling system

1. The radiator
   a. Keep it filled with a clean non-corrosive coolant to insure that the radiator tubes in the core remain open
   b. The radiator cap must provide a pressure seal for effective operation of the cooling system
   c. Hose connections must be tight
2. Thermostat
   a. The thermostat should be tested annually to insure opening and closing at the specified temperature. This may be done by removing the hose and placing it in a pan of water heated to 160°-165°F
3. The water pump

VISUAL CAST
SLIDE 6-11

The Water Pump

   a. Function
      (1) To circulate the water throughout the cooling system
   b. Construction and operation
      (1) The water pump is a pre-lubricated impeller type, consisting of
         (a) The pump housing in which the principle parts of the pump are installed
         (b) The bearing assembly is pressed into the pump housing and held in position by the spring clip
         (c) The pulley assembly, to which the fan is bolted, is pressed to the bearing assembly shaft. A horse-shoe clip serves as a locking device
         (d) The water pump seal is pressed into the pump housing. Its function is to prevent water from entering the area of the pump housing containing the bearing
         (e) Wear of the seal will, however, cause leakage at the carbon washer, the slinger will prevent water from entering the bearing and working out the bearing grease. Water getting past the seal is drained from the pump housing through a vent
         (f) The impeller is pressed to the bearing assembly shaft and is the driven part of the pump that circulates the water throughout the cooling system
         (g) The rear of the pump housing is enclosed by means of a gasket and cover
   c. Servicing the water pump

(NOTE: The complete procedure for servicing the water pump is outlined in Service Training Job Plan No. 16)

VII. Conference Conclusion

A. Summarize the main parts of this conference dealing with the non-electrical engine accessories
   1. Answer any questions the group may ask regarding the non-electrical engine accessories

B. Distribute the service training material
   1. Conference Guide No. 6, one for each trainee

C. Tell the group that the next conference will deal with the 8N Ford Tractor electrical system and state the time it is scheduled to begin

SERVICING THE GOVERNOR

TRAINING TIME: ¾ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Tool Board No. FT 46
   b. Governor Gauge

JOB PROCEDURE:

I. REMOVING THE GOVERNOR FROM THE TRACTOR

Step 1—Disconnect the throttle and carburetor linkage.

Step 2—Remove the two cap screws that secure the governor to the timing gear housing.

II. DISASSEMBLING THE GOVERNOR

Step 1—Remove the base screw (A-Figure 1).

Step 2—Remove the fly ball unit, the shaft, and the driven gear assembly (E-Figure 1) as a unit.

Step 3—Remove the spring clip (D-Figure 1). Disassemble the shaft and the fly ball unit.

Step 4—Remove the lever shaft assembly.

a. Remove the oil fitting from the back of the governor.

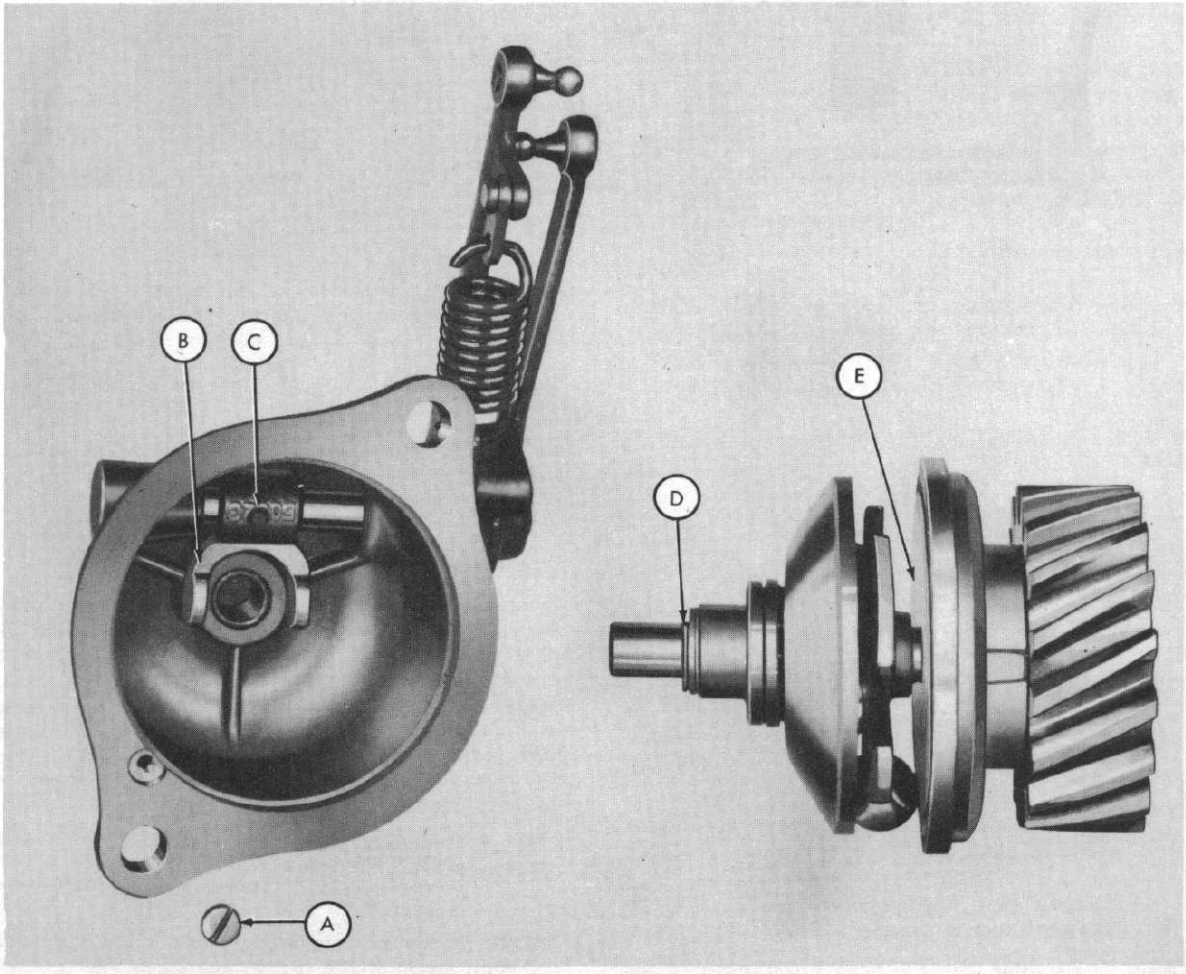

Fig. 1

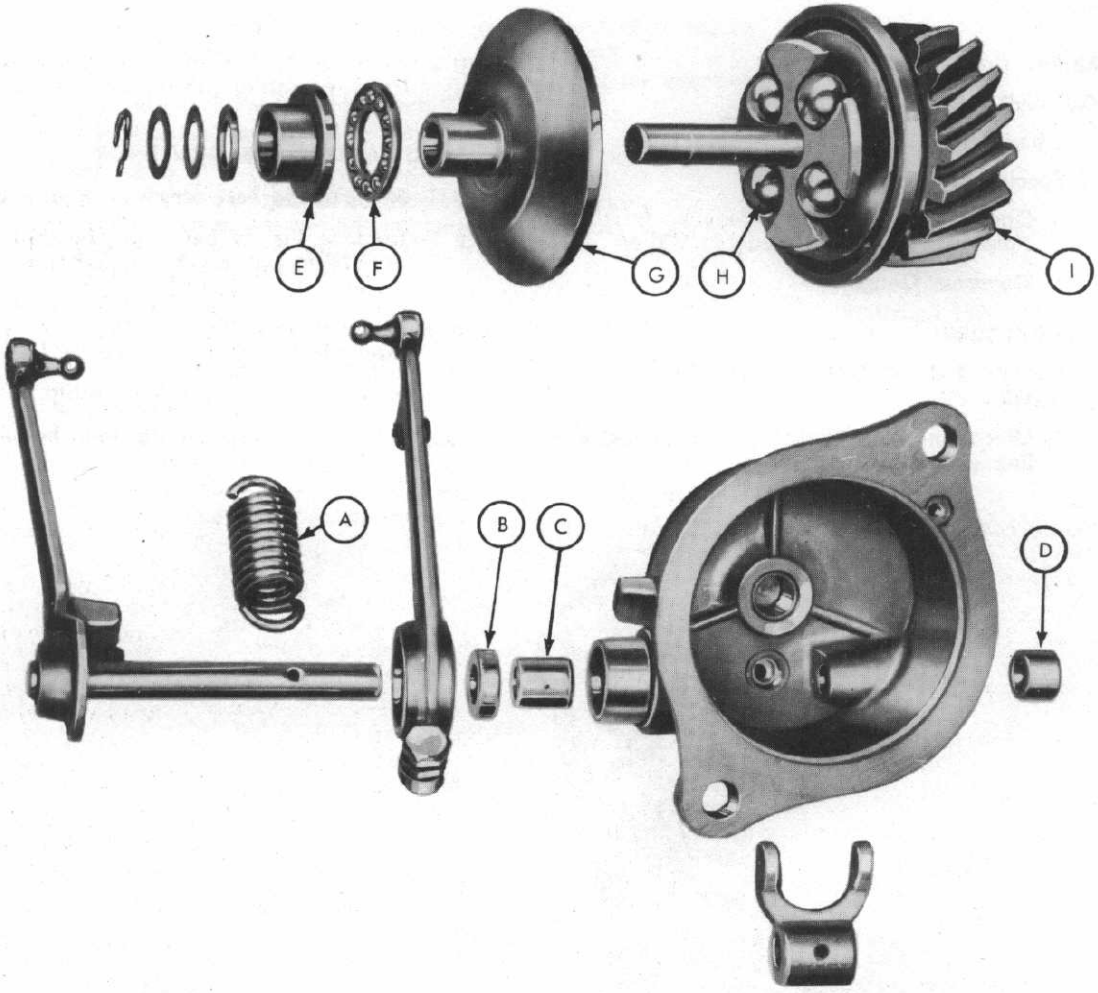

Fig. 2

b. Drive the pin (C-Figure 1) out of the lever shaft and fork.

c. Remove the shaft and lift out the fork (B-Figure 1).

d. Remove the lever spring (A-Figure 2).

e. Drive the lever shaft plug (D-Figure 2) from the governor body.

f. Remove the needle bearing (C-Figure 2), and the dust seal (B-Figure 2) from the governor body.

III. OVERHAULING THE GOVERNOR

Step 1—Examine the fly balls (H-Figure 2) for flat spots, pits or excessive wear.

Step 2—Examine the inner surface of the cone shaped upper bearing race (G-Figure 2). It should be smooth and even. If it is grooved or pitted, renew the cone.

Step 3—Check the condition of the fork base (E-Figure 2), the thrust bearing (F-Figure 2), the drive shaft bearing and the drive gear (I-Figure 2). Renew any worn or damaged parts.

Step 4—Check the governor lever shaft assembly and needle bearing for binding or excessive looseness and renew parts where required.

NOTE: If the inner lever assembly is loose, a piece of shim stock of the proper thickness, ½" x 2⅞" may be inserted.

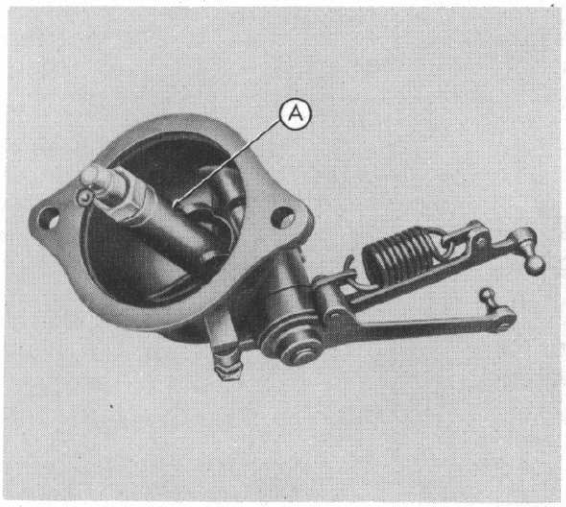

Fig. 3

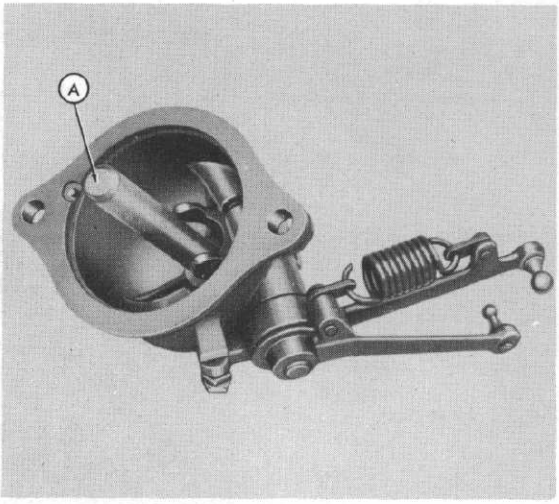

Fig. 4

Step 5—Examine the governor shaft bushing. If it is worn or damaged, remove as shown in A-Figure 3. (Do not loose thrust washer)

NOTE: When new tractors are used for training, do not remove the bushing.

IV. ASSEMBLING THE GOVERNOR

Step 1—Reassemble and install the lever shaft assembly in the governor.

Step 2—Reinstall the governor shaft bushing using a suitable reinstalling tool as shown in (A-Figure 4).

CAUTION: Make sure the thrust washer is in place before installing the bushing.

Step 3—Reassemble the governor fly ball unit and check the clearance between the washer and fork base, using a governor setting gauge as shown in Figure 5.

a. Clamp the shaft and driver assembly in the gauge as shown.

b. Insert the GO—NO GO gauge between the washer and fork base. If only the thin end of the gauge can be inserted, clearance is satisfactory. If the thick section of the gauge can be inserted, the clearance is excessive and thin shims should be added until the clearance is correct.

Step 4—Reinstall the fly ball unit and the shaft, and drive gear assembly in the governor housing.

Step 5—Check the governor lever adjustment.

a. Clamp the housing in the gauge as shown in Figure 6.

b. Hold the governor outer lever in wide open position.

c. Insert the GO—NO GO gauge as shown and if only the first step of the gauge can be inserted, clearance is satisfactory.

NOTE: If clearance is not correct, unclamp the housing and lay the governor arm across the flats on the fixture. Strike the governor arm lightly and recheck the clearance.

Step 6—Reassemble the governor to the timing gear housing on the tractor.

NOTE: Make sure the gasket between the governor housing and the timing gear housing is in place.

Step 7—Install the governor control rod.

Step 8—Install oil filter and oil lines.

Fig. 5

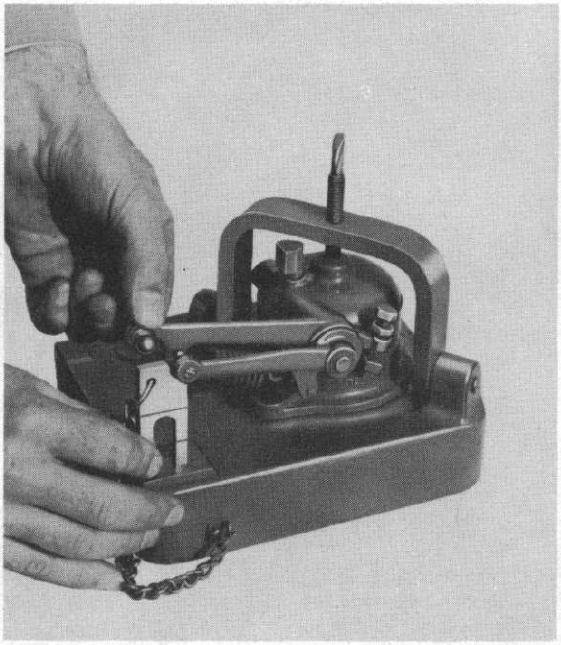

Fig. 6

NOTES

Prepared by the Service Department

DEARBORN MOTORS CORPORATION

DETROIT 3, MICHIGAN

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SERVICING THE CARBURETOR

TRAINING TIME: ½ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools
2. Float Position Gauge No. 9950-D

JOB PROCEDURE:

I. REMOVING THE CARBURETOR FROM THE TRACTOR

Step 1—Disconnect the choke (B-Figure 1).

Step 2—Disconnect the governor control rod (E-Figure 1).

Step 3—Disconnect the air cleaner pipe (A-Figure 1).

Step 4—Disconnect the fuel line at (D-Figure 1).

Step 5—Remove the two hex head nuts (C-Figure 1) and remove the carburetor from the manifold.

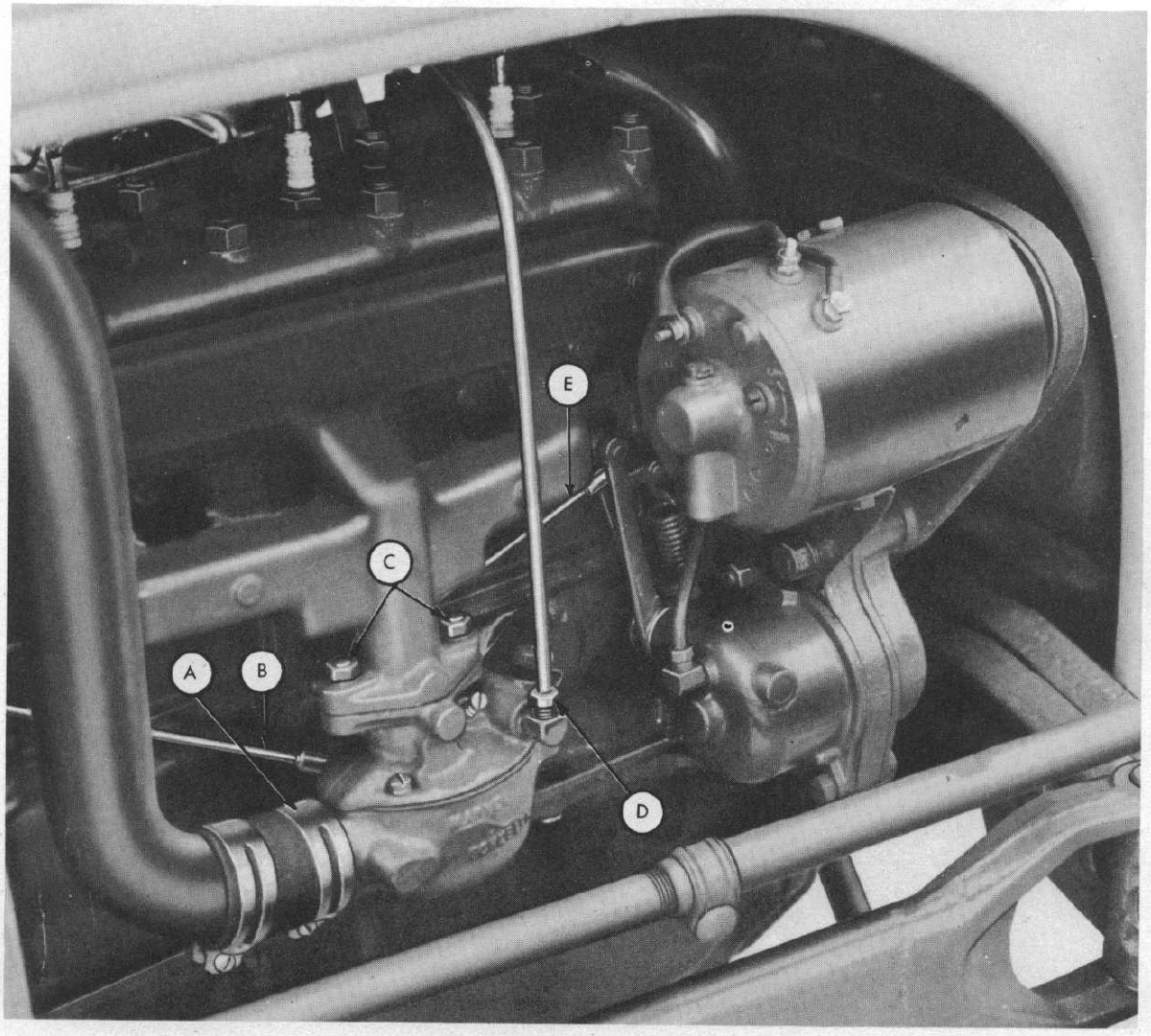

Fig. 1

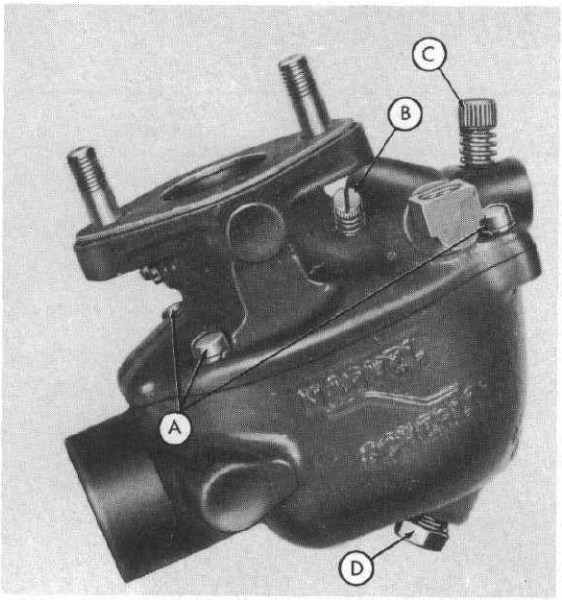

Fig. 2

II. DISASSEMBLING THE CARBURETOR

Step 1—Remove the main adjustment needle and spring (C-Figure 2).

Step 2—Remove the idle adjusting needle and spring (B-Figure 2).

Step 3—Remove the drain plug (D-Figure 2).

Step 4—Remove the four screws and lockwashers (A-Figure 2) that secure the carburetor body to the throttle body and separate the two.

Step 5—Pull the pin (A-Figure 3) and remove float (B-Figure 3).

Step 6—Remove the gasket and the venturi tube (D-Figure 3).

Step 7—Remove the needle valve, the seat, and the gasket (A-Figure 4).

Step 8—Remove the fuel line fitting and inlet strainer (A-Figure 5).

Step 9—Remove the main jet (C-Figure 3).

Step 10—Thoroughly clean all parts and passages in the throttle and carburetor body.

NOTE: Do not use a drill or wire to clean jets as the possible enlargement of calibrated holes will

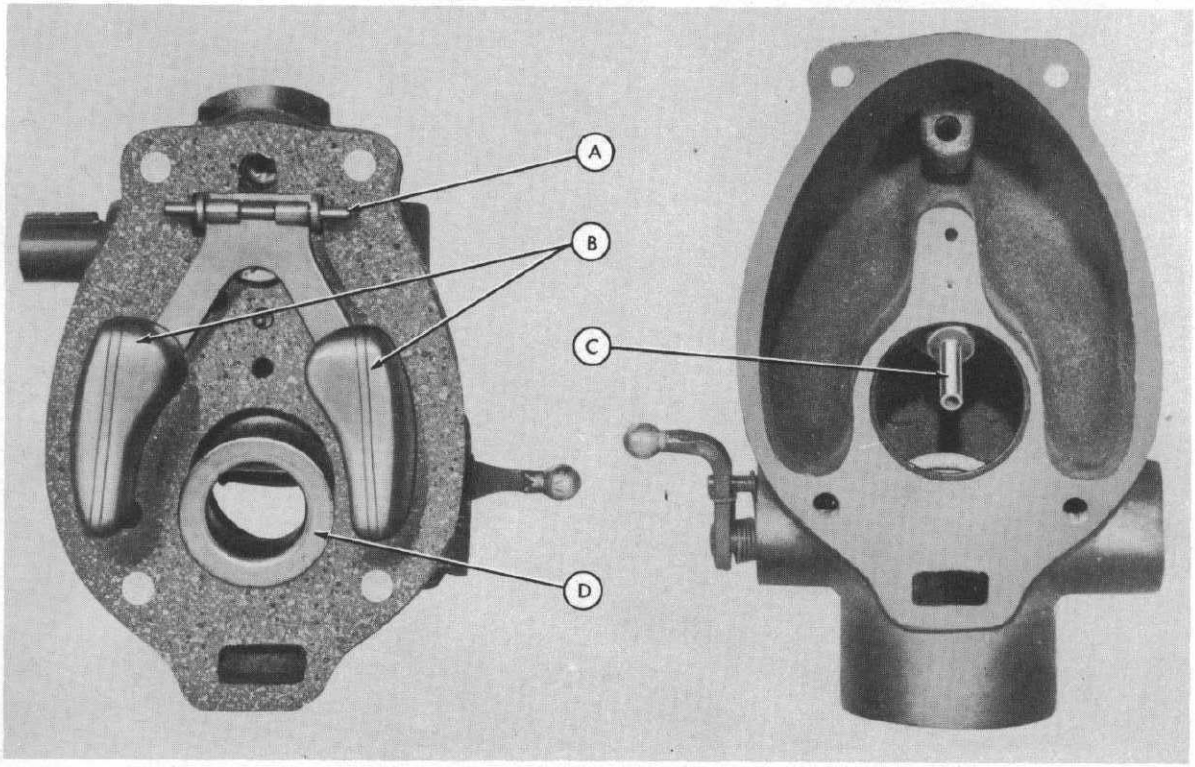

Fig. 3

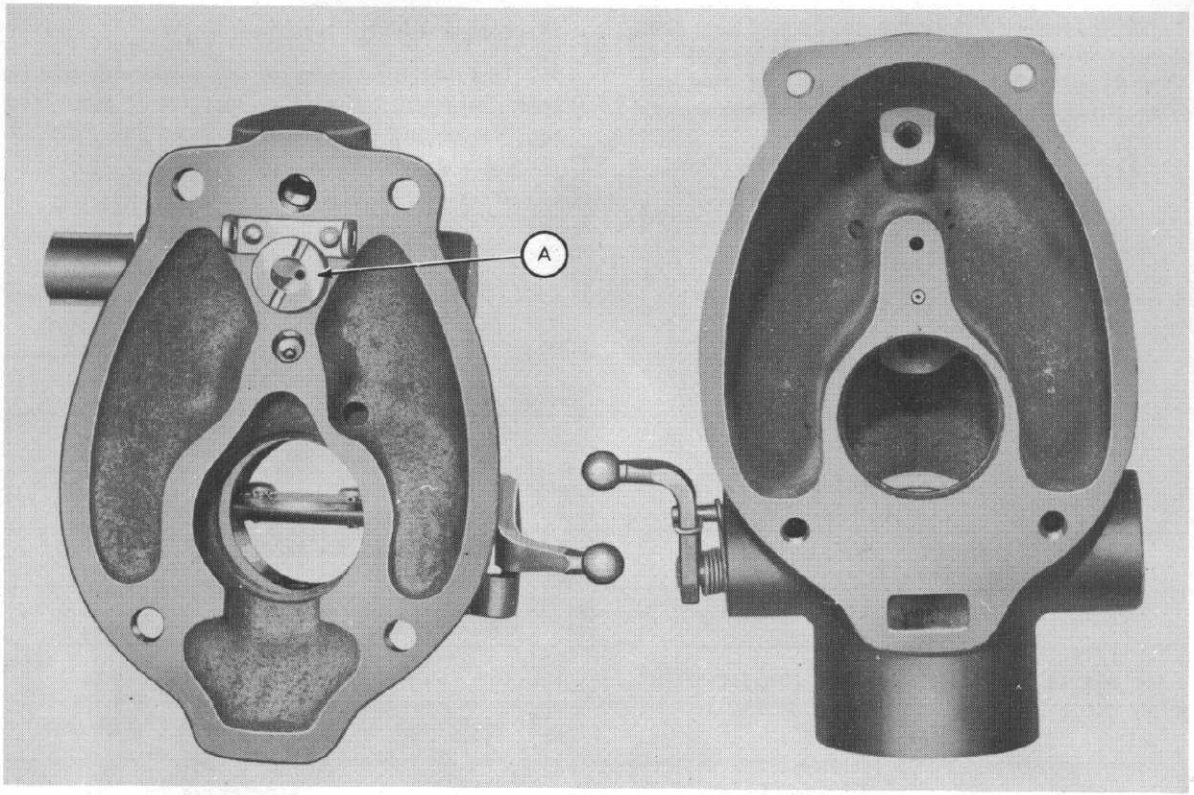

Fig. 4

disturb the operational balance of the carburetor. If necessary, soak the carburetor over night in cleaning solvent to dissolve excessive dirt and grease.

