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SECTION 1 SPECIFICATIONS

ENGINE SPECIFICATIONS

Brake Horsepower18	Breaker Point Gap020" (0.5 mm)	
Bore3.50" (88.90 mm)	Spark Plug Gap025" (0.6 mm)	
Stroke2.250 (57.15 mm)	Spark Run33° BTDC	
Displacement43.16ci (710 cm ³)	Spark Retard (Static timing) 7° BTDC	
Compression Ratio6.85:1	Oil FilterFull Flow	
Cranking Compression (PST)110 lbs. (758 kPa)	Valve Seat Angle44° 33'	
Governor TypeFlyball Type	Valve Face Angle45°	
Rotation (Viewed from fly- wheel)CW	Valve Timing for .040" (1.0 mm) Lash at ValveIntake Opens 4 de- grees 42' B.T.D.C.	
Spark PlugA.C. 85TS	Intake Closes 39 de- grees 40' A.B.D.C.	
Air CleanerPaper Cartridge	Exhaust Opens 39 de- grees 42' B.B.D.C.	
Spark Plug Size18 mm	Exhaust Closed 4 de- grees 40' A.T.D.C.	
Carburetor Setting		
High Speed (Turns open) .2¼ to 2¾ (ZENITH)		
Idle Speed (Turns open) . .1 to 1¼ (ZENITH) 1 to 2 (KEIHIN)		

TABLE OF CLEARANCES

Valve Tappet, Intake, Cold003" to .004" (0.08 to 0.10 mm)	Compression Ring Gap010 to .020 (0.25 to 0.51 mm)
Valve Tappet, Exhaust, Cold003" to .004" (0.08 to 0.10 mm)	Oil Control Ring Gap015 to .045 (0.38 to 1.14 mm)
Crankshaft End Play005" to .009" (0.13 to 0.23 mm)	Cam Shaft End Play002 to .007 (0.05 to 0.18 mm)
Rod To Crank Pin0011 to .0027 (0.03 to 0.07 mm)	Cam Gear Backlash002 to .004 (0.05 to 0.10 mm)
Rod (Side Play)005 to .015 (0.13 to 0.38 mm)	Cam Shaft Journal Bearing Bore Clearance0008 to .0023 (0.02 to 0.06 mm)
Rod To Wrist PinPress Fit	Main Bearing Clearance0004 to .002 (0.01 to 0.05 mm)
Wrist Pin To Piston Boss0004 to .0011 (0.01 to 0.03 mm)	Intake Valve Stem To Guide0015 to .0022 (0.04 to 0.06 mm)
Piston To Bore Clearance (Bottom of Skirt at 90° To Pin) .000 to .002 (0.0 to 0.05 mm)	Exhaust Valve Stem To Guide0025 to .0032 (0.06 to 0.08 mm)

DIMENSIONS

Crankshaft Journal (Main)1.9985/1.999" (50.76/50.77 mm)
Crankshaft Journal (Rod)1.7485/1.749" (44.41/44.42 mm)
Valve Stem Diameter Intake0.311/0.3103" (7.90/7.88 mm)
Valve Stem Diameter Exhaust0.309/0.3083" (7.85/7.83 mm)
Piston Pin Diameter0.8752/0.8749" (22.23/22.22 mm)
Piston Rings Compression3/32" (2.38 mm)
Piston Rings Oil
Rod Wrist Pin Hole0.8743/0.8738 (22.21/22.19 mm)
Camshaft Journal0.968/0.9675 (24.59/24.57 mm)

The following are the exact dimensions to which crankshafts should be ground when using under-size bearings:

UNDER- SIZE	MAIN JOURNALS	CRANK PIN JOURNALS
.015" (0.38 mm)	1.9840-1.9835" (50.39-50.38 mm)	1.7340-1.7335" (44.04-44.03 mm)
.030" (0.76 mm)	1.9690-1.9685" (50.01-50.00 mm)	1.7190-1.7185" (43.66-43.65 mm)

The following are the exact dimensions to which all cylinders should be bored when using oversize pistons:

OVERSIZE	CYLINDER DIAMETER
.020 (0.51 mm)	3.5200-3.5210" (89.40-89.43 mm)
.030 (0.76 mm)	3.5300-3.5310" (89.66-89.69 mm)

CAPACITIES

Fuel Tank Side Mount 7 Gallon (26.5 L) Rear Mount 6 Gallon (22.7 L) Transmission 1½ Pint (0.71 L) With Power Take-Off 2 Pint (1.0 L)	Differential ¾ Pint (0.35 L) Auxiliary Transmission 1 Pint (0.5 L) Engine — Model 218 2 Quarts (1.90 L) With Filter 2½ Quarts (2.38 L)
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LUBRICANTS & FUELS

Engine Oil—Use API specifications, SC motor oil only; Above 32° F (0°C)—SAE 30, Below 32° F (0°C)—SAE 10W
 Gasoline—Lead free, low lead or regular—not lower than 86 octane
 Transmission—Use SAE 80 above 32° F (0°C) or SAE 20W below 32° F (0°C)

Differential—Use EP80-90 multigrade lubricant
 Auxiliary Transmission—Use SAE 80 above 32° F (0°C) or SAE 20W below 32° F (0°C)



NOTE: Engine life expectancy may be extended by using leaded fuel.

GEAR RATIOS

Transmission	
High	1:1
Second	1.6:1
Low	2.6:1
Reverse	3.5:1
Auxiliary Transmission	2:1
Power Take-Off	2.47:1

BATTERY

Voltage	12
Ampere Hour Rating (At 20-hour rate)	40
Ground Terminal Polarity	Negative
Number of Cells	6


BULBS, FUSES & FLASHERS

Description	Specification	Trade No.	Cushman No.
Bulbs:			
Headlight	30-30 Watt	No. 4467	809723
Tail Light	32-4CP	No. 1157	882852
Turn Signal, Front	21CP	No. 1156	882836
Turn Signal, Rear	32CP	No. 1157	882851
Turn Signal, Pilot	1CP	No. 53	811953
Speedometer Light	1CP	No. 53	811953
High Beam Indicator	-----	-----	881295
Fuses:			
Turn Signal Fuse	3AG-10 amp. or AGC 10 amp.		111590
Windshield Wiper Fuse	3AG-4 amp. or AGC 4 amp.		817628

TABLE OF TORQUE VALUES

	Foot lbs.	Inch lbs.	N:m
Crankcase Screws	22-25		30-34
Cylinder Nuts	22-25		30-34
Connecting Rod	18-20		24-27
Spark Plug	22-25		30-34
Flywheel Nut	60-70		80-95
Valve Cover	5-7	60-80	7-9
Rocker Arm Shaft Nut	8-10	103-113	11-13
Manifold Nuts (Intake & Exhaust)	8-10	103-113	11-13
Governor & Timer Mounting Stud		46-51	5-6
Timer Nuts		53-59	5-7
Oil Drain Plug	28-31		38-42
Oil Gallery Plug	28-31		38-42
All 1/4-20 and 1/4-28 Engine Screws	6-8		8-11
With Soft Gaskets	5-12		7-16
Whiz-Lock Nut—Differential To Power			
Frame Mounting	150-170		203-221
Starter Drive Nut	25-30		34-40
Alternator Pulley Nut	40-50		54-70

TORQUE SPECIFICATION HEX HEAD CAP SCREWS

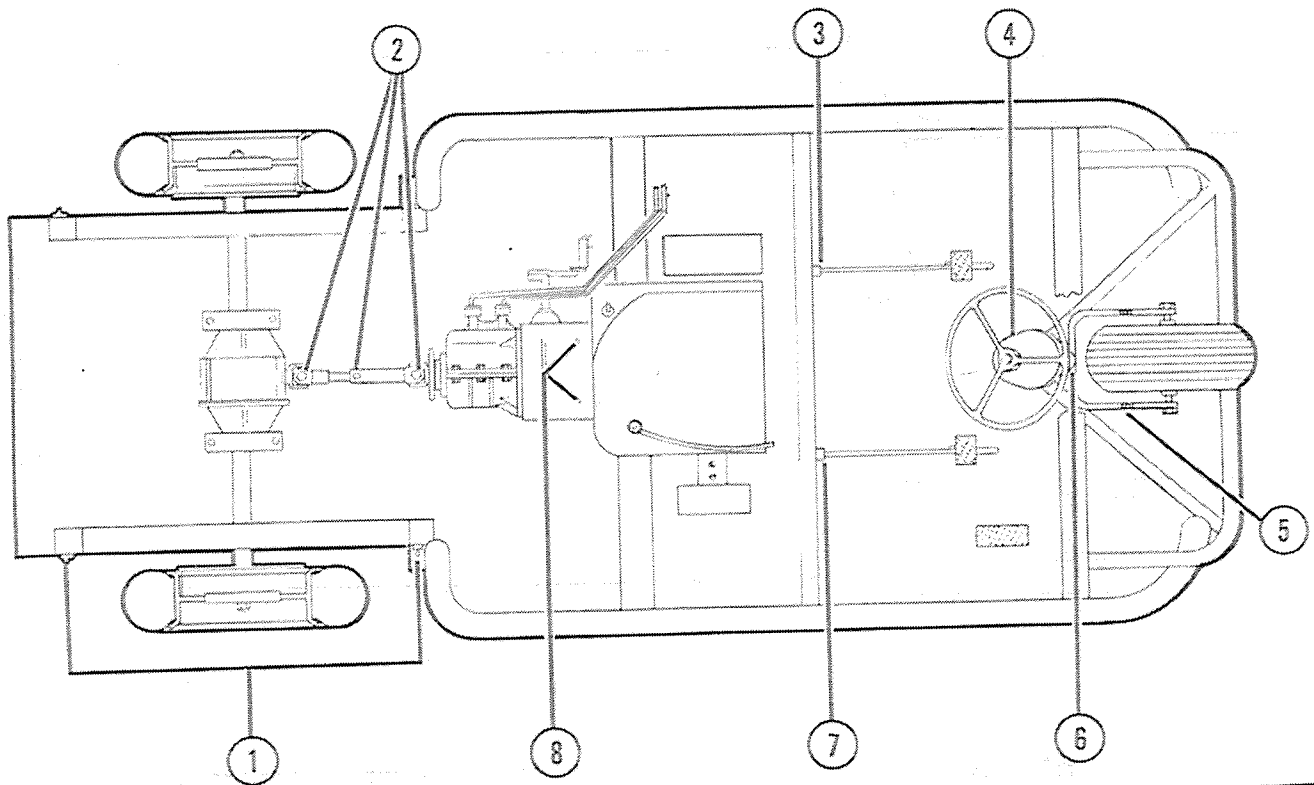
GRADE SCREW	MARKING	DEFINITION	MATERIAL	MINIMUM TENSILE STRENGTH
SAE Grade 5 ASTM A449		Minimum Commercial Quality (Lower quality not recommended)	Medium Carbon Steel Quenched and Tempered	105,000 P.S.I.
SCREW SHANK SIZE OR DIAMETER, FINE OR COARSE THREAD	TORQUE VALUES ENGLISH UNITS (All values are for dry assemblies)		TORQUE VALUES METRIC	
1/4	8 ± 2 lb. ft.		8 TO 13 N·m	
5/16	16 ± 2 lb. ft.		19 TO 24 N·m	
3/8	28 ± 2 lb. ft.		36 TO 40 N·m	
7/16	46 ± 4 lb. ft.		56 TO 70 N·m	
1/2	69 ± 5 lb. ft.		90 TO 100 N·m	
9/16	101 ± 9 lb. ft.		120 TO 150 N·m	
5/8	138 ± 12 lb. ft.		170 TO 200 N·m	
3/4	230 ± 20 lb. ft.		280 TO 340 N·m	
7/8	348 ± 35 lb. ft.		420 TO 510 N·m	
1	536 ± 50 lb. ft.		640 TO 800 N·m	



NOTE: The torque values shown should be used as a general guideline when specific torque values are not given.


SECTION 2 LUBRICATION

MODELS 898425 AND 898525 CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil* Check battery liquid level Inspect air filter element*
EVERY 100 HOURS
Perform previous services Replace air filter element
EVERY 200 HOURS
Perform previous services Lubricate chassis (see lube chart) Clean battery and terminals Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace fuel filter Check point gap* Check plug and replace if necessary* Check carburetor settings*

*  NOTE: Refer to engine manual for engine servicing recommendations.*

EVERY 2000 HOURS

Perform previous services
Change differential oil
Change transmission oil
Repack front wheel bearings
Repack rear wheel bearings
Check brake linings


See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

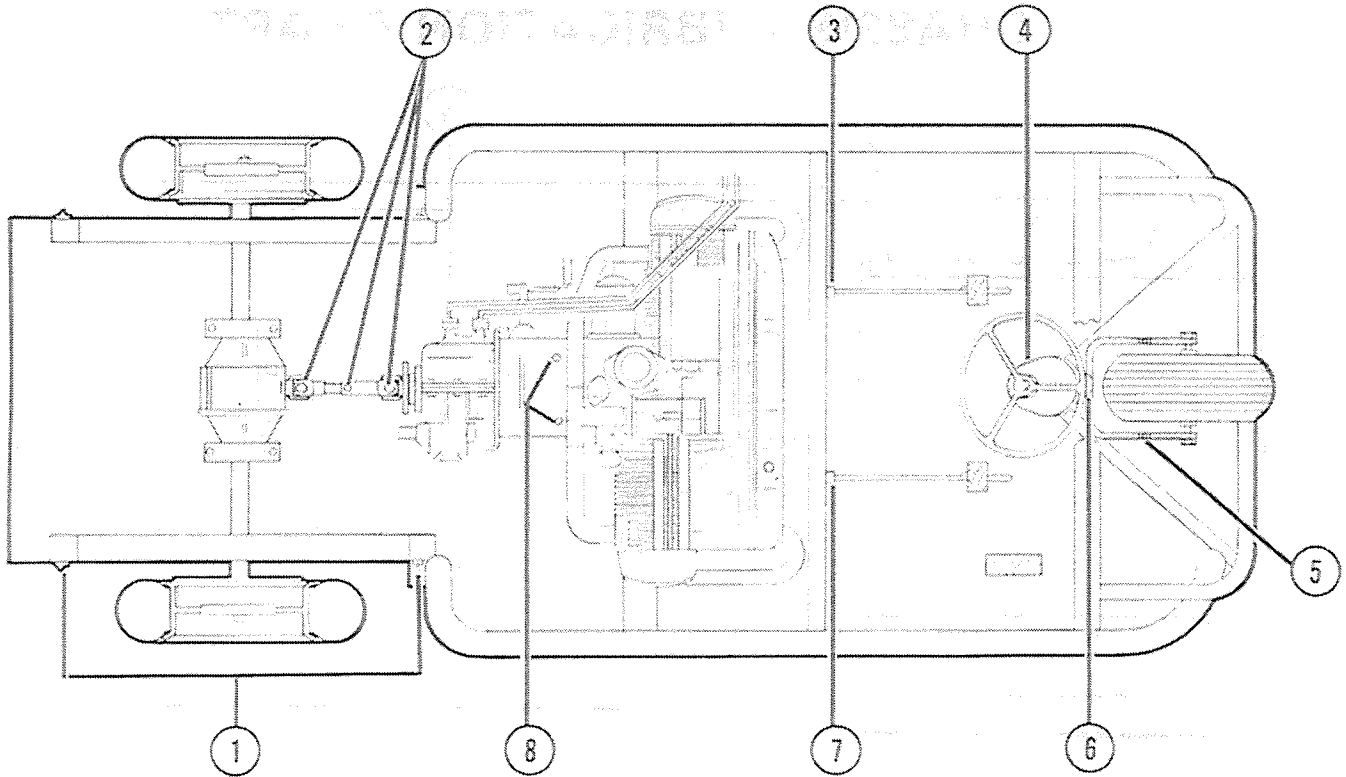
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS**
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box: one pump per fitting	3
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	1

**Use a lithium base pressure gun grease on all grease fittings.

 NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

MODELS 898434 AND 898435
CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Check starter motor brushes Check brake linings **Lubricate door paddle handle and link assembly pins
EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

Perform every 200 hours

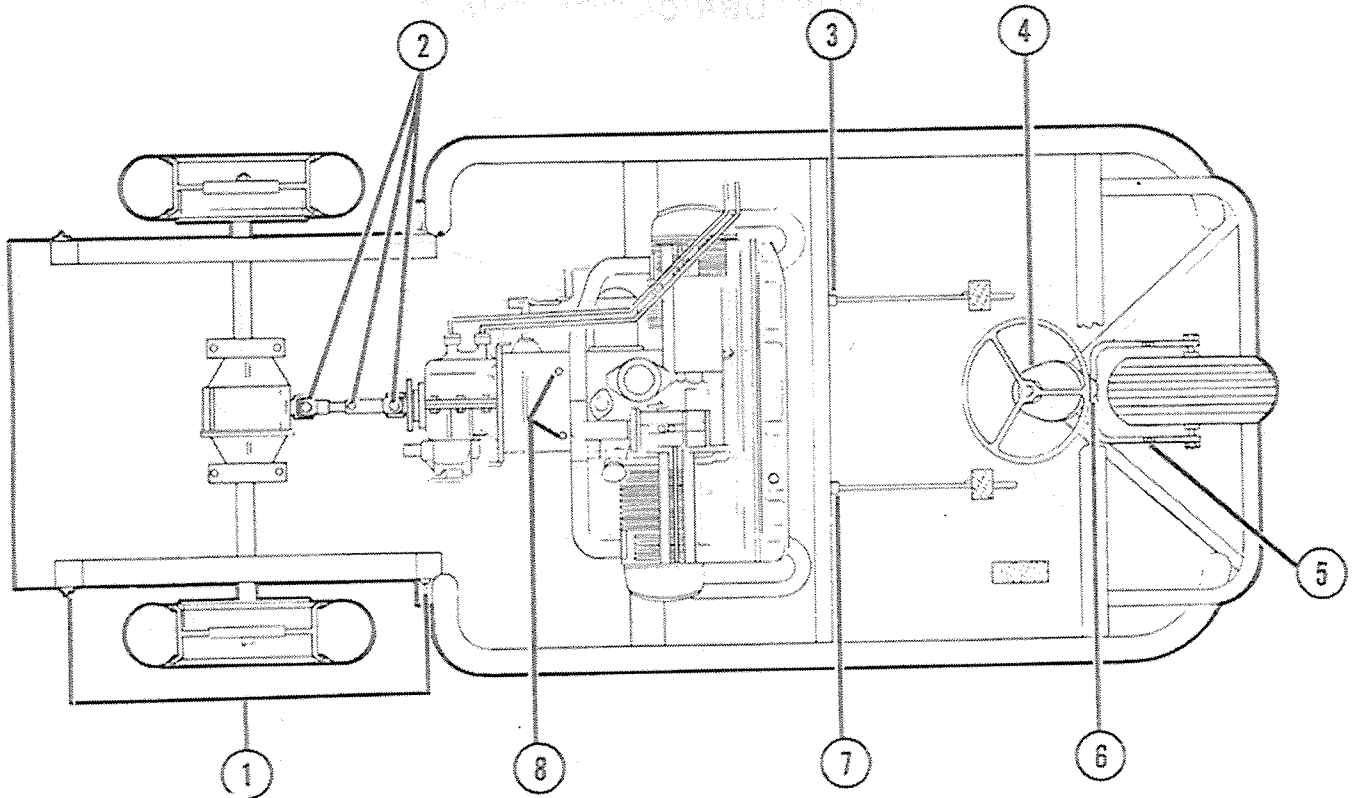
LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box; one pump per fitting	2
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	1

*Use a lithium base pressure gun grease on all grease fittings.

**Lubriplate #105 or equivalent.

NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

MODELS 898419 AND 898519
CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

EVERY 2000 HOURS
Perform previous services Change differential oil Change transmission oil Repack front wheel bearings Repack rear wheel bearings Check starter motor brushes Check brake linings

See specifications for recommended types of lubricant.