III. ASSEMBLING THE CARBURETOR

Step 1—Install the drain plug.

Step 2—Install the main jet.

Step 3—Install the fuel line fitting and inlet strainer.

Step 4—Install the idle air adjustment needle and spring.

NOTE: Completely close the idle adjustment and then open 1½ revolutions for approximate setting.

Step 5—Install the gasket, seat and needle valve.

Step 6—Install the gasket and the venturi tube.

Step 7—Install the float and check with a "GO—NO GO" float position gauge.

NOTE: If the float is not $^{9}/_{32}$" from the carburetor body, bend the float lever until it is parallel and measures $^{9}/_{32}$".

Step 8—Assemble the throttle body to the carburetor body using the four screws and lockwashers.

Step 9—Install the main adjustment needle.

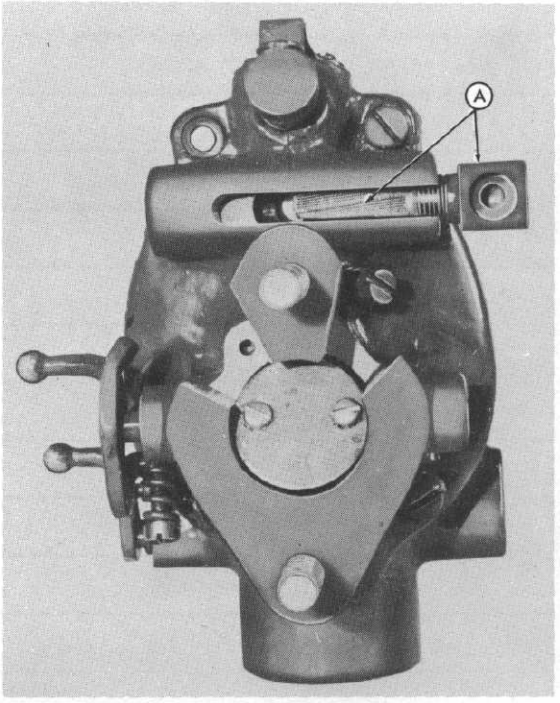

Fig. 5

NOTE: Completely close the needle and then open it approximately 1½ turns from the closed position.

Step 10—Install the carburetor on the manifold.

Step 11—Connect the choke and governor control rods.

IV. ADJUSTMENT

NOTE: Final adjustment of the carburetor will be made when the engine is completely assembled and the engine analysis is made in Job Plan 23.

NOTES

SERVICING THE WATER PUMP

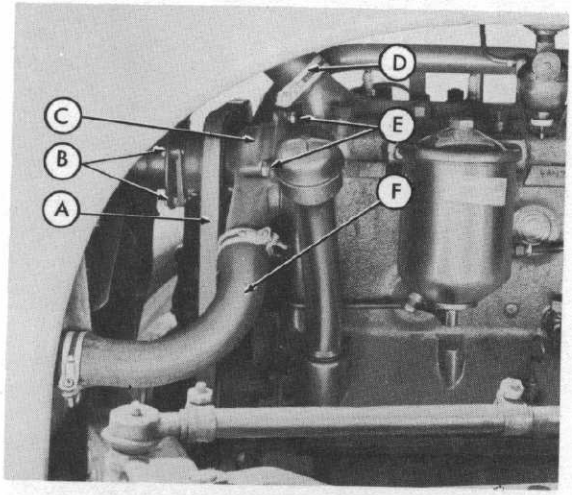

Fig. 1

TRAINING TIME: ½ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Serivce Tool Board No. FT 46
   b. Sleeve (replacing water seal)

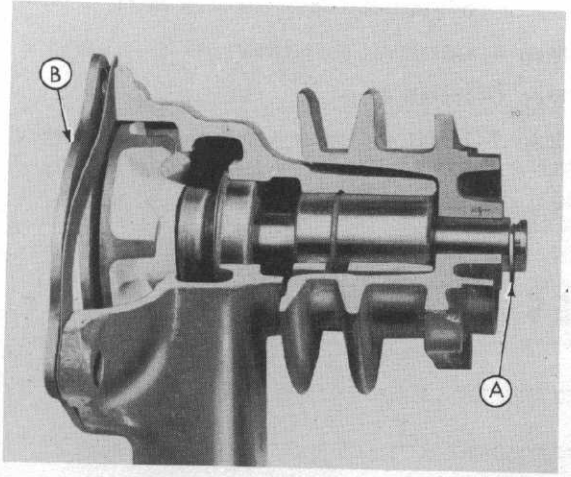

Fig. 2

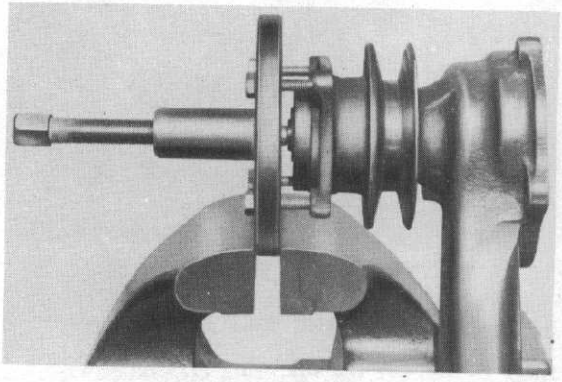

Fig. 3

JOB PROCEDURE:

I. REMOVING THE WATER PUMP FROM THE TRACTOR

Step 1—Disconnect the upper radiator hose (D-Figure 1).

Step 2—Remove the fan belt (A-Figure 1).

Step 3—Remove four cap screws (B-Figure 1) holding the fan and remove the fan assembly.

Step 4—Disconnect the lower radiator hose (F-Figure 1).

Step 5—Remove the cap screws and stud nuts (E-Figure 1) and remove the pump assembly (C-Figure 1) from the engine.

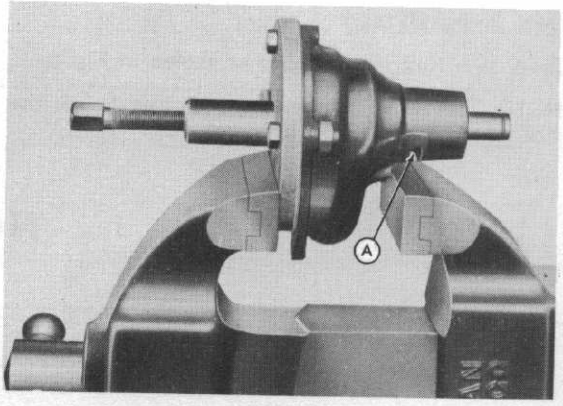

Fig. 4

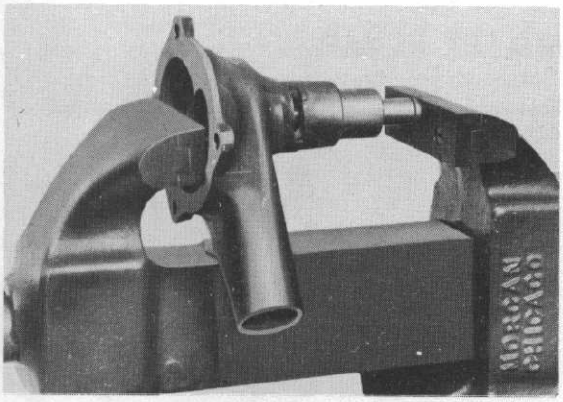

Fig. 5

II. DISASSEMBLING THE WATER PUMP

Step 1—Remove the snap ring (A-Figure 2).

Step 2—Remove the rear cover plate (B-Figure 2).

Step 3—Press the fan pulley off the shaft using a suitable puller as shown in Figure 3.

Step 4—Remove the lock ring (A-Figure 4) from the shaft at the front of the pump body. Press the shaft out of the pump body as shown in Figure 4 and remove the impeller.

III. REPLACING THE WATER SEAL ASSEMBLY

Step 1—Drive out the water seal assembly.

Step 2—Drive in a new water seal with a tool that applies equal pressure all around the edges of the seal.

IV. ASSEMBLING THE WATER PUMP

Step 1—Install the shaft as shown in Figure 5.

NOTE: a. The shaft and bearing is replaced as a unit.

Step 2—Install the lock ring.

Step 3—Install the impeller as shown in Figure 6.

NOTE: The impeller should be slightly below the surface of the housing (not more than $\frac{1}{32}$").

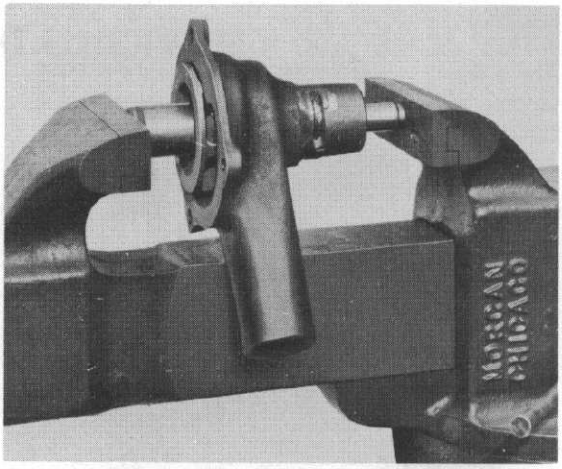

Fig. 6

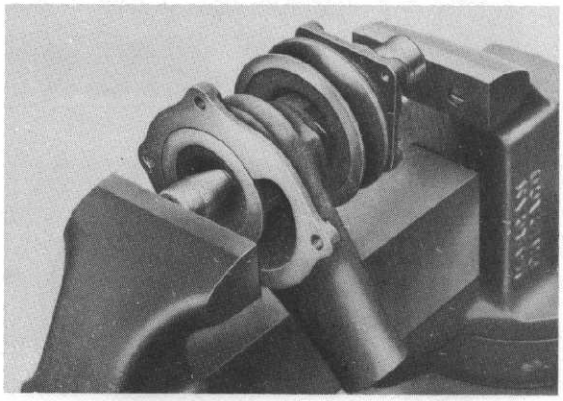

Fig. 7

Step 4—Install the pulley assembly as shown in Figure 7 (far enough on the shaft to permit installation of the snap ring).

Step 5—Install the snap ring.

Step 6—Install the plate.

Step 7—Install the water pump studs in the engine block.

Step 8—Install the water pump on the tractor.

NOTES

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NOTES

Prepared by the Service Department

DEARBORN MOTORS CORPORATION
DETROIT 3, MICHIGAN

PRINTED IN U.S.A.

THE ELECTRICAL SYSTEM

CONFERENCE OBJECTIVES:

1. To review the basic principles of the electrical system of an internal combustion engine.
2. To discuss the construction, operation and servicing of the 8N Ford Tractor electrical system.

CONFERENCE TIME: 1 Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 7-1—8N Ford Tractor Electrical System
   b. 7-2—Generator and Starter
   c. 7-3—The Voltage Regulator
   d. 7-4—The Battery
   e. 7-5—Distributor and Coil Assembly
4. Film 16mm. sound "Ignition"
5. Generator—2 Brush Type
6. Generator—3 Brush Type
7. Conference Guide No. 7 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conference

1. The basic mechanical parts of the tractor and its principles of operation and servicing have been covered in previous conferences. However, at this point the tractor still lacks the *SPARK* to operate

CHART 7-1
The Electrical System

2. The modern tractor which uses gasoline for fuel requires
   a. Electrical power to start the engine
   b. Electrical power to ignite the fuel mixture
   c. Electrical power to recharge the battery
   d. Electrical power for accessories
3. By adding the electrical system to the basic tractor we are able to provide the necessary "SPARK" to create power

B. Conference objectives

1. To discuss the construction, operation and servicing of the 8N Ford Tractor electrical system

II. Basic Principles of An Electrical System

A. Introduction

1. The electrical system may be divided into two parts

   a. The ignition system which consists of the storage battery, induction coil, breaker points and condenser, rotor and distributor cap, spark plugs and resistor

   b. The additions for starting and for recharging the storage battery

      (1) The starter

      (2) The generator

      (3) The regulator

B. "Ignition"—16mm sound film

"Ignition"— Part I 16mm Sound Film

(NOTE: Explain to the group that efficient servicing of the ignition system is dependent on the serviceman understanding its operation. Part I of this film shows how the ignition system operates)

1. Show the Part I of the film

2. Summarize the film in terms of the parts of the 8N Ford Tractor ignition system and their function

VISUAL CAST SLIDE 7-1

8N Ford Tractor Electrical System

   a. Battery

      (1) The storage place of electrical energy required for providing the necessary spark for operating the engine

   b. Induction coil

      (1) The voltage from the storage battery, alone, is insufficient to produce the spark required in the combustion chamber

      (2) To produce the high voltage required to jump the gap in the spark plugs, an induction coil, which is really a step up transformer, is used. By this means, the voltage of the battery is stepped up to produce desired results

   c. Breaker points and condenser

      (1) Breaker points are made of high conductance materials and perform the "make" and "break" operation in the primary circuit necessary to produce the induced voltage in the secondary circuit. The condenser works with the breaker points and stores electrical energy which greatly reduces arcing between the breaker points. The condenser thus serves to increase the life of the points by reducing pitting and burning.

   d. Distributor

      (1) The distributor provides the mechanical means for discharging the condensor to successfully energize each spark plug at the exact moment the spark is needed. This function is accomplished by a rotating switch which directs the secondary current to the desired spark plug so that they will fire in the proper order.

   e. Spark plugs

      (1) Spark plugs have a porcelain insulated electrode connected to the distributor and a second electrode grounded to the cylinder head. The condition of these

electrodes and the adjustment of the gap between them is an important factor in the efficient performance of the ignition job.

f. Resistor

(1) Protects the ignition system by metering the amount of current flowing from the battery.

C. The starter and generator

1. Introduction

a. As previously indicated, the electrical system of the modern tractor includes an electrical starter for starting the engine, a generator to recharge the storage battery and a two stage regulator to regulate the flow of current to the battery and also to prevent the flow of current from the battery when the charging rate is less than 6.2 volts.

b. Basically the starter and generator in the tractor are DC dynamos.

2. Construction

VISUAL CAST SLIDE 7-2

Generator and Starter

a. The starter and generator have the following parts

(1) Field frame or yoke; supports the field poles and end frames

(2) Field poles—soft iron cores supported by the field frame

(3) Field windings—electrical conductors wound on the field poles to form electro magnets

(4) Armature core—soft iron core which carries electrical windings and forms the rotating portion of the machine

(5) Armature windings—electrical conductors wound on the armature and connected to the commutator

(6) Commutator—forms electrical contact between the armature windings and the brushes

(7) Brushes and brush rigging—apparatus for making rubbing contact between the external circuit and the commutator

(8) End frames—end members of the machine which are attached to the frame and support the bearings and brush rigging

(9) Bearings—hold the armature in proper alignment with field poles and provide free running support for it

b. The starter relay is attached to the electrical circuit and is merely an electrical magnet that takes the place of the old mechanical method of making and breaking the starter connections

c. Servicing Starter and Generator

(NOTE: The procedure for servicing the generator and starter will be covered in the shop work that follows this conference.)

D. The regulator

VISUAL CAST SLIDE 7-3

The Voltage Regulator

1. The voltage regulator consists of three units, each performing a separate and distinct function

a. The cutout relay

(1) Opens and closes the circuit between the battery and generator

b. The voltage regulator unit
   (1) Holds the system voltage at a pre-determined value
c. The current limiting regulator
   (1) Controls the maximum ampere output of the generator

2. The regulator permits the generator to deliver current at full capacity to the battery, until the battery is fully charged. When the battery is fully charged, the output is reduced automatically to prevent overcharging.

3. Voltage Regulator Test

   a. The voltage regulator can be tested for accurate performance by use of the Owners Service Test Set. This procedure will be demonstrated later in the training program.

   b. A voltage regulator that does not meet test specifications should be removed and replaced with a new unit, for it will soon burn out the armature in the generator.

III. Servicing the 8N Ford Tractor Electrical System

A. The battery

VISUAL CAST SLIDE 7-4

The Battery

1. Specifications
   a. 6 Volt, 13 plate battery with a capacity of 80 ampere hours at 20 hour rate. It will maintain a slightly more than 4 ampere output rate for 20 hours.

2. Checking the battery
   a. Check it at least once a week with a hydrometer. Each cell should be tested and refilled with distilled water. Do not attempt to make a hydrometer test of a cell that has water added until the tractor has run for at least a half hour
   b. Hydrometer readings of 1.225 or less indicate that the battery is not sufficiently charged. Readings of 1.250 or above indicate full charge

3. General service hints
   a. Clean any corrosion from the battery by washing with baking soda and water. Rinse thoroughly
   b. Check vent openings in the battery caps, clean if necessary
   c. Battery cables and connections should be cleaned in a similar manner
   d. Connections to terminals should be tight
   e. Coat the terminals with vaseline or cup grease *after* the cables are installed to prevent corrosion
   f. Disconnect the ground strip first when removing the battery and connect last when installing the battery

B. The coil, breaker points, condenser and distributor cap

VISUAL CAST SLIDE 7-5

Distributor and Coil Assembly

(NOTE: The complete procedure for servicing the distributor and coil assembly is outlined in Service Training Job Plan No. 18. However, the following service points may be discussed at this time.)

1. The ignition coil can be weak or dead. A dead coil causes failure of the ignition system, while a weak coil limits top speed and causes hard starting.

   A coil that is suspected of being dead or weak should be given a capacity test. This test can be made by using the Owners Service Test Set or a coil tester

2. Breaker points must be clean, smooth, and have proper clearance or gap. Points which are badly pitted are a general cause of poor distributor operation. The principal causes of pitting are:
   a. Bad condenser
   b. Loose connections in the electrical circuit
   c. Point gap incorrect
   d. Points out of alignment
   e. Dirt between the points
   f. Battery overcharged
   g. Generator output too high

3. The distributor cap should be inspected for cracks and carbon streaks, also the rotor for corroded or dirty contact points

E. The spark plugs

1. Complete servicing of spark plugs is very important. It is a matter which should be stressed in training service personnel and owners. The complete story of servicing spark plugs is presented now in Part II of the 16mm sound film entitled "Ignition"

2. Show the film

3. Conclusion of the film
   a. Tell the group that following this conference, a demonstration will be conducted showing the spark plug servicing procedures.

16mm Sound Film "Ignition"— Part II

IV. Conference Conclusion

A. Summarize the main points of this conference and answer any questions the group may have regading the 8N Ford Tractor electrical system.

B. Distribute the Services Training Material
   a. Conference Guide No. 7, one for each trainee
   b. Tell the group that the next conference will deal with the hydraulic system and the time it is scheduled to begin.

NOTES

NOTES

SERVICING THE GENERATOR

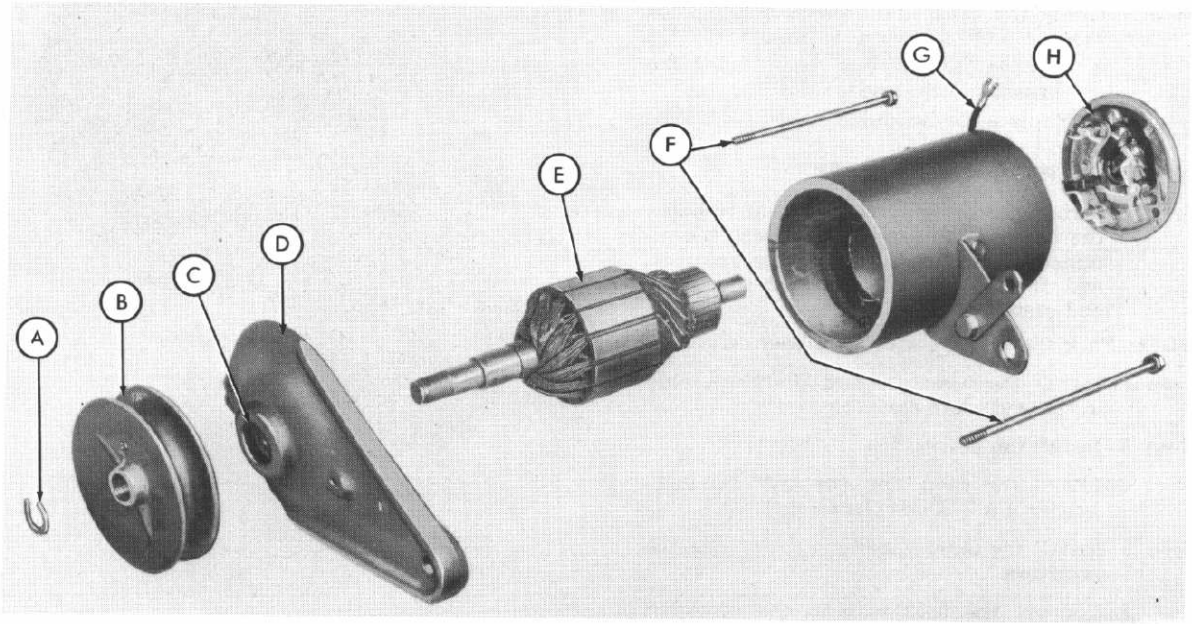

Fig. 1

TRAINING TIME: ½ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools

JOB PROCEDURE:

I. REMOVING THE GENERATOR FROM THE TRACTOR

Step 1—Remove the three electrical leads from the generator.

Step 2—Release the fan belt tension and remove the belt from the generator pulley.

Step 3—Back off on the bolt that holds the brace to the timing gear housing.

Step 4—Remove the long bolt that secures the generator to the engine assembly.

Step 5—Remove the generator.

II. DISASSEMBLING THE GENERATOR

Step 1—Remove the two long bolts (F-Figure 1) that secure the generator to the front end plate (D-Figure 1).

Step 2—Remove the armature front end plate and pulley assembly as a unit.

Step 3—Remove the brush end plate assembly (H-Figure 1).

a. Disconnect the field lead (G-Figure 1) from the brush.

Step 4—Remove the snap ring (A-Figure 1) from the pulley shaft.

Step 5—Unscrew the pulley (B-Figure 1) from the shaft and remove the armature and shaft (E-Figure 1) from the end plate (D-Figure 1).

NOTE: To remove the pulley from the armature shaft on the 2-Brush Generator (8N-10000-B):

a. Remove the nut (A-Figure 3).
b. Remove the lockwasher (B-Figure 3).
c. The pulley (C-Figure 3), which is locked to the armature shaft with a woodruff key (D-Figure 3) may now be pulled from the shaft.

Step 6—Remove the bearing stop ring, the concave retainer, the oil seal, the generator oil seal retainer, the bearing, oil seal retainer, and the oil seal from the generator front end plate (C-Figure 1).

III. CLEANING AND INSPECTING THE GENERATOR

Step 1—Thoroughly clean the armature and commutator with a cloth and mineral spirits.

NOTE: Avoid getting any mineral spirits on the armature windings.

Step 2—Check the armature windings for broken or damaged leads.

Step 3—Check the generator brushes and replace them if they are worn or broken.

a. Remove the screws that hold the brushes to the end plate.

b. Replace the brushes.

IV. ASSEMBLING THE GENERATOR

Step 1—Install the oil seal, the oil seal retainer, the bearing, the generator oil seal, the retainer, the oil seal, the grease retainer, and the bearing stop ring in the front end plate.

NOTE: Pack the bearing with light bearing grease.

Step 2—Install the armature and shaft assembly in the end plate assembly.

Step 3—Install the pulley.

Step 4—Install the snap ring (or nut and lockwasher if a 2-Brush Generator).

Step 5—Install the outer generator cover over the armature.

Step 6—Connect the field wire to the insulated brush in the generator end plate assembly.