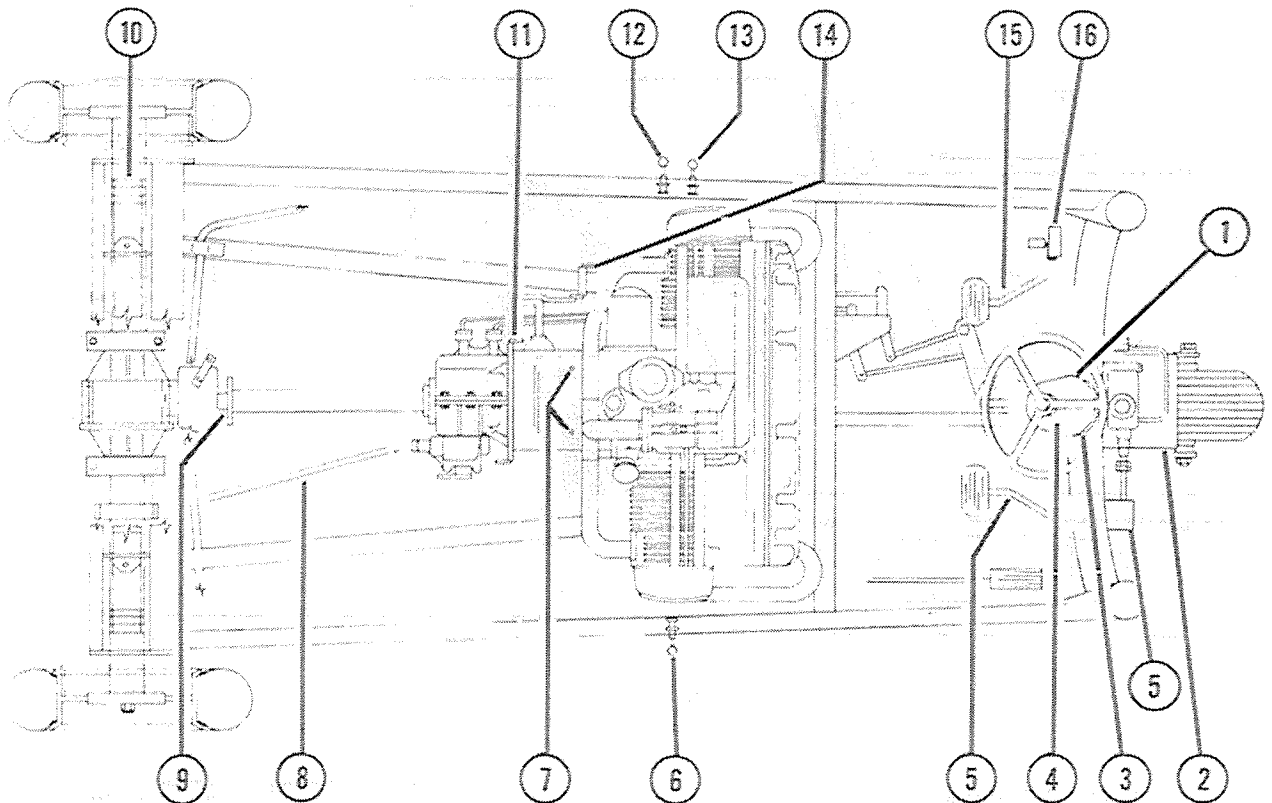
CHASSIS LUBRICATION GUIDE
 Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box: one pump per fitting	3
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	1

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

MODEL 898407 CHASSIS LUBRICATION CHART



2

MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element Oil hydraulic pump chain
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check auxiliary transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings
EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repace rear wheel bearings Repack P.T.O. carrier bearing Check starter motor brushes Check brake linings

EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil Change auxiliary transmission oil See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

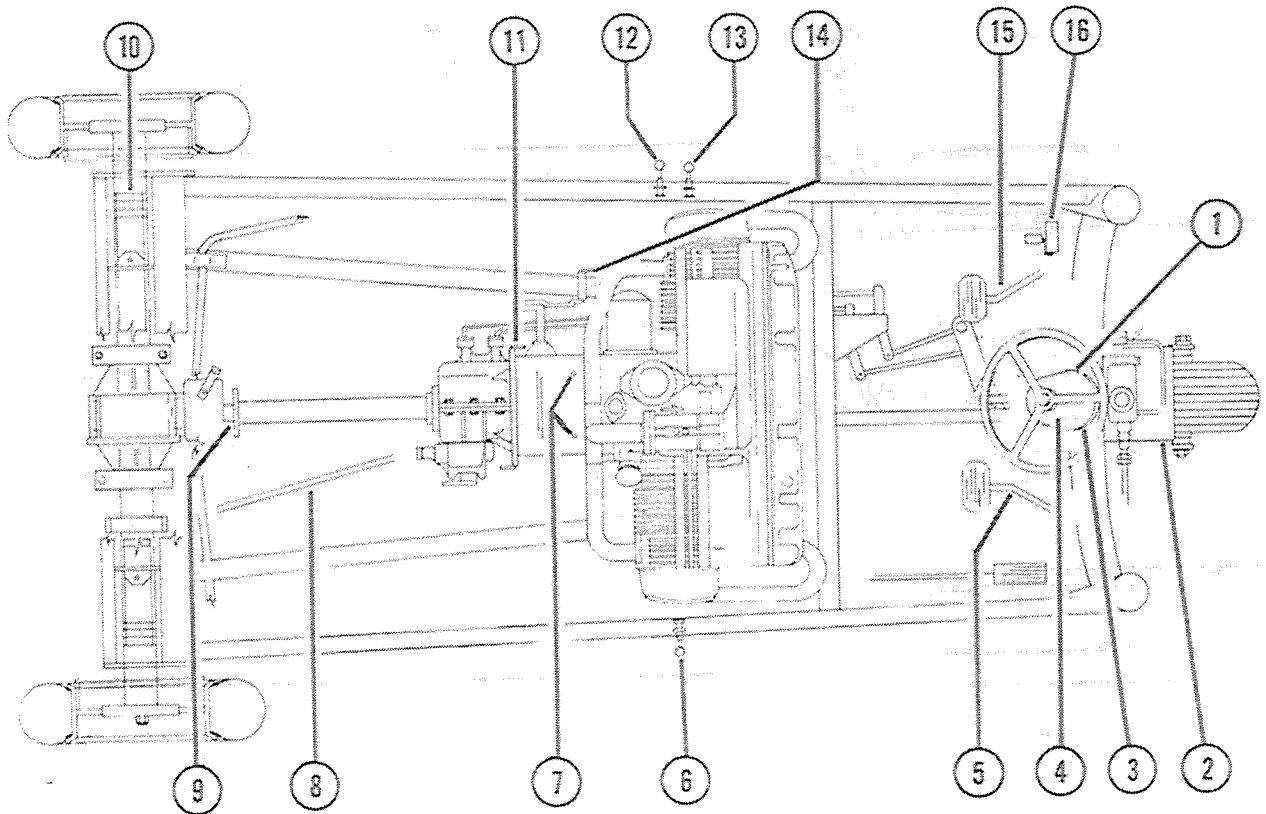
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Lower end of shifter shaft	1
2. Leading link bushings	2
3. Lower fork pivot bearing	1
4. Steering gear box: one pump per fitting	2
5. Brake pivot	2
6. P.T.O. shifter	1
7. Clutch arm	2
8. P.T.O. drive shaft	2
9. Drive shaft (one-ton flatbed): 1976 and earlier	2
10. Rear spring shackles	4
11. Hydraulic pump shifter bellcrank	1
12. Auxiliary transmission shifter	1
13. Hydraulic pump shifter	1
14. Clutch bellcrank	1
15. Clutch pivot	1
16. Parking brake handle	1

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Excessive grease can damage the seals on items 8 and 9 or the castings on item 4.

MODEL 898415 CHASSIS LUBRICATION CHART



2

MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element Oil hydraulic pump chain
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check auxiliary transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings
EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Repack P.T.O. carrier bearing Check starter motor brushes Check brake linings

EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil Change auxiliary transmission oil See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE Perform every 200 hours

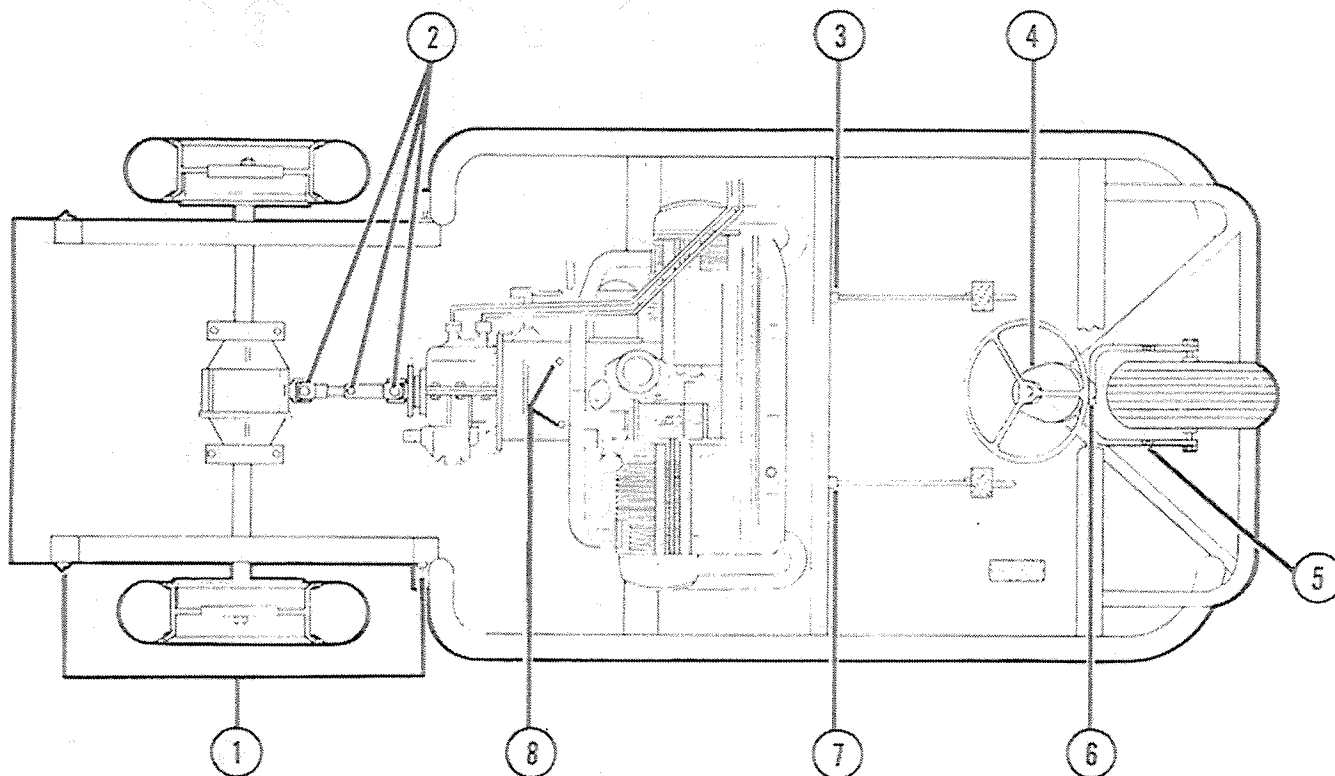
LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Lower end of shifter shaft	1
2. Leading link bushings	2
3. Lower fork pivot bearing	1
4. Steering gear box; one pump per fitting	2
5. Brake pivot	2
6. P.T.O. shifter	1
7. Clutch arm	2
8. P.T.O. drive shaft	2
9. Drive shaft (one-ton flatbed): 1976 and earlier	2
10. Rear spring shackles	4
11. Hydraulic pump shifter bellcrank	1
12. Auxiliary transmission shifter	1
13. Hydraulic pump shifter	1
14. Clutch bellcrank	1
15. Clutch pivot	1
16. Parking brake handle	1

*Use a lithium base pressure gun grease on all grease fittings.



NOTE: Excessive grease can damage the seals on items 8 and 9 or the castings on item 4.

**MODEL 898436
CHASSIS LUBRICATION CHART**



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Check starter motor brushes Check brake linings **Lubricate door paddle handle and link assembly pins.
EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

Perform every 200 hours

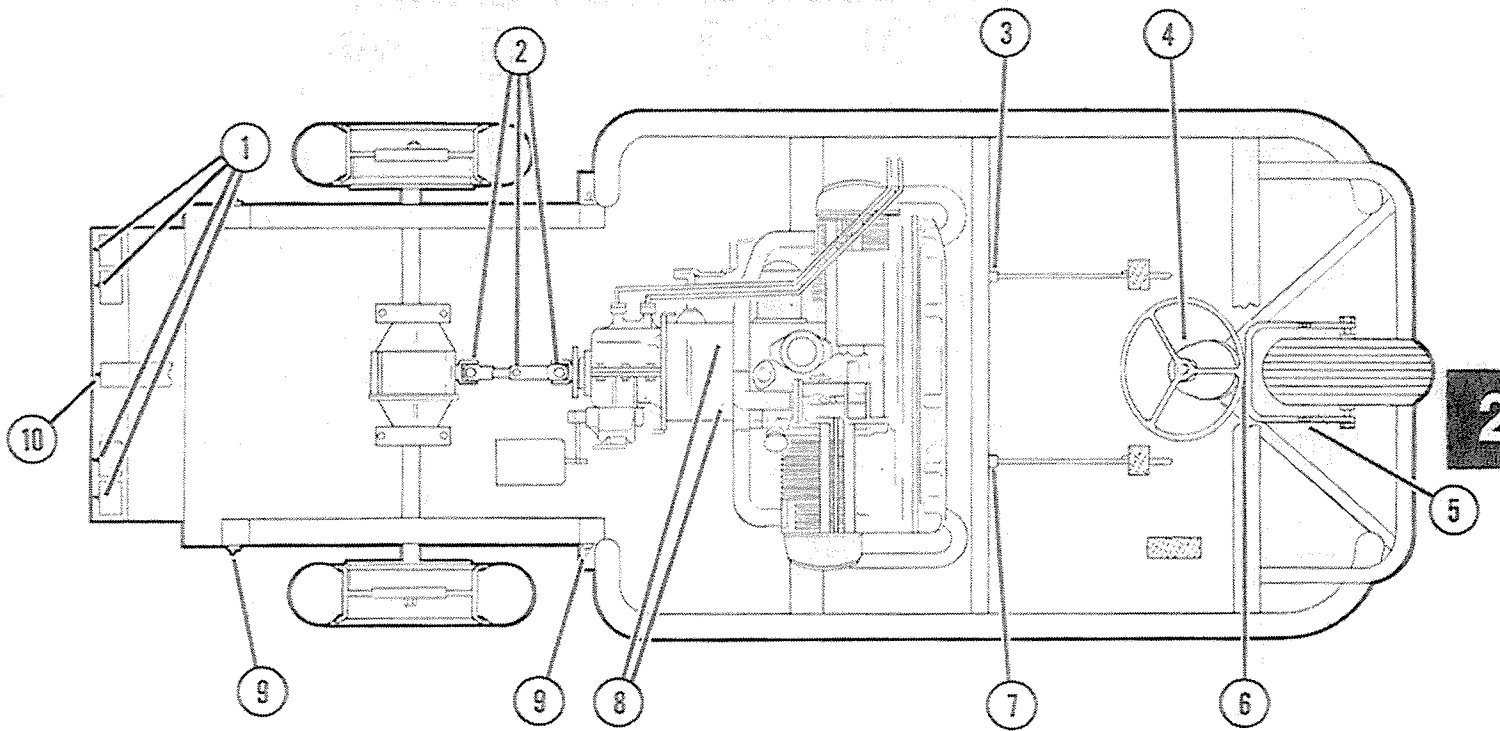
LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box: one pump per fitting	2
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	1

*Use a lithium base pressure gun grease on all grease fittings.

**Lubriplate #105 or equivalent.

NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

MODEL 898437 CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element Oil hydraulic pump chain
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment Check hydraulic pump fluid level
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

NOTE: Do NOT overfill the hydraulic pump. Severe damage may result. Refer to hydraulic system, Page 47.

EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Repack P.T.O. carrier bearing Check starter motor brushes Check brake linings **Lubricate door paddle handle and link assembly pins
EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil
See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

Perform every 200 hours

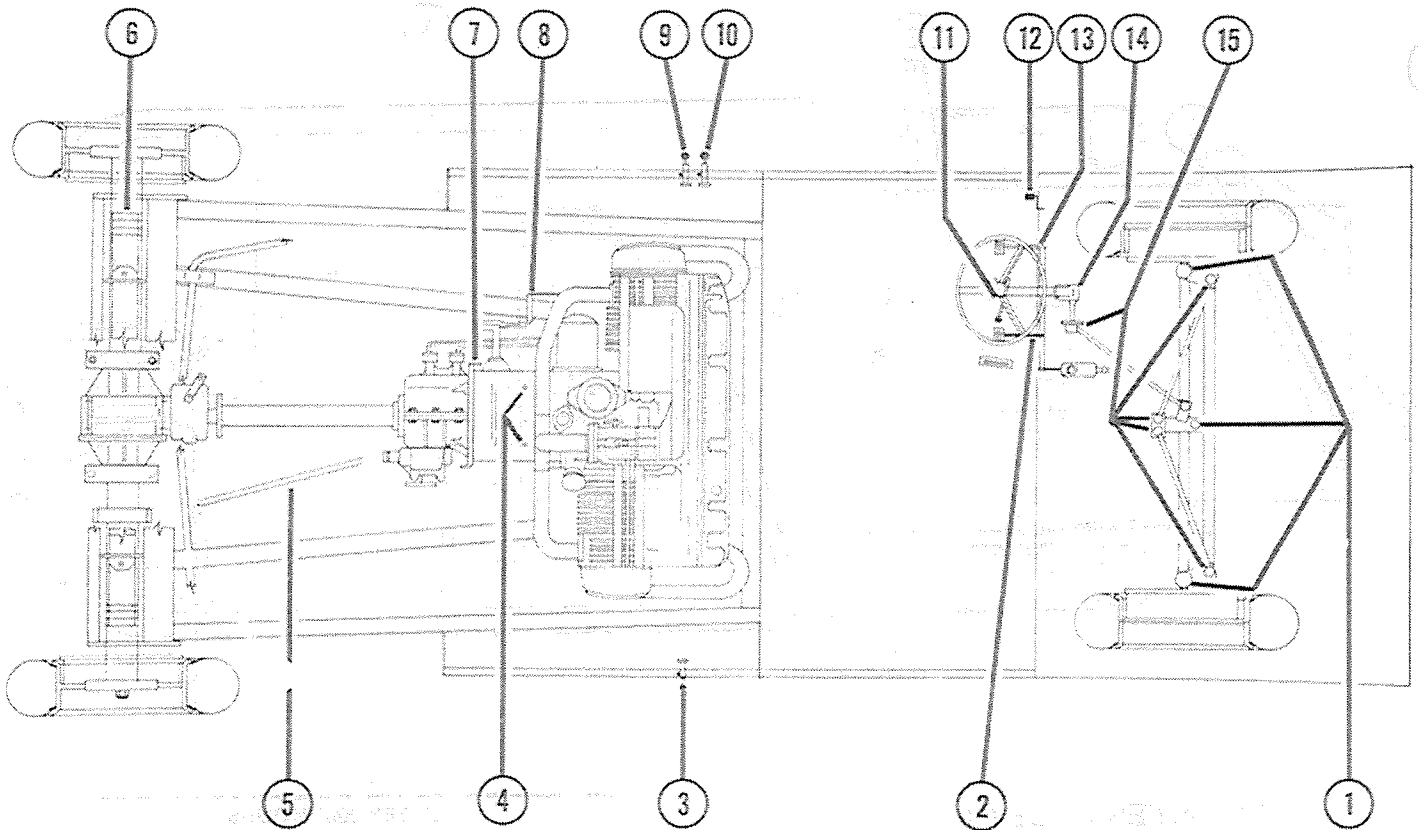
LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Box pivot bushings	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box: one pump per fitting	2
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	2
9. Rear spring shackles	4
10. Rear of hydraulic cylinder	1

*Use a lithium base pressure gun grease on all grease fittings.

**Lubriplate #105 or equivalent.

NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery acid level
EVERY 100 HOURS
Perform previous services Inspect air filter element Oil hydraulic pump chain
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check auxiliary transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings
EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Repack P.T.O. carrier bearing Check starter motor brushes Check brake linings

EVERY 4000 HOURS

Perform previous services
Change differential oil
Change transmission oil
Change auxiliary transmission oil
See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

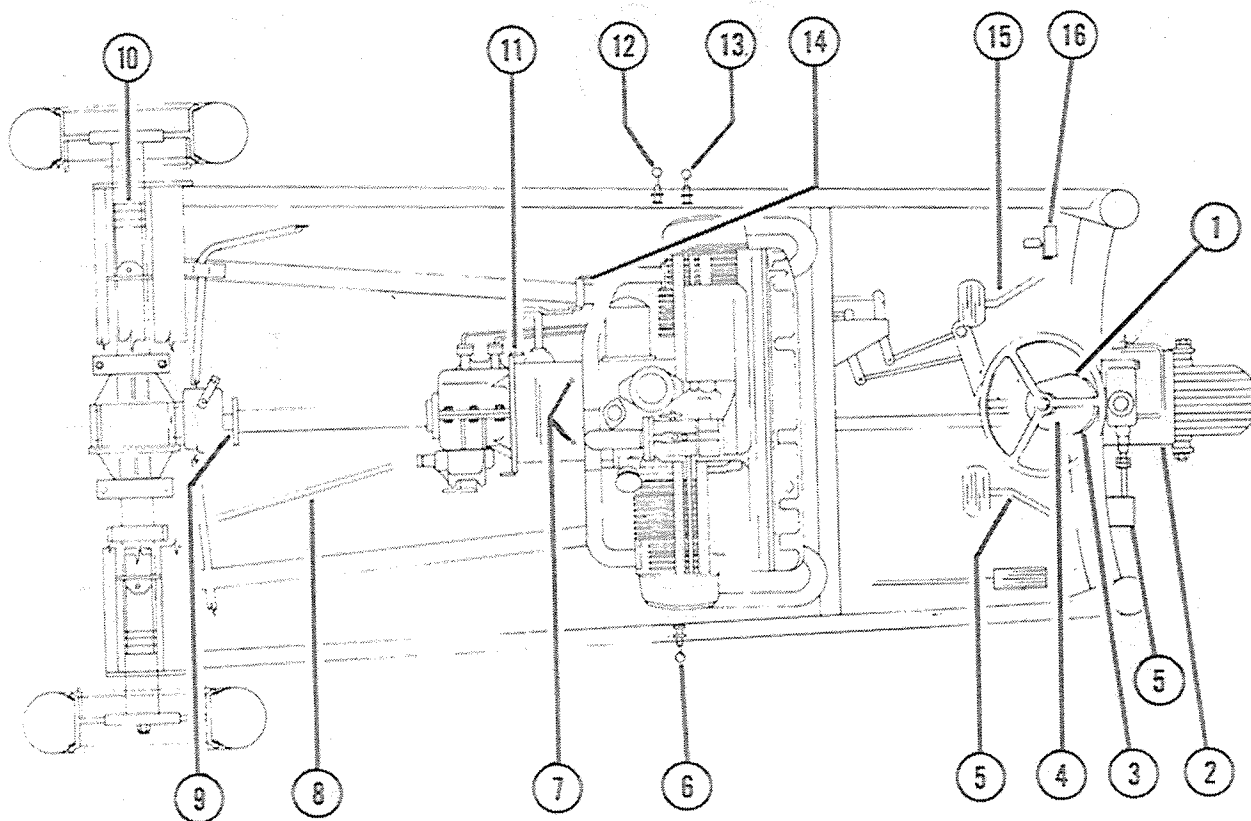
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. King pin and steering pivot	(3)
2. Brake linkage	(1)
3. P.T.O. shifter	(1)
4. Clutch arm	(2)
5. P.T.O. drive shaft	(2)
6. Rear spring shackles	(4)
7. Hydraulic pump shifter bellcrank	(1)
8. Clutch bellcrank	(1)
9. Auxiliary transmission shifter	(1)
10. Hydraulic pump shifter	(1)
11. Lower end of shifter shaft	(1)
12. Parking brake handle	(1)
13. Clutch linkage	(1)
14. Steering gear box	(1)
15. Steering linkage	(6)

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Items 5 & 14. Excessive grease can damage seals.

CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element Oil hydraulic pump chain
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check auxiliary transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings
EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Repack P.T.O. carrier bearing Check starter motor brushes Check brake linings

EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil Change auxiliary transmission oil See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE

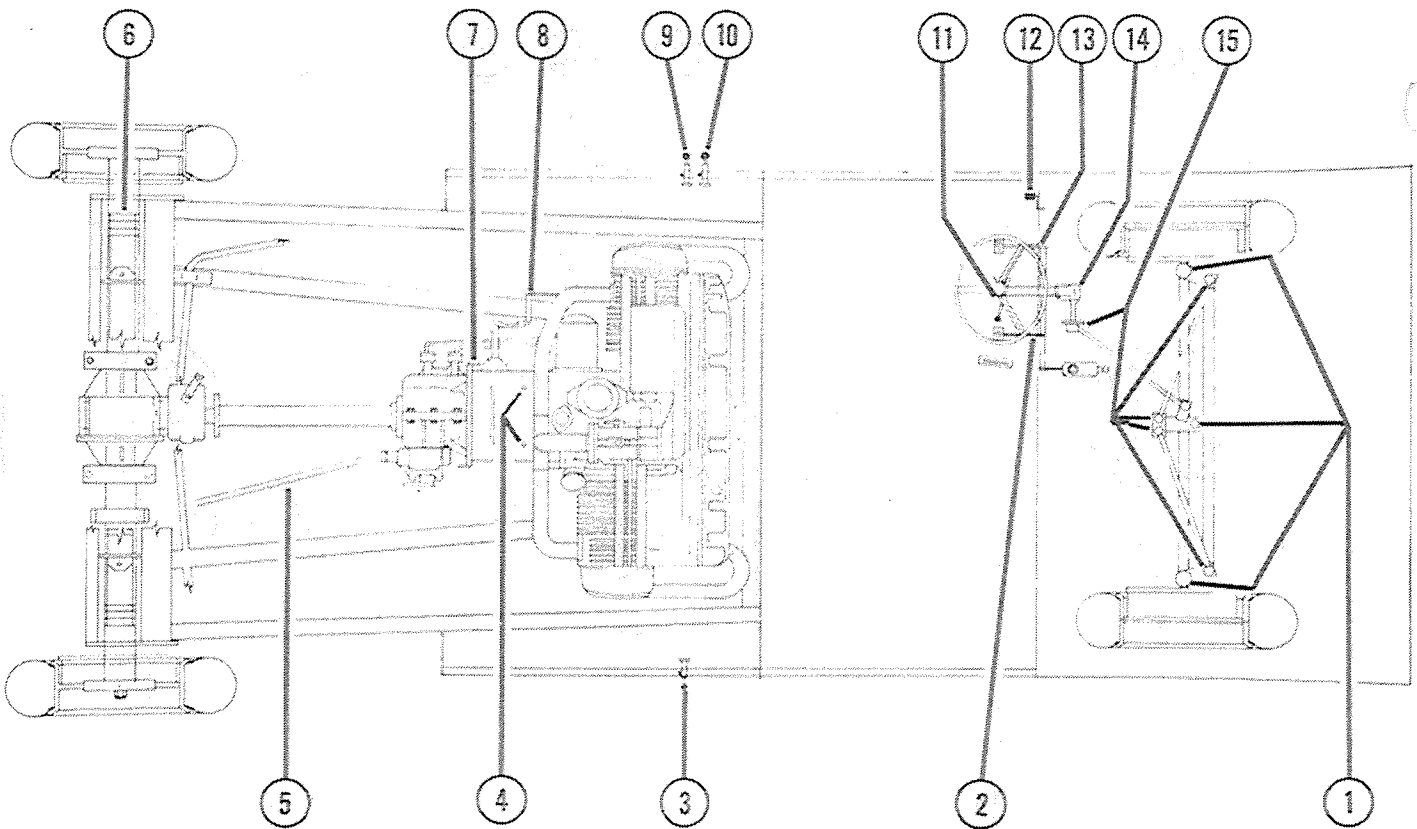
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Lower end of shifter shaft	1
2. Leading link bushings	2
3. Lower fork pivot bearing	1
4. Steering gear box: one pump per fitting	2
5. Brake pivot	2
6. P.T.O. shifter	1
7. Clutch arm	2
8. P.T.O. drive shaft	2
9. Drive shaft (one-ton flatbed): 1976 and earlier	2
10. Rear spring shackles	4
11. Hydraulic pump shifter bellcrank	1
12. Auxiliary transmission shifter	1
13. Hydraulic pump shifter	1
14. Clutch bellcrank	1
15. Clutch pivot	1
16. Parking brake handle	1

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Excessive grease can damage the seals on items 8 and 9 or the castings on item 4.

CHASSIS LUBRICATION CHART



2

MAINTENANCE GUIDE	
EVERY 50 HOURS	
Check engine oil level	
Check battery liquid level	
EVERY 100 HOURS	
Perform previous services	
Inspect air filter element	
Oil hydraulic pump chain	
EVERY 200 HOURS	
Perform previous services	
Change engine oil	
Change oil filter	
Lubricate chassis (see lube chart)	
Clean battery and terminals	
Lubricate starter drive	
Check differential oil level	
Check transmission oil level	
Check auxiliary transmission oil level	
Check hydraulic brake fluid	
Check brake adjustment	
Check clutch adjustment	
EVERY 1000 HOURS	
Perform previous services	
Replace air filter element	
Replace fuel filter	
Check valve clearance	
Check point gap	
Check plugs and replace if necessary	
Check carburetor settings	

EVERY 2000 HOURS	
Perform previous services	
Change differential oil	
Change transmission oil	
Change auxiliary transmission oil	
Repack front wheel bearings	
Repack rear wheel bearings	
Repack P.T.O. carrier bearing	
Check starter motor brushes	
Check brake linings	
See specifications for recommended types of lubricant.	

CHASSIS LUBRICATION GUIDE

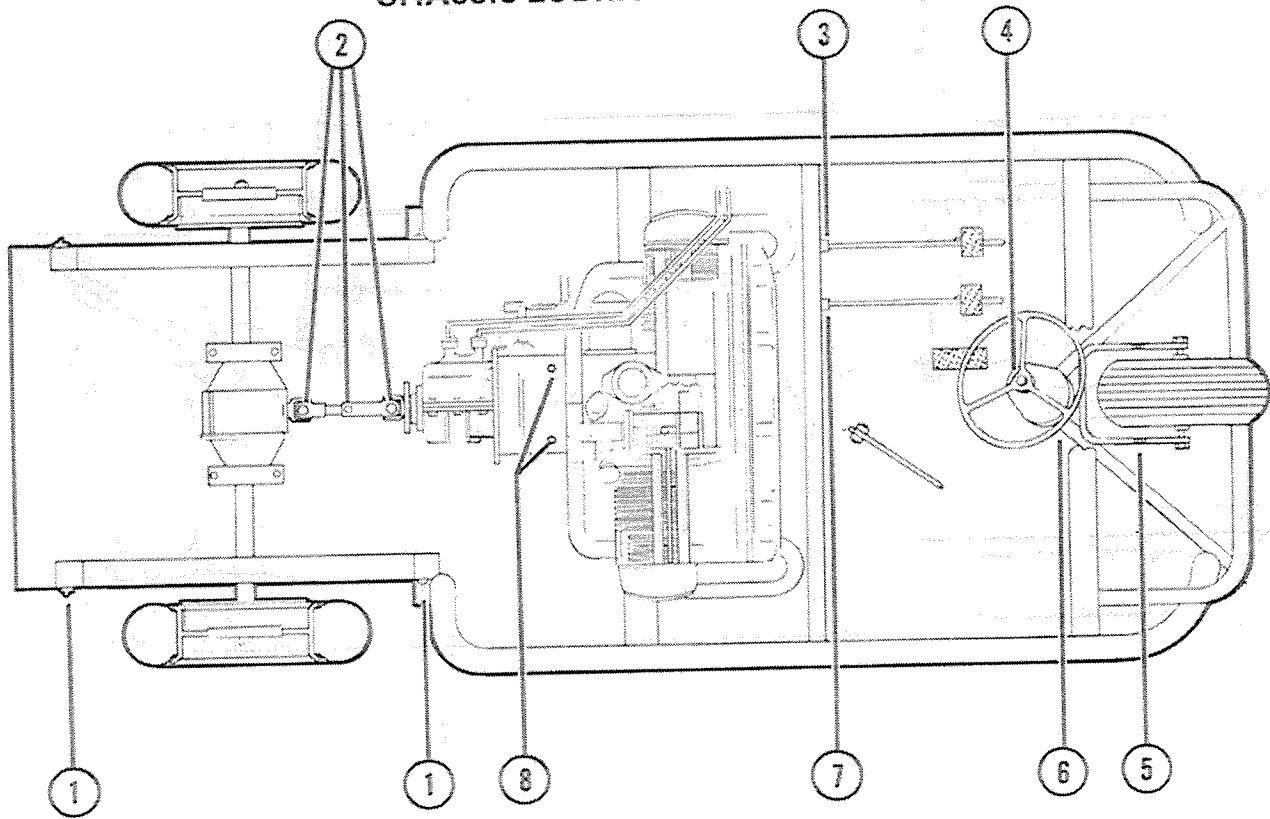
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. King pin and steering pivot	(3)
2. Brake linkage	(1)
3. P.T.O. shifter	(1)
4. Clutch arm	(2)
5. P.T.O. drive shaft	(2)
6. Rear spring shackles	(4)
7. Hydraulic pump shifter bellcrank	(1)
8. Clutch bellcrank	(1)
9. Auxiliary transmission shifter	(1)
10. Hydraulic pump shifter	(1)
11. Lower end of shifter shaft	(1)
12. Parking brake handle	(1)
13. Clutch linkage	(1)
14. Steering gear box	(1)
15. Steering linkage	(6)

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Excessive grease can damage the seals on item 5 or the castings on item 14.

MODEL 898515
CHASSIS LUBRICATION CHART



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Check starter motor brushes Check brake linings
EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil
See specifications for recommended types of lubricant.

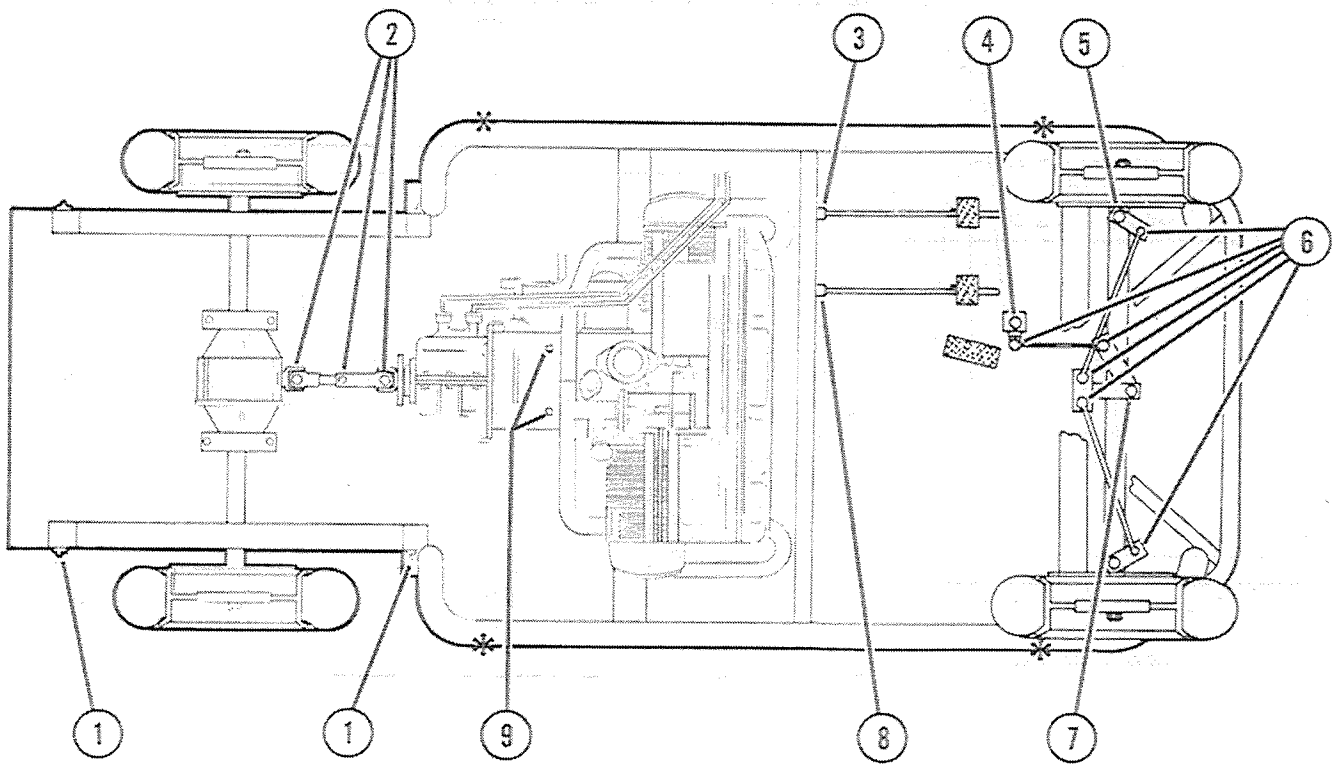
CHASSIS LUBRICATION GUIDE
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box: one pump per fitting	2
5. Leading link bushings	2
6. Lower fork pivot bearing	1
7. Brake bellcrank	1
8. Clutch arm	2

*Use a lithium base pressure gun grease on all grease fittings.

NOTE: Excessive grease can damage the seals on item 2 or the castings on item 4.

**MODEL 898444
CHASSIS LUBRICATION CHART**



MAINTENANCE GUIDE

EVERY 50 HOURS
Check engine oil level Check battery liquid level
EVERY 100 HOURS
Perform previous services Inspect air filter element
EVERY 200 HOURS
Perform previous services Change engine oil Change oil filter Lubricate chassis (see lube chart) Clean battery and terminals Lubricate starter drive Check differential oil level Check transmission oil level Check hydraulic brake fluid Check brake adjustment Check clutch adjustment
EVERY 1000 HOURS
Perform previous services Replace air filter element Replace fuel filter Check valve clearance Check point gap Check plugs and replace if necessary Check carburetor settings

EVERY 2000 HOURS
Perform previous services Repack front wheel bearings Repack rear wheel bearings Check starter motor brushes Check brake linings **Lubricate door paddle handle and link assembly pins.
EVERY 4000 HOURS
Perform previous services Change differential oil Change transmission oil
See specifications for recommended types of lubricant.

CHASSIS LUBRICATION GUIDE
Perform every 200 hours

LUBRICATION AREA	NUMBER OF GREASE FITTINGS*
1. Rear spring shackles	4
2. Drive shaft	3
3. Clutch bellcrank	1
4. Steering gear box	1
5. King pin bushings	2
6. Steering linkage	6
7. Steering pivot	1
8. Brake bellcrank	1
9. Clutch arm	2

*Use a lithium base pressure gun grease on all grease fittings.
**Lubriplate #105 or equivalent.

NOTE: Excessive grease can damage the seals on item 2 or 4.

2

SECTION 3 TUNE-UP

ENGINE TUNE-UP



SAFETY WARNING: The electrical and exhaust systems on the vehicle can cause sparks, which could ignite gases or explosive materials.



SAFETY WARNING: Do not remove or install the engine cover while engine is running. The engine cover is a machinery guard. Its removal exposes the operator to moving parts. Keep hands, hair and clothing away from flywheel, air intake, and all moving parts.

There are three fundamentals to be considered in making an engine tune-up. They are compression, ignition and carburetion. Since compression does not depend on either carburetion or ignition, it is advisable that the compression always be checked first when performing a tune-up job.

Before making the actual compression test, it is essential that the battery is completely charged so that the engine can be rotated at the maximum starter rpm. It is likewise essential that the engine be warmed up to approximately operating temperature before making the test. After warming up the engine, remove both spark plugs and block the carburetor throttle and choke in a wide open position. Insert the gauge in the spark plug hole of one cylinder, operate the starter and observe the gauge reading. Repeat the same test on the other cylinder. If the compression on either one or both cylinders is less than 100 pounds, it would indicate leaking valves, leaking or worn piston rings or possibly both, in which case it would be necessary to remove the cylinders and make the necessary repair or replacements. At no time should the compression vary more than 10 pounds between the two cylinders.

If compression tests meet the specifications listed above, the following operations should be made in sequence:

1. Replace spark plugs.
2. Check ignition timing advance mechanism; repair as necessary.
3. Clean and adjust or replace points. If points are replaced, replace condenser also.
4. Check ignition timing and adjust as necessary.
5. Check valve tappet clearance and adjust if necessary.
6. Clean and rebuild carburetor.
7. Check air cleaner. Paper cartridges must be replaced when dirty or leaking.
8. Check starter brushes, replace if necessary.
9. Check for frayed or damaged wiring.

10. Check battery and recharge or replace as necessary.

SPARK PLUGS

Spark plugs improperly adjusted or worn and dirty will cause hard starting and faulty operation. Adjust gap to .025 (0.6 mm). When spark plugs are replaced, be sure the replacements are of the proper type.

CHECKING SPARK ADVANCE MECHANISM

With an automotive timing light connected to either spark plug and engine idling between 900 and 1000 rpm, observe location of timing mark on flywheel. Make a corresponding mark with a pencil on the fan housing. Then with engine running at governed rpm make another corresponding mark on the fan housing. With the engine stopped, measure the distance between the two pencil marks. This distance should be approximately 1-7/8" (47.6 mm). If the distance is less, it is an indication that the advance mechanism is not working properly and must be repaired.

Refer to "Timer and Governor Overhaul."

POINT SETTING

Remove the timer cover and rotate the engine until the points are fully open. Using a feeler gauge, measure the breaker point gap. Points must be set at .020 (0.5 mm). If points need adjusting, loosen the breaker plate screw and move the adjusting screw until the proper adjustment is reached. Tighten breaker plate screw and recheck point gap.

Replace timer cover.

The breaker point setting should only be adjusted in the manner described. At no time should the fixed contact be loosened or the breaker arm bent to provide adjustment.

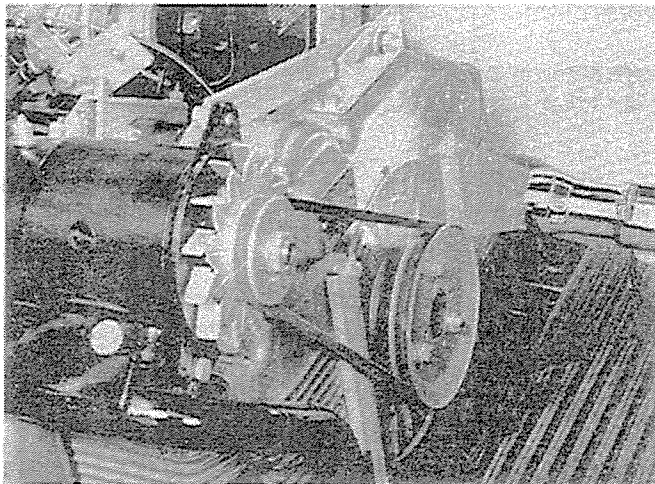
REPLACING THE CONDENSER

Loosen the timer lead screw nuts. They need not be removed. Remove the condenser lead and the condenser mounting screw. Replace condenser and tighten lead screw nuts. Be sure insulating washers are in place.