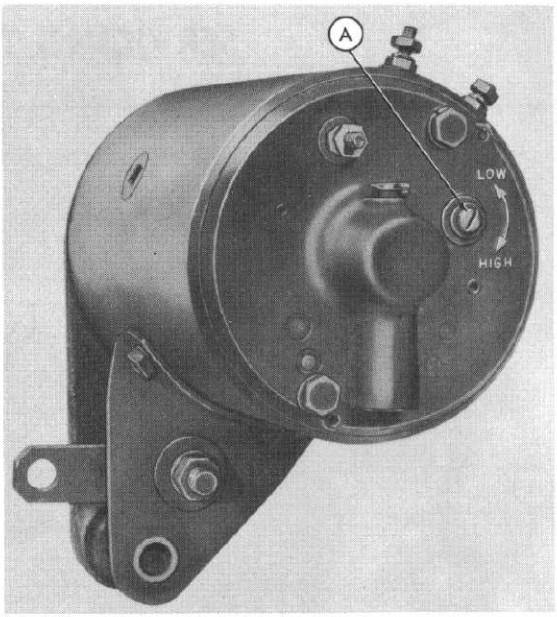

Fig. 2

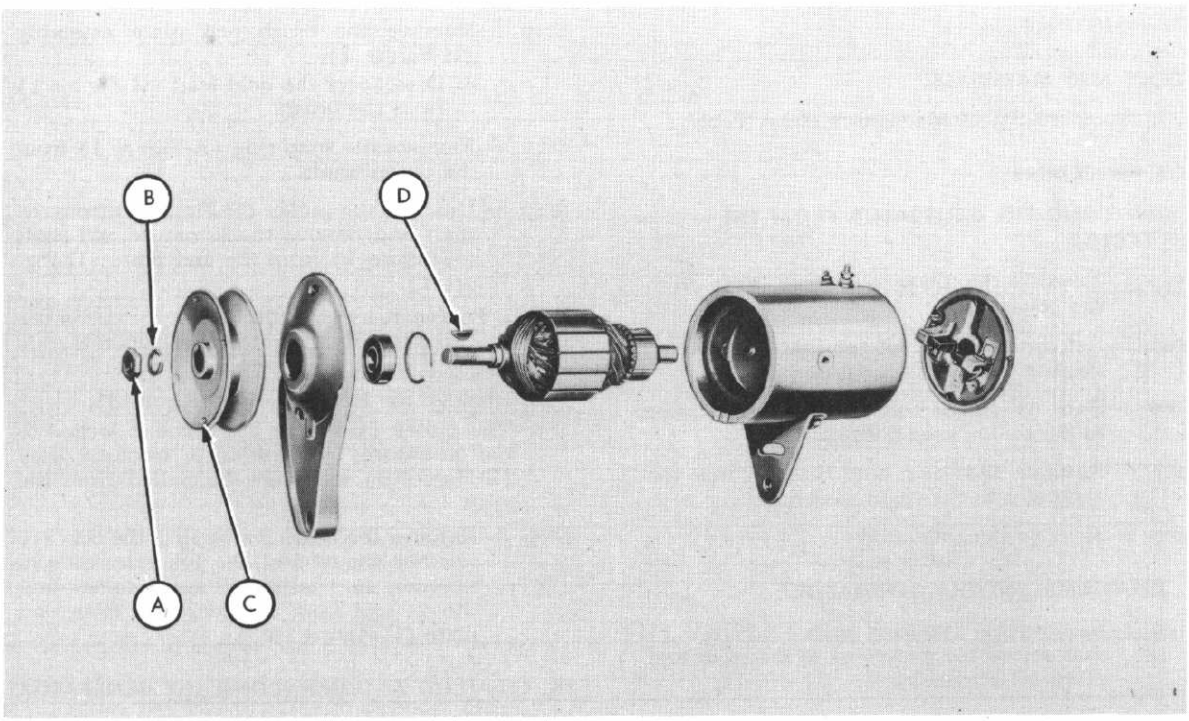

Fig. 3

Step 7—Install the brush end plate assembly.

NOTE: Use care to avoid damage to the brushes.

V. ADJUSTING THE GENERATOR

Step 1—Turn the generator by hand to see that it turns freely.

Step 2—On the 3-Brush Generator (8N-10,000 and 8N-10,000-A) adjust the third brush for maximum generator output by turning the adjustment screw (A-Figure 2) to the "high" position. on the brush end plate.

VI. INSTALLATION ON THE TRACTOR

Step 1—Bolt the generator on the engine.

Step 2—Place the fan belt on the generator pulley and install the bolt on the belt tension adjustment bracket.

Step 3—Adjust belt tension.

NOTES

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SERVICING THE DISTRIBUTOR

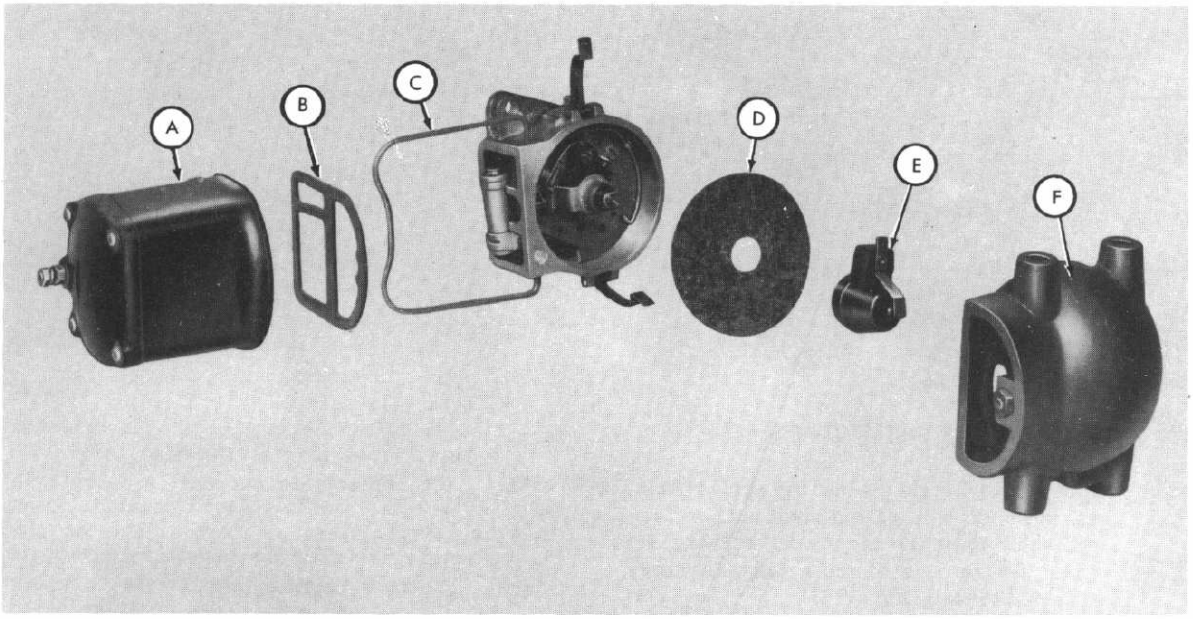

Fig. 1

TRAINING TIME: ½ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools

JOB PROCEDURE:

I. REMOVING THE DISTRIBUTOR FROM THE TRACTOR

Step 1—Disconnect the electrical lead from the coil.

Step 2—Remove the four leads to the distributor cap.

Step 3—Loosen the fan belt.

Step 4—Remove the two cap screws that support the distributor and remove the distributor and gasket from the tractor.

II. DISASSEMBLING THE DISTRIBUTOR

Step 1—Spring the coil clip (C-Figure 1) forward and lift off the coil (A-Figure 1) and gasket (B-Figure 1).

Step 2—Remove the distributor cap (F-Figure 1).

Step 3—Remove the rotor (E-Figure 1).

Step 4—Remove the gasket (D-Figure 1).

Step 5—Remove snap ring, plate and shaft assembly.

III. REPLACING AND ADJUSTING THE POINTS

Step 1—Remove the spring contact screw (B-Figure 2).

Step 2—Remove the cotter pin and washer (C-Figure 2) from the breaker arm post.

Step 3—Lift the breaker arm assembly off of the breaker arm post.

Step 4—Remove the two cap screws and lockwashers (A-Figure 2) that secure the stationary breaker contact to the plate assembly.

Step 5—Lift out the stationary breaker contact.

Step 6—Install new points by reversing the above procedure.

Step 7—Adjust the points.

a. Turn the rotor shaft until the breaker contact arm is in contact with the highest point on the cam. (Breaker contact points open.)

b. Adjust the stationary contact point to a gap of .014-.016.

NOTE: This adjustment is made by loosening the two cap screws (A-Figure 2) and turning the eccentric screw (D-Figure 2).

Step 8—Reassemble.

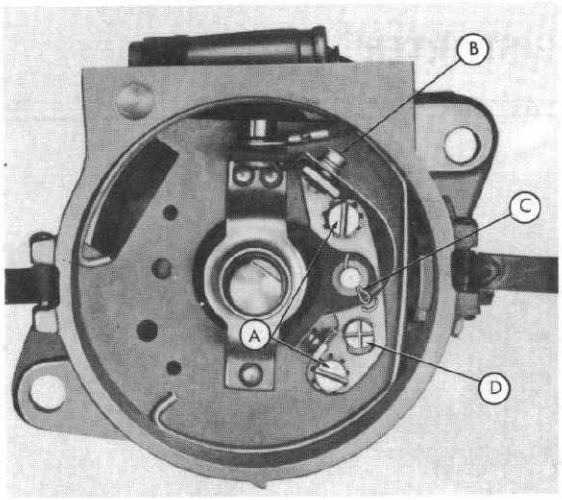

Fig. 2

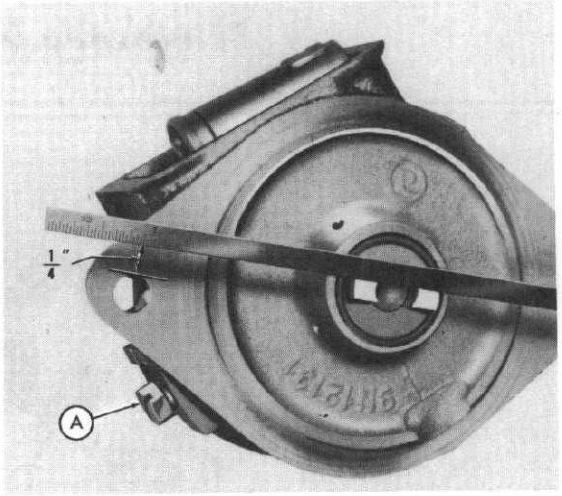

Fig. 3

IV. BASIC TIMING THE DISTRIBUTOR

Step 1—Place a steel scale against the shaft shank on the wide side of the shaft and rotate the shaft until the scale edge is ¼ inch from the top side of the small mounting hole as shown in Figure 3.

Step 2—Check the breaker contact (with the shaft in the position as explained above, they should just start to open).

NOTE: If the contacts do not start to open with the shaft in the above mentioned position, loosen the timing screw (**A**-Figure 3) and move the timing plate and screw until the contacts start to open.

Step 3—Tighten the timing plate screw (**A**-Figure 3). Reassemble the distributor and install it on the tractor.

NOTES

SERVICING THE STARTER

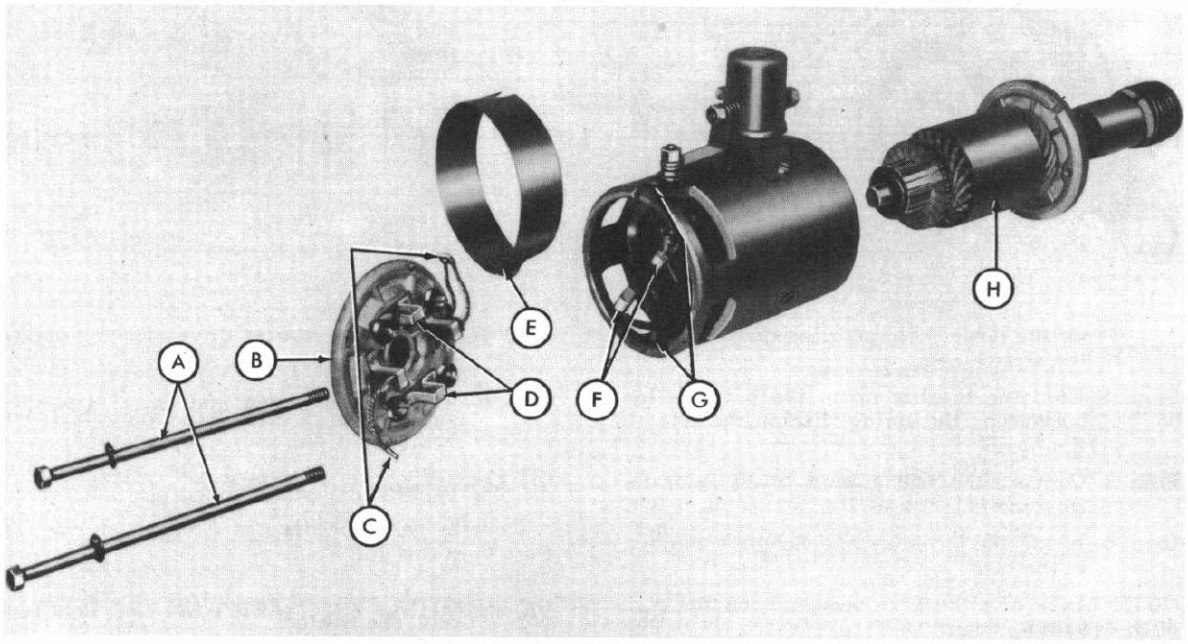

Fig. 1

TRAINING TIME: ½ Hr.

TOOLS AND MATERIALS:

1. Standard Set of Mechanics Hand Tools

JOB PROCEDURE:

I. REMOVING THE STARTER FROM THE TRACTOR

Step 1—Disconnect the electrical leads to the starter relay.

Step 2—Loosen the two long bolts until the starter assembly is free from the engine housing.

Step 3—Remove the starter assembly from the tractor.

II. DISASSEMBLING THE STARTER

Step 1—Remove the two long bolts (A-Figure 1).

Step 2—Remove the armature and the bendix assembly (H-Figure 1) as a unit.

Step 3—Remove the cover band (E-Figure 1) from the starter case.

Step 4—Remove the brush end plate assembly (B-Figure 1).

a. Remove the two insulated brushes (F-Figure 1) from the brackets (D-Figure 1) in the brush end plate.

b. Remove the two screws (G-Figure 1) that hold the ground brushes (C-Figure 1) to the starter housing.

III. CLEANING AND INSPECTING THE STARTER

Step 1—Thoroughly clean the armature and commutator with a cloth and mineral spirits.

NOTE: Avoid getting any mineral spirits on the armature windings.

Step 2—Check the armature windings for broken or damaged leads.

Step 3—Check the starter shaft bearings in the brush assembly and rear starter plate and replace if necessary.

Step 4—Check the brushes and replace them if they are broken or worn.

a. Remove the damaged brush from the leads.

b. Solder new brushes to the leads.

IV. ASSEMBLING THE STARTER

Step 1—Position the brush plate assembly to line

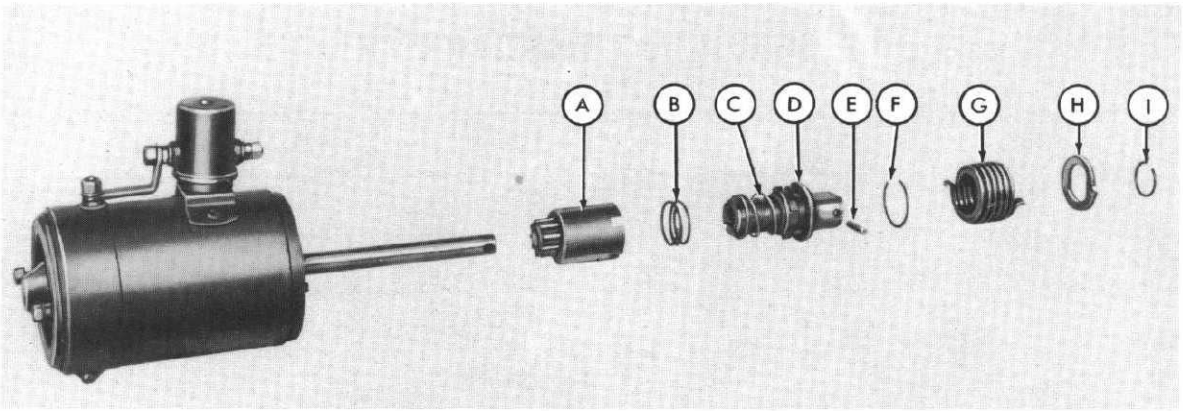

Fig. 2

up the dowel hole with the dowel hole in the starter case.

Step 2—Hold the brushes up in the brackets by positioning the spring clips on the side of the brush.

Step 3—Connect the two ground brush leads to the case.

Step 4—Install the armature and bendix assembly in the case.

NOTE: Make sure the fibre washer is on the end of the armature shaft.

Step 5—Install the two long bolts.

Step 6—Push the brushes down on the commutator with a small screwdriver through the starter case band opening.

Step 7—Install the starter case band.

V. DISASSEMBLING THE BENDIX

Step 1—Remove the lock spring (I-Figure 2).

Step 2—Remove the starter spring anchor plate (H-Figure 2).

Step 3—Remove the bendix spring (G-Figure 2).

Step 4—Remove the spring clip (F-Figure 2), and the starter spring anchor plate (D-Figure 2).

Step 5—Remove the pin (E-Figure 2) that secures the bendix assembly to the shaft.

Step 6—Remove the screw and shaft assembly (C-Figure 2).

Step 7—Remove the starter drive meshing spring (B-Figure 2).

Step 8—Remove the pinion and barrel assembly (A-Figure 2).

VI. ASSEMBLING THE BENDIX

Reverse the procedure in Steps 1 through 8, Part V, of this Job Plan.

VII. INSTALLING THE STARTER ON THE TRACTOR

Step 1—Position the starter assembly on the tractor engine.

Step 2—Tighten the two bolts that secure the starter to the engine.

Step 3—Connect the electrical leads.

NOTE: At conclusion of Job 19:

a. Remove the engine lift plate.

b. Check the spark plug gaps and install spark plugs.

c. Install the wiring harness.

d. Install the battery box and air cleaner.

e. Install the tool box.

f. Install the battery and battery box cover.

g. Install the fan.

h. Install the radiator.

i. Install the hood.

NOTES

NOTES

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DEARBORN MOTORS CORPORATION
DETROIT 3, MICHIGAN

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THE HYDRAULIC CONTROL

CONFERENCE OBJECTIVES:

1. To review the construction and operation of the 8N Ford Tractor Hydraulic Control
2. To discuss service problems related to the hydraulic control

CONFERENCE TIME: 1 Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Visual Cast Projector
3. Visual Cast Slides
   a. 8-1—Hydraulic Pump
   b. 8-2—Hydraulic Pump (Construction)
   c. 8-3—Hydraulic Control—Lift Cover
   d. 8-4—Lift Cover Assembly (Construction)
4. Demonstration Board—Hydraulic Control
5. Motor Driven Model—Hydraulic Control
6. Cutaway Pump
7. Inlet and Outlet Valve Seat Reamers
8. Hydraulic Pump (Disassembled)
9. Exhaust Valve (Spiral groove type)
10. Lift Cover Assembly
11. Conference Guide No. 8 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conferences

1. Up to this point in our training program we have *a tractor*. A tractor, that for all practical purposes could run and operate, performing the functions of any medium sized tractor

CHART 8-1
The Hydraulic Control

2. The manufacturers of the 8N Ford Tractor were not satisfied with just *a tractor*. Into this tractor was designed and installed a hydraulic unit to greatly increase its usefulness as an all-purpose farm and light industrial use tractor

B. It is our objective in this conference to:

1. Review the construction and operation of the hydraulic control
2. To discuss service problems related to this unit

II. Construction of the Ford Tractor Hydraulic Control

A. Introduction

1. In keeping with our first objective, we should like to briefly review the construction and operation of the Ford Tractor Hydraulic Control. This will provide a common background which will be helpful in connection with the discussion of adjustments, which comes later on

B. The hydraulic pump

VISUAL CAST SLIDE 8-1

Hydraulic Pump

1. The pump is a self-contained unit located in the center housing immediately back of the transmission. It is operated by the PTO shaft.

NOTE: The transmission housing, differential and center housing, all form one large continuous reservoir which is charged with 5 gallons of oil. This oil is used in operating the hydraulic control. The type of oil recommended is straight mineral oil S.A.E. 90, or heavy duty motor oil S.A.E. 50, for temperatures above 32°F; S.A.E. 80, or heavy duty motor oil S.A.E. 30, for temperatures below 32°F.

VISUAL CAST SLIDE 8-2

Hydraulic Pump (construction)

2. It consists of a cast housing containing an assembly of the following parts:
   a. Four cylinders and four pistons with one inlet and one outlet valve for each cylinder
   b. An exhaust control valve which governs the oil flow from the ram cylinder
   c. An intake control valve which governs the oil flow into the pump
   d. A control valve lever which
      (1) Actuates the control valves
      (2) Permits the intake and exhaust valves to be closed at the same time (neutral position).
      (3) Permits either valve to be open and the other closed (*never* both open at the same time).
   e. The safety valve
      (1) Located just above control valve rocker arm
      (2) Releases when the oil pressure exceeds the established safe working limit—pressures of 1400 to 1600 P.S.I.
   f. The check valve which relieves the back pressure on the outlet valves in the side plates (valve chamber)
   g. Valve chamber assembly which is the casting containing the valve chambers and cylinders. There are two of these, one for each side of the pump

Cutaway of Pump (Review the parts of the pump by identifying actual parts)

C. The hydraulic lift cover assembly

VISUAL CAST SLIDE 8-3

Hydraulic Control (lift cover assembly)

1. The lift cover assembly is attached to the pump by means of the control arm.

   This assembly contains the controlling mechanism of the hydraulic control.

2. It consists of the cover plate casting which supports or contains:
   a. The control spring and yoke
   b. The lift arms
   c. Quadrant and touch control lever
   d. Implement position control lever

VISUAL CAST SLIDE 8-4

Lift cover assembly (Construction)

e. Ram cylinder and piston (connected to the pump by an oil tube)

f. Control arm (which is actuated by the touch control lever and forms a linkage between the hydraulic lift cover assembly and the intake and exhaust control valves in the pump)

g. Constant draft control spring

h. Implement position control spring

i. Cam on lifting arm shaft

j. Connecting linkage

Lift Cover Assembly (Review the parts of the lift cover by identifying actual parts)

III. Operation

A. Introduction

1. As previously indicated, the Ford Tractor Hydraulic Control consists essentially of two separate units; the pump and the lift cover assembly
2. The combined action of these two units, working through the tractor links, provides the means for raising and lowering the attached implements
3. Let us consider what takes place in the operation of these two units

B. The hydraulic pump

1. The pump is driven directly from the tractor P.T.O. shaft (which is made operative by engaging the P.T.O. lever). The eccentric pump cam is splined to the P.T.O. shaft. This pump cam rotates inside two scotch yokes, which have a piston on each end. This arrangement transfers the rotary motion of the P.T.O. shaft into the horizontal motion required to move the pump pistons.
2. The pump circulates oil as long as the P.T.O. shaft turns and the intake control valve is open.
   a. When the exhaust control valve is closed and the intake control valve is open, the oil is forced up through the tube to the ram cylinder.
   b. When the intake control valve is closed and the exhaust control valve is open, the oil in the ram cylinder drains down the oil tube into the pump, out through the exhaust valve into the reservoir

Demonstration Board (explain the operation of the hydraulic system)

C. The hydraulic lift cover assembly

1. Action in raising and lowering implements
   a. With the tractor engine running and the P.T.O. lever engaged, the implement may be raised or lowered by moving the touch control lever on the quadrant
   b. When the touch control lever is moved, the hydraulic mechanism produces a corresponding movement in the implement lift arms
      (1) To raise implements
         (a) As the touch control lever is moved upward on the quadrant, the control arm, which connects the lift cover to the intake and exhaust valve rocker on the pump, moves forward toward the pump housing. This motion opens the intake control valve by pushing it inward, permitting the oil to flow

through the pump inlet valve into the pistons, and through the outlet valves to the ram cylinder

(b) As oil is pumped into the ram cylinder, the piston is forced rearward, thus raising the lift arms until the skirt of the piston contacts the control arm and moves the control arm sufficiently to place the valves in neutral

(2) To lower implements

(a) As the touch control lever is moved downward on the quadrant, the control arm, which connects the lift cover to the intake and exhaust valve rocker on the pump, moves rearward or away from the pump housing. This action, assisted by the spring behind the intake valve, closes the intake control valve and shuts off the supply of oil to the pump.