IGNITION TIMING

Correct ignition timing is very important if peak engine performance is to be obtained.

A timing mark is cast into the front fan housing at the extreme top of the air intake opening. Another timing mark will be found in the form of a lug cast on one fin of the flywheel. With the breaker points set at the proper gap, these two timing marks must line up at the instant the breaker points open.



1. Timing Mark

If a timing adjustment is necessary, loosen the two clamp nuts which secure the timer body to the crankcase, and rotate the timer body to make the desired adjustment. By observing the arrow stamped above the letter "T" in the timer cover, it can be determined which way to rotate the timer body to either advance or retard the ignition timing. Rotating the timer in the direction to which the arrow is pointing will advance the timing. Be sure that the timing is correct after the timer clamp nuts are tightened.

3

While it is possible to time an engine manually with the engine stopped, a much more accurate timing can be obtained by using a strobe timing light. This must be done with the engine operating slow enough so the timing is not advanced by the automatic spark advance. To determine this speed, observe the movement of the flywheel timing mark with the timing light while adjusting the idle speed. Set the timing so the timing marks are aligned exactly. If the engine is to be timed dead (engine not running) with a low voltage continuity light across the breaker points, it will be necessary to disconnect the primary coil wire from the timer post.

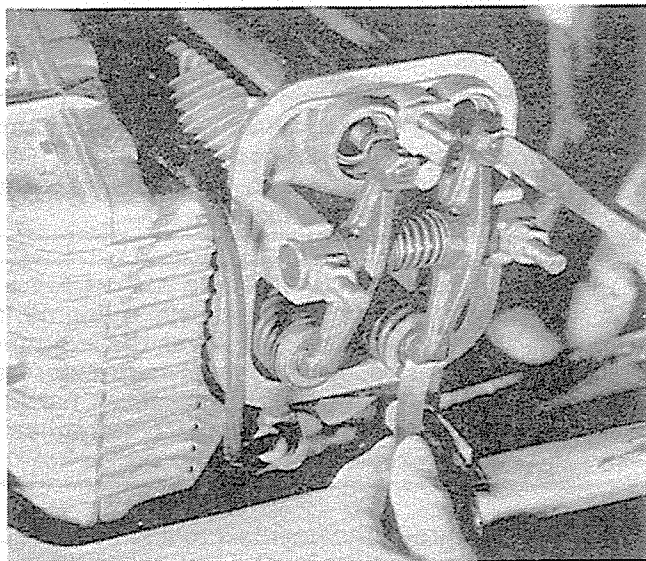
TAPPET ADJUSTMENT



NOTE: The engine must be cold when tappet adjustment is made.

Remove the valve covers from each cylinder. Turn the engine until the timing marks on the flywheel and front fan housing are lined up. The valves of ONE cylinder will now be in a closed position and ready for adjustment. Hold the adjusting screw with a screw-driver and loosen the lock nut. Turn the adjustment screw until a clearance of .003-.004" (0.08-0.10 mm) is obtained between the rocker arms and the valve stems. This distance must be measured with a feeler gauge. Tighten the lock nut and recheck the clearance.

Turn the engine one revolution and line up the timing marks. The tappet adjusting operation may now be performed on the opposite cylinder. Replace valve covers using new gaskets. Torque valve cover nuts to 5-7 lbs. ft. (7-9 N:m).



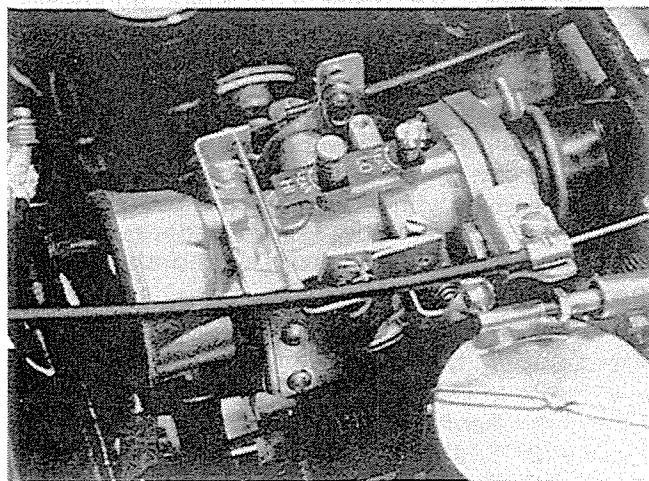
CARBURETOR ADJUSTMENT

(For cleaning and overhaul see FUEL SYSTEM section)

ZENITH CARBURETOR

The engine should operate satisfactorily when the carburetor is adjusted to these settings.

- High Speed . . . 2¼ to 2¾ turns open
- Low Speed 1 to 2 turns open
- Float Setting ¼" (6.4 mm)



1. Low Speed Adjustment
2. High Speed Adjustment

If the engine will not operate with the recommended settings, the carburetor needs cleaning or some other abnormal condition exists in the engine.

A leaking carburetor indicates a defective float, defective inlet needle and seat or incorrect float setting. If the float setting is incorrect it must be changed to obtain the correct setting of ¼" (6.4 mm).

KEIHIN CARBURETOR

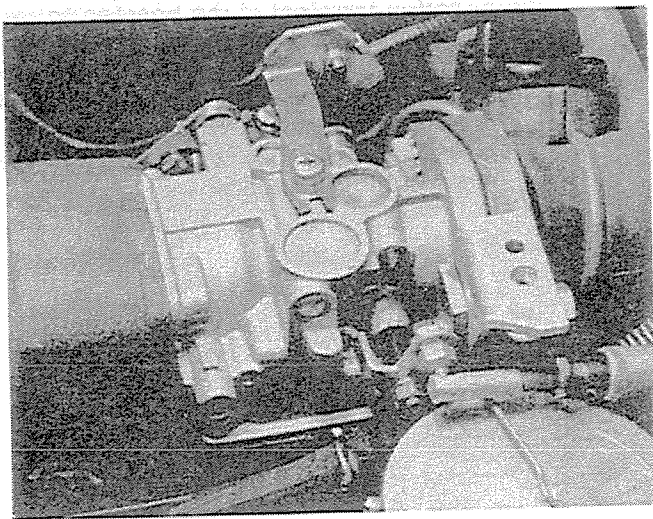
The U.S. Environmental Protection Agency (USEPA) regulations require that vehicle exhaust emissions be within certain limits as stated in the Federal Register dated Wednesday, January 5, 1977, Part II, Air Pollution Control. The Keihin carburetor used on "on-the-road" vehicles manufactured between January 1, 1979, and the start of the 1980 model year is designed to meet these standards. This carburetor will cause the engine to be less responsive and is more noticeable before the engine reaches operating temperature.

It will be necessary to check and set exhaust emission levels whenever the carburetor is reworked or replaced. This is accomplished by using an exhaust analyzer to measure the level of carbon monoxide. One type of analyzer available is SUN model EPA-75.

Following is the recommended carburetor adjustment procedures:

1. Start the engine and allow it to reach normal operating temperature.
2. Make sure the choke is completely off.
3. Adjust the throttle stop screw to provide an engine speed of 900 r.p.m.
4. Connect the CO meter.
5. Remove the limiter cap and adjust the idle mixture screw to give a maximum CO reading of 1.5%.
6. Install the limiter cap with the stop tab pointing straight up. Any adjustment made within the range of the limiter cap will result in an emission level that complies with the Federal Regulations.

For this engine, the HC (hydrocarbon) levels as stated in the above-mentioned Federal Regulations are met when the CO levels are maintained within the limits specified.



1. Throttle Stop Screw
2. Low Speed Idle Mixture Screw

EMISSION CONTROL INFORMATION

The emission control decal is located on the starting motor.



NOTE: The carburetor settings and the ignition timing specified must be maintained.

The correct settings are necessary to conform to U.S. Environmental Protection Agency Regulations applicable for this vehicle.

AIR CLEANER

Frequency of air cleaner service depends on the conditions of operation. Refer to the instructions printed on the air cleaner.

Replaceable paper filter air cleaners are used on all engines. Surface dirt may be removed by tapping the filter lightly. The condition of the filter is best determined by holding it over a light bulb. If light cannot be seen through the paper, a new filter should be installed. Likewise, if pinholes of bright light appear in the paper, the filter should be replaced. The latter condition is the most dangerous, since pinholes in the paper allow dirt to enter the engine.



NOTE: A dirty air filter will cause a loss of power from the engine. Operating engine without a filter will shorten the life of the engine.

STARTER MOTOR

Lubricate the starter drive every 2,000 miles or 200 hours of operation with a solution of fast-evaporating solvent and powdered graphite mixed to the approximate consistency of 20-weight oil. Remove the rubber plug from the engine fan housing above the starter drive and saturate the drive with this solution.

After the solvent has evaporated, a dry lubricant will remain. This type of lubricant collects a minimum amount of dirt and dust.

BATTERY

The battery's primary function is to provide power to operate the starting motor, ignition, lights and accessories. The storage battery is a secondary chemical generator—one that produces an electric current by chemical action after having been charged from an outside source. Each cell in the storage battery consists of negative plates of sponge lead and positive plates of lead peroxide immersed in a solution of water and sulphuric acid. After being charged, each cell will produce a voltage of about 2.1 volts. Six cells, connected in series, are assembled in a case to make up a 12-volt battery.



SAFETY WARNING: Battery electrolyte is an acidic solution and should be handled with care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid immediately.



NOTE: This is a negative ground wiring system, reversing battery connection will damage alternator rectifier. Booster batteries used for starting must be connected with proper polarity. Battery cables should be disconnected before using a "Fast Charger".

3

BATTERY SERVICING

Visually inspect the battery for the following:

1. Corrosion
2. Frayed or broken cables
3. Cracked case or cell covers
4. Low or overfilled liquid

BATTERY CARE



SAFETY WARNING: Do not allow open flames or sparks near a battery when connecting for jump starting or while recharging the battery with a charger. Hydrogen gas is generated during the charging process and can be explosive. Provide adequate ventilation to prevent possible danger.

Check the following at regular intervals:

1. Clean battery top and terminals by washing with a solution of ammonia or baking soda. Keep vent plugs tight so that solution does not enter cells. After washing, flush top of battery with clean water.

2. Keep battery terminal connections tight and free from corrosion. If corroded, clean cable terminals and battery posts separately with a soda solution and a wire brush. Inspect cables for fraying or broken strands.
3. Keep liquid above the plates and separators at all times. Check level and add distilled water as necessary at weekly or semi-monthly intervals. If water is added in freezing weather, charge the battery to full charge at once.
4. Keep the battery fully charged at all times. Check the state of charge at frequent intervals by making specific gravity readings with a battery hydrometer. Note that a hydrometer reading is not accurate if water has been added recently due to the fact that the water may not be mixed with the electrolyte.



NOTE: DISCONNECT one of the battery leads before attaching battery charger to charger.

JUMP STARTING WITH BOOSTER BATTERY

Both booster and discharged battery should be treated carefully when using jumper cables. Follow exactly the procedure outlined, being careful not to cause sparks.

1. Set parking brake and put transmission in neutral. Turn off lights and other electrical loads.
2. Attach one end of one jumper cable to the positive terminal of the booster battery and the other end to the positive terminal of the discharged battery. Do not permit vehicles to touch each other.
3. Attach one end of the remaining cable to the negative terminal of the booster battery and the other end to a good ground on the vehicle or engine away from the discharged battery. Do not lean over the battery when making this connection.
4. Reverse this sequence exactly when removing the jumper cables.

ENGINE OVERHAUL

REMOVAL

Disconnect all throttle, choke and electrical connections from the engine. Disconnect exhaust system; if vehicle is equipped with a heater, disconnect the exhaust at the rear of each heat exchanger.

Remove all engine mounting bolts and the four screws securing transmission to the clutch housing. The engine assembly may then be lifted from the chassis.

Remove 42-amp. alternator and heater hose if vehicle is so equipped. Remove ignition coils and spark plug wires. Remove all shrouding from the engine.

Remove the clutch cover. Remove the clips holding the throwout bearing and lift the throwout bearing from the clutch.

Remove the screws securing the clutch pressure plate assembly to the clutch drive plate, two from each clutch release arm bracket. The pressure plate and the disc and lining assembly may now be removed from the clutch housing. Remove the retaining screws from the clutch drive plate and lift the plate from the clutch drive hub.

Remove the screws securing the clutch housing to the crankcase and remove the housing.

Remove the retaining nut and bolt from the clutch drive hub, and remove the hub from the crankshaft.

Disconnect and remove the air cleaner from the engine.

Remove the cap screws from the fan housing, and the fan housing plates. The front fan housing and the end plates may then be lifted from the engine.

FLYWHEEL

Before removing the flywheel, you must remove the alternator pulley assembly.

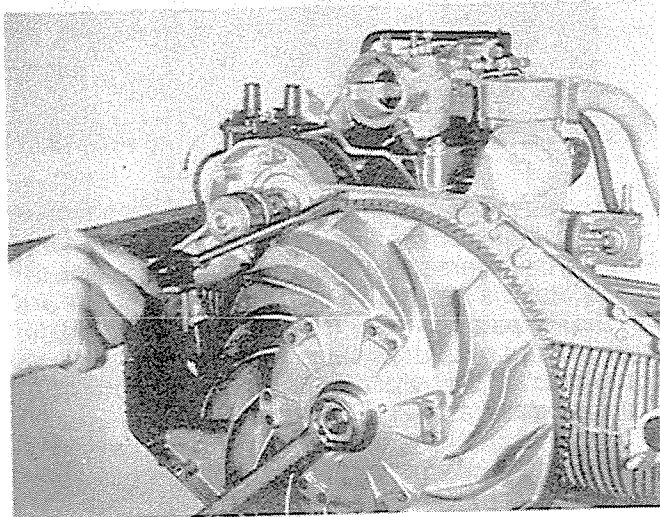


Figure 1

Remove the three 5/16" x 2-1/4" long bolts securing the pulley to the flywheel. A special cast iron extension is used to space the pulley out past the fan housing.

Removing the nut from the flywheel requires a 1-5/16" wrench or socket. Placing a large screwdriver between the rear fan housing and the starter ring gear will allow you to hold the flywheel and to remove the lockwasher and nut from the crankshaft. (See Figure 1)

A special knock off tool, Part No. 112015, is used to remove the flywheel. This tool should be screwed onto the end of the crankshaft—use a wrench to tighten. See Figure 2.

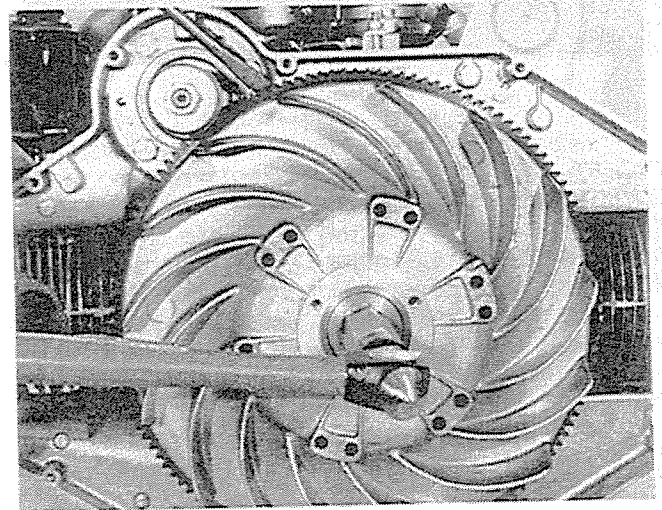


Figure 2



NOTE: There is a 1/8" (3.1 mm) gap between the end of the knock off tool and the flywheel. This will allow the flywheel to move freely off the taper of the crankshaft. This is done by using a metal hammer and hitting the knock off tool sharply while putting some pressure on the back side of the flywheel.

Remove the exhaust manifolds from the engine. Remove the clip which supports the fuel line to the intake manifold, and remove the four nuts which hold the manifolds to the cylinder. Release the tension on the hose clamp at the carburetor adapter, and the intake manifold assembly may be removed from the engine.

Remove the cap screws supporting the starter assembly to the inner fan housing. The starter may now be lifted from the engine.

Remove the cap screws which secure the fan housing to the crankcase, and lift the fan housing from the engine. It may be necessary to tap the fan housing with a hammer to free it from its pilot.

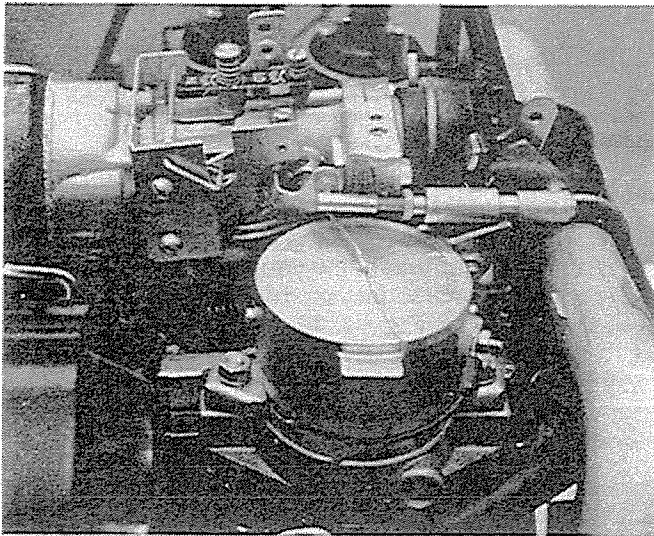


Figure 3

4 Disconnect the governor linkage from the carburetor. See Figure 3. Remove the nuts, clamps and studs from timer governor body and lift the assembly from the crankcase (it may be necessary to slightly rotate the crankshaft while lifting the timer assembly from the crankcase).

Disconnect the breather hose at the breather and at the carburetor and remove. Remove carburetor mounting screws and nuts and lift carburetor from the engine.

Remove the breather valve retaining screws and lift the breather valve assembly from the engine. Figure 4.

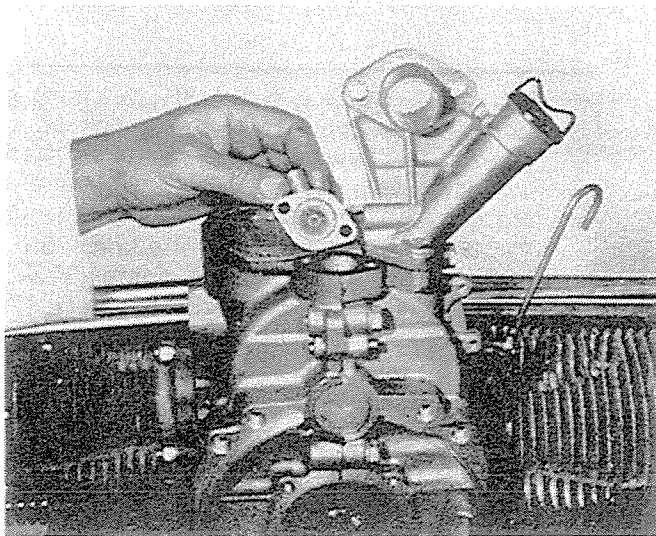


Figure 4

Remove the resistor.

Remove the oil filter. The filter is of the screw-on type and can be removed by the use of an oil filter wrench.

Remove both valve covers.

Remove the rocker arm mounting hardware from each cylinder and lift the rocker arm assembly from the cylinders. Observe the position of this hardware so that it may be replaced in its proper position. Figure 5.

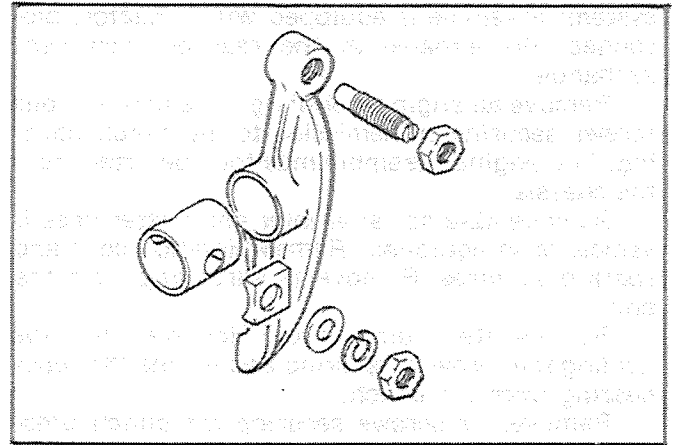


Figure 5

Remove the oil supply tube retaining plate and pull the oil supply tube, push rods and push rod tubes from the cylinders. Be sure the "O" ring is on the lower end of the oil supply tube. If it is not on the end of the tube, it must be removed from the crankcase. Figures 6 and 7.