(b) At the same time the exhaust control valve is pushed forward, opening the exhaust port. This permits the oil to drain from the ram cylinder, down the oil tube, through the pump housing and out into the oil reservoir

(c) As oil is drained from the ram cylinder, hydraulic pressure on the piston is relieved and it is pushed forward by the weight of the implement and links on the lift arms, thereby lowering the tractor lift arms

2. Action in automatically maintaining constant draft

a. Constant draft means maintaining a constant pull at all times on the tractor by the implement

b. In discussing the action that takes place in automatically maintaining constant draft, we will assume that the implement position control lever is disengaged and that the implement has been lowered and is working at the desired depth. With the implement engaged in the ground we know a certain pull or draft upon the implement is necessary to start and maintain forward motion. We also know that when the implement has reached the desired working draft as set by the touch control lever, the intake and exhaust valves have been moved into neutral

c. From here on, this is what happens

(1) Let us further assume that the implement is moving along in the ground under constant draft with the main control spring partially compressed and suddenly the draft on the implement is increased

(2) When this occurs part of the force resulting from the increased draft is transmitted through the top link to further compress the main control spring (due to rotation of the implement about the drawbar or the implement link pins). This further compression of the main control spring swings the control arm forward

(3) This forward motion of the control arm opens the intake control valve, and permits oil to be pumped to the ram cylinder, causing the lift arms to rise. As the implement rises, the draft decreases to its original amount and the main control spring expands to its partially compressed position, allowing both the pump intake and exhaust valves to be moved into neutral

(4) The hydraulic mechanism has in this manner automatically adjusted itself to maintain a constant draft

(5) Now for the sake of illustrating the reverse action, let us assume that draft on the implement is decreased. This will allow the main control spring to expand from its partially compressed position and move the control arm rearward. This action opens the exhaust valve permitting oil to flow out of the ram cylinder. The lift arms are lowered by the weight and suck of the implement, the working depth of the implement is increased, and consequently the draft increases

(6) As the draft increases, the main control spring is compressed to its partially compressed position, the control arm moves forward and positions the control valves in neutral. Once again the mechanism has automatically adusted itself to maintain the draft as originally set by the touch control lever

NOTE: When operating in constant draft in a field where soil conditions and texture vary, manual operation of the touch control lever is necessary to maintain reasonably uniform implement working depths

3. Action in implement position control

a. Control of the downward position or specific working depth of an implement is an important factor in numerous agricultural operations. When working in fields which have a reasonably smooth surface, such control is made possible and for all practical purposes is automatically maintained by using implement position control. Obstructions in the field such as rocks and heavy roots can force the implement upward, but the weight and suck of the implement will immediately return it to its selected position, automatically. However, an increase in draft due to heavier soil will not raise the implement so that the working depth remains constant

b. We know that the raising and lowering of implements is accomplished by moving the touch control lever up or down on the quadrant. When using implement position control we do two things

(1) First, we engage the implement position control lever (up position)

(2) Second, we move the touch control lever to raise or lower the implement to the depth at which we want it to work

c. When the implement position control lever is engaged, a special linkage is placed in position between a cam on the lift arm shaft and the control arm. In effect, this linkage makes the constant draft linkage non-operative. The movement of the cam against the end of the linkage actuates the control arm which, in turn, moves the intake and exhaust valves in the pump into neutral. This establishes the position at which the implement will be carried. The position of the implement will, as indicated above, be determined by the position of the touch control lever on the quadrant

d. The following action occurs in the hydraulic mechanism when using implement position control. Let us assume that the implement is in transport position and that we are going to lower it to work at some pre-determined depth below the surface of the ground

(1) We move the touch control lever downward on the quadrant until the implement is positioned where we want it

(2) As the lift arms move downward, the cam on the lift arm shaft moves the implement control linkage forward sufficiently to overcome the distance the control arm was moved by the touch control lever and further, to move the control arm sufficiently to place the intake and exhaust valves in neutral

(3) When the valves are thus placed in neutral, the position of the implement is established. The hydraulic control will then prevent any further lowering of the implement

Motor Driven Model

At the close of the explanation of operation, demonstrate (1) raising and lowering, (2) constant draft and (3) implement position control.

IV. Servicing The Hydraulic Control

A. The pump

NOTE: The complete procedure for servicing the pump is outlined in Service Training Job Plan No. 20. However, the following points should be discussed regarding pump servicing)

Disassembled Hydraulic Pump

(Discuss pump servicing using an actual pump to emphasize points)

1. Cleanliness in the system
   a. Most hydraulic pump troubles can be traced to dirt in the system
   b. Dirt, metal filings etc., which may accumulate in the oil reservoir are eventually circulated through the pump, causing scoring of the control valves and bushings, lodging on inlet and outlet valve seats all of which creates problems such as low pressure, sticky valves, and worn parts
   c. A complete cleaning job requires that the pump be completely disassembled, washed and air dried; the lift cover be thoroughly washed, including the ram cylinder and piston; the entire center housing (oil reservoir)
2. Proper seating of the inlet and outlet valves, and the relief valve
   a. Any of the above valves that do not seat properly result in loss of oil pressure, and a resultant sluggish system
   b. In a complete overhaul of the pump these valves should be checked to assure that they are seating perfectly
   c. Seats that have become worn or pitted may be reseated by using specially designed reamers.

Cutaway Pump

(Demonstrate reseating procedure)

3. Correct installation of control valve bushings
   a. The control valve bushings are replaceable, and are designed to give the proper valve overlap when installed flush with the face of the pump housing
   b. The intake control valve bushing is chamfered on the internal diameter to permit a full flow of oil into the bushing when the control valve lever is in the full open position
4. Sticky exhaust valve
   a. The accumulation of dirt in the system, together with the pressure of heavy loads will cause the exhaust valve to "freeze" in the bushing
   b. Experimental tests that have been in progress for some time find that this problem can be corrected by the use of an exhaust valve designed with spiral grooves

Exhaust Valve with Spiral Grooves

c. Relieving the pressure on the system will in most cases release the valve. The system should be thoroughly cleaned to aid in preventing the valve from sticking

5. No leaks in the system

a. Leaks in the pump or pressure line to the ram cylinder result in a slow to non-operating system

b. All gaskets should be re-newed if the pump has been removed and disassembled

Lift Cover Assembly

B. The lift cover assembly

1. Introduction

a. Thus far our discussion has dealt with how the hydraulic control operates as a unit, and the servicing of the pump. In order for the hydraulic control to function properly, the entire mechanism must be in proper adjustment. Reports indicate that a majority of hydraulic difficulties can be traced to improper adjustment

b. The pump requires little or no adjustment. The lift cover is the unit that controls the efficient operation of the implement attached to the tractor. So the importance of its servicing cannot be over emphasized

2. Overhaul of the lift cover

(NOTE: The complete procedure for disassembly, inspection, and assembly of the lift cover is outlined in Service Training Job Plan No. 21.)

a. Answer any questions the group may have regarding the overhaul of the lift cover

3. Lift cover adjustments

Lift Cover

(Point out and explain the lift cover adjustments)

a. Main control spring

(1) Function

(a) To transmit the forward force of the top link through the horizontal portion of the rocker, through the rocker to the yoke pin, through the adjusting yoke, through the control spring and to the hydraulic pump control arm. This is the forward force which holds the front end of the tractor down

(b) To measure the force of the top link. The greater the draft of the implement, the greater the force which is transmitted to the control spring. As the force increases, the spring compresses in direct proportion. As the spring compresses, the plunger is moved forward thereby moving the control arm

(c) To cushion the initial instantaneous shock on the tractor and implement when an obstruction is hit. This is a very important function

(d) To compress under the impact force created when hitting an obstruction. The amount of this compression is greater than the compression of the spring under normal operating conditions. This quickly actuates the control arm and raises the implement

(2) Adjustment

(a) The main spring should be adjusted so that it is

possible to turn the control spring by exerting pressure with thumb and forefinger. There should be no end play between the spring and its seat and adjusting yoke. If there is end play, remove the pin connecting the rocker to the adjusting yoke. Turn the yoke until there is no end play. If the yoke does not line up properly to insert the pin, back the yoke off until it does line up.

(b) Every six months, remove the adjusting yoke and grease the threaded portion of the plunger so that these two parts will not "freeze" due to rust. When these two parts "freeze" so that great force is needed to turn the yoke, the plunger may be damaged

(c) Adjust by disconnecting the main control spring yoke from the rocker, and then turning the yoke until proper tension is obtained

b. Touch control lever (friction)

(1) Function

(a) The touch control friction adjustment should be such that the control lever will stay in a set position and that it also will be easy for the operator to move the lever

(2) Adjustment

(a) Tighten or loosen the nut on the end of the hydraulic lift control lever shaft. This nut should be adjusted so that a pull of four to five pounds is required to move the lever

c. Quadrant adjustment

(1) Function

(a) The quadrant assembly is made adjustable so that complete operating range of the touch control lever is obtained. This complete operating range is obtained when the touch control lever moved to the maximum up position, completely opens the intake control valve without compressing the constant draft spring

(2) Adjustment

(a) Remove the inspection plate from the side of the center housing. With the implement position control lever disengaged, take hold of the control arm by inserting the left hand through the inspection plate opening, and with the right hand slowly raise the touch control lever toward the top of the quadrant

(b) Determine by feeling when the intake valve end of the control lever just contacts the pump housing. If the quadrant adjustment is correct, the control valve lever will just touch the pump housing when the touch control lever is at the top of the quadrant

(c) If the control valve lever does not contact the pump housing, the quadrant assembly should be moved back until it does

(d) If the control valve lever contacts the pump housing, before the touch control lever is at the top of the quadrant, the quadrant assembly should be moved forward

d. Constant draft spring adjustment

(1) Function

(a) The constant draft spring assembly provides the pivot from which the control arm actuates the control valve lever

(2) Adjustment

(a) Remove the lift cover from the tractor and position in a vise with the main control spring up. With the implement position control lever disengaged, check the length of the constant draft spring. It should measure approximately $3\frac{9}{16}$" in length. If the spring is too long or too short adjust the nut on the spring assembly until the correct length is obtained. If the adjusting nut is a lock nut, tighten up until the washer bears against the shoulder

e. Implement position control spring adjustment

(1) Function

(a) Under certain field conditions it is desirable to set the working depth of implements at a fixed position regardless of draft. The implement position control spring assembly does this. Engagement of the implement position control spring assembly changes the control arm pivot point from the constant draft spring to the implement position control spring, thereby, eliminating (except under shock load) the action of the control arm due to increased or decreased draft on the implement

(3) Adjustment

(a) Engage the implement position control lever. Position the touch control lever on the quadrant so that there is a ¾" opening between the top edge of the lever and the top end of the slot in the quadrant. Raise the lift arms to their top operating position as indicated by marks on the lift arm and housing

(b) Raise the implement position control spring linkage until the pin contacts the cam on the lift ram arm. Raise the control arm until the swivel comes in contact with the collar on the constant draft spring.

(NOTE: Be sure the swivel is in contact with the control arm.)

(c) The implement position control spring is the correct length if the following points of contact are made:
—Pin is touching the cam on the lift ram arm.
—Swivel is in contact with the collar on the constant draft spring
—Implement position control spring adjusting bolt is touching the control arm

(d) If adjustment is necessary loosen the lock nut and turn the adjusting bolt until the proper length is obtained

V. Conference Conclusion

A. Review the operation of the hydraulic control by going through the complete cycle using the demonstration board — **Demonstration Board**

1. Point out the principal parts of the hydraulic control
2. Show the action of these parts in relation to each other in:
   (a) Raising an implement
   (b) Lowering an implement
   (c) Obtaining constant draft
   (d) Obtaining implement position control

B. Discuss any questions the group may ask regarding the hydraulic control.

C. Distribute Service Training Material

1. Conference Guide No. 8, one for each trainee
2. Tell the group that the next conference will deal with the pre-delivery check and the use of the Owners Service Test Set in engine analyzing, and the time it is scheduled to begin

NOTES

SERVICING THE HYDRAULIC PUMP

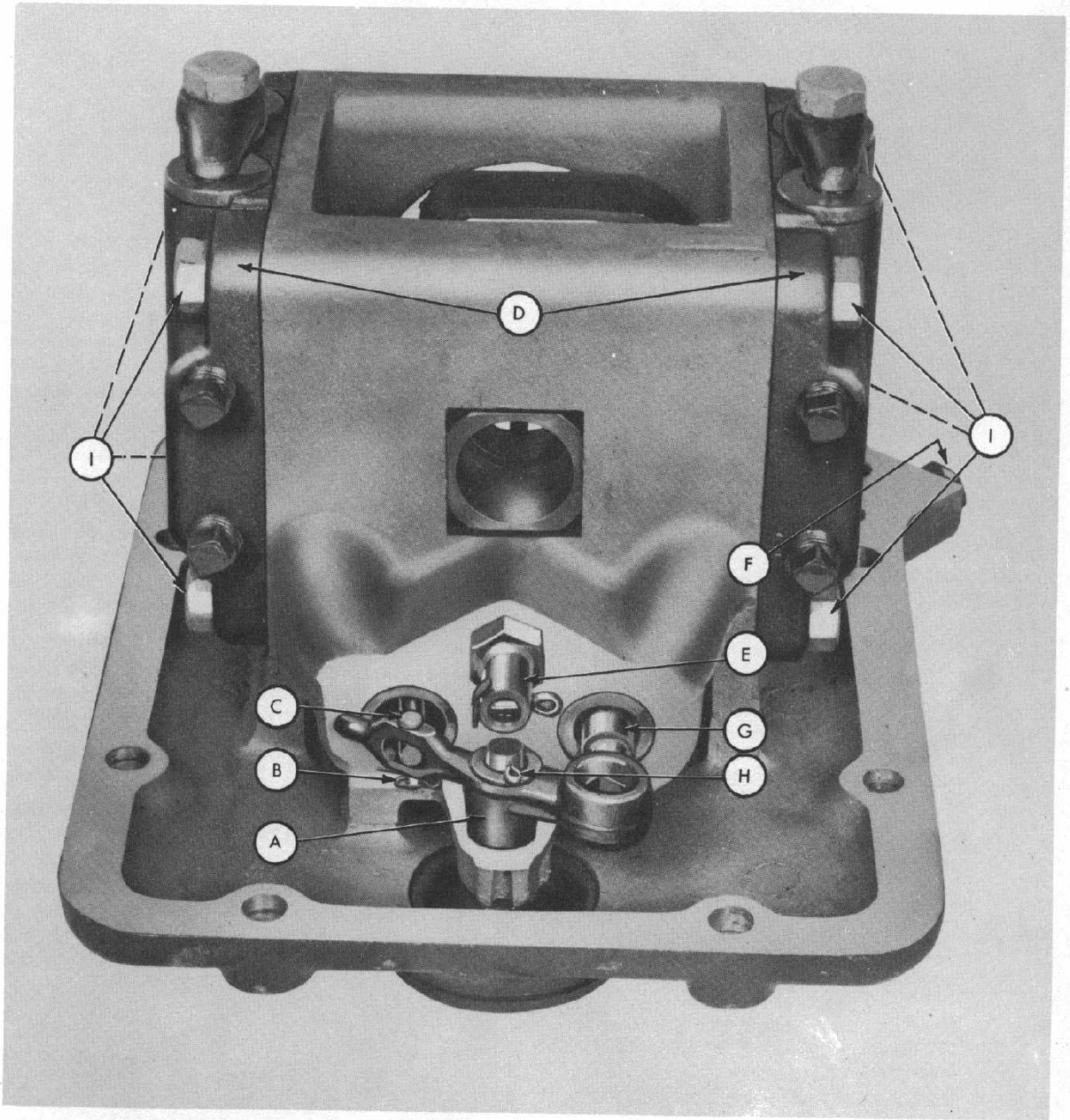


Fig. 1

TRAINING TIME: 1½ hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools
2. Special Tools and Equipment
   a. One set of special tools available for the Ford Tractor Service Tool Board No. FT 46
   b. Relief valve seat refacing tool
   c. Inlet and outlet valve seat refacing tool

SERVICING THE HYDRAULIC PUMP

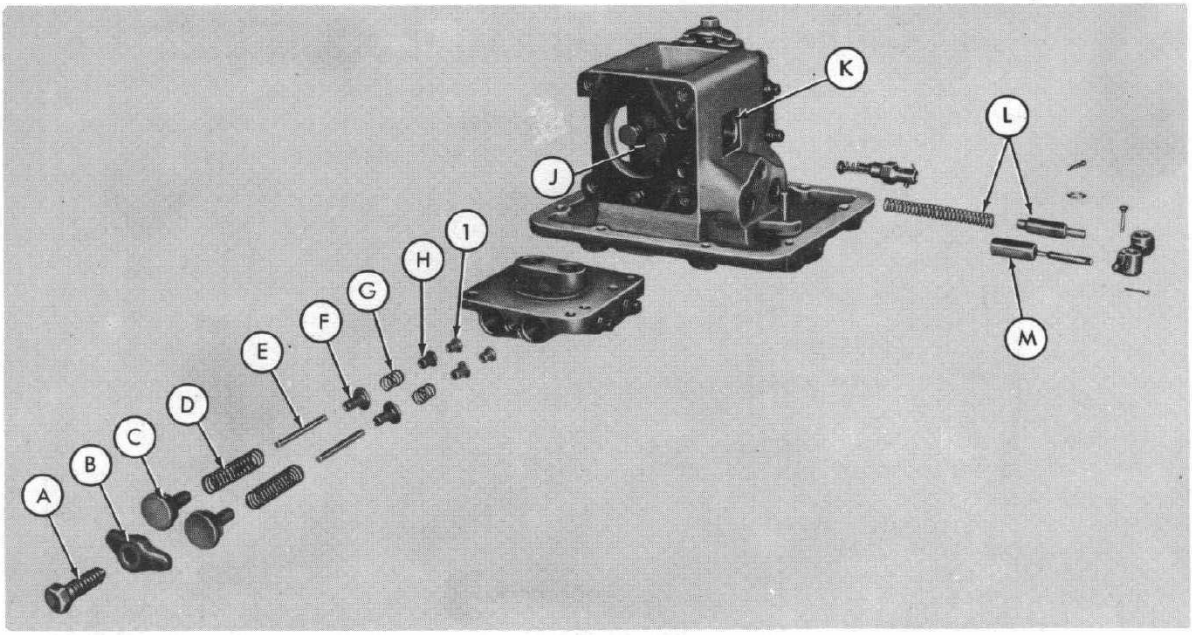


Fig. 2

JOB PROCEDURE:

I. REMOVING THE HYDRAULIC PUMP FROM THE TRACTOR

Step 1—Drain the oil from the center housing. (Plug in base of pump and plug in the center housing.)

Step 2—Remove the P.T.O. shaft from the tractor.

Step 3—Remove the nine cap screws and flat washers that secure the pump base in the center housing and lower the pump out of the center housing.

II. DISASSEMBLING THE HYDRAULIC PUMP

Step 1—Remove the safety valve and check valve (E-Figure 1).

Step 2—Remove the cotter pin (B-Figure 1) and clevis pin (C-Figure 1) which secures the exhaust valve to the control valve lever.

Step 3—Remove the cotter pin and washer (H-Figure 1) from the control valve lever post.

Step 4—Remove the control valve lever (A-Figure 1).

CAUTION: Hold the spring loaded intake control valve (G-Figure 1) in the pump base with one hand while removing the control valve lever to prevent it from being forced out by the spring.

Step 5—Remove the intake control valve and spring (L-Figure 2) from the pump housing.

Step 6—Remove the exhaust control valve (M-Figure 2) from the pump housing.

Step 7—Remove the four cap screws (I-Figure 1) which secure each valve chamber to the pump base.

Step 8—Remove the valve chambers (D-Figure 1) and gaskets from the pump base by tapping lightly with a soft face hammer.

Step 9—Lift the cam and piston assembly (J-Figure 2) out of the pump base.

Step 10—Remove the power take-off shaft bushing (K-Figure 2) from the pump base.

Step 11—Remove the cap screw (A-Figure 2) from the clamp (B-Figure 2) on each valve chamber and remove the clamp.

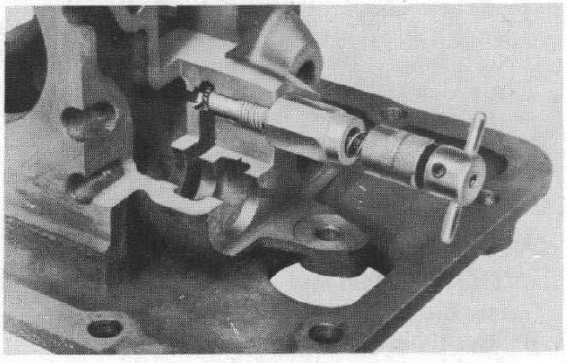


Fig. 3

Step 12—Remove the two spring seats (C-Figure 2), outlet valve springs (D-Figure 2), valve guides (E-Figure 2), outlet valves (F-Figure 2), inlet valve springs (G-Figure 2), inlet valves (H-Figure 2), and the valve guide sockets (I-Figure 2), from each valve chamber cover.

Step 13—Remove the drain plug and gasket (F-Figure 1).

III. CLEANING AND INSPECTING THE HYDRAULIC PUMP

Step 1—Wash all parts of the pump and pump base in mineral spirits and dry off with an air hose.

Step 2—Check the inlet and outlet valve seats to see that they are seating 100%.

NOTE: Improper seating may be due to the barrel of the valve not being concentric with the seat of the valve. If this is the case it will be necessary to replace the valve. If improper seating is due to the seat in the chamber casting it may be corrected by using a valve seat refacing tool as shown in Figure 3.

Step 3—Check the hydraulic check valve for 100% seating.

NOTE: Improper seating of the check valve may be corrected by using a check valve seat refacing tool as shown in Figure 4.

Step 4—Check the pistons and cylinders for scoring.

Step 5—Check the power take-off shaft bushing.

NOTE: Manufacturing specifications give a maximum of .002 inch clearance between the shaft and bushing.

Step 6—Inspect the intake and exhaust control valves for scoring and replace if necessary.

Step 7—Inspect the intake and exhaust control valve bushings for scoring and replace if necessary.

NOTE: Use the following procedure in replacing the bushings:

1. Drive the control valve bushings out of the pump base.
   a. Remove the cotter pin from the rear end of the intake valve bushings.
   b. Drive the bushing out of the pump base as shown in Figure 5.
   c. Drive the exhaust valve bushing out of the pump base, using the same method and tool as used in removing the intake valve bushing.
2. Install the intake control valve bushing in the pump base.
   a. Apply a light coat of oil to the bushing.

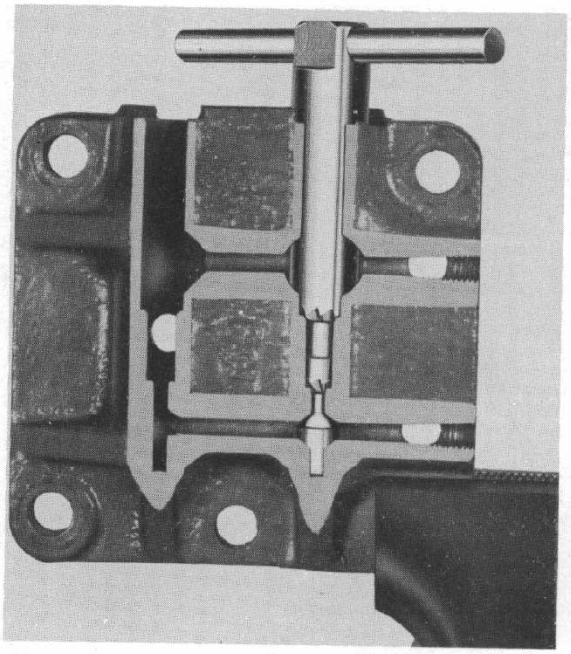


Fig. 4

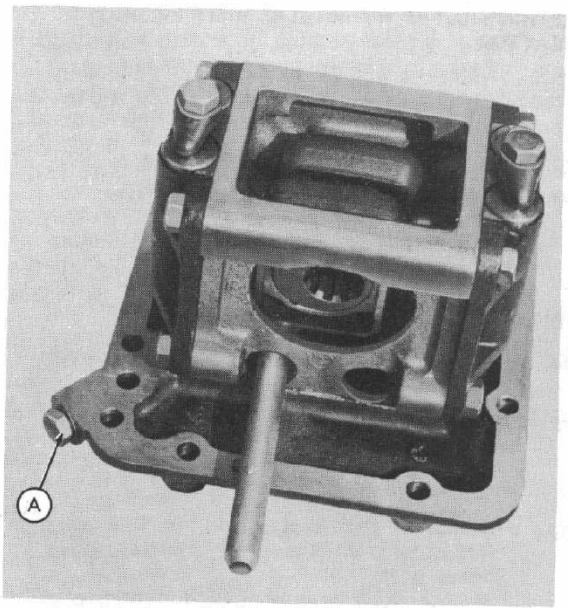


Fig. 5

   b. Place the bushing in the pump base with the cotter pin hole in a horizontal position to facilitate installation of the cotter pin.
   c. Press the bushing in until it is flush with the face of the pump base.

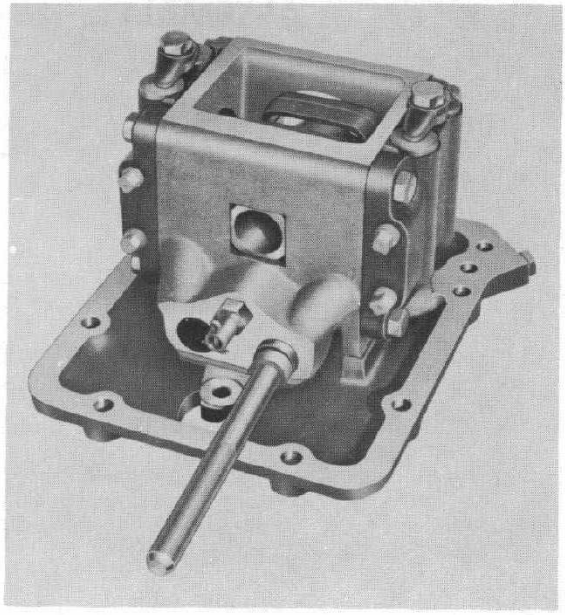


Fig. 6

3. Install the exhaust control valve bushing in the pump base.
   a. Apply a light coat of oil to the bushing.
   b. Press the bushing in until it is flush with the face of the pump base.

NOTE: If no arbor press is available, drive the bushing in using a 3 lb. copper hammer and the tool shown in Figure 6.

IV. ASSEMBLING THE HYDRAULIC PUMP

Step 1—Install the control valves.
   a. Install the retaining washer in the rear end of the intake control valve bushing.
   b. Install the cotter pin in the bushing.
   c. Insert the spring and intake control valve in the bushing. This valve must be held in place due to the spring tension.
   d. Insert the exhaust control valve.

Step 2—Install the valve control lever.

NOTE: Hold the spring loaded valve in place until the lever is installed.

Step 3—Install the washer and cotter pin on the control lever post.

Step 4—Install the clevis pin and cotter pin that secure the exhaust control valve to the valve control lever.

Step 5—Install the power take-off bushing in the pump base.

Step 6—Install the cam and piston assembly in the pump base.