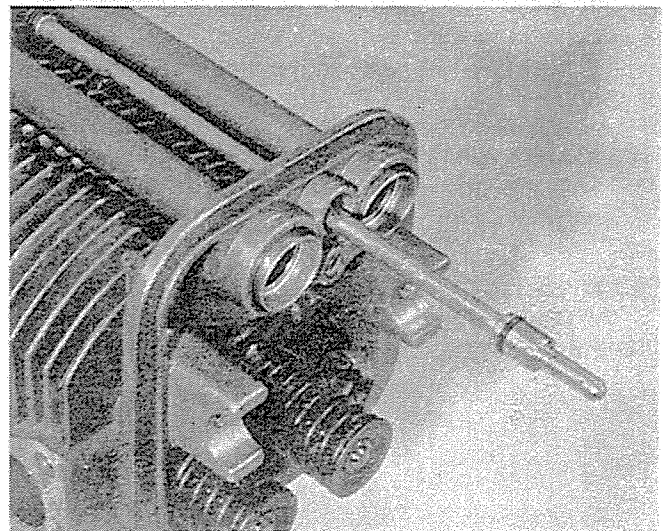


Figure 6

Remove the spark plug from each cylinder. Remove the cylinder retaining nuts and washers. Pull the cylinders away from the crankcase and off of the pistons being cautious that the pistons are not damaged when they free themselves from the cylinder and drop downward. It is advisable to use some kind of protective material at the bottom of the crankcase at this point. See Figure 8.

Remove the oil drain block from each cylinder and push the oil drain tube out through the lower part of the cylinder.

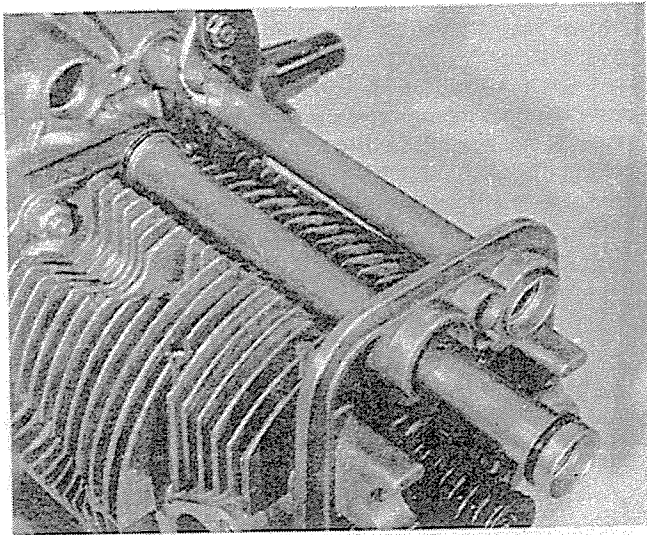


Figure 7

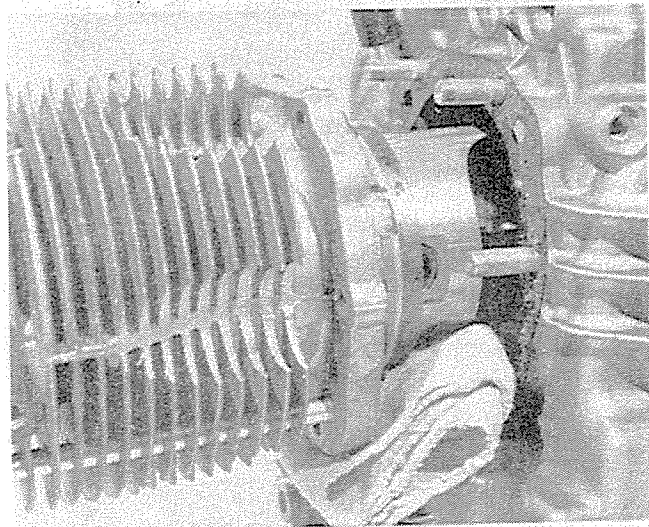


Figure 8

Remove the tappets from the crankcase. This may be done with a magnetic tool or by inserting a finger into the push rod cavity and pulling the tappets from the crankcase. See Figure 9.

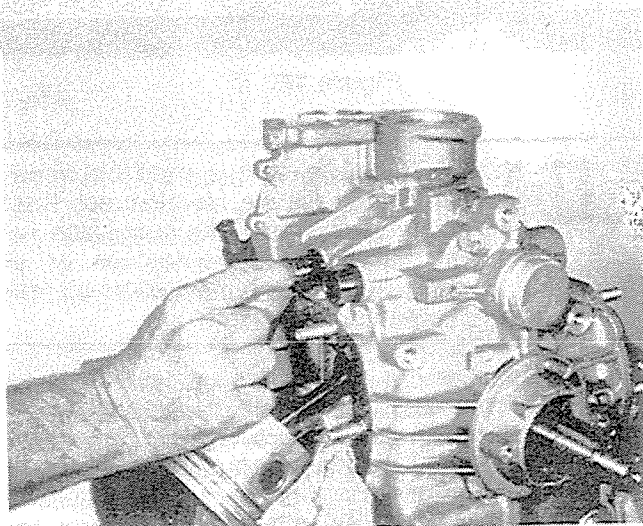


Figure 9

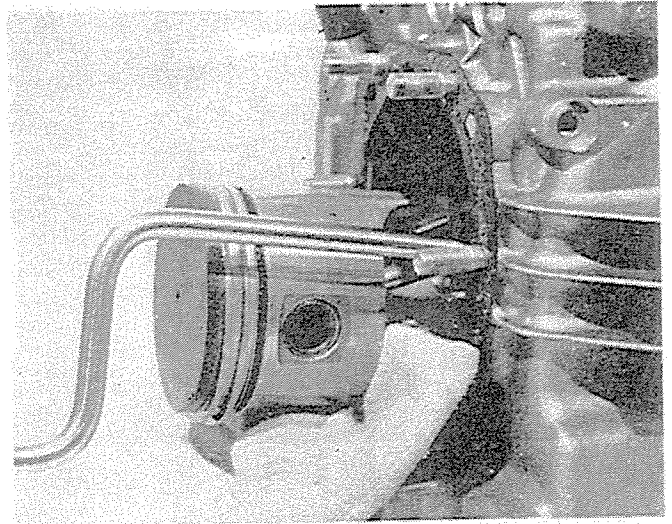


Figure 10

Remove the nuts from the connecting rod caps and lift the rod and piston assemblies from the crankcase. It is advisable to replace the rod caps on each rod after removal, since each cap must be replaced on its respective rod. (They must not be interchanged.) See Figure 10.

If the original pistons are to be reused, they must be installed in the same cylinders from which they were removed.

Remove the oil pressure relief valve assembly from the crankcase. See Figure 11.

Remove the oil strainer cover from the bottom of the crankcase.

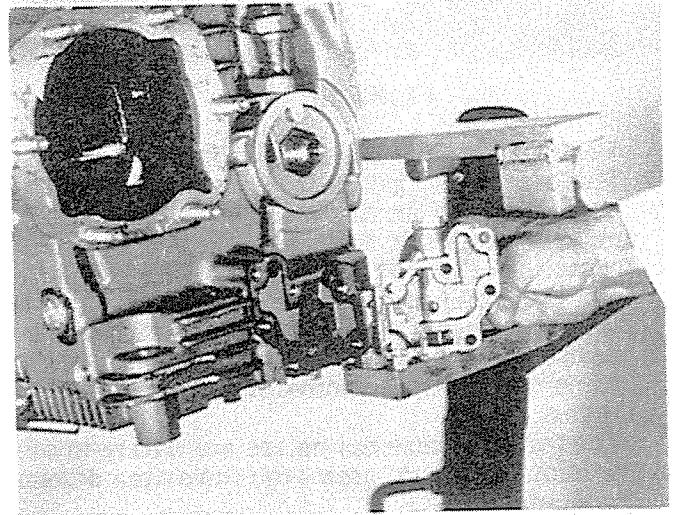


Figure 11



NOTE: Since the oil strainer is spring loaded, it will be necessary to apply hand pressure to the plate while the retaining screws are being removed to avoid damage to the plate or strainer. See Figure 12.

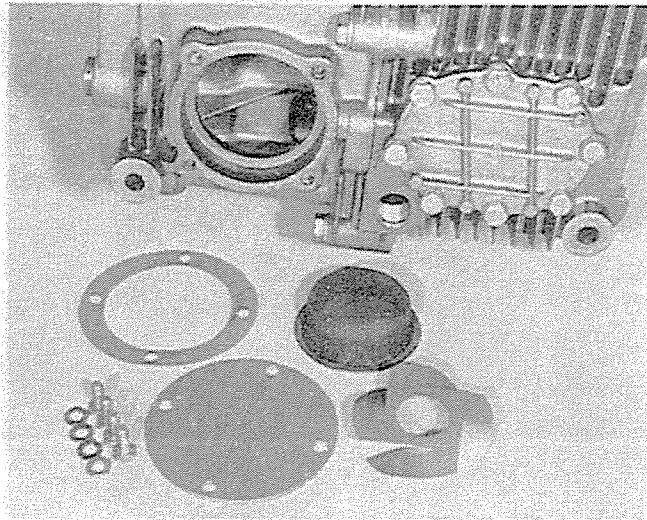


Figure 12

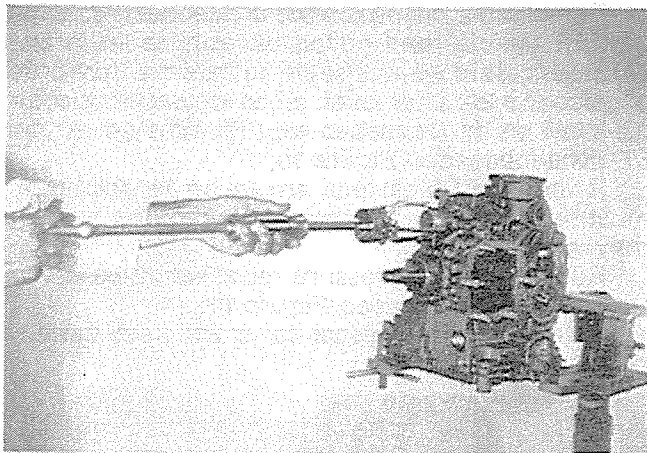


Figure 13

Remove camshaft cover. See Figure 13.

Remove the oil pump cover and remove the pump gears from their respective positions. The pump drive shaft may now be removed from the crankcase. To eliminate the possibility of future oil pump problems, care must be taken that the oil pump gears are not nicked, marred, scratched or otherwise damaged. It is advisable to wrap them in some kind of protective cloth to prevent damage.

The two crankcase halves are now ready to be separated. First, remove the two crankcase aligning pins.



NOTE: These are tapered pins and must be driven out with a punch from the small end of the pins.

Remove all crankcase retaining cap screws, including those at both main bearing locations. The rear main bearing screws are located inside the crankcase. See Figure 14.

There are 13 cap screws holding the crankcase

halves together, be sure they are all removed before attempting to separate the halves. A few taps with a mallet on the crankcase should separate the two halves easily. See Figure 15. Do not attempt to separate the two crankcase halves by prying them apart. If the crankcase halves do not separate by tapping with a mallet, check to see if all the retaining screws have been removed.

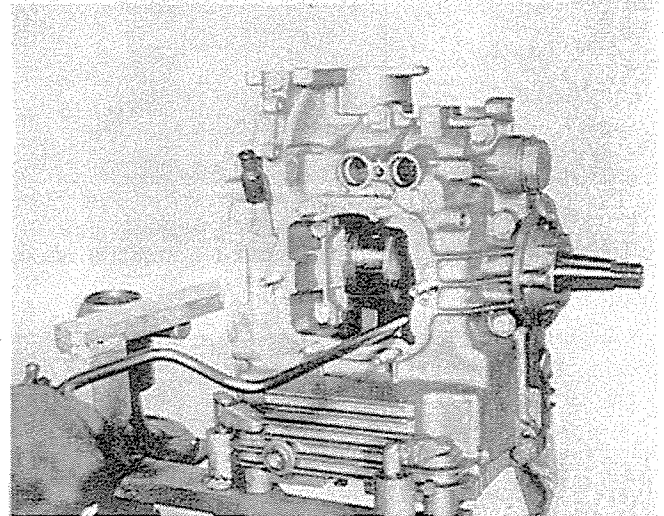


Figure 14

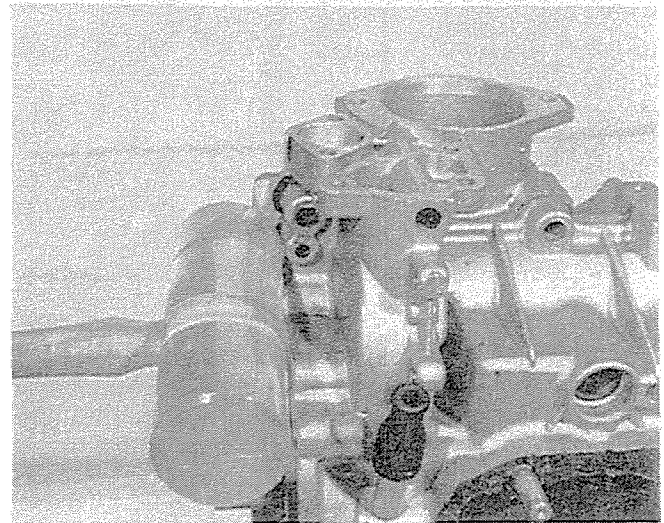


Figure 15



NOTE: No gasket is used between the two crankcase halves. Protect the two mating surfaces of the crankcase halves so that no mars, scratches or other damage occurs to this area or oil leaking problems may result.

Remove the crankshaft and camshaft assemblies from the one half of the crankcase. Again, care must be exercised to prevent damage of the teeth on either the cam or crank gear. Remove the main bearing, insert halves from both halves of the crankcase. Also slide the oil seals from the

ends of the crankshaft and camshaft. Both inserts and oil seals should be discarded. Never reuse.

REASSEMBLY

The following text explains in detail reassembly of the engine, along with the disassembly and complete repair and reassembly of various component parts which were removed from the engine as an assembly. Before proceeding with the various steps in the following paragraph, it will be necessary to thoroughly clean all parts before proceeding with the actual reassembly. Any parts requiring special care or cleaning will be covered in their respective paragraphs.

CRANKCASE PREPARATION

The mating surfaces of both crankcase halves must be thoroughly cleaned to insure proper sealing upon reassembly. Use lacquer thinner or some suitable solvent for removing the old sealer. Don't use carburetor cleaner for a cleaning agent. Be sure that all oil passages cast into crankcase halves are open and clean. NEVER use a scraper or any tool which will mar the surfaces. This also applies to places where gaskets are used, such as oil pressure valve assembly, oil pump cover, etc.

Install the main bearing inserts in both halves of the crankcase. See Figure 16.

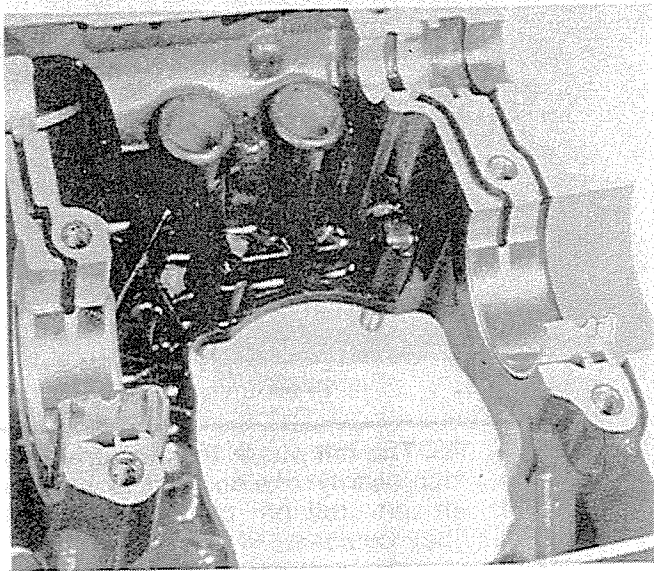


Figure 16

CRANKSHAFT PREPARATION

After the crankshaft has been thoroughly cleaned, the crank throws should be measured with a micrometer to detect any undersize or out-of-round condition. See Figure 17.

If bearing surfaces are undersize or out of round in excess of .001 (0.03 mm) they should be reground. Undersize bearing inserts are available in .015 (0.38 mm) and .030 (0.76 mm). Inspect surface of the gear spacer that faces the crankshaft main bearing for any mars or roughness. Replace

if necessary. The crankshaft timing gear should also be replaced for the same reason. If it is necessary to replace either the gear spacer or the timing gear, a hydraulic press or an automotive type gear puller is necessary. When installing a gear spacer, the inside bevel must face crank throws to clear crank radius. To install the timing gear, heat gear to 400° F. (204°C) in an oven.



NOTE: Care must be exercised so that 400° F. (204°C) is not exceeded, otherwise, loss of temper from the gear may result.

When gear is properly heated, it may then be easily fitted to the crankshaft. Be sure the gear is installed with the timing mark facing away from the gear spacer. Bevel edge must be toward crank throw and timing mark must face away from crank throws. See Figure 18.

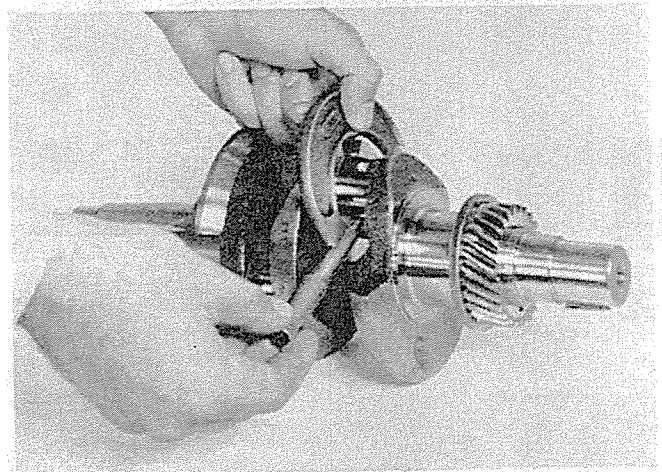


Figure 17

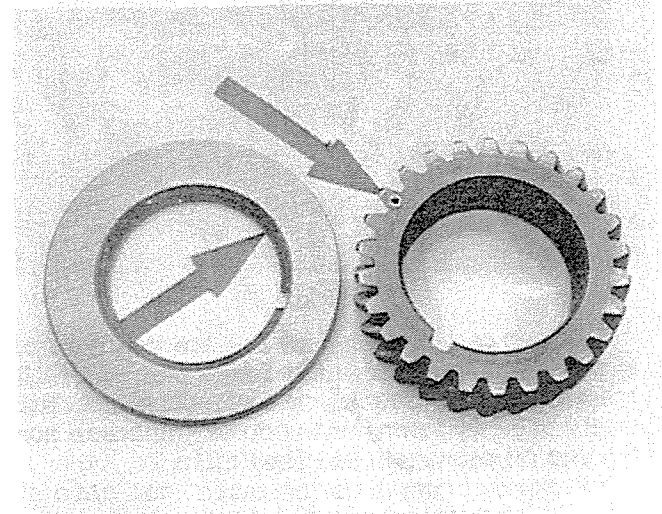


Figure 18

CAMSHAFT PREPARATION

Inspect camshaft and gear assembly for wear or damage. When replacing gear cover seal, be sure seal is properly seated. Replace either or both if necessary.

Lubricate both the crankshaft and camshaft bearing surfaces on both halves of the crankcase with engine oil. Place the crankshaft and camshaft assemblies in position in the crankcase half without the oil passages.

The crankshaft and camshaft assemblies must rotate freely with no binding. Backlash can be checked by using a dial indicator. Measurement must be taken at camshaft gear tooth. See Figure 19. Be sure the timing marks are aligned. See Figure 20.

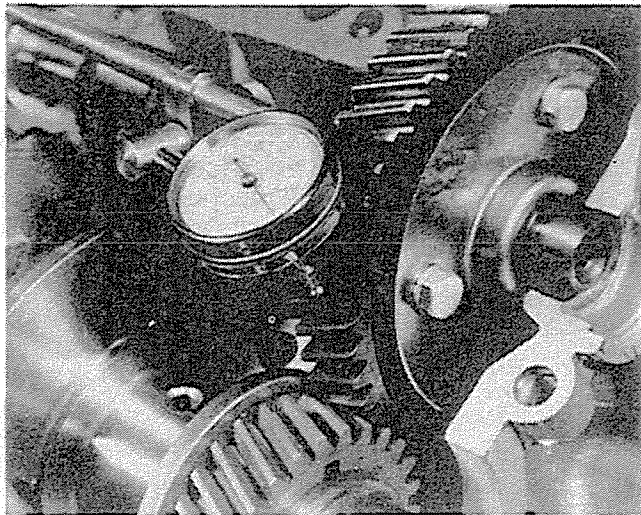


Figure 19

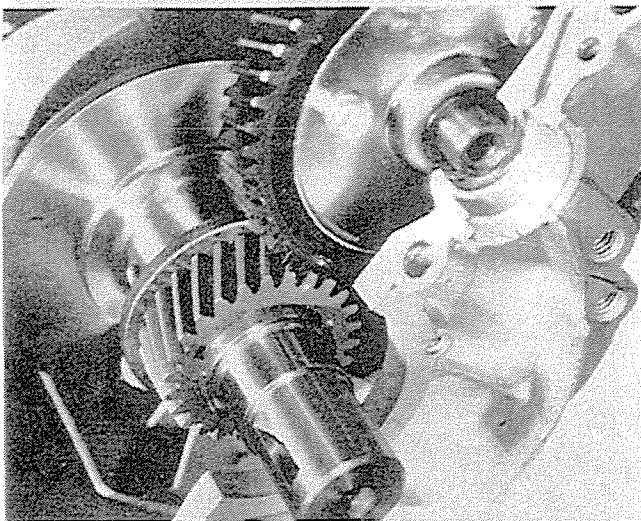


Figure 20

The two crankcase halves are now ready to be rejoined. Minnesota Mining Sealer No. EC847 is recommended. Place a bead of sealer approximately 1/8" (3.1 mm) wide on the crankcase half with the oil passages. See Figure 21.

Special care must be taken that none of this sealer is placed into the oil channels. A sealer bead wider than 1/8" (3.1 mm) will be forced into the oil channels after the crankcase half screws have been tightened to the proper torque.

Place the remaining crankcase half in position as quickly as possible to avoid the possibility of the sealer drying to a point of losing its adhering qualities. Install the crankcase aligning pins and retaining screws and tighten to recommended torque of 22-25 lbs. ft. (30-34 N:m).

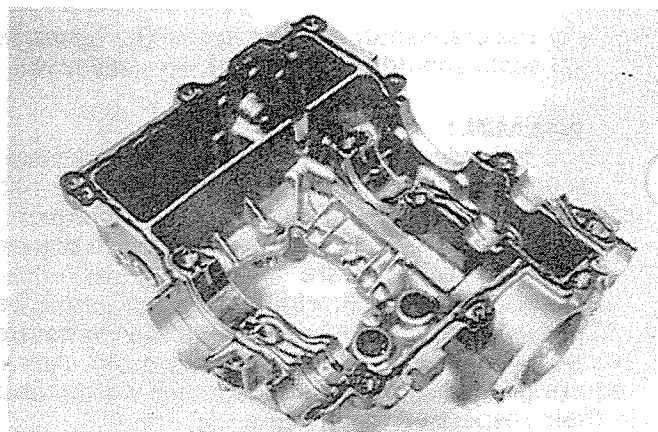


Figure 21

Check the crankshaft end play by measuring with a feeler gauge between the rear main thrust area and the crankshaft. End play should be .005-.009" (0.13-0.23 mm). If the clearance is more than .009" (0.23 mm), it is likely that the gear is not pressed completely on the crankshaft. If clearance is less than .005 (0.13 mm), a warped gear spacer is likely. Either condition must be corrected.

Using oil seal protector No. 824633 and oil seal driver No. 160360, install the camshaft breather oil seal. The O.D. of the seal must be coated with sealer and driven in until it bottoms on the shoulder in the crankcase. See Figure 22.

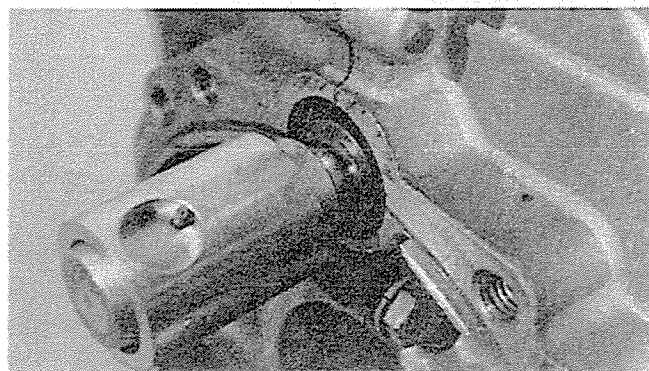


Figure 22



NOTE: The roll pin in the seal driver is not necessarily a stop. If the seal is driven until roll pin bottoms, the seal may be damaged.

Using oil seal protector No. 110846 and oil seal driver No. 112011, install the main bearing oil seal on the driveout end of the crankshaft.

The seal must be driven in until it is flush with the outside of the crankshaft. See Figures 23 and 24.

Using seal protector No. 112012 and seal driver 112017, install the main bearing oil seal on the flywheel side of the engine. The seal should be driven into the crankcase until the driver has contacted the side of the crankcase. See Figures 25 and 26.

After installation of these oil seals, the assembly should be rotated several times to be sure there is no bind due to a cocked or improperly installed oil seal.

Using crankcase sealer, install the expansion plug and cover in their respective positions in the crankcase at each end of the camshaft.

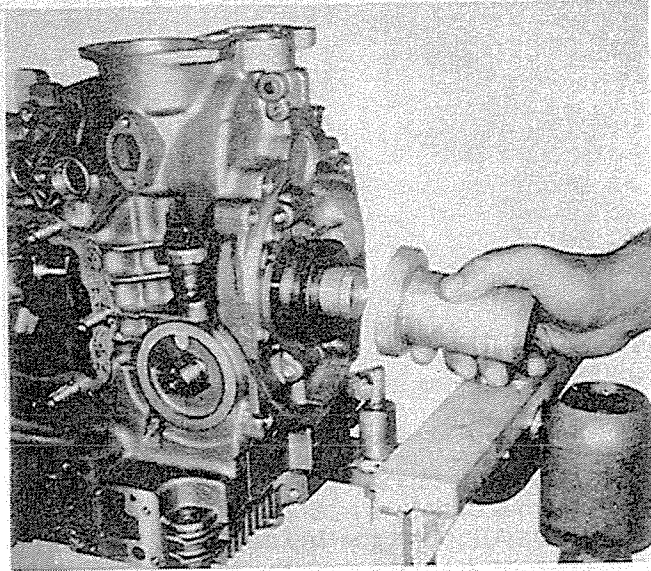


Figure 23

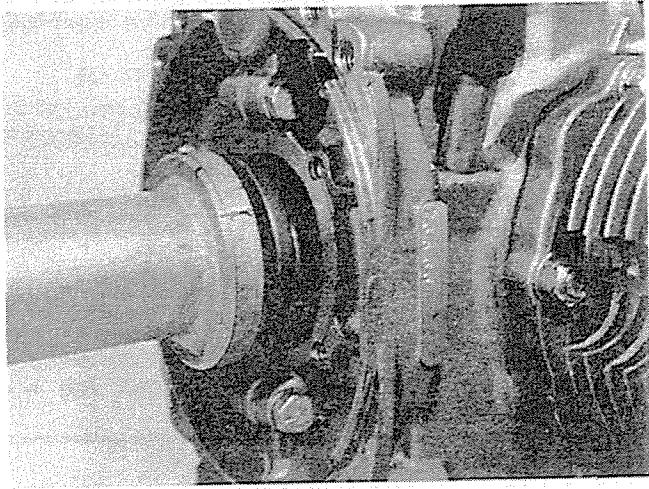


Figure 24

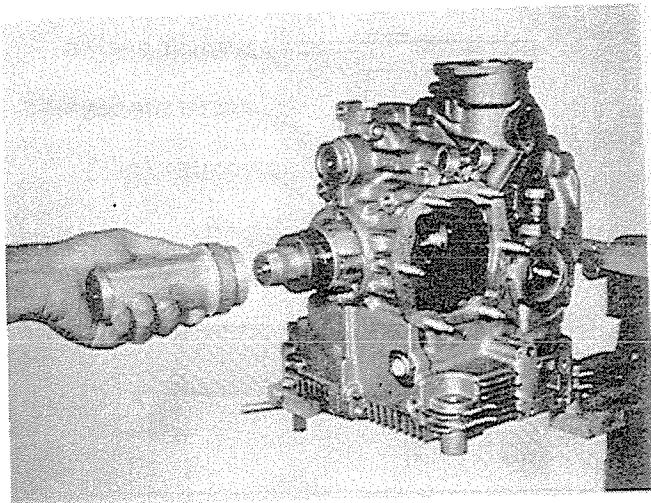


Figure 25

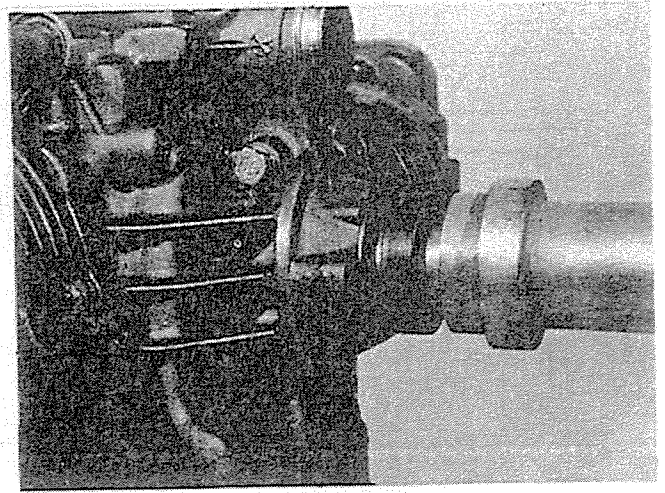


Figure 26

RECONDITIONING CYLINDERS AND VALVES

Using a valve spring compressor such as those used on overhead valve automotive engines, remove the valve keepers, spring retainers, springs and valve spring washers (valve stem seal set, intake only) and valves from the cylinder. See Figure 27.

Clean the valves with a wire-wheel brush. All carbon must be removed from the top and bottom of the head. Do not overlook the varnish which might have accumulated on the stem.

In refacing valves, take off only the minimum of metal required to clean up the valve faces. If the outer edge of the valve becomes too thin or sharp due to excessive grinding, the valve must be replaced. The valve head margin must be at least $3/64$ " (1.19 mm). This margin is the area above the contact surface of the valve face. See Figure 28.

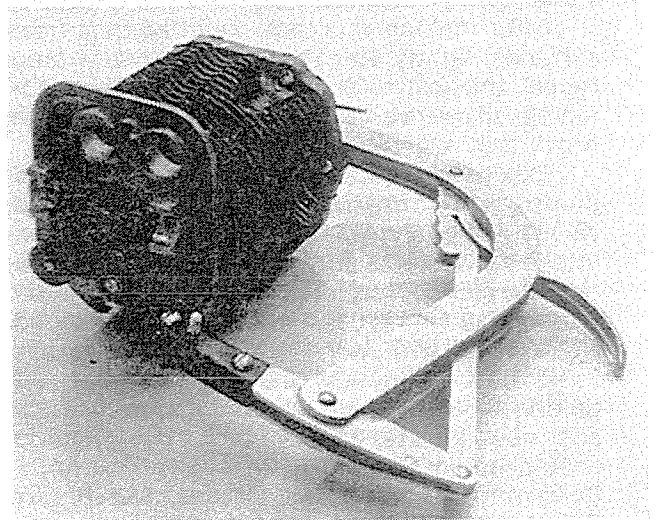


Figure 27

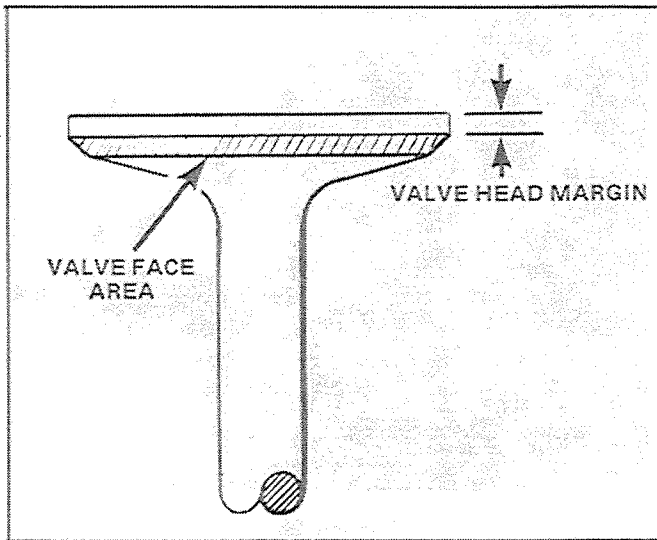


Figure 28

Inspect the valve seats in the combustion chamber for cracks, burns, pitting, ridges or improper angle. If any of the above conditions are noted, the seats must be reground.

4



NOTE: Valve seats are permanently installed and cannot be replaced. Therefore, a minimum of metal should be removed when grinding the valve seats.

The valve seat width, after refacing, should be a liberal $1/16''$ (1.59 mm) for intake seats, but not more than $3/32''$ (2.38 mm) in any case. The width of exhaust seats should be $3/64''$ to $1/16''$ (1.19 to 1.59 mm).

Test valve for concentricity with seat and also for tight seating. Valves can be tested by coating the valve face with Prussian Blue and turning the valve against its seat. This indicates whether the seat is concentric with the valve guide, but does not prove that the valve face is concentric with the valve stem or that the valve is seating all around.

After making this test, wash all blue from the surfaces, lightly coat the valve seat with blue and repeat the test to see whether a full mark is obtained on the valve. Both tests are necessary to prove that a proper seat is being obtained.

Excessive clearance between valve stems and guides will cause improper seating and burned valves. When there is too much clearance between intake valve stems and guides, there is a tendency to draw oil vapor through the guide on the suction stroke, causing excessive oil consumption, fouled spark plugs and poor low speed performance.

If the valve guides are to be replaced, the old guides should be pressed out with an Arbor Press and new guides pressed in. The intake guide should be so positioned that it will extend $1/16$ (0.40 mm) above the guide boss. See Figure 29. This is to allow the valve seal washer to be properly seated. After the new guides have been

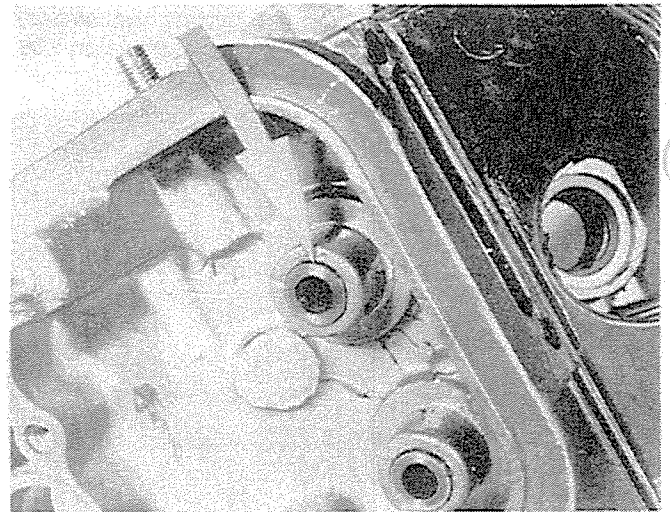


Figure 29

pressed into the bosses, they must be sized with a hand reamer to between $.3115$ and $.3125''$ (7.91 to 7.94 mm). Although the inside diameter of both valve guides are the same, the stem clearance of the exhaust valve is different than that of the stem clearance of the intake valve. The diameter of the exhaust valve stem and the intake valve stem are as follows:

Valve guide reamer Part No. 111275

Exhaust valve stem diameter $.3100$ to $.3093''$
(7.87 to 7.94 mm) Clearance $.0032$ to $.0015''$
(0.08 to 0.04 mm)

Intake valve stem diameter $.3110$ to $.3103$ (7.90 to 7.88 mm) Clearance $.0022$ to $.0005''$ (0.06 to 0.01 mm)



NOTE: It is essential that the valve seats be refaced after new guides are installed.

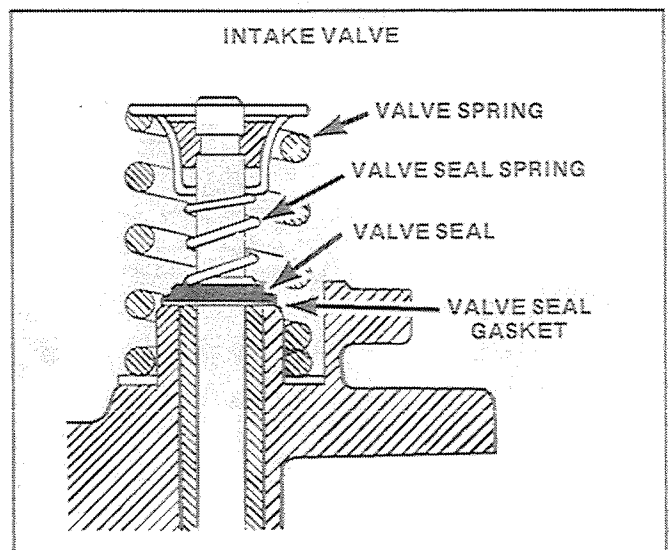


Figure 30

The intake valve **only** utilizes a valve stem seal set, which consists of a neoprene gasket, a Teflon lip seal and a hold-down spring. **NEVER** attempt to reuse the above mentioned seals.

A plastic installer is provided with each kit for seal protection. Place the installer over the valve stem. Place the flat neoprene gasket over the valve stem on top of the valve guide.

With the Teflon lip seal thoroughly oiled, position the seal over the valve stem with the flat side toward the cylinder. Extreme caution must be exercised when installing the lip seal over the valve stem to avoid any damage to the seal by the valve stem grooves. Place the hold-down spring on the lip seal assembly, being sure the spring seats properly on the seal body. Install intake valve spring, retainer and keepers. See Figure 30.



NOTE: To avoid damage to the seal, compress the valve only enough to allow installation of the keepers. Forcing the valve spring retainer into the seal when using a spring compressor will collapse the seal and cause oil seepage into the cylinder between the valve stem and guide.

A TIP FOR FUTURE SERVICE

It is possible to install these seals without removing the cylinder from the engine. Remove the spark plug and in its place install an air plug valve holder to which an air line can be attached.

The air pressure in the cylinder will hold the valve tight against its seat, making it possible to remove the valve spring using a lever type valve spring compressor, without losing the valves in the cylinder.

Lever type valve spring compressors and air plug valve holders are available through automotive suppliers.

When new rings are installed without reboring cylinder, the glazed cylinder walls should be slightly dulled but without increasing the bore diameter. This is done with a "glaze-buster" or with a hone equipped with the finest grade of stones.

Using an inside micrometer, check the cylinder for a taper or out-of-round condition; a cylinder with more than .005" (0.13 mm) out of round should be rebored and proper oversize piston and rings used. Figure 31. Following are the dimensions that the cylinder should be bored for a given oversize.

Oversize	Cylinder Diameter
.020" (0.51 mm)	3.5200-3.5210" (89.40-89.43 mm)
.030" (0.76 mm)	3.5300-3.5310" (89.66-89.69 mm)

Honing the cylinder after reboring is necessary to remove machine marks left by the boring tool. Approximately .001 to .0015" (0.03 to 0.04 mm) of metal should be removed from the cylinder bore with the hone, using a 150 grit stone.

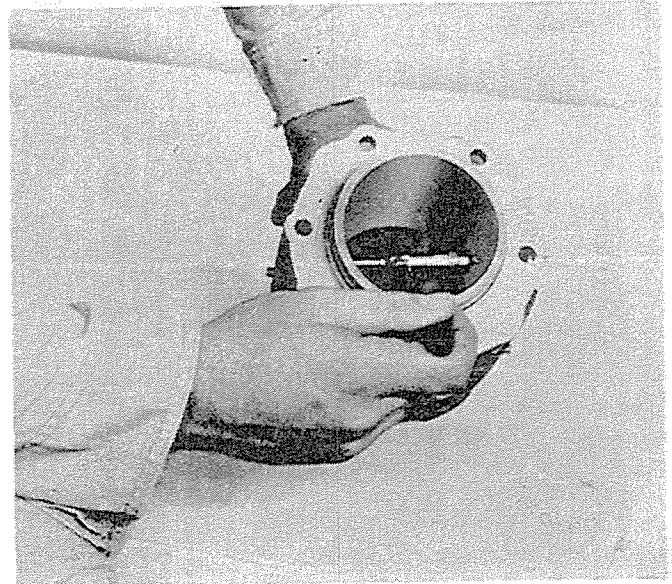


Figure 31

This will leave a 25 to 35 RMS micro inch finish to the surface of the cylinder. Allowances must be made for the honing operation when the cylinder is bored so that after honing, the cylinder will be the correct size. The cylinder bore should then be scrubbed, using a stiff bristle brush, warm water and soap suds to loosen any metal particles left by the honing operation. Wash with clean water, and dry thoroughly to prevent any rust from forming.

If, through continued use, the spark plug hole in the cylinder becomes damaged or the threads stripped, it is possible to repair the damaged threads by installing a Heli-Coil.

We recommend a AC-C85 spark plug for use with a Heli-Coil. This is a gasketed plug; under no circumstances should a tapered seat plug be used with a Heli-Coil, as the tapered seat in the cylinder is removed when the Heli-Coil is installed.

CUSHMAN does not offer the Heli-Coil repair kit as it is generally available through automotive suppliers.

Fit a new "O" ring around the outside diameter of the oil return tube and push it down until it bottoms against the lip. Install the oil return tube through the ridge of the cylinder and up through the fins. With a new gasket in position on the cylinder and a new "O" ring fitted to the oil drain block, secure drain block to cylinder with the proper screws and at the same time position oil drain tube into oil drain block.

PREPARING PISTONS AND CONNECTING RODS

Examine both the piston and rod assemblies to determine if wrist pin replacement is necessary.

If wrist pin replacement is necessary or if the cylinder must be rebored and an oversized piston installed, use the piston wrist pin puller. See Figure 32.