NOTE: The pistons on the scotch yokes are off center. Position the scotch yokes so that the pistons are at their closest position to each other. The recessed end of the cam is installed to the rear of the pump and fits over the shoulder of the power take-off bushing.

Step 7—Reassemble the inlet and outlet valves in the valve chamber covers.

NOTE: Reverse the procedure in Part II (Steps 11 and 12 of this Job Plan).

Step 8—Install the valve cover chambers on the pump base casting.

Step 9—Install the washer and drain plug.

Step 10—Install the gasket and pump assembly in the tractor center housing.

NOTE: Do not tighten the pump base cap screws securely until the P.T.O. shaft has been installed.

Step 11—Install the P.T.O. shaft.

Step 12—Turn the tractor motor over slowly with the P.T.O. engaged allowing the shaft to position the hydraulic pump to insure perfect alignment.

Step 13—Tighten the cap screws in the pump base to the center housing securely.

NOTES

SERVICING THE HYDRAULIC LIFT COVER ASSEMBLY

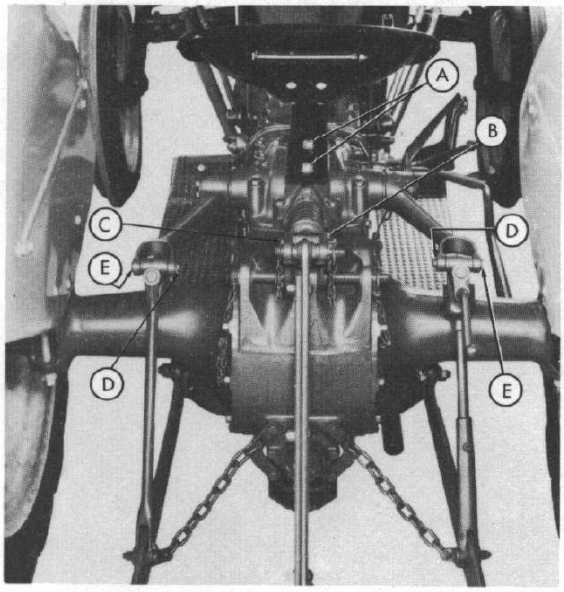


Fig. 1

TRAINING TIME: 1½ Hrs.

TOOLS AND MATERIALS:

1. Standard Set of Mechanic's Hand Tools

JOB PROCEDURE:

I. REMOVING THE HYDRAULIC LIFT COVER ASSEMBLY FROM THE TRACTOR

Step 1—Remove the two hex head nuts (A-Figure 1) and remove the tractor seat.

Step 2—Remove the cotter pin (B-Figure 1) from the rocker pin.

Step 3—Pull the rocker pin (C-Figure 1) and free the rocker from the main control spring yoke.

Step 4—Remove the cotter pins (D-Figure 1) from both leveling arm knuckle pins.

Step 5—Remove the knuckle pins (E-Figure 1) disengaging the leveling arms from the lift arms.

Step 6—Remove the fourteen hex head bolts that secure the lift cover casting to the center housing.

Step 7—Set the touch control lever in the down position (A-Figure 2).

NOTE: Be sure the implement position control lever is disengaged.

Step 8—Place the lift arms in the down position (B-Figure 2).

Step 9—Grasp the assembly at the base of the quadrant with the right hand and the left lift arm with the left hand. Lift the rear of the assembly upward with a slight forward motion as shown in Figure 2.

CAUTION: Handle carefully to avoid damaging the control arm and linkage assembly.

II. DISASSEMBLING THE HYDRAULIC LIFT COVER UNIT

Step 1—Support the lift cover assembly in a vise in a vertical position with the main control spring up, as shown in Figure 3.

Step 2—Remove the four bolts (A-Figure 3) that secure the ram cylinder to the lift cover casting.

Step 3—Remove the ram cylinder and gasket (B-Figure 3).

Step 4—Remove the cotter pin and clevis pin (C-Figure 3) that secures the connecting rod to the ram arm and lift out the piston rod.

Step 5—Remove the hydraulic touch control lever retainer (D-Figure 3) from the quadrant.

Step 6—Remove the locknut, spring and flat washer (E-Figure 3) that secures the hydraulic touch control lever.

Step 7—Remove the hydraulic touch control lever (F-Figure 3).

NOTE: Remove the woodruff key and friction disk (G-Figure 3) from the shaft.

Step 8—Remove the cotter pin (A-Figure 4) and the flat washer which secures the implement position control lever to the implement position control linkage.

Step 9—Remove the control arm, the constant draft control linkage, and the implement position control linkage.

a. Unscrew the yoke (I-Figure 4) and remove the main control spring (J-Figure 4).

b. Remove the cotter pin, nut, and the flat washer (D-Figure 4) from the touch control lever shaft.

c. Remove the self-locking nut and flat washer (B-Figure 4) from the lower end of the constant draft control spring.

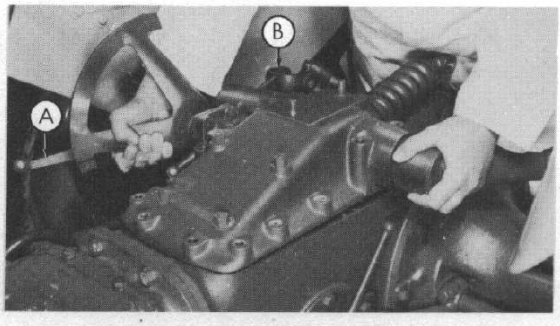


Fig. 2

d. Remove the four cap screws and washers (K-Figure 4) and remove the quadrant assembly.

e. Remove the swivel (E-Figure 4), bushing (F-Figure 4) and the spring (G-Figure 4) from the constant draft plunger and control arm.

f. Remove the control arm (L-Figure 4).

g. Remove the touch control lever shaft (C-Figure 4) and the implement position control linkage assembly.

h. Remove the implement position control linkage assembly from the shaft.

i. Remove the main control spring support and cover plate (H-Figure 4).

j. Remove the plunger and the draft control link. (A-Figure 5).

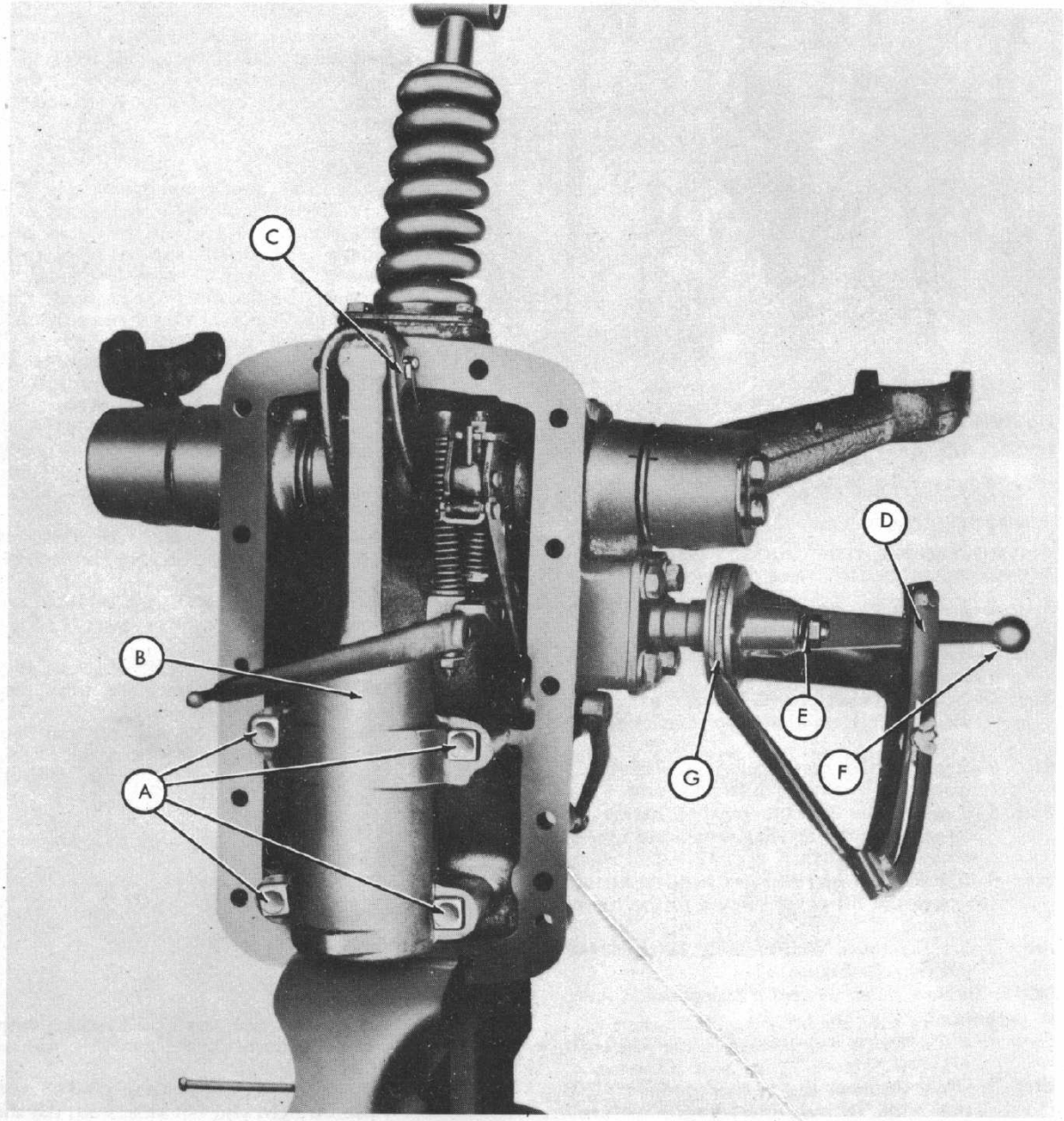


Fig. 3

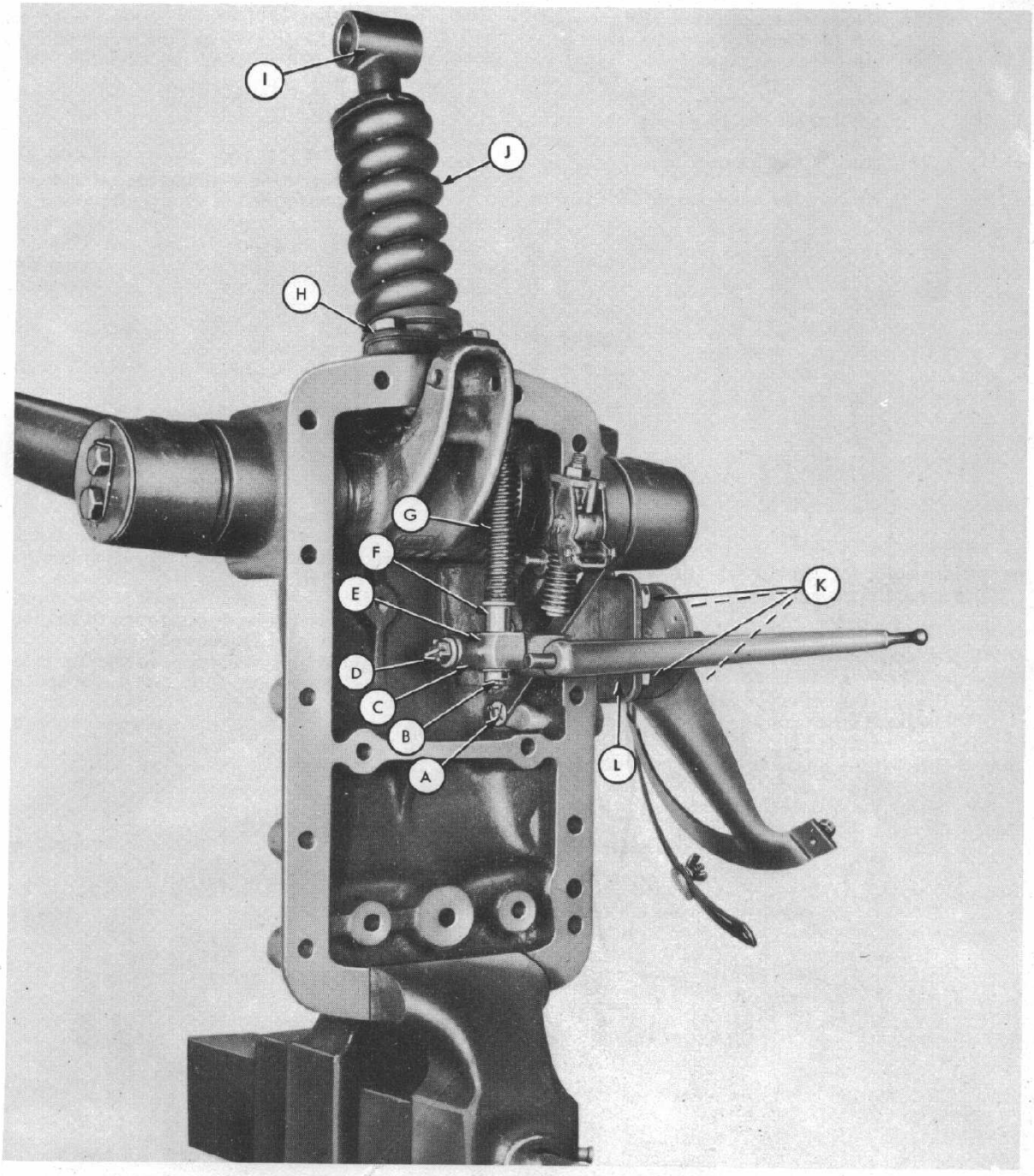


Fig. 4

Step 10—Remove the lift arms (B-Figure 5).

a. Straighten the tabs on the lockwashers (C-Figure 5) on both lift arms.

b. Remove the two cap screws (D-Figure 5) from both lift arms and remove the arms.

Step 11—Drive the shaft out of the casting with a soft face mallet and remove the ram arm (A-Figure 6).

Step 12—Drive the bronze bushing (B-Figure 6), one on right and left side, from the shaft housing of the cover casting.

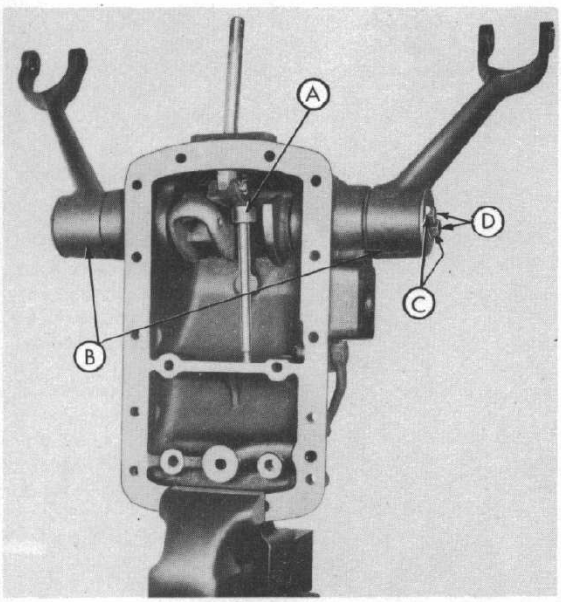


Fig. 5

III. CLEANING AND INSPECTING THE HYDRAULIC LIFT COVER ASSEMBLY

Step 1—Clean all parts thoroughly in cleaning fluid.

NOTE: It is important that any foreign matter that might get into the oil be removed.

Step 2—Inspect the lift cover casting. It should be replaced if it is cracked or damaged in any way.

Step 3—Inspect the lifting arm shaft bushings. Replace them if they are scored, pitted, or if the inside diameter is excessively worn.

Step 4—Inspect the lifting arm shaft. If it is damaged, or if the bearing surface is excessively worn, it should be replaced.

Step 5—Inspect and replace any linkage that is twisted, bent, or damaged in any way.

Step 6—Inspect the ram cylinder and the piston. Replace the ram cylinder if it is scored or excessively worn. Replace the piston if it is scored or cracked.

IV. ASSEMBLING THE HYDRAULIC LIFT COVER UNIT

Step 1—Install the bronze bushing in one side of the casting.

Step 2—Install the shaft and ram arm.

Step 3—Install the bronze bushing in the other side of the casting.

Step 4—Install the lift arms.

NOTE: Tighten until the shaft end play is removed and bend down the tabs on the lockwashers.

Step 5—Install the plunger and connecting link assembly.

Step 6—Install the main control spring cover plate, dust seal, and the support plate.

Step 7—Install the main control spring and yoke.

NOTE: Leave the control spring and yoke assembly loose to facilitate assembly of the constant draft control linkage assembly.

Step 8—Install the position control linkage and flat washers on the touch control lever shaft.

Step 9—Install the touch control lever shaft and implement position control linkage assembly in the lift cover casting.

Step 10—Install the gasket and quadrant assembly.

NOTE: Line up the marks on the quadrant assembly and lift cover casting. Turn the quadrant assembly until the top edge is flush with the lift cover casting and tighten securely.

Step 11—Install the control arm on the touch control lever shaft.

Step 12—Install the spring on the constant draft control plunger.

Step 13—Install the bushing on the plunger.

Step 14—Install the swivel on the plunger and insert the pin on the swivel in the control arm.

Step 15—Install the flat washer and self-locking nut on the end of the plunger.

Step 16—Install the flat washer the castellated nut, and the cotter pin on the touch control lever shaft.

Step 17—Attach the connecting link of the implement position control linkage to the implement position control lever.

Step 18—Tighten the main control spring yoke until there is no end play in the spring

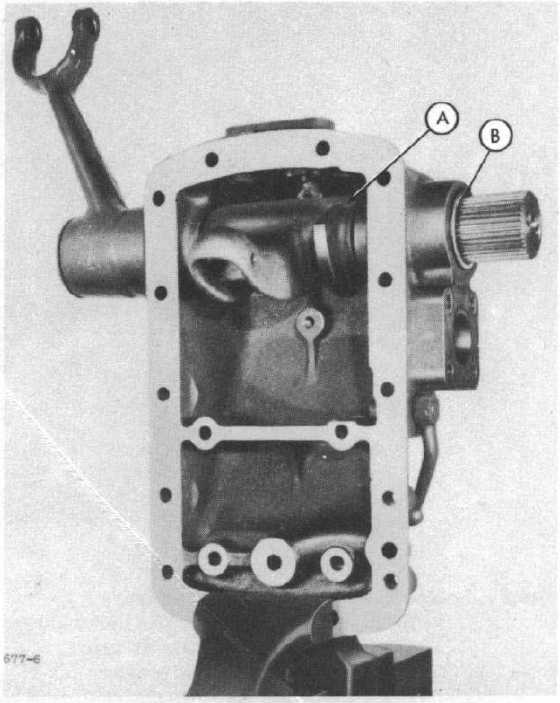


Fig. 6

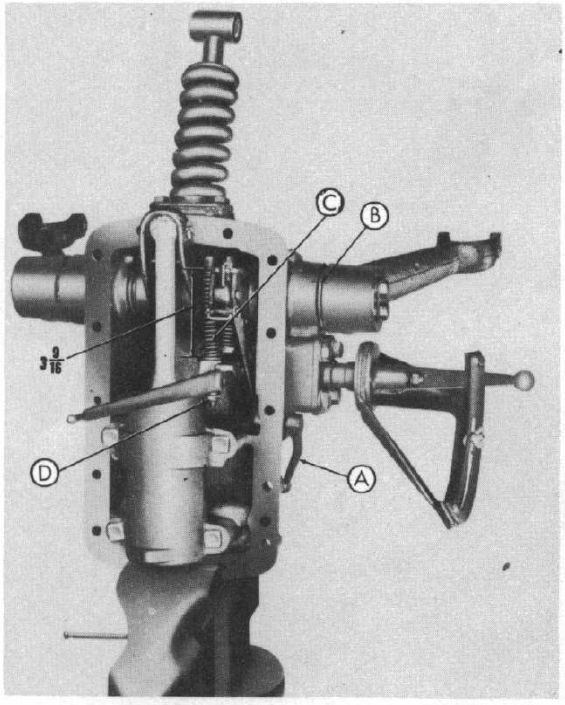


Fig. 7

and it is possible to turn the spring by hand using the pressure of the thumb and first two fingers.

Step 19—Install the friction washer, the woodruff key, the touch control lever, the spring, the flat washer, and the self-locking nut on the quadrant assembly.

Step 20—Install the touch control lever retainer on the quadrant.

Step 21—Install the ram cylinder piston rod.

Step 22—Install the gasket and the ram cylinder.

V. ADJUSTING THE HYDRAULIC CONTROL MECHANISM

Step 1—Adjust the constant draft spring.

a. Be sure the implement position control lever (A-Figure 7) is disengaged.

b. Check the length of the constant draft spring (C-Figure 7). It should measure $3\frac{9}{16}$".

c. If the spring is too long or too short adjust the nut (D-Figure 7) until the correct spring length is obtained. If the adjusting nut is a locknut tighten up until the washer bears against the shoulder.

Step 2—Adjust the implement position control spring.

a. Engage the implement position control lever (A-Figure 9) by moving it to the "up" position.

b. Move the hydraulic touch control lever until there is a ¾ inch opening between the top edge of the lever and the top end of the slot in the quadrant as shown at (B-Figure 9).

c. Raise the lift arms to their top operating position as indicated by marks on the lift arm and housing (B-Figure 7).

NOTE: Make sure the control arm (G-Figure 9) moves freely.

d. Raise the implement position control spring linkage until the pin (C-Figure 9) contacts the cam on the lift ram arm.

e. Raise the control arm (G-Figure 9) until the swivel comes into contact with the collar on the constant draft control spring.

f. Adjust the length of the implement position control spring (E-Figure 9) by loosening the locknut (D-Figure 9) and turning the adjusting bolt (F-Figure 9), so that it contacts the control arm when the pin is touching the cam and the swivel is in contact with the constant draft spring.

CAUTION: Check the position of the hydraulic touch control lever and lift arms to be sure they were not moved while making the adjustments.

VI. INSTALLING THE HYDRAULIC LIFT COVER ASSEMBLY ON THE TRACTOR

Step 1—Install new gasket on center housing.

NOTE: For training purposes it is not necessary to replace an undamaged gasket.

Step 2—Lower the hydraulic lift cover assembly into position.

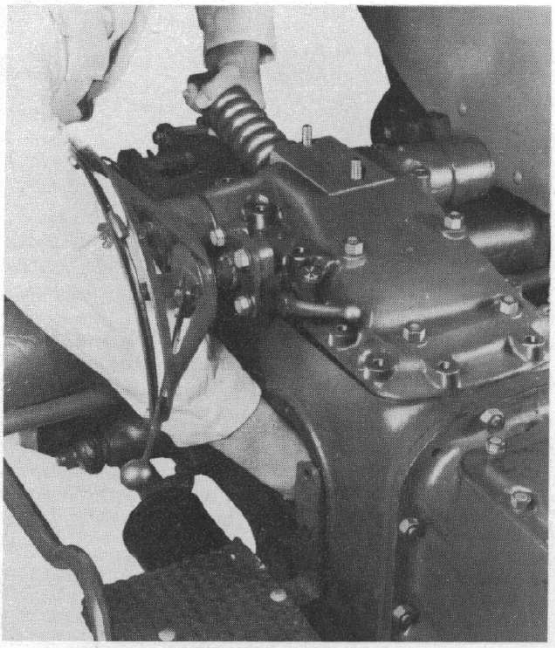


Fig. 8

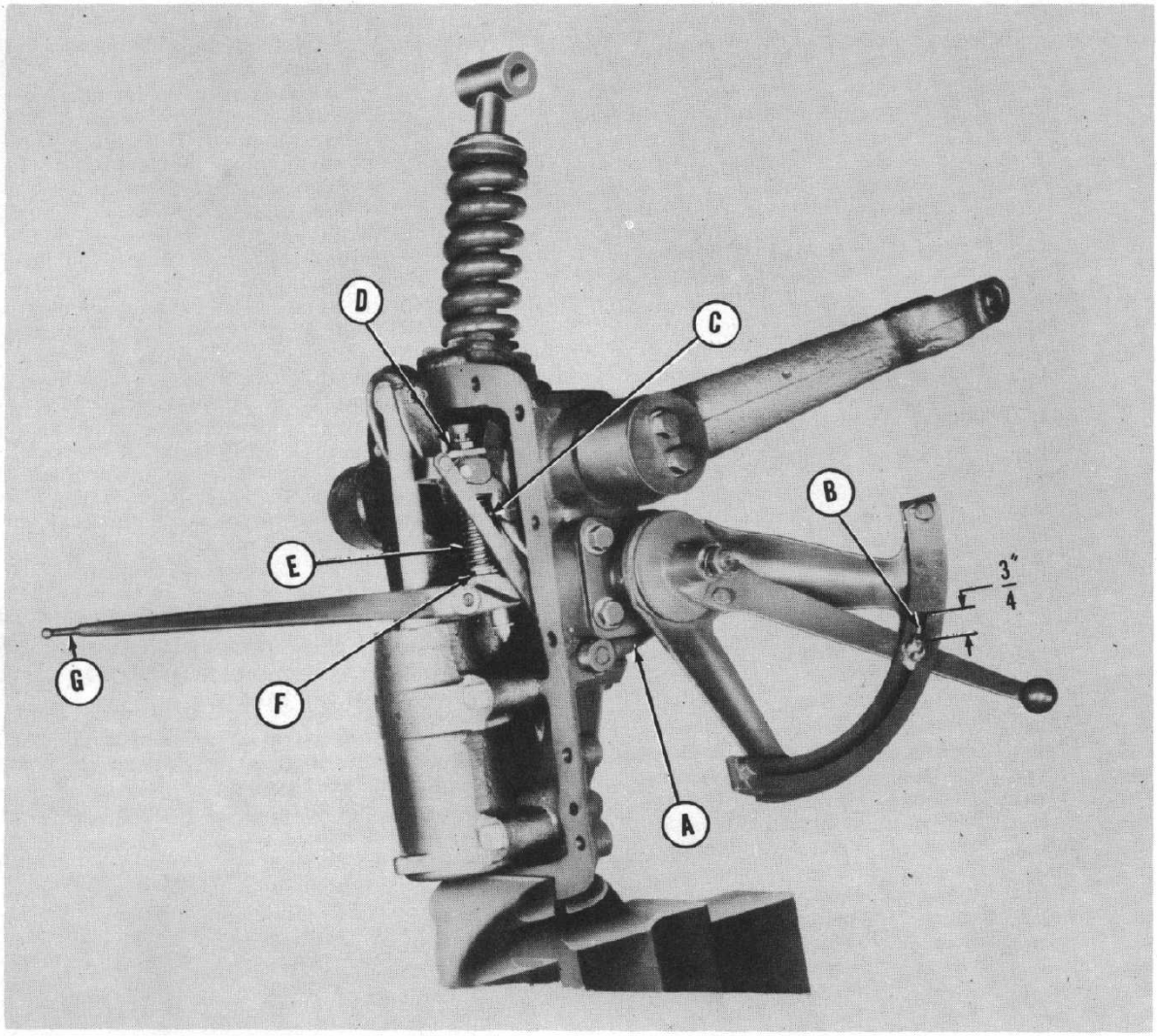


Fig. 9

NOTE: Be sure the touch control lever, the hydraulic lift arms and the implement position control lever are in the "DOWN" position before lowering the lift cover unit into position.