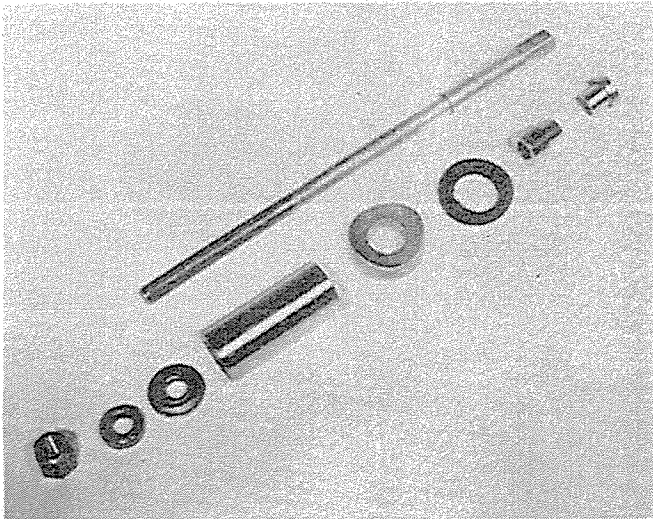


Figure 32

4



NOTE: Never attempt to remove the wrist pin by using a hammer and a punch.

Before using this wrist pin puller, read the instructions thoroughly. The puller must be installed so that you are pulling the wrist pin from the rod assembly. It will be putting the pressure between the piston block and the rod assembly. This surface is flat and machined to prevent possible twisting or extreme pressures to the wrist pin. See Figure 33.

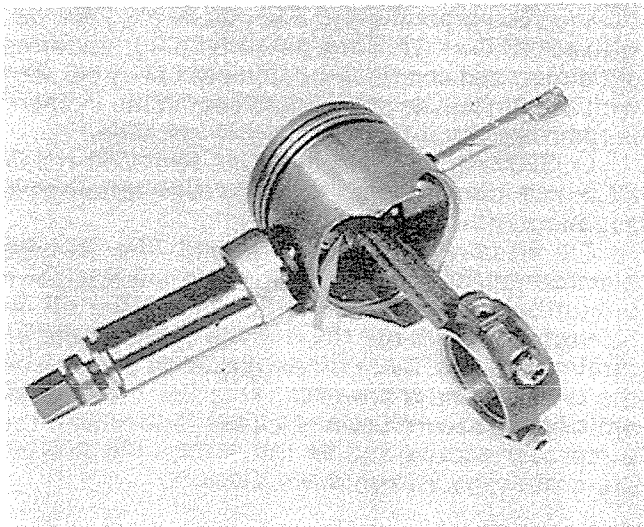


Figure 33

Examine the rod, wrist pin and the piston for possible damages and replace the necessary parts.

Before installing a new wrist pin, always measure the outside diameter with a micrometer. This will determine the press fit in the rod assembly. The wrist pin diameter should be .8752/.8749" (22.23/22.22 mm). See Figure 34.

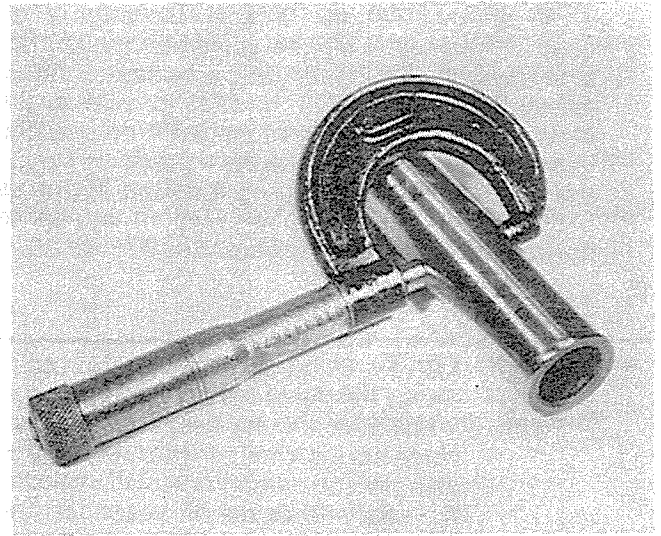


Figure 34

Use an inside telescoping gauge to measure the wrist pin hole diameter in the rod. This measurement must be correct to give the proper fit of the wrist pin. The rod wrist pin hole should be .8743/.8738 (22.21/22.19 mm).

Using the inside telescoping gauge, measure the "piston" wrist pin hole. This figure, along with the wrist pin figure should give you a clearance of .0011/.004" (0.28/0.10 mm).

Before installing the wrist pin puller, read the instructions thoroughly.

Before installing the wrist pin, be sure the rod assembly and the piston are installed to one another correctly. The piston has a top and a bottom to it. The oil holes, which are in the wrist pin boss, must be to the top of the engine. When placed in the engine, the match marks for the end cap to the rod must be to the top of the engine. See Figure 35.

Lubricate the pin and piston boss before assembly.



NOTE: One of the parts from the wrist pin puller has been removed to reinstall the pin. See Figure 36.

When installing the wrist pin, always pull the pin so the pressure from the rod and the piston is up against the machined or flat surface of the piston boss.

The wrist pin will be centered on the rod assembly when the wrist pin puller is properly used.

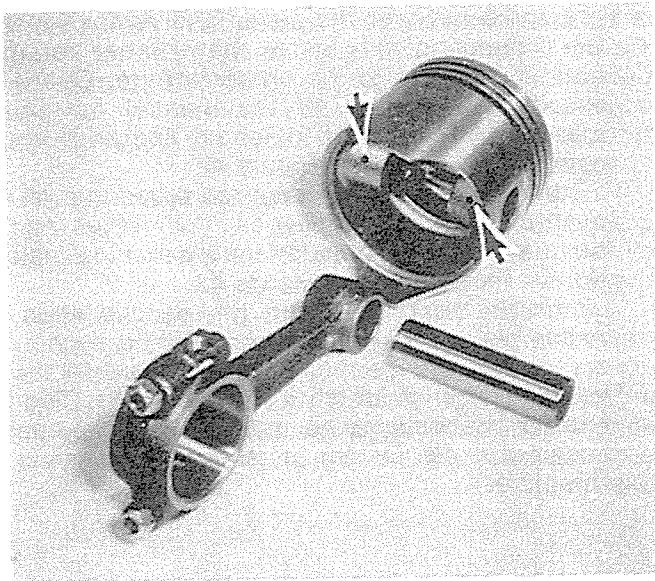


Figure 35

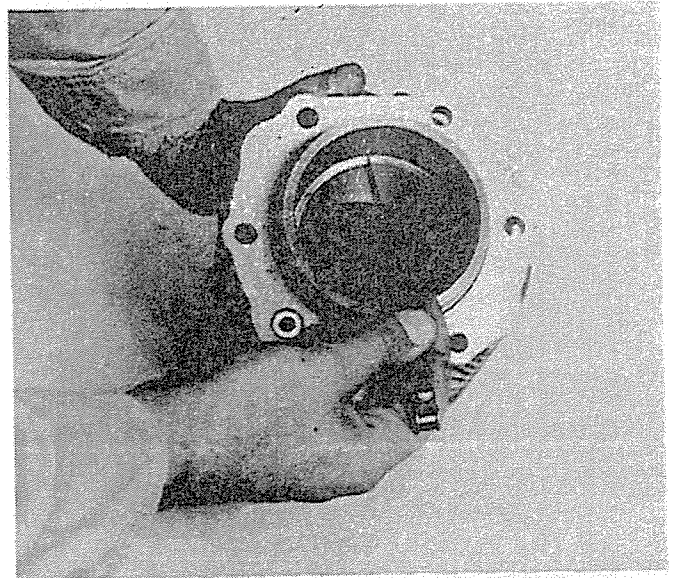


Figure 37

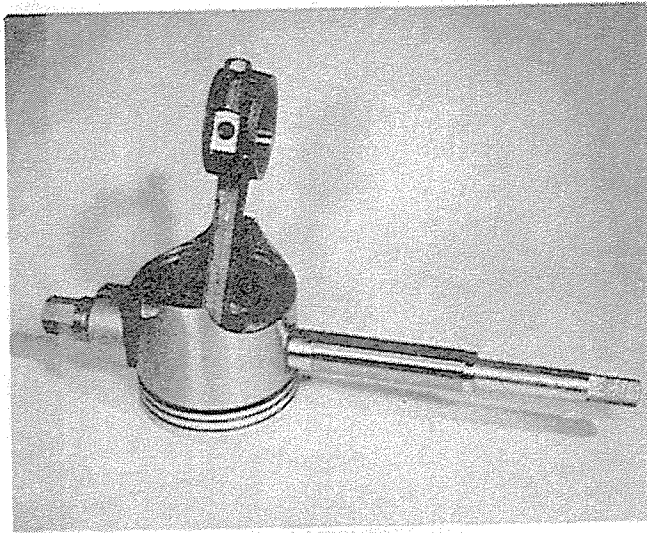


Figure 36

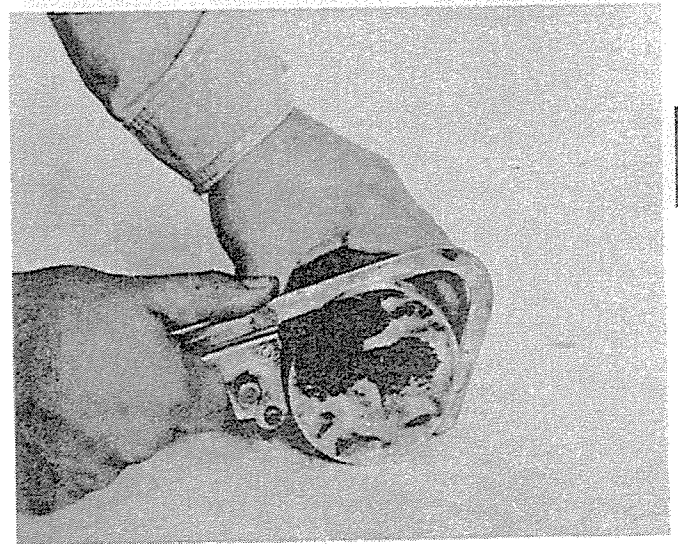


Figure 38

To accomplish this, pull the short bushing on the wrist pin puller flush with the unmachined flat surface on the side of the piston.

Regardless of why or at what mileage the cylinders were removed, it is always advisable to install new rings on each piston. Individually place each ring into the cylinder and push it down 1" (25 mm) with a piston and measure the gap between the two ends of the ring. This gap should be no less than .010" (0.25 mm) on a new ring. See Figure 37.

If additional gap is required, file the ends of the ring until the .010" (0.25 mm) gap is obtained. Be sure the ring ends are filed squarely. With the piston rings properly gapped and the piston ring grooves properly and thoroughly cleaned (see Figure 38), install the oil control ring assembly in the bottom groove of each piston. Install the two compression rings in the two top ring grooves of each piston. A piston ring installation tool is recommended for this operation. See Figure 39.

After all piston rings have been installed, rotate the rings so all the ring gaps are staggered on the upper side of the piston. Never leave the ring gaps lined up.

Install the rod bearing inserts into both rods and rod caps. Be sure the lips of each insert fit into the recesses of their respective positions. Note the markings on both the rod and bearing caps. See Figure 40. These markings must correspond when the rod caps are assembled to the rods. Thoroughly lubricate the bearings and the crankshaft throws, and install the connecting rod assemblies to the crankshaft. See Figure 41.

Tighten connecting rod nuts to 18-20 lbs. ft. (24-27 N:m) torque.

Select the proper cylinder for its respective location.

Thoroughly lubricate the piston rings on one piston and install the ring compressor. Slide the piston into the cylinder until all three rings have entered the cylinder bore. Slide the ring com-

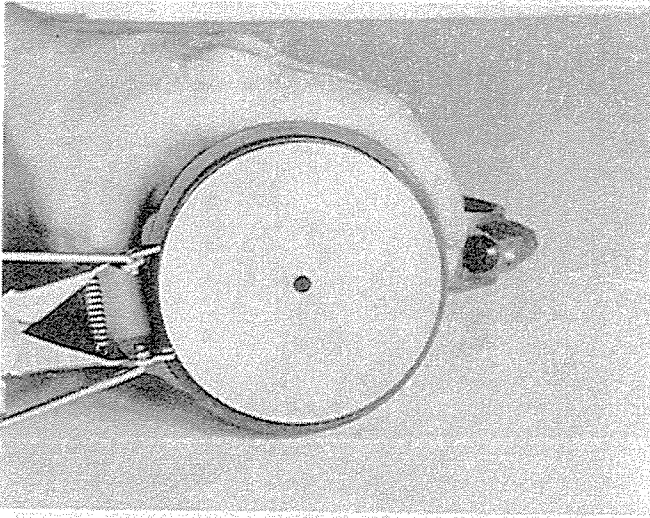


Figure 39

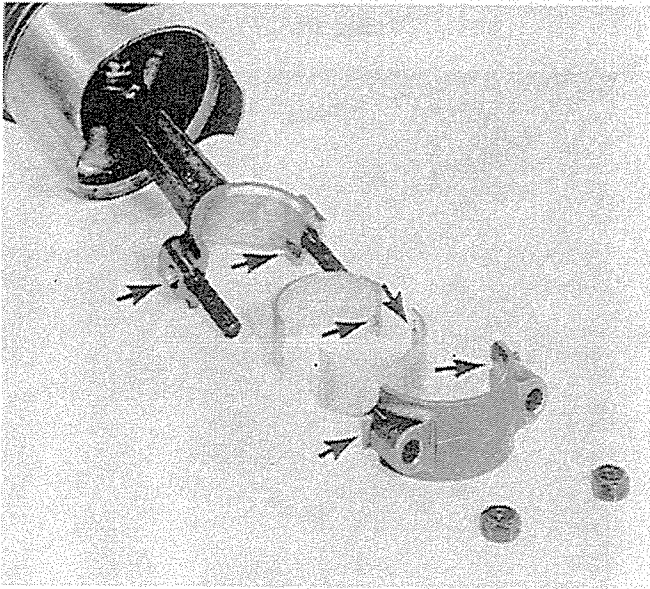


Figure 40

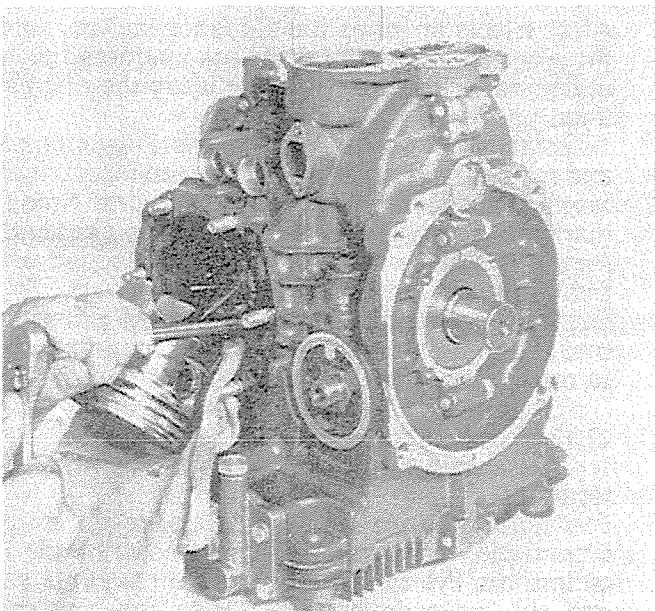


Figure 41

pressor down over the piston and remove it from the connecting rod. Install the cylinder retaining nuts and tighten to the proper torque. Check the specification section of the manual for proper torque values. Repeat the above operation on the opposite cylinder. See Figure 42

Install the tappets, push rod tubes and oil discharge tubes. Use only new "O" rings and be certain they are in position before making installation of the tubes. See Figure 43.

Install the push rods with the cup ends up. Assemble the rocker arm assembly to each cylinder and install the mounting hardware in the reverse manner of which it was removed. The ball ends of the rocker arms must fit into the cups of each push rod. Do not install the valve covers at this time.

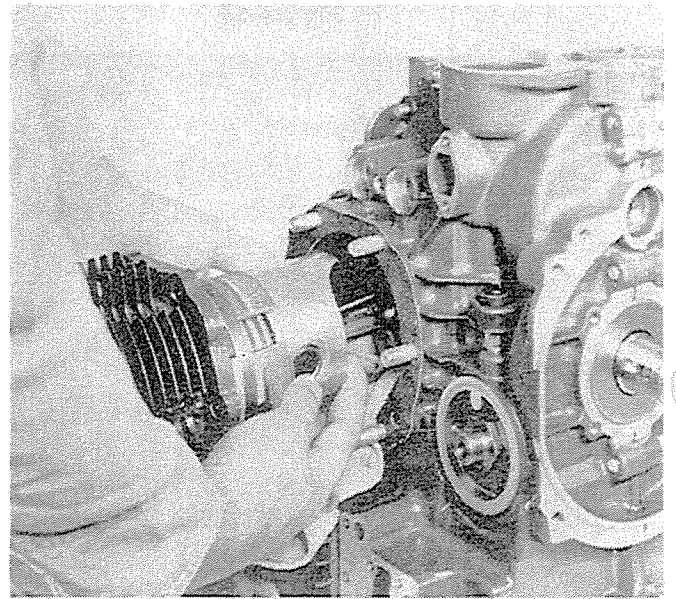


Figure 42

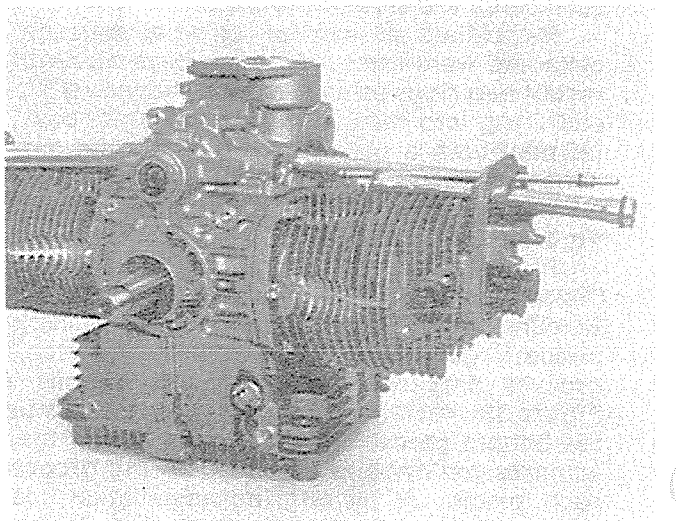


Figure 43

INSTALLING OIL PUMP STRAINER SCREEN

Re-install the oil strainer screen into the bottom of the crankcase. A new gasket must be used when installing the strainer cover.

OIL PUMP INSTALLATION

Inspect the pump drive gear for cracks between the teeth. A cracked gear will allow it to slip on the shaft causing a drop or lack of oil pressure within the engine.

With the oil pump gears and the oil pump drive shaft thoroughly cleaned, place the two gears into position in the oil pump cavity. Note the retainer ring on the oil pump drive shaft. This retainer prevents the shaft from being pulled out from its position in the pump drive gear when the timer assembly is removed from the engine; consequently, it is imperative that the retainer is in position.

Use a new gasket and crankcase sealer when installing the pump cover. See Figure 44.

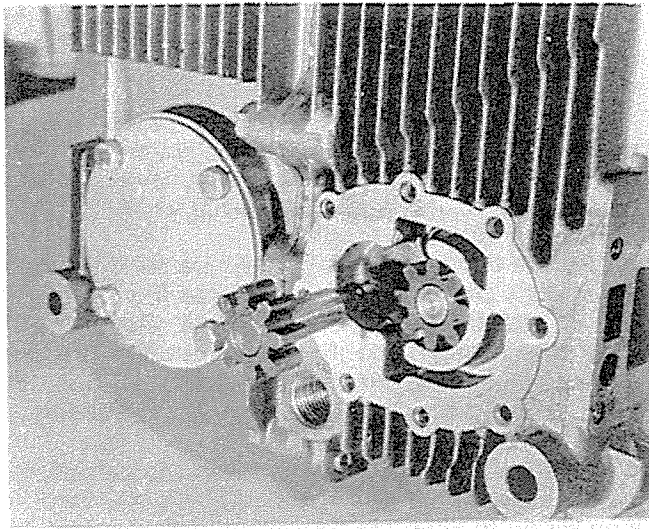


Figure 44

Completely disassemble oil pressure relief valve and thoroughly clean with a solvent, removing all dirt particles and varnish. Do not use emery cloth or any abrasive material to clean varnish from relief valve. Due to the high oil pressures encountered in certain sections of the relief valve housing, it is essential that the mating surface on this housing, along with the machined surface of the crankcase, be perfectly true. Check these surfaces with a straight edge. If there is any warpage or misalignment, either replace with a new housing or correct the old housing by truing the mating surface with emery cloth placed on a flat surface using a figure 8 motion. Use an air hose to determine that all oil channels and crevices relief valve and chamber must be free of any nicks or burrs). Assemble oil pressure relief valve and

spring with new gasket on valve screw, then attach assembly to engine using new gaskets, and torque all bolts evenly and securely. Check torque recommendations in Specifications Section of this manual.

FLYWHEEL INSTALLATION

Install the rear fan housing to the crankcase. Be sure all screws are properly tightened.

Place the flywheel key into the keyway. Install the flywheel, lockwasher and nut. Be sure the flywheel nut is securely tightened or damage may result to the flywheel or crankshaft or both. Tighten flywheel nut to 65 lbs. ft. (90 N:m) torque.

STARTING MOTOR INSTALLATION

Install the starter motor to the inner fan housing and replace the rear starter support bracket. Position the front fan housing and install mounting screws.