Step 3—Set the lift cover assembly on the center housing, placing the front of the assembly slightly to the rear of the position required to line up the bolt holes.

Step 4—Insert the right hand in the center housing at the inspection plate opening as shown in Figure 9, and guide the tip of the control arm into position in the control valve lever.

Step 5—Bolt the lift cover assembly to the center housing.

Step 6—Attach the leveling arms to the lift arms.

VII. FINAL CHECK OF ADJUSTMENTS

NOTE: The complete procedure for making the final check of hydraulic control adjustments is covered in Service Training Manual "Ford Tractor Hydraulic Adjustments" Form SE-5256, page 1-14.

PRINTED IN U.S.A.

PRE-DELIVERY CHECK AND ENGINE ANALYSIS

CONFERENCE OBJECTIVES:

1. To discuss the important phases of a complete pre-delivery check
2. To train personnel in the use of the Owners Service Test Set

CONFERENCE TIME: ½ Hr.

CONFERENCE AIDS:

1. Control Chart—8N Ford Tractor Advanced Service Training
2. Owners Service Test Set
3. Conference Guide No. 9 (one for each trainee)

CONFERENCE PROCEDURE:

I. Introduction

A. Tie in with the previous conferences

1. Stress the fact that up to this point we have simulated the overhaul of the 8N Ford Tractor. We have completed the performance of mechanical work, however, the tractor is not ready for delivery to the customer. Whether it be a new tractor or a rebuilt tractor, a systematic pre-delivery check must be followed to assure customer satisfaction

B. Stress the objectives of this conference

1. Objectives
   a. To stress the important phases of a complete pre-delivery check
   b. To train personnel in the use of the Owners Service Test Set

II. Pre-Delivery Check

A. Introduction

1. Customer satisfaction or dissatisfaction begins to form the moment a tractor is delivered and continues to develop as he uses that tractor

2. It is the distributor's and the dealer's responsibility to initiate the formation of customer satisfaction by delivering a tractor that has been completely checked and is ready for top performance. This specifically applies to new tractors, but the principle applies to rebuilt tractors as well

B. What constitutes a complete pre-delivery check?

CHART 9-1
Pre-Delivery Check

1. The answers to that question can only be found in asking another—"What will initiate and continue to foster the development of customer satisfaction?"

   a. First impressions

CHART 9-2
First Impressions

   (1) Put yourself in the customer's "shoes", you've just paid or made arrangements to pay over a thousand dollars for a new tractor. Underline the word *new*—because

that's the word that sticks in your mind—and don't forget to underline *self pride* because you've selected the Ford Tractor over the opposition of some of your neighbors who also know that the *new* tractor is coming

(2) With your customer in that frame of mind, that first impression better be good, and you can insure a good first impression by delivering a NEW tractor:
   (a) That is thoroughly clean
   (b) Tires clean and properly inflated
   (c) That is free from unpainted, chipped or scuffed paint surfaces
   (d) That is free from dents, bent or broken parts
   (e) That literally "shines" the word NEW

b. Second impressions

CHART 9-3

Second Impressions

(1) After your customer gets accustomed to the newness of his tractor and is satisfied, the second impressions begin to formulate into satisfaction or dissatisfaction. These second impressions are based on your customer's reconvincing himself "that he did the right thing". Did he get all that was coming for his money? If he says yes, customer satisfaction is still growing, and that answer is based on:
   (a) Is the operators handbook in the tool box?
   (b) Did he get all of his tool package?
   (c) Is the cooling system filled with the proper coolant?
   (d) Are there any cooling system leaks?
   (e) Is the fan belt adjusted correctly?
   (f) Is there gas in the tank?
   (g) Are there any gas leaks?
   (h) Is there a proper amount of oil in the crankcase, transmission, and center housing?
   (i) Are the tires and wheels mounted correctly?
   (j) Is the battery O.K.?
   (k) Are the engine accessories all securely bolted to the engine?
   (l) Has the tractor been lubricated?
   (m) Is there oil in the air cleaner?
   (n) Is there oil in the steering gear housing?

CHART 9-4

Check

c. Third impressions

CHART 9-5

Third Impressions

(1) If your customer is still satisfied after his second impressions, the third group of impressions will soon begin to formulate and continue for some time to come. Needless to say, the results of these third impressions are important. The old adage "three times and out" applies to you and your customer's satisfaction after these impressions are made. Again, put yourself in the customer's shoes. You have seen what you bought and are satisfied. You have looked it over and are satisfied your dealer gave you all you had coming. Now, let's put the tractor to work. It will not take long for your customer to begin getting that third set of impressions. If a complete predelivery check has been made, there is nothing to worry about—if not, it may be wise to get out of the line of fire—because by this time, several of the neighbors have "dropped in" and the tractor's performance better be good

(2) If you have a complete delivery check you know that:

CHART 9-6

Check

(a) The tractor will start
(b) That the governor speed is right at idle and max. speed
(c) That the carburetor is set O.K.
(d) That the gauges show correct oil pressure and amperage
(e) That there are no spark plug or head gasket leaks
(f) That there are no abnormal engine noises
(g) That it will easily shift into all five gears
(h) That the clutch free play is O.K.
(i) That the brakes are properly adjusted and the brake pedals are equalized
(j) That the front wheels are aligned
(k) That the steering mechanism is adjusted correctly
(l) That the hydraulic mechanism is operating correctly
(m) That there are no loose bolts or nuts
(n) That the rear axle bearing adjustment is correct
(o) That the rear axle nuts are tight

d. Putting into practice a systematic pre-delivery check

CHART 9-7

Pre-Delivery Checking Requirements

(1) A complete pre-delivery check takes time, but the dividends in terms of future business cannot be overlooked by any Dearborn Distributor or Dealer

(2) What is required by the Distributor and Dealer organizations in order to do this job of pre-delivery check satisfactorily?

(a) An appreciation of the fact that this job must be done for the future success of the Distributor and Dealer organization.
(b) The creation and use of an established pre-checking procedure.
(c) The assignment of this responsibility to responsible personnel in the organization.
(d) The necessary follow up by management to insure its proper execution.

III. Engine Analysis

A. Introduction

1. Our first objective pointed toward the importance of the pre-delivery check as a basis for building customer satisfaction. If this job has been done well, the foundation has been laid for today's satisfied customer becoming tomorrow's future customer.

2. We can't wait for tomorrow and expect this future customer to walk in. The dealer must continue to promote customer satisfaction, to constantly keep in contact with the customer, checking and anticipating repairs due to wear.

B. Selling service

Show the Owners Service Test Set

1. The Dearborn Dealers have at their disposal one of the most scientific and modern devices to forecast service problems and adjustments due to normal use and to "sell" the necessary service required. That device is the Engine Analyzer, or Owners Service Test Set.

2. It is our second objective in this conference to train personnel attending this program in the use and operation of the Owners Service Test Set.

C. The Owners Service Test Set

1. The Owners Service Test Set makes possible a completely new standard of tractor service because it establishes a completely new standard in test equipment. It was developed by the Heyer Products Company with the cooperation of Ford Service Engineers not only to aid you in maintaining and restoring built-in Ford Test Standards of performance, but expressly for the purpose of enabling you to give-on-the-job service. Every Ford Tractor owner is assured of satisfaction and efficiency of operation through this specialized service with precision test equipment.

2. The maximum use of the Owners Service Test Set can only be obtained when service personnel are fully qualified in its use. A fully qualified user of the Owners Service Test Set must:
   a. Know the various tests that can be made, and why those tests are made.
   b. Know the performance standards established for each test.
   c. Must know how to perform each test.

3. During the shop work to follow, the Owners Service Specialist will demonstrate the use of the Owners Service Test Set, explaining:
   a. What tests can be made
   b. Why those tests are made
   c. How those tests are made

4. In your Service Training Job Plan No. 23, you will have the complete procedure for performing all of those tests together with the standards of performance

5. Following the demonstration you will have an opportunity to perform all of the tests

IV. Conference Conclusion

A. Summarize the main points of the conference and answer any questions the group may ask

B. Distribute the Service Training Material
   1. Conference Guide No. 9, one for each trainee

C. Tell the group that following the performance of the shop work, the group will return to the conference room to take a written examination on the ABC's of the 8N Ford Tractor servicing and overhaul. Tell them the time that the examination is to begin.

PRE-DELIVERY CHECK

DIRECTIONS: Make a thorough inspection of the tractor, checking all points listed in the columns below. If the item checked is satisfactory, make a check mark (√) in the "O.K." column. If it is not satisfactory, but is corrected, make a check mark (√) in the "CORRECTED" column. If the trouble is not corrected do not check either column, but briefly state the nature of the trouble.

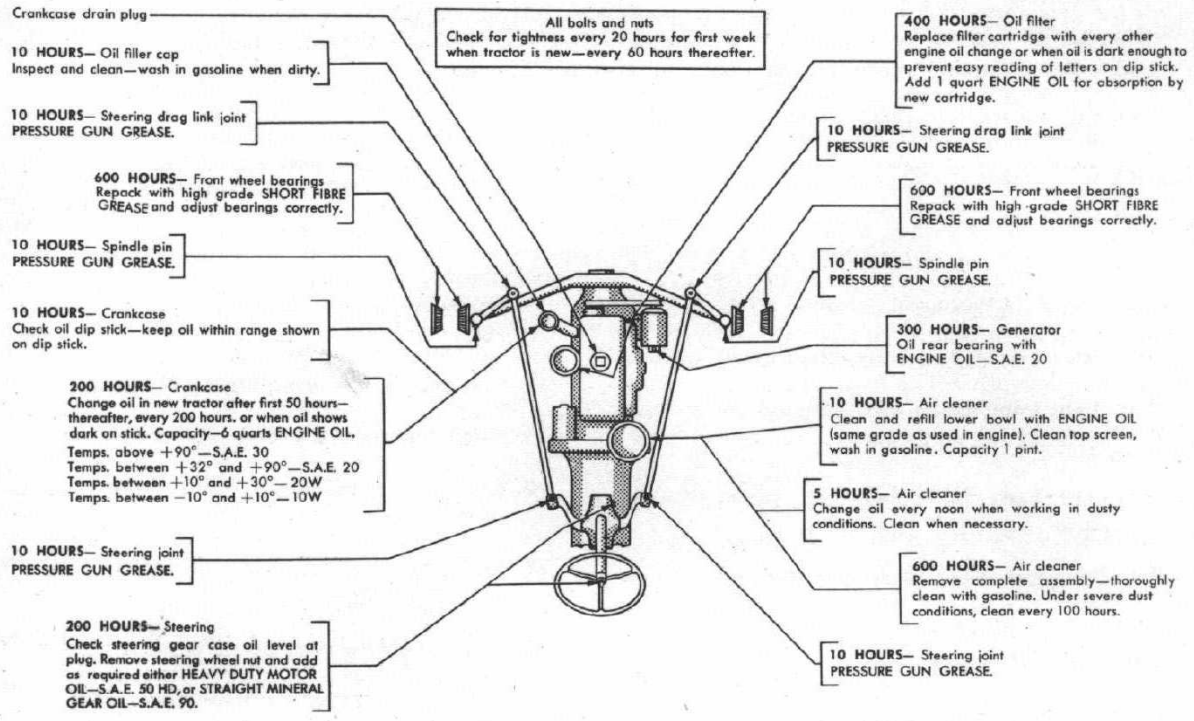
TRAINING TIME: 1½ Hrs.

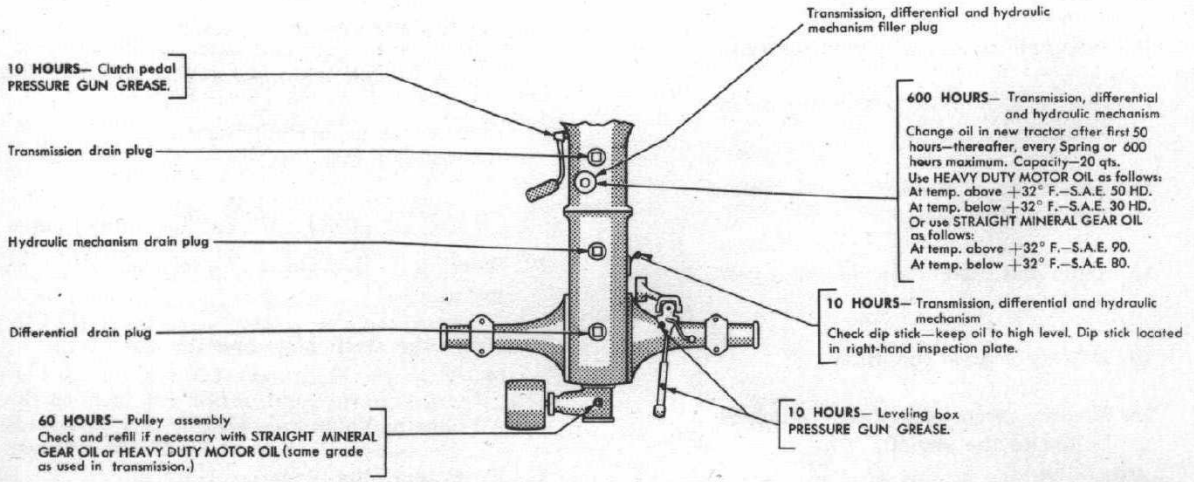
	O.K.	Corrected
1. Tractor is thoroughly clean		
2. Tires are clean and properly inflated		
3. Free from unpainted, chipped or scuffed paint surfaces		
4. Free from dents, bent or broken parts		
5. Operator's hand book is in the tool box		
6. Tool package intact		
7. Cooling system properly filled		
8. Cooling system free from leaks		
9. Fan belt is properly adjusted		
10. Adequate supply of gas in the tank		
11. Gas tank and lines are free from leaks		
12. Crankcase, transmission and center housing filled with oil		
13. Tires and wheels are mounted correctly		
14. Battery in good condition		
15. Engine accessories are securely bolted to the engine		
16. The tractor is properly lubricated		
17. Oil to proper level in the air cleaner cup		
18. Steering gear housing filled with oil		
19. Engine starts easily		
20. Governor speed O.K. at idle and max. speed		
21. Carburetor is properly adjusted (main and idle jets)		
22. The gauges show correct oil pressure and amperage		
23. Head gaskets tight and free from leaks		
24. No abnormal engine noise		
25. Easily shifts into all five gears		
26. Proper amount of clutch free play		
27. Brakes are properly adjusted and the brake pedals are equalized		
28. Front wheels are properly aligned		
29. Steering mechanism is properly adjusted		
30. Hydraulic mechanism operates correctly		
31. All bolts and nuts are tight		
32. Rear axle bearing is correctly adjusted		

DATE_____ TRACTOR SER. NO._____ CHECKED BY_____

LUBRICATION CHART

FORD TRACTOR





ENGINE ANALYSIS

TRAINING TIME: 1½ Hrs.

TOOLS AND MATERIALS:

1. Owners Service Test Set
2. Kilovolt Spark Meter
3. Standard Set of Mechanics Hand Tools

GENERAL INFORMATION

This engine test set is mounted on the tractor hood and the battery leads of the test set are connected to the battery terminals as shown in Figure 1. The leads are connected to the battery to provide power to operate the tachometer and combustion analyzer units as well as to light the meter and gauge scales. In this connection it should be understood that tests other than those using the tachometer and the combustion analyzer units of the set can be made without using battery power if so desired, but the meter scales will not light.

JOB PROCEDURE:

I. BATTERY CAPACITY AND CONDITION TEST

A. Test made with the battery installed in the tractor.

Step 1—Turn Meter Selector Switches to "Battery-Starter" test.

Step 2—Turn the Resistance Load Knob (A-Figure 1) to the right until the pointer on the Battery Size scale (B-Figure 1) reaches the ampere hour size of the battery being tested.

NOTE: For the ampere hour size of the battery used in the Ford Tractor see the specifications sheet accompanying this Job Plan.

Step 3—Check the reading on the Battery Condition scale (C-Figure 1). The battery condition will be shown by the area in which the indicator is positioned as described below. Turn the Resistance Load Knob all the way to the left immediately.

GREEN: Good starting ability and condition, recharge unnecessary.

YELLOW: Doubtful, should be rechecked in 30 days.

RED: Recharge (or poor connections at battery posts if the test was made with the test set lead clamps attached over the cable terminals rather than directly to the battery posts).

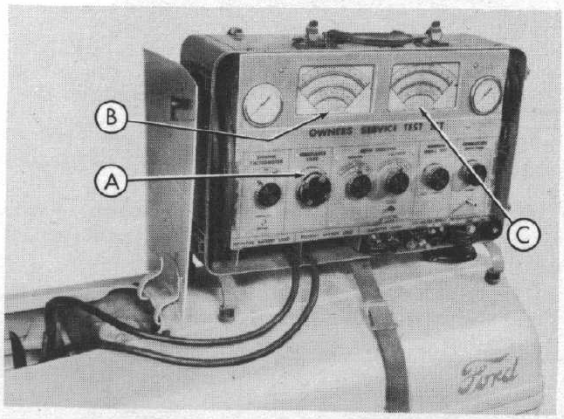


Fig. 1

NOTE: When the reading is in the YELLOW or the RED section, remove the cable terminals from the battery posts and retest with the test set leads clamped directly on the battery posts. This will assure good connections and avoid having a good battery test poorly on the scale.

B. Test made after recharging the battery.

NOTE: The battery tester is calibrated for 80°F. and will read accurately only if the battery temperature is between 60° and 100°F and the battery has been standing for 12 to 90 hours after a full recharge. In this case a reading in the RED indicates a worn out battery which should be replaced to avoid sudden failure.

CAUTION: Do not use this test on hot batteries immediately after a fast charge.

II. STARTER AMPERAGE (CRANKING THE ENGINE) TEST

Step 1—Attach the push button jumper (A-Figure 2) with one lead to the starter relay at the starter button connection, and ground the other as shown in the insert Figure 2.

NOTE: The jumper is a convenience for the operator. With it he can crank the engine and read the meters on the test set at the same time.

Step 2—Turn the Resistance Load Knob (B-Figure 2) all the way to the left and check to see that there is no indication on the Starter Amps scale (C-Figure 2).

Step 3—Use the push button control on the jumper lead as shown in Figure 2 and crank the engine over a few seconds (ignition off) and note carefully the exact voltage indicated on the starter volts scale (D-Figure 2). Then stop cranking the engine.

Step 4—Turn the Resistance Load Knob (A-Figure 3) to the right until the pointer on the Starter Volts scale (B-Figure 3) indicates the same voltage noted while starter was turning the engine.

Step 5—Read the Starter Amps scale (C-Figure 3). The pointer will indicate the starter current required to crank the engine.

NOTE: Read amperes not Ampere Hours when making this test. The purpose of this test is to

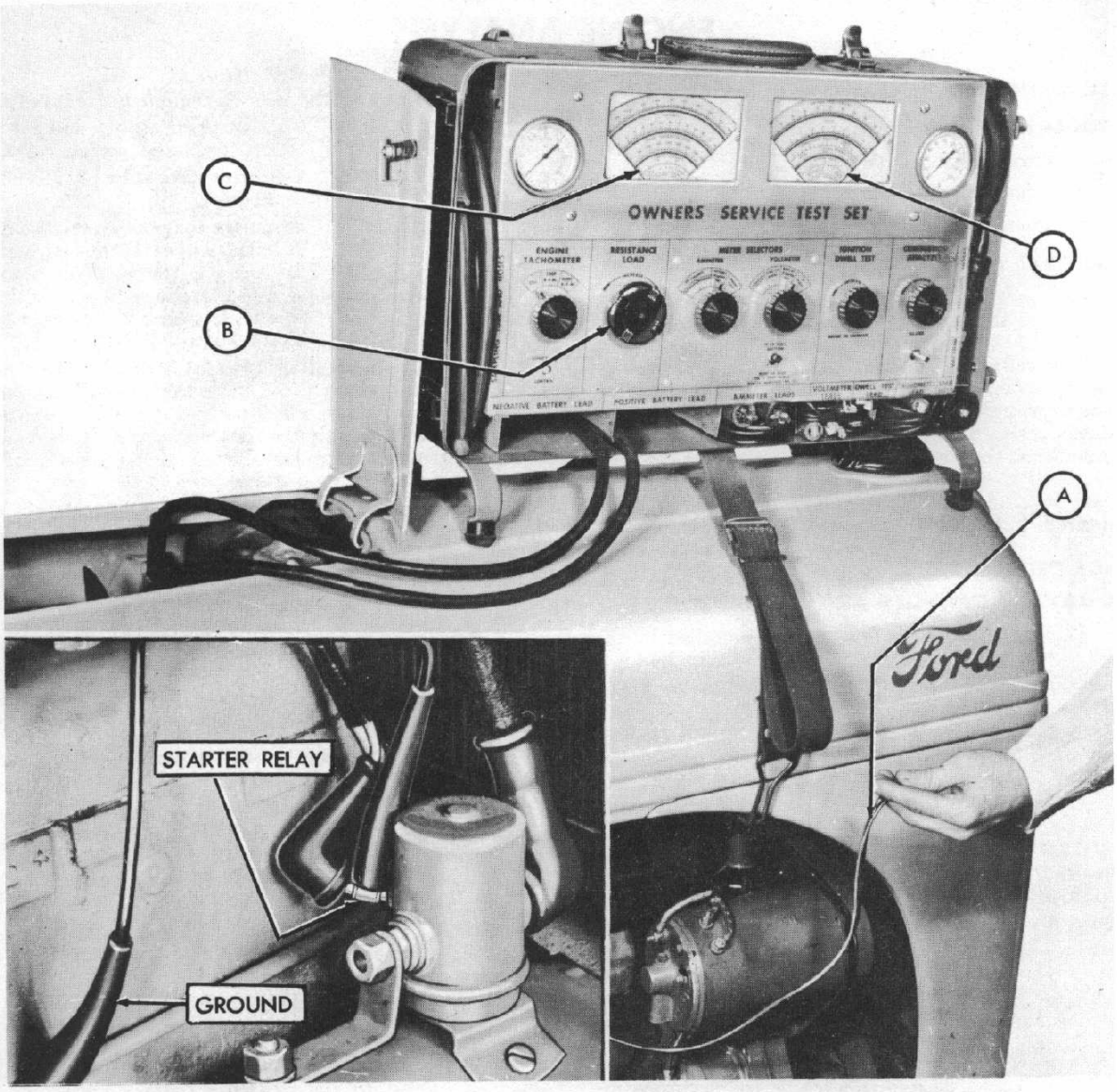


Fig. 2

check the brushes, commutator and armature windings and internal heavy current connections. A reading higher than the maximum shown on the specifications sheet accompanying this Job Plan indicates excessive resistance in the system or trouble in the mechanical components of the starter system. The source of this trouble will be located in the performance of Parts III and IV of this Job Plan.

III. STARTER AMPERAGE (NO LOAD) TEST

Step 1—Turn the ammeter knob (A-Figure 4) to NORMAL.

Step 2—Attach the push button control jumper (follow the procedure in Step 1, Part II, of this Job Plan).

Step 3—Connect the ammeter leads.

a. The red lead (positive) is clamped to the starter relay connection which goes to the starter (see insert, Figure 4.)

Step 4—Hold the push button control of the jumper with the right hand (ignition on) and start the engine.

NOTE: Make sure the Resistance Load Knob (B-Figure 4) is turned all the way to the left.

Step 5—Hold the black lead (negative) against the negative battery post with the left hand as shown in Figure 4.

Step 6—While the starter is turning, read the exact amperes indicated on the amperes scale (C-Figure 4).

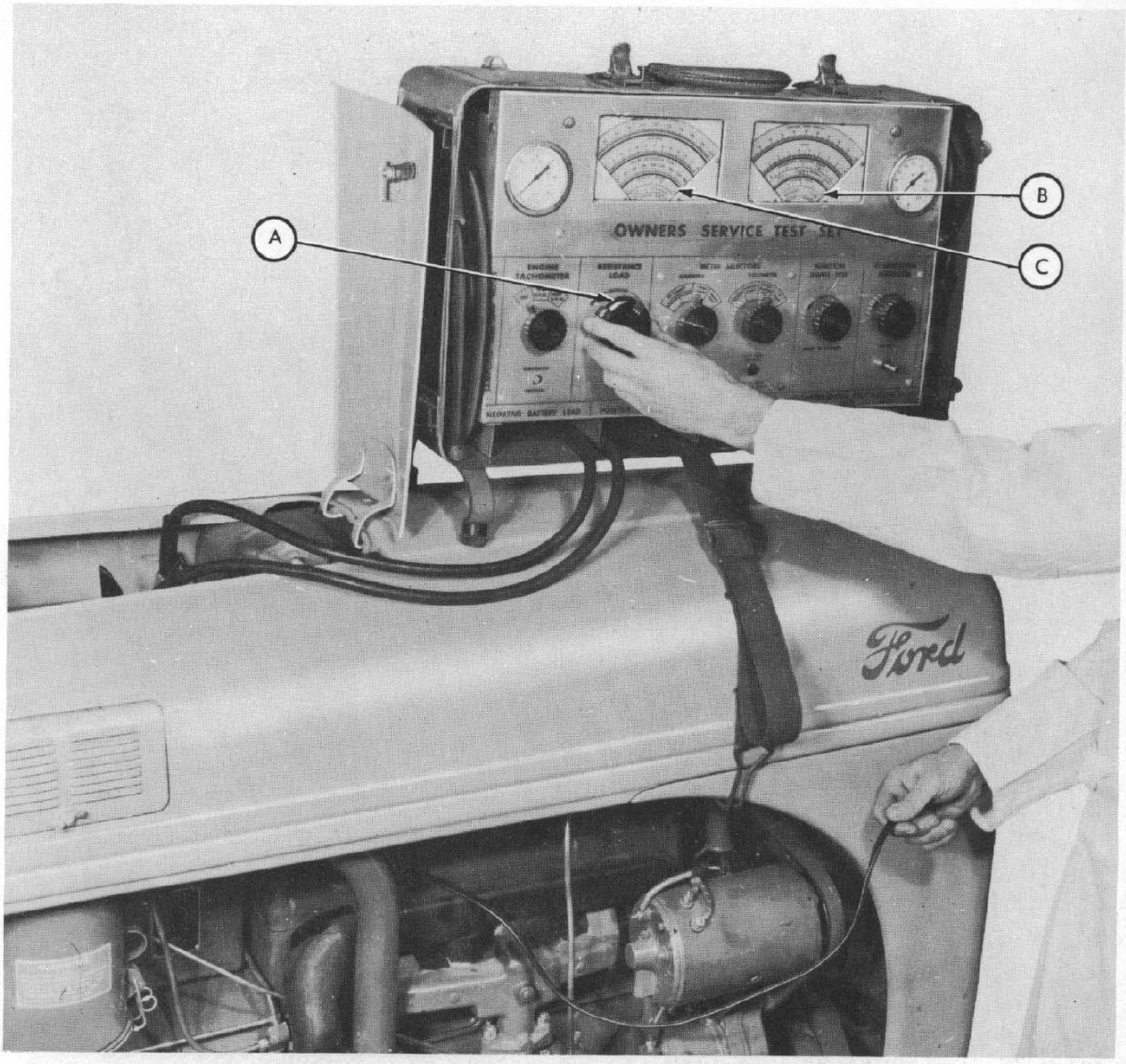


Fig. 3

NOTE: The purpose of this test is to check bearing and shaft alignment as well as the disengagement of the Bendix Drive. A reading higher than the maximum shown on the specifications sheet accompanying this job plan indicates mechanical trouble in the starter motor or the Bendix Drive.

IV. STARTER CIRCUIT RESISTANCE TEST

NOTE: The purpose of these tests is to check poor connections at the starting motor, the battery ground strap or the battery terminals. The Starter relay is being checked for pitting or fusing of internal contact points.

A. Starter Relay.

Step 1—Set the voltmeter selector switch to the 9 Volt scale.

Step 2—Connect the negative, (black) voltmeter lead to the negative battery cable connection at the relay.

Step 3—Connect the positive (red) volt meter lead to the starter connection.

Step 4—Attach the push button control jumper. (Follow procedure in Step 1, Part II, of this job plan).

Step 5—Crank the engine with the ignition **off**. With the engine cranking, push the 9/10 volt button.

Step 6—Read the voltage drop on the 9 volts scale and divide by 10. Check reading with the specifications sheet. It should be approximately .026 volts.

B. Starter Ground Circuit.

Step 1—Connect the negative (black) voltmeter lead to a starter bolt (any good ground at the starter).

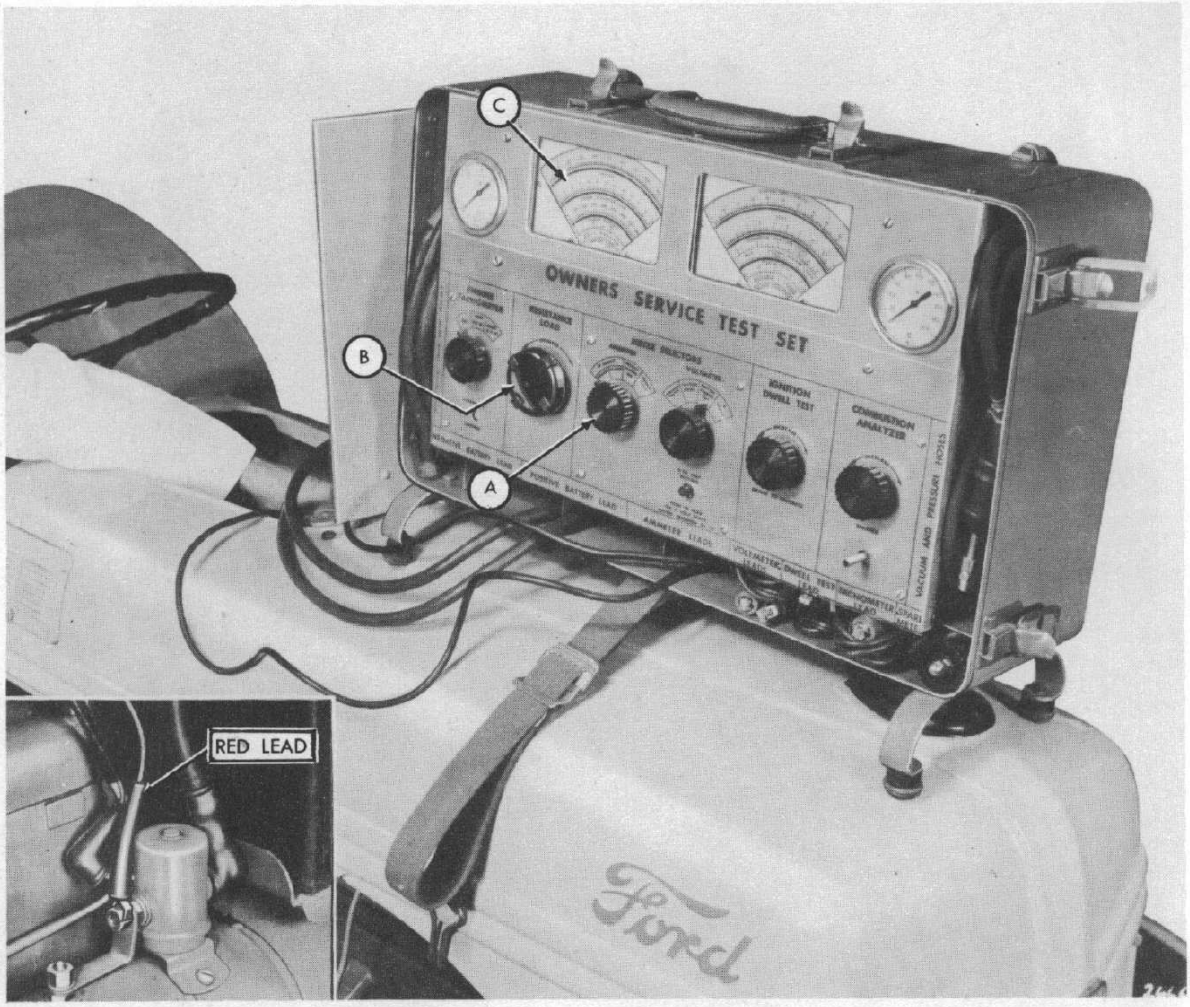


Fig. 4

Step 2—Connect the positive (red) voltmeter lead to the battery ground cable where it connects to the battery.

Step 3—With the engine cranking, push the 9/10 volt button and read the voltage drop on the 9 volts scale and divide by 10. Check the reading with specifications.

C. Battery Negative Terminal to the Starter Terminal.

Step 1—Connect the positive (red) voltmeter lead to the negative battery cable connection at the starter relay.

Step 2—Connect the negative (black) voltmeter lead to the negative battery cable where it connects to the battery.

Step 3—With the engine cranking, press the 9/10 volt button and read the voltage drop on the 9 volts scale and divide by 10. Check the reading with the specifications sheet.

V. TACHOMETER TEST

Step 1—Turn the engine tachometer knob (C-Figure 5) to 1000 RPM.

Step 2—Turn the ammeter knob (D-Figure 5) to ENGINE TACH.

Step 3—Turn the voltmeter knob (E-Figure 5) to 9 VOLTS.

NOTE: If this test is made with engine running at high RPM, it will be necessary to set the engine tachometer control on 4000 RPM.

Step 4—Attach the tachometer lead to any spark plug as shown at (F-Figure 5).

Step 5—Start the engine.

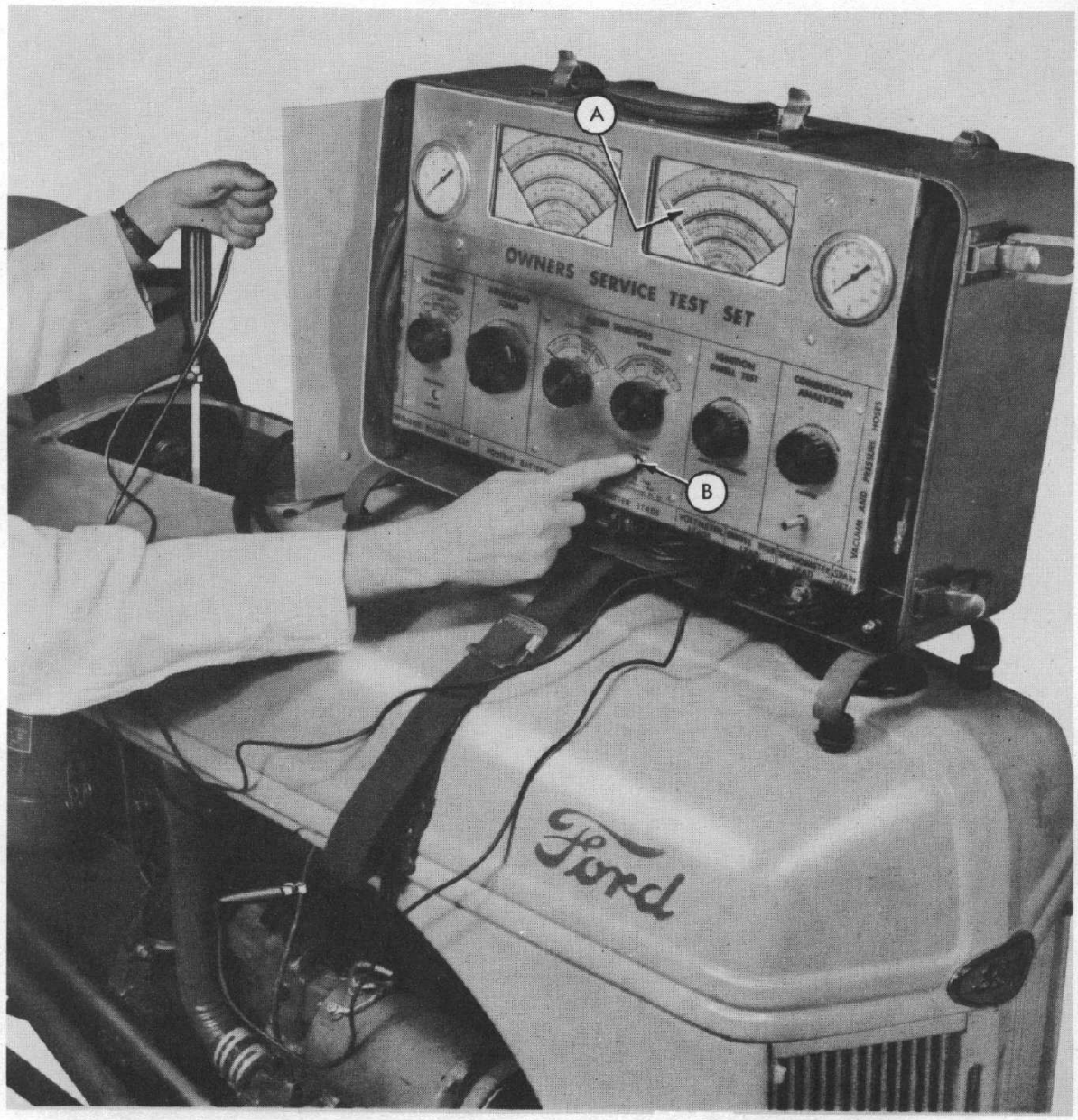


Fig. 5

Step 6—Check the RPM on the scale (A-Figure 5) if the test is at low RPM. To check maximum RPM, turn the tachometer control to 4000 RPM and read on scale (B-Figure 5).

NOTE: Ford Tractor idle speed is 400 to 500 RPM; maximum speed is 2200 RPM.

VI. VOLTAGE REGULATOR AND VOLTAGE CUT-IN TEST

Step 1—Turn the engine tachometer knob (A- Figure 6) to 4000 RPM.

Step 2—Turn the ammeter knob (B-Figure 6) to ENGINE TACH.

Step 3—Turn the voltmeter knob (C-Figure 6) to 9 VOLTS.

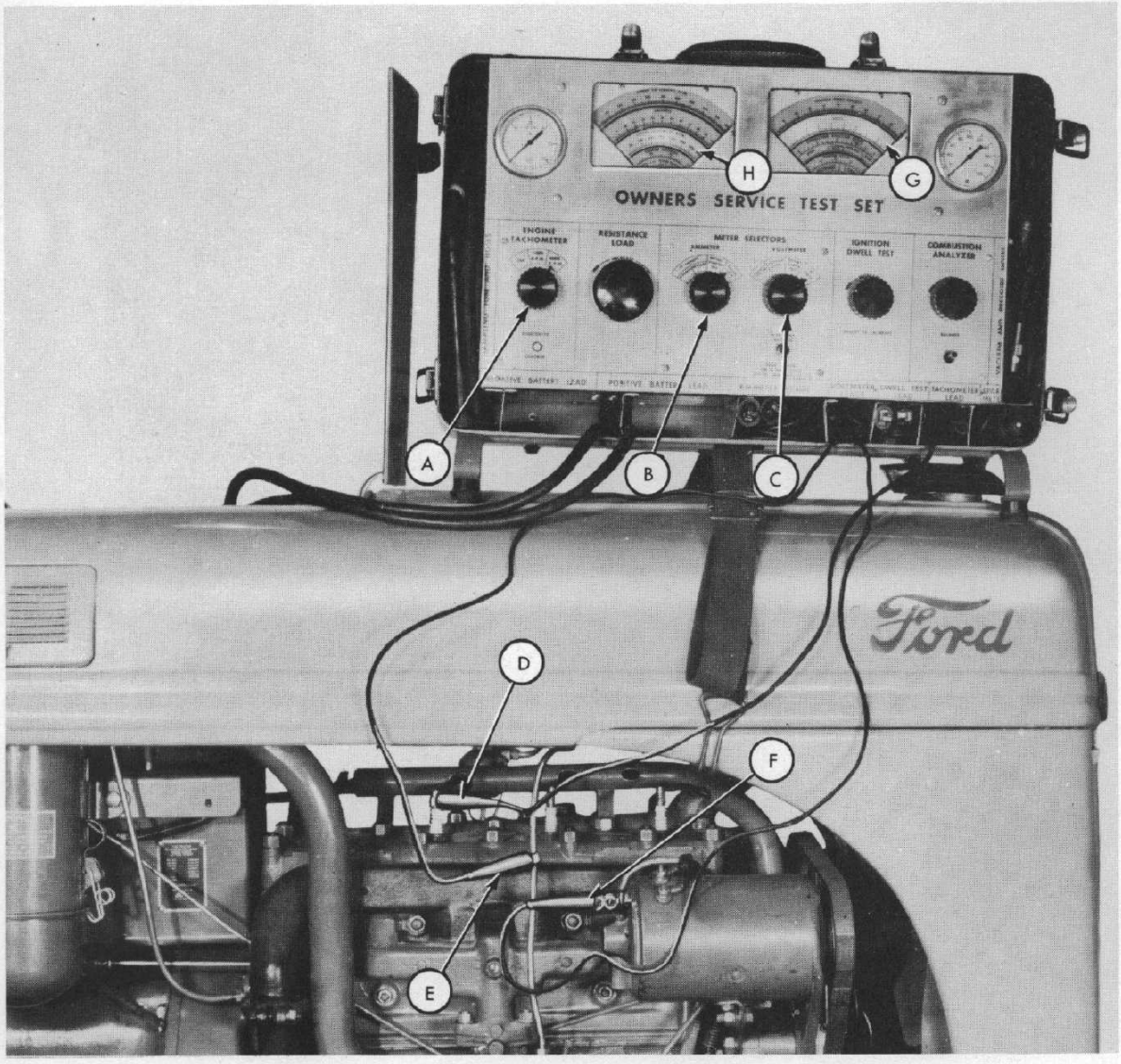


Fig. 6

Step 4—Attach the tachometer lead to any spark plug as shown at (D-Figure 6).

Step 5—Attach the voltmeter leads from the test set by clipping the negative (black) lead (F-Figure 6) to the generator armature post and grounding the positive (red) lead (E-Figure 6).

Step 6—Start the engine and speed it up slowly to 1400 RPM and read on scale (H-Figure 6).

Step 7—Read the volts on the voltmeter (G-Figure 6).

NOTE: The purpose of this test is to check the voltage at which the regulator is holding the generator. The voltage regulator is preset to cut in at 6.1 to 6.5 volts, and to cut out at 6.9 to 7.4 volts.

VII. GENERATOR OUTPUT TEST

Step 1—Attach the tachometer lead to any spark plug as shown at (A-Figure 7).

Step 2—Remove the lead from the armature terminal on the generator and connect it to the positive amperage lead of the test set as shown at (B-Figure 7).

Step 3—Connect the negative amperage lead to the generator armature terminal (C-Figure 7).

Step 4—Turn the engine tachometer knob (E-Figure 7) to 4000 RPM.

Step 5—Turn the ammeter knob (D-Figure 7) to ENGINE TACH.

Step 6—Start the engine and speed it up to 1500 RPM. Read on Engine Tachometer scale (F-Figure 7).

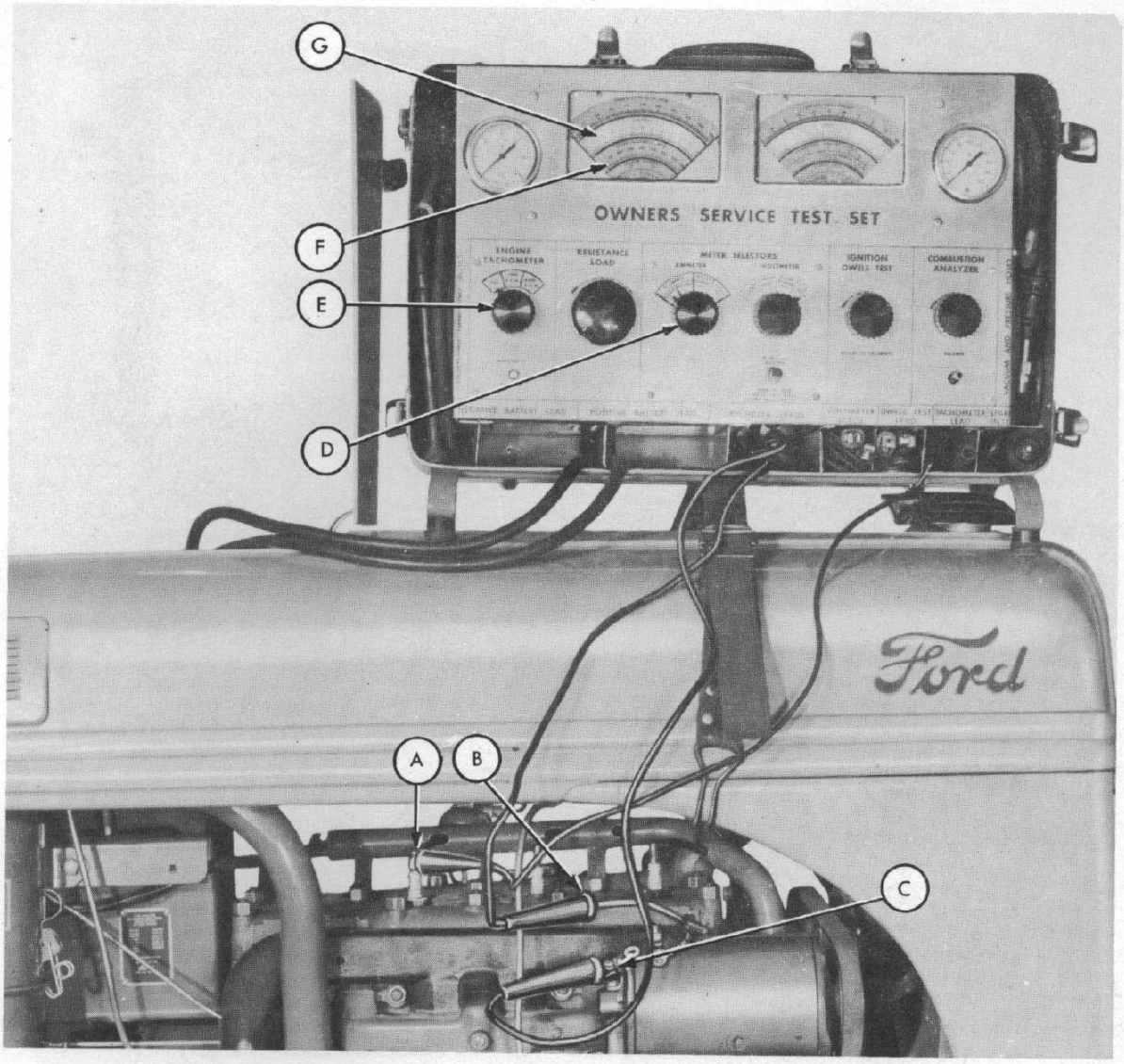


Fig. 7

Step 7—Turn the ammeter knob (D-Figure 7) to NORMAL.

Step 8—Read the amperage shown on the 60 amp. scale (G-Figure 7).

NOTE: The generator (8N-10000 and 8N-10000A) output should be 10 amps. with a maximum of 11.5 amps. The maximum generator output for 8N-10000B should be 20.0 amps.

VIII. GENERATOR FIELD CURRENT TEST

NOTE: The tachometer lead may be left attached to any spark plug as shown at (D-Figure 8).

Step 1—Disconnect the field lead (E-Figure 8) from the generator.

Step 2—Connect the positive amperage lead (F-Figure 8) to the generator field terminal and the negative amperage lead (C-Figure 8) to the negative battery post.

Step 3—Turn the ammeter knob (B-Figure 8) to NORMAL and read the amperage on the 60 amp. scale (A-Figure 8). Convert the amperage reading to ohms by dividing the battery voltage by the amperes indicated on the 60 amp. scale.

NOTE: The purpose of this test is to check the internal field winding connections and condition of the field winding insulation. Consult the specifications sheet accompanying this Job Plan for the correct amperage reading.

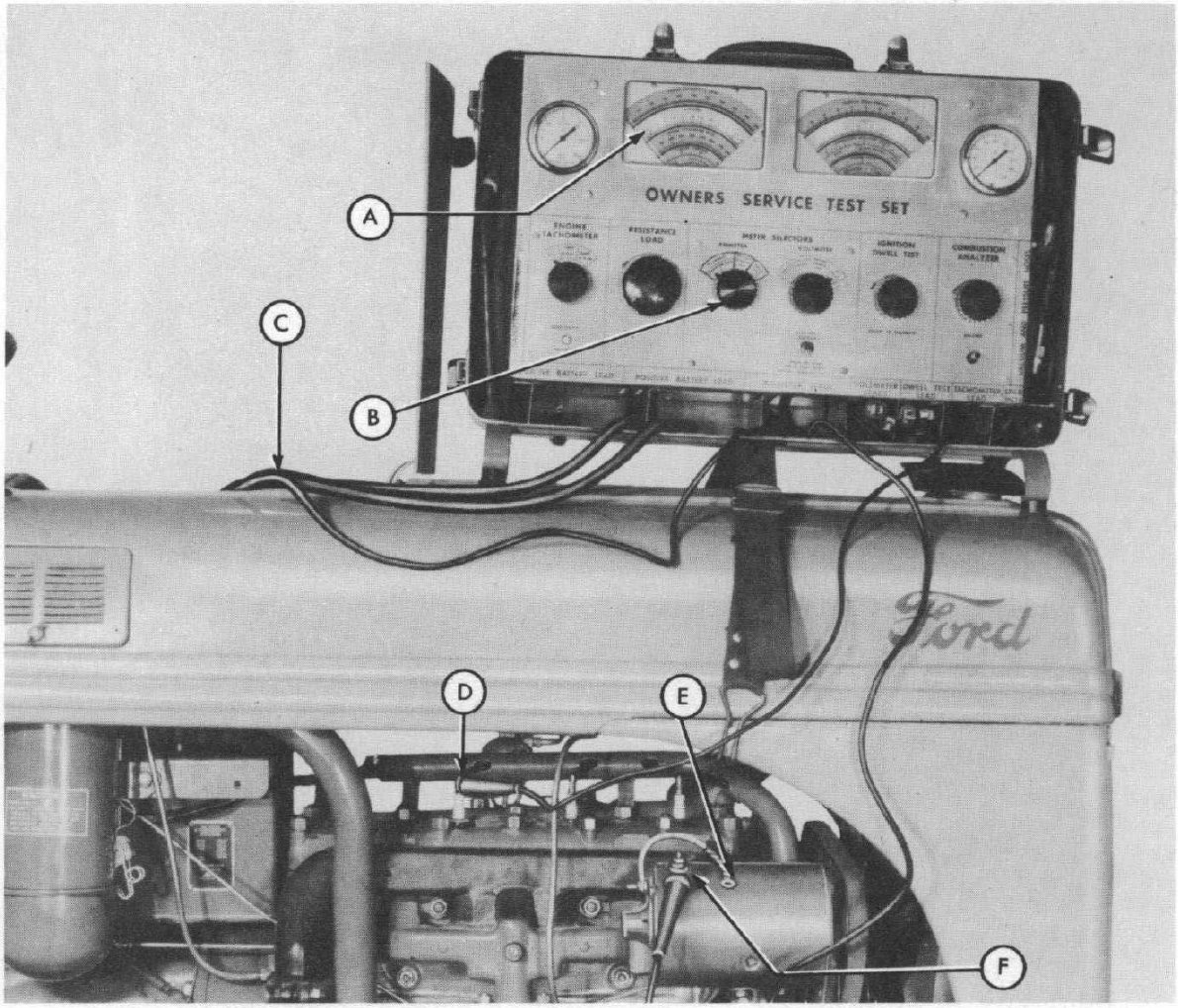


Fig. 8

IX. GENERATOR ARMATURE TEST

Step 1—Connect the Field lead if disconnected.

Step 2—Remove the fan belt.

Step 3—Connect the positive amperage lead to the armature terminal on the generator as shown at (A-Figure 9).

Step 4—Connect the negative amperage lead (B-Figure 9) to the negative battery post.

NOTE: The generator should now run as a motor. The 3-brush generator should draw from 5 to 6 amps. when running freely. The 2-brush generator should draw about 11 amps. (Check the reading on the 60 amp. scale (C-Figure 10).

Step 5—Stall the pulley by hand and check the reading on the ampere scale (C-Figure 9). The reading should be approximately 15 amps. on the 3-brush generator and should remain constant. The reading should be approximately 20 amps. on the 2-brush generator.

Step 6—Hold the generator pulley by hand allowing the pulley to turn slowly. The pull on the generator pulley should be even, and the ammeter reading steady.

NOTE: This test checks the condition of the brushes, commutator, armature connections and windings. A lessening of pull on the generator pulley accompanied by a decreased amperage reading at one particular position of the armature is an indication that a dead segment (open winding) is under the brush. A partially shorted armature will show high amperage.

X. CYLINDER COMPRESSION TEST

NOTE: This test checks the condition of the valves and rings. It also indicates the presence of carbon.

Step 1—Warm up the engine to normal operating temperature.

Step 2—Remove all spark plugs.

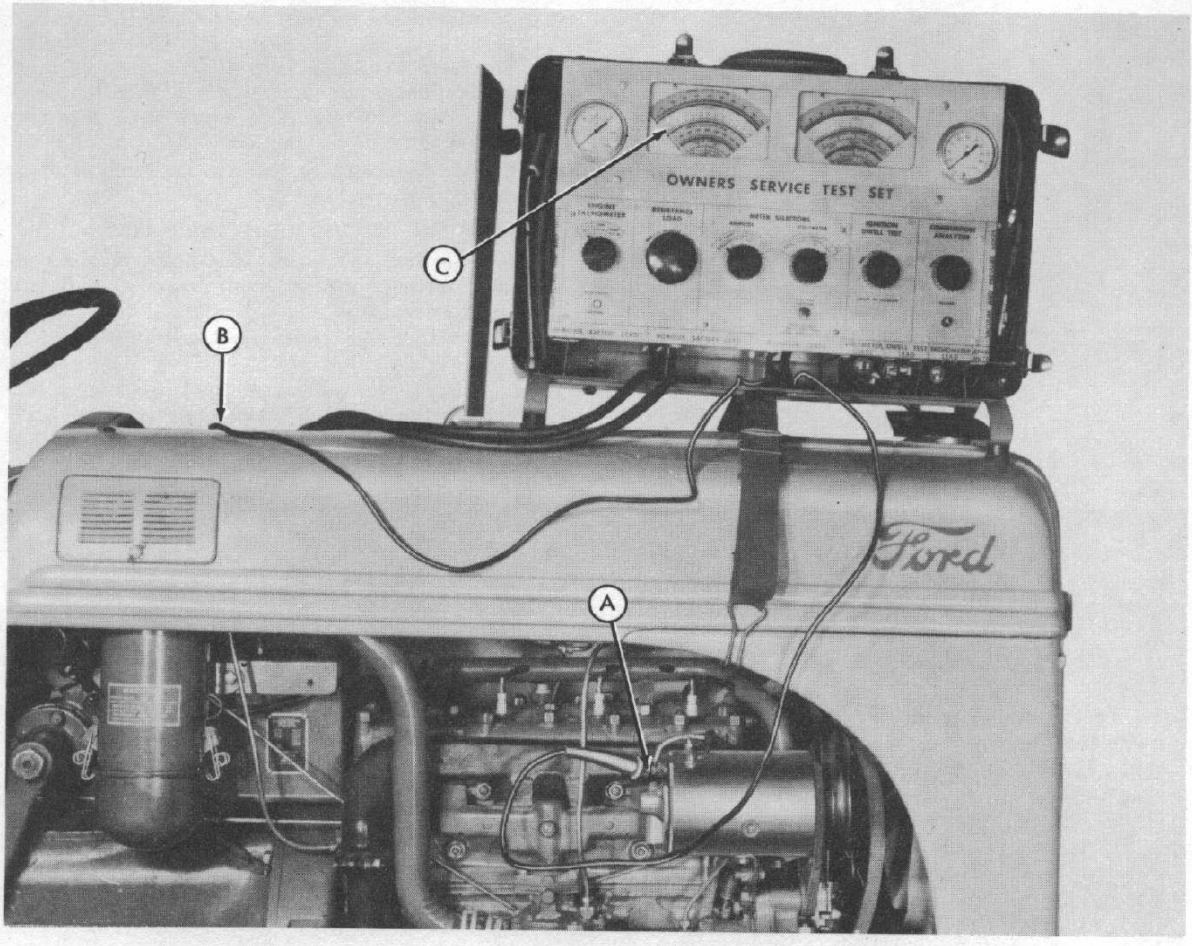


Fig. 9

Step 3—Plug the pressure hose adaptor with the proper rubber bushing, into a spark plug opening as shown at (A-Figure 10).

Step 4—Move the throttle on the tractor to the wide open position.

Step 5—Crank the engine with the push button control attached to the starter relay and ground and read on the pressure gauge (B-Figure 10). Continue cranking the engine for four or five seconds until the reading shows no further increase. The adaptor is provided with a check valve which permits the compression in the gauge to accumulate. Check the specifications sheet accompanying this Job Plan for the correct compression pressure.

Step 6—Remove the adaptor and check each cylinder in the same manner. The cylinder compression should read ± 10 lbs. of each other.

NOTE: Before removing the adaptor from the spark plug opening, press the release valve on the adaptor to reduce the reading by 20 pounds so that it will be certain to be below the compression of the next cylinder. By not reducing the compression to zero, less cranking is required on the balance of the cylinder.

XI. IGNITION DWELL TEST

Step 1—Turn off the ignition switch.

Step 2—Attach the dwell test leads of the test set by clipping the negative (black) lead to the lower terminal on the resistor (B-Figure 11) and the positive (red) dwell lead to the coil side of the ignition resistor (A-Figure 11).

Step 3—Attach the tachometer lead (C-Figure 11) to any spark plug.

Step 4—Adjust the ignition dwell test knob (D-Figure 11) until the ignition dwell meter (E-Figure 11) reads 100%. If no reading is obtained on the dwell meter, turn the engine over without starting it, until a reading is registered on the meter.

Step 5—Start the engine and set at idle speed.

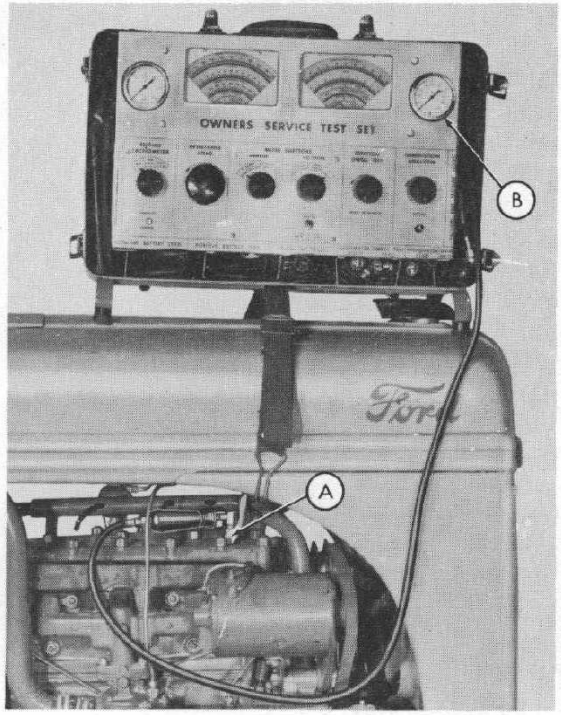


Fig. 10

Step 6—Read the percent of dwell on the ignition dwell meter (E-Figure 11). It should read 39% to 42.5% if the distributor points are properly set. A reading higher or lower than 39% to 42.5% indicates improper spacing of the points.

NOTE: It is necessary to remove the dwell leads to stop the engine.

XII. IGNITION CIRCUIT RESISTANCE TEST

NOTE: This test checks the condition of the connections, wiring, ignition coil primary, and primary circuit resistor.

Step 1—Attach the voltmeter leads to (D and E-Figure 12).

Step 2—Turn the voltmeter knob (B-Figure 12) to the 9-VOLT scale.

Step 3—Turn on the ignition switch, but do not start the engine. Leave the switch on for approximately 3 minutes to warm up the circuit.

Step 4—Check the reading on the voltmeter scale (A-Figure 12). If it is below one volt, press the 9/10 volt button (C-Figure 12) and divide the reading on the 9-volt scale by 10. If the meter reads backwards, reverse the leads.

NOTE: If no reading is obtained on the voltmeter scale, the distributor points are open and may be closed by turning the engine over (without start-

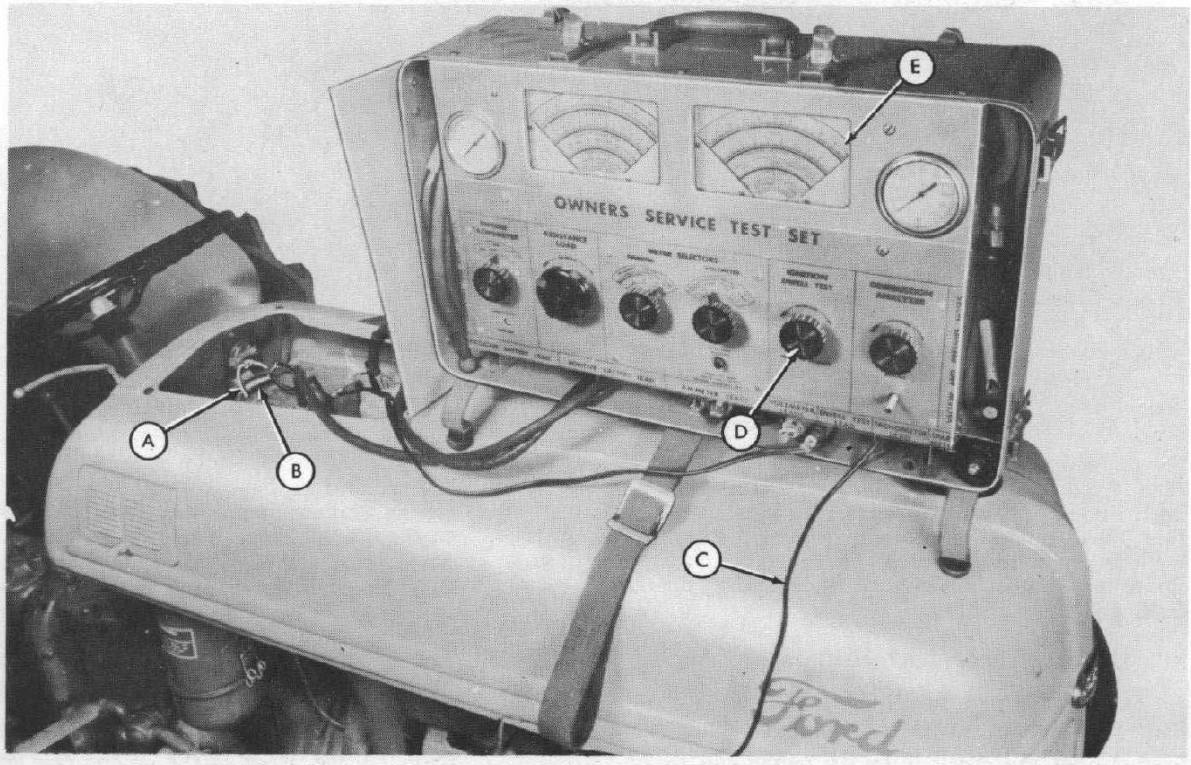


Fig. 11

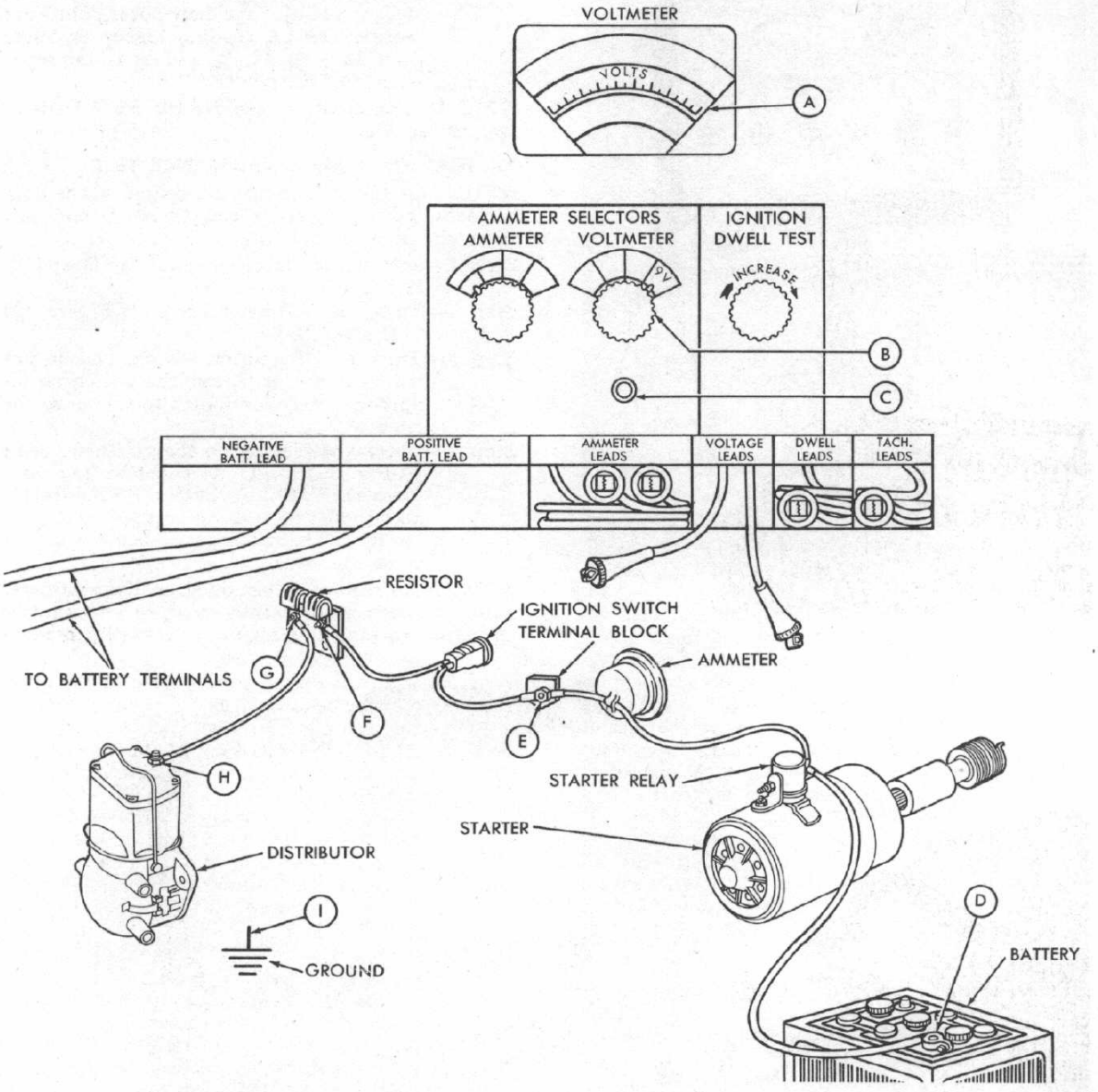


Fig. 12

ing). Check the specifications sheet accompanying this Job Plan for the maximum voltage drop. Follow this procedure attaching the voltmeter leads to the following points in Figure 12; E and F, F and G, G and H, H and I.

XIII. SPARK INTENSITY AT PLUG TEST

A. To check spark plug firing voltage.

Step 1—Start the engine and operate at idle speed.

Step 2—Set the spark intensity meter gap to 12 KV, connect the ground lead to the engine, and engage the spark meter clamp to the spark plug as shown in Figure 13.

Step 3—Momentarily "race" the engine two or three times. If the spark jumps the gap in the spark meter, the spark plug has high firing voltage and should be removed, cleaned, gapped (.025″) and tested in a spark plug tester.

B. To measure maximum spark.

Step 1—Disconnect all spark plug wires and lay them on the plugs so the engine can be operated.

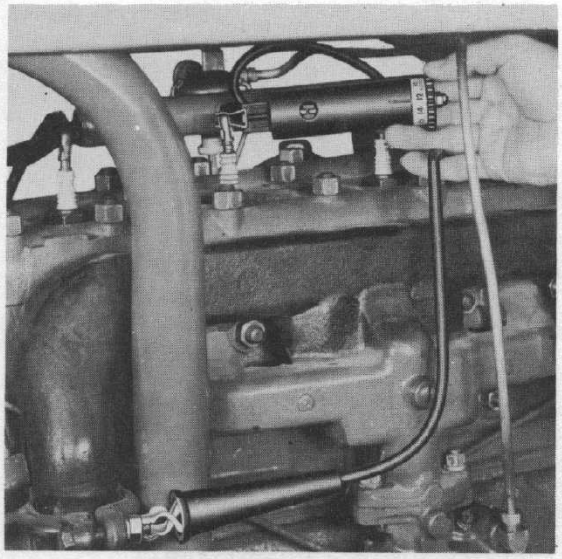


Fig. 13

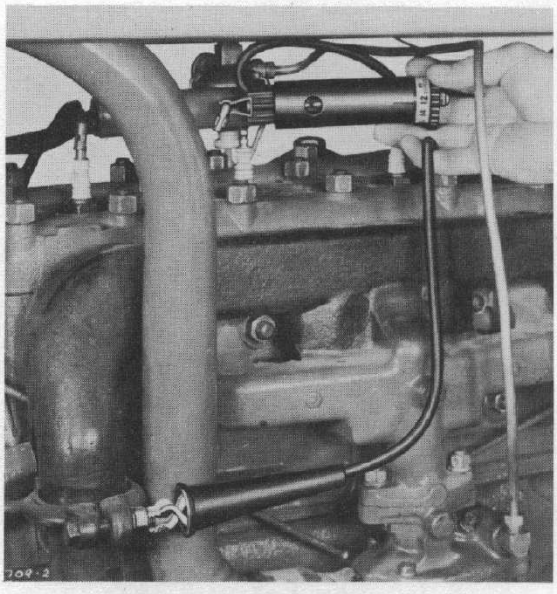


Fig. 14

Step 2—Start the engine and operate at idle speed.

Step 3—Connect the spark meter ground lead to the engine.

Step 4—Pick up each spark plug wire in turn (as shown in Figure 14) and determine the maximum gap the spark will jump without missing. The gap is determined by adjusting the calibrated scale on the spark tester. (The spark meter should be set at 14 KV and the spark must jump without missing.) Check the specifications sheet accompanying this Job Plan for the correct gap spacing. Too small a kilovolt reading indicates a weak and unsatisfactory spark. Low spark intensity at all plugs probably indicates a weak ignition coil. Low spark intensity at any one spark plug indicates a leaky cable.

XIV. MANIFOLD VACUUM TEST

Step 1—Remove the ¼" pipe plug from the intake manifold and screw the vacuum adaptor from the test set into the hole as shown at (A-Figure 15).

Step 2—Fit the vacuum hose over the adaptor.

Step 3—Crank the engine with the ignition off. The vacuum gauge (B-Figure 15) should read 5 inches.

Step 4—Start the engine and read the vacuum on the vacuum gauge (B-Figure 15).

NOTE: Check the reading with the information given on Figure 16.

XV. COMBUSTION ANALYSIS TEST

Step 1—Set the voltmeter knob to the combustion analysis position.

Step 2—Attach the tachometer lead to one of the spark plugs as shown at (C-Figure 17).

Step 3—Balance the combustion analyzer meter (A-Figure 17) by adjusting the combustion analyzer knob (B-Figure 17) to the balance point on the scale.

Step 4—Insert the gas pick-up unit of the test set into the exhaust pipe.

Step 5—Start the engine and operate at 700 RPM to provide a sufficient supply of exhaust through the analyzer.

Step 6—Open the carburetor main jet (E-Figure 17) one full turn to assure a rich mixture of fuel.

Step 7—Adjust the carburetor idle jet (D-Figure 17) in or out until the highest stable reading is noted on the tachometer.

Step 8—Turn the Tachometer Knob to 4000 RPM and advance the throttle until the tachometer reads 1400 RPM.

Step 9—Check the reading on the combustion analyzer meter (A-Figure 17).

Step 10—Adjust the carburetor main jet (E-Figure 17) to the point where the best performance is obtained and the pointer falls in the NORMAL section on the meter (A-Figure 17).

NOTE: The type of work being done with the tractor may govern the richness or leanness of the above setting within the NORMAL range.

Step 11—Decrease the engine RPM to idle speed and check the tachometer to see that the reading is reasonably stable.

Step 12—Adjust the idle jet (D-Figure 17) to compensate for richness or leanness of the fuel mixture indicated by the performance of the engine and tachometer.

NOTE: This test checks the setting of the idle jet and permits adjustment of the main jet for optimum performance under given conditions.


B
OWNERS SERVICE TEST SET
ENGINE TACHOMETER
RESISTANCE LOAD
METER SELECTORS
AMMETER
VOLTMETER
IGNITION DWELL TEST
COMBUSTION ANALYZER
NEGATIVE BATTERY LEAD
POSITIVE BATTERY LEAD
AMMETER LEADS
VOLTMETER LEADS
DWELL TEST LEAD
TACHOMETER LEAD
Ford
A

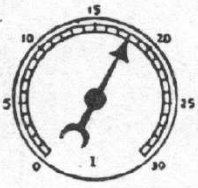
Fig. 15

Vacuum Gauge Reading

PERTAINING TO MOTOR TUNE-UP

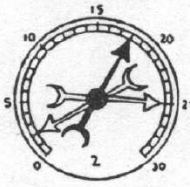
DARK NEEDLE INDICATES STEADY HAND
LIGHT NEEDLE INDICATES FLUCTUATING HAND

Normal Motor



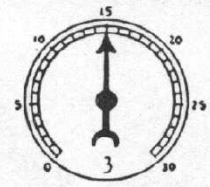
Hand steady between 17 and 21

Normal Motor



Opening and closing throttle rapidly. Rings and valves O.K.

Poor Rings or Oil

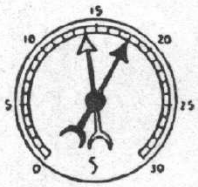


Hand steady but lower than normal

Poor Rings or Oil

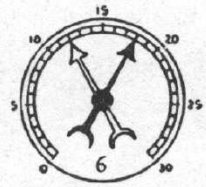
Opening and closing throttle rapidly. Hand pulls down to zero

Sticky Valve



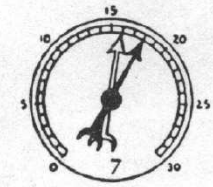
Hand drops occasionally about 4 divisions

Burnt Valve



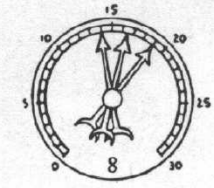
Hand drops regularly several divisions

Leaky Valve



Hand drops 2 or more divisions when valve should close

Loose Valve Guides

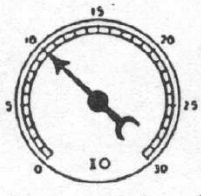


Fast vibration of hand between 14 and 19

Weak Valve Springs

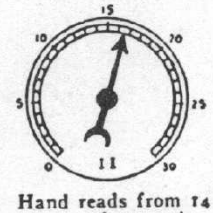
Motor racing, hand registers 10 to 22. Wider variations as speed is increased

Late Valve Timing



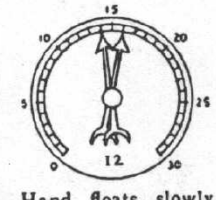
Hand reads from 8 to 15 and remains steady

Late Ignition Timing



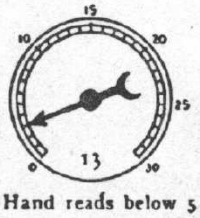
Hand reads from 14 to 17 and remains fairly steady

Plug Gaps too Close or Points not Synchronized



Hand floats slowly between 14 and 16

Leaky Intake or Carburetor Gasket



Hand reads below 5

Leaky Head Gasket Between Cylinders

Hands float regularly between 5 and 19

Choked Muffler

High reading at first. Breaks to 0 and builds back slowly to about 16

Carburetor Out of Adjustment

Hand floats slowly between 13 and 17

Fig. 16


OWNERS SERVICE TEST SET
ENGINE TACHOMETER
RESISTANCE LOAD
METER SELECTORS
AMMETER
VOLTMETER
IGNITION DWELL TEST
COMBUSTION ANALYZER
NEGATIVE BATTERY LEAD
POSITIVE BATTERY LEAD
AMMETER LEADS
VOLTMETER LEADS
TACHOMETER LEAD
A
B
C
D
E
Ford

Fig. 17

NOTES

NOTES

NOTES

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