VALVE TAPPET ADJUSTMENT

Turn the flywheel until the timing mark on the front fan housing and the timing mark on the one fin of the flywheel line up. With the engine in this position, both valves on one cylinder will be closed, and the tappet adjustment may be made. Loosen the lock nut at the top of each rocker arm and turn the adjusting screw until .003" to .004" (0.08 to 0.10 mm) clearance is obtained between each rocker arm and valve stem. Be sure lock nuts are securely tightened. Using a new "O" ring under the valve cover, the cover and the valve cover retaining nuts may be installed. Be sure the proper washers are used under the valve cover retaining nuts. Turn the engine one revolution so that the timing marks are again lined up and perform the same valve adjusting procedure on the opposite cylinder. See Figure 45.

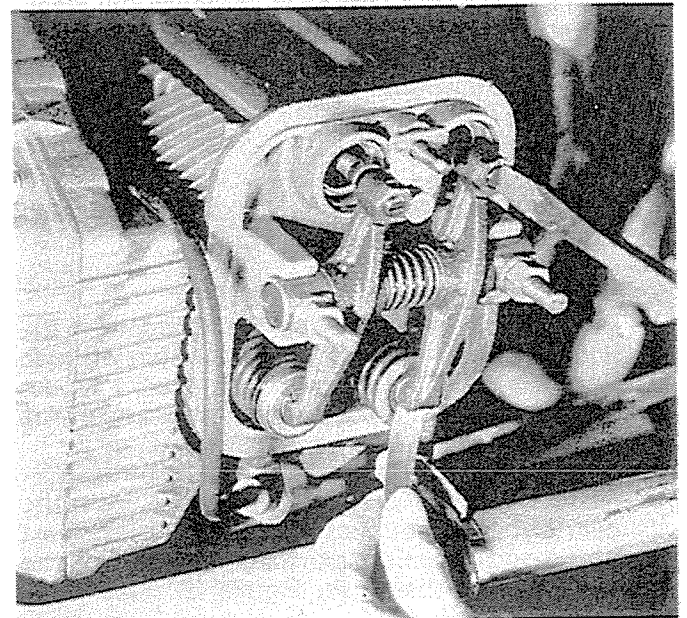


Figure 45

TIMER AND GOVERNOR INSTALLATION (See Timer-Governor Section for Overhaul)

Rotate the flywheel in a clockwise direction until the timing marks on the flywheel and fan housing are lined up. Hold the timer and governor assembly above the engine in its normal position. Turn the timer housing until the coil wire terminal is pointing toward the center line of the bend in the intake manifold. With your other hand, rotate the timer shaft until the highest point on the breaker point cam is facing the breaker point pivot pin.

Install the timer and governor assembly making sure that the gasket is in place.

The hex hole in the bottom of the timer shaft must fit over the hex shaft which goes to the oil pump. As the timer is placed into the crankcase, rotate the shaft slightly to align the two parts.

As the timer continues on down, the drive gear on the timer and governor assembly will come in contact with the cam shaft gear and the breaker point lobe will rotate counterclockwise as the gears mesh. Be sure the coil wire terminal on the outside of the timer housing, is still pointing toward the center line of the bend of the intake manifold and the high point of the breaker point cam is just coming in contact with the breaker point block. This position is critical to provide proper ignition timing.

Install the studs holding the governor base to the crankcase and tighten. Install the two timer clamps along with the lock washer and nut, but do not tighten at this time. Connect the positive wire of a continuity light to the timer ignition stud and the negative wire to a good ground. Rotate the timer base clockwise until the light goes off. Preliminary timing is now set. An automotive timing light will be used later to assure that ignition timing is set on 7 degrees before top dead center (timing marks in alignment).

Use a clean feeler gauge to measure the clearance between the breaker points. This clearance must be .020" (0.5 mm).

OIL FILTER

Install a new oil filter.

Lubricate the gasket with engine oil and tighten with hand pressure only.

IGNITION COIL AND RESISTOR

Reinstall all air cooling baffles along with the two ignition coils. Attach the high tension wires to the ignition coils. Connect the blue wire to the battery post of the one coil and the other end of the blue wire to the ignition resistor.

Connect the black wire to the distributor post of the second coil. There is a short wire from the distributor post of the first coil to the battery post of the second coil. Connect the other end of the black wire to the timer. Figure 46.

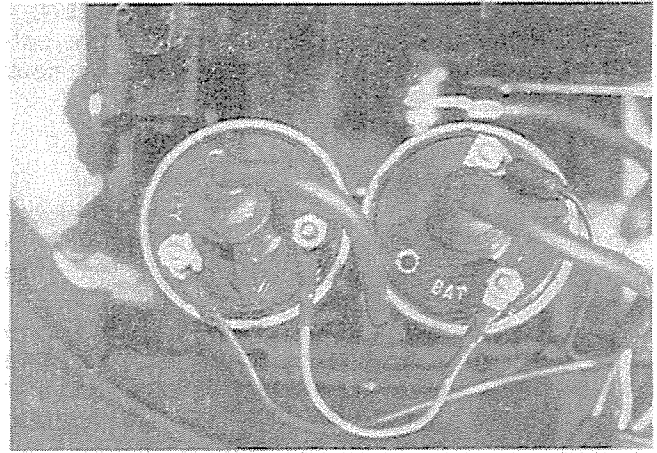


Figure 46

ALTERNATOR

Install the alternator and bracket to the front fan housing. Connect wires to the alternator and alternator resistor. (See Alternator Section for overhaul).

CARBURETOR (See Fuel System Section for Complete Overhaul)

Use a new gasket to mount the carburetor on the oil filler housing. Use the "L" shaped bracket with a weld nut on the left side next to the throttle linkage and an internal shake proof washer on the right mounting screw.

Before tightening the screws, be sure the gasket is in its proper place and see that the casting of the carburetor and the casting of the oil filler mounting flange are flush or parallel to one another. The carburetor throat must line up properly with the hole in the mounting casting.

Adjustment should be made on the carburetor prior to starting the engine. Adjust the throttle stop screw to open the throttle slightly but not far enough to uncover the number 2 idle discharge port.

THROTTLE LINKAGE ADJUSTMENT

Adjust the throttle linkage so that overtravel link is extended 1/8" (3.18 mm) minimum when the throttle is in the idle position. The governor lever should be 1/64" to 1/16" (0.40 to 1.59 mm) when the throttle linkage is in the full throttle position and the throttle butterfly shaft is against the full throttle stop.

The fast idle cam has been placed on all carburetors. Set the fast idle linkage to obtain 1800 to 2000 engine RPM when engaged. The engine is returned to its normal idle speed by bumping the throttle open, allowing the fast idle linkage to return to its normal position.

Pulling the choke to the "on" position will lift the fast idle cam into position and open the throttle plate in the carburetor. The throttle plate will be positioned between the number 1 and number 2 idle discharge holes in the Venturi.



SAFETY WARNING: The throttle must close freely. Actuate linkage several times to be sure throttle returns to the idle position without restriction.



SAFETY WARNING: Check the condition of all fuel hoses before installation on the vehicle. Be sure hoses are not cracked or split and all clamps and grommets are in position.



NOTE: Spark plug threads are die cast aluminum. When installing spark plugs in the engine, always use care to insure that the plugs are started into the threads correctly. Do not over tighten a spark plug. The recommended torque is 22-25 ft. lbs. (30-34 N:m).

Use a hose clamp pliers to install the gasoline hose from the fuel pump. Install a new breather valve into the valve housing and install the housing assembly to the crankcase using a new gasket. Install the breather valve hose and clamp.

Install the air cleaner cover along with a new paper element, Cushman Part Number 111316.

Before installing a new spark plug, check the spark plug gap. A correct gap setting is necessary for efficient firing. A gap too narrow, causes rough running at low speeds; a gap too wide, results in the engine missing because the voltage is insuffi-

cient to jump the gap. Recommended spark plug setting for the AC-C85TS is .025" (0.6 mm).

ENGINE TO CHASSIS INSTALLATION

Depending on how the vehicle is equipped, install the alternator, heater hoses, shrouding, etc.

The engine can now be placed in the frame. Be sure the engine mounting bolts and the bolts between the clutch housing and the engine are properly installed and securely tightened.

After making a precautionary check to be sure the oil drain plug has been replaced and all the crankcase components have been installed and thoroughly tightened, put 2½ quarts (2.38 L) of the recommended oil in the crankcase. Connect the positive starter wire.

With the transmission in neutral position, start the engine and let it idle for approximately 10 minutes. The carburetor low speed adjustment needle may be adjusted to the best idling operation. Stop the engine after the warm-up period and connect an automotive type timing light. Start the engine and operate at idling speed (below 750 RPM) and observe the relationship between the timing mark on the outer fan housing and the timing mark on the flywheel fin. If these marks do not exactly coincide, rotate the timer body assembly until these marks have exactly lined up. When the proper timing has been acquired, tighten the two timer retaining nuts. Road test the vehicle for proper operation. The regular new vehicle break-in procedure must be observed after a complete engine overhaul.

TROUBLESHOOTING

*HARD STARTING

1. Incorrect ignition timing
2. Loose connection in ignition system
3. Faulty ignition coil
4. Faulty condenser
5. Burnt or shorted breaker points
6. Faulty spark plugs
7. Restricted fuel line or filter
8. Faulty fuel pump
9. Improper carburetor adjustment
10. Water in fuel
11. Valve leakage
12. Worn piston ring

LACK OF POWER

1. Engine overheating (see above)
2. Restricted exhaust system
3. See items under Hard Starting

*ENGINE STALLS

1. Improper carburetor adjustment
2. Choke partly closed
3. Leak in intake system
4. Faulty ignition coil
5. Faulty condenser
6. Faulty spark plugs or improper gap
7. Burnt breaker points or improper gap
8. Poor compression

OVERHEATING

1. Crankcase oil level too low
2. Crankcase oil level too high
3. Engine overloaded
4. Improper fuel
5. Fuel mixture too lean
6. Incorrect ignition timing
7. Restricted cooling vents
8. Excessive carbon

*ENGINE MISSES UNDER LOAD

1. Water in fuel
2. Improper breaker point gap
3. Improper spark plug gap
4. Improper ignition timing
5. Faulty ignition coil
6. Faulty condenser
7. Improper carburetor adjustment
8. Faulty spark plug wires
9. Faulty fuel filter

LOW OR NO OIL PRESSURE

1. Low crankcase oil level
2. Faulty pressure sending unit
3. Crankcase oil too light
4. Oil pressure relief valve stuck
5. Oil strainer screen plugged
6. Pump drive gear loose on shaft
7. Short in wiring

ENGINE KNOCK

1. Low crankcase oil level
2. Low oil pressure
3. Excessive bearing wear

4. Crankshaft journals out of round
5. Crankcase oil too light
6. Low grade fuel
7. Improper ignition timing
8. Excessive carbon
9. Engine overheated
10. Loose flywheel
11. Improper valve adjustment
12. Cylinder sleeve loose in casting
13. Improper ignition timing

EXCESSIVE OIL CONSUMPTION

1. Worn piston rings
2. Worn cylinder walls
3. Worn or faulty valve stem seals
4. Worn or faulty breather seal on camshaft
5. Cylinders reversed

VAPOR LOCK OR SIMILARITIES

1. Restricted cooling vents
2. Fuel line contacting hot area of engine
3. Fuel pump weak (low pressure)

*BACKFIRING

1. Improper valve tappet clearance
2. Improper breaker point clearance
3. Faulty ignition coil
4. Faulty condenser
5. Broken or weak spark advance weight springs
6. Improper ignition timing
7. Improper carburetion adjustment
8. Leaking exhaust valves

* A defective Faria tachometer can cause complete or intermittent ignition failure. Diagnose by disconnecting tachometer wires from ignition coils and connecting coils as shown in this section on page 14.

SECTION 5 FUEL SYSTEM

ZENITH CARBURETOR REPAIR

The Zenith carburetor includes a horizontal balance type fuel bowl, a single ring shaped float, adjustable main jets, a three-position spring loaded choke plate with poppet valve, an idle adjusting needle and a throttle stop screw. (Figure 1) The throttle body casting contains an inverted Venturi. The idle tube and main discharge is pressed into the long boss which extends to the inside of the throttle body and should not be removed. This boss also serves as a mounting support for the fuel bowl and the adjustable main jet. In this "balanced" design, all the air for operation of the various carburetion systems must enter through the air cleaner. Therefore, any restriction in the air cleaner will have a minimum effect on the mixture ratio.

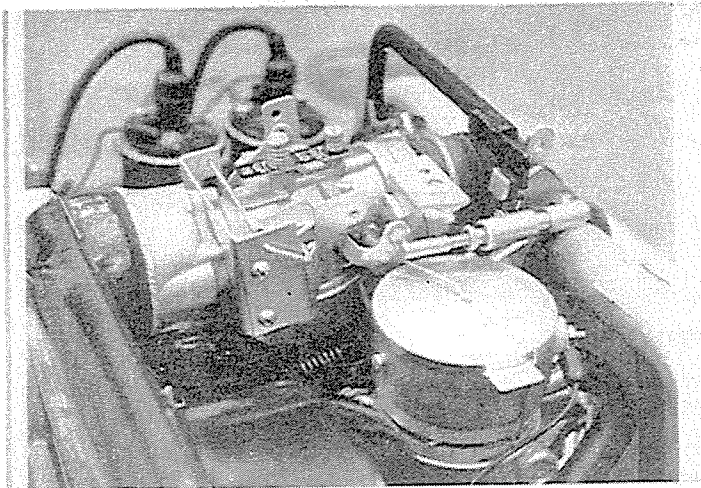


Figure 1

The engine should operate satisfactorily when the carburetor is adjusted within the range of the specifications. If not, the carburetor needs cleaning or some other abnormal condition exists. A leaking carburetor indicates a defective float or inlet needle and seat or incorrect float settings.

The carburetor should be cleaned and inspected at regular intervals depending on the service conditions. To remove the carburetor from the engine:

1. Remove the throttle linkage from the carburetor to the governor assembly.
2. Remove the crankcase breather hose using clamp ring pliers to remove the ring clamps.
3. Remove the gasoline hose from the carburetor.
4. Disconnect the choke cable.
5. Remove the two screws mounting the carburetor to the oil filler base.

A complete carburetor (Figure 2) consists of the carburetor body, fast idle cam and the connector between the air cleaner and the carburetor. Individual parts may also be ordered.

Dirt, improper adjustment, improper assembly, etc., are the most common causes of carburetor trouble.

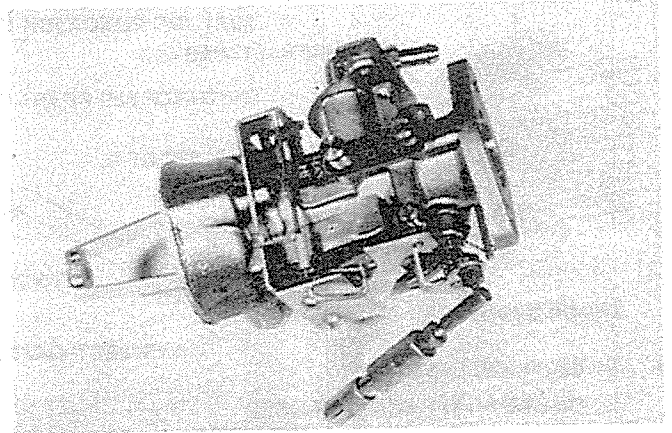


Figure 2



NOTE: Some solvents and cleaners will damage the synthetic rubber parts used in the carburetors. If you are in doubt about the solvent you are using, test an old part in it and observe the results.

Clean and dry the outside of the carburetor and check for cracks in the casting, bent or broken shafts, loose levers and/or damaged threads before proceeding with disassembly.

Figure 3 shows an exploded view of the Zenith carburetor.

A defective float, defective inlet needle and seat or an incorrect float setting can cause fuel leakage. To correct this, remove the main jet seat and gasket which are on the bottom of the bowl. Remove the bowl from the carburetor.



NOTE: The float spring end must be positioned inside the bowl when replacing the bowl on the carburetor.

The float setting can be checked by placing 1/4" (6 mm) drill bit between the bowl gasket and the float. (Figure 4). If the float setting is incorrect, light finger pressure should be applied to the float arm to correct. Check the operation of the float to be sure that the hinge and the axle do not bind and that the float moves straight up and down.

The needle and seat is a replacement part which comes in the carburetor repair kit and should always be replaced when repairing the carburetor. The needle has a neoprene rim which helps prevent it from sticking in the seat. However, the neoprene does become hard and may be broken.

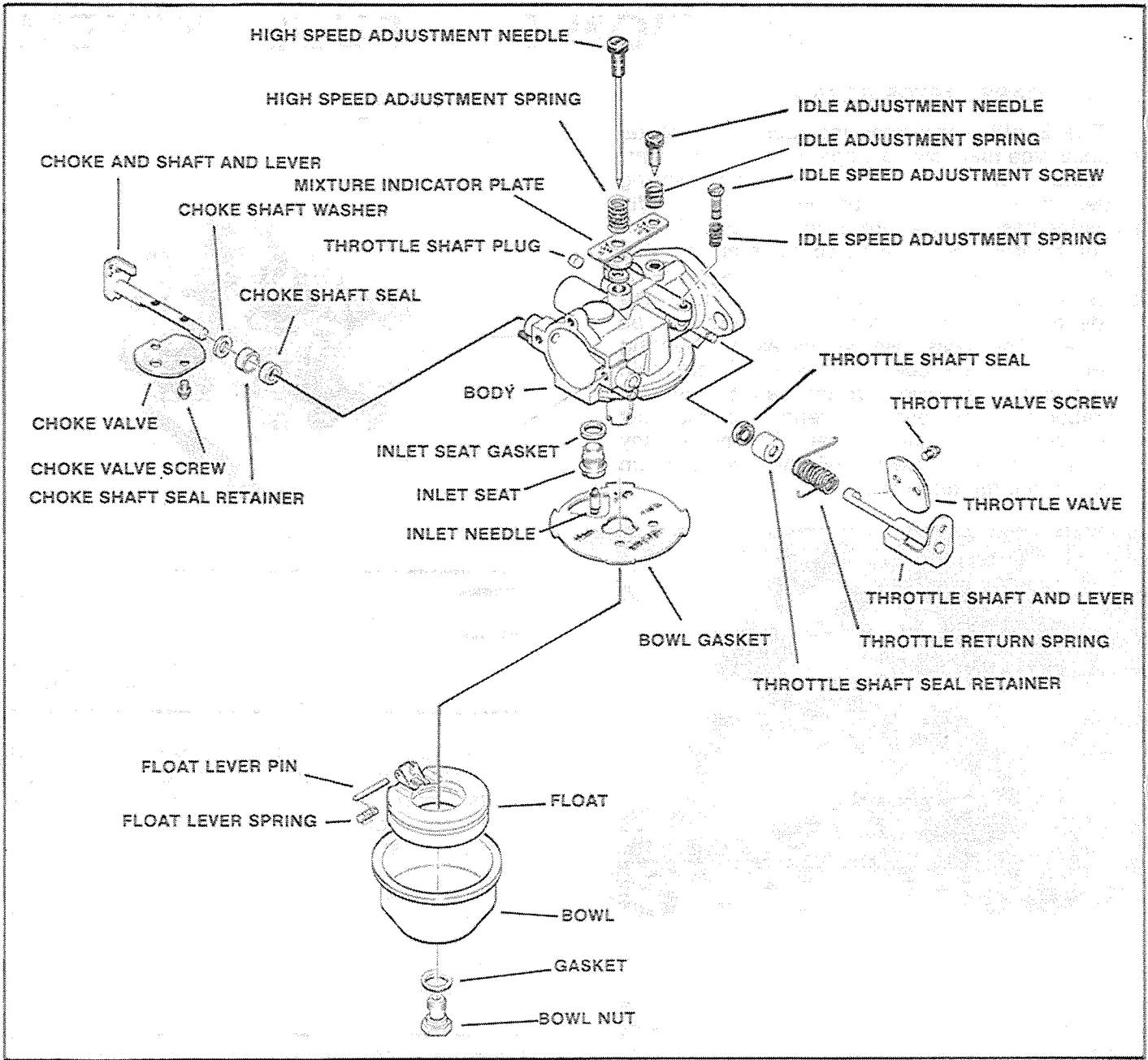


Figure 3

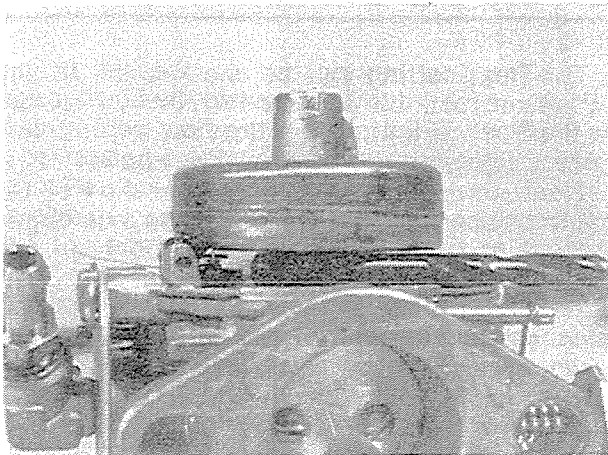


Figure 4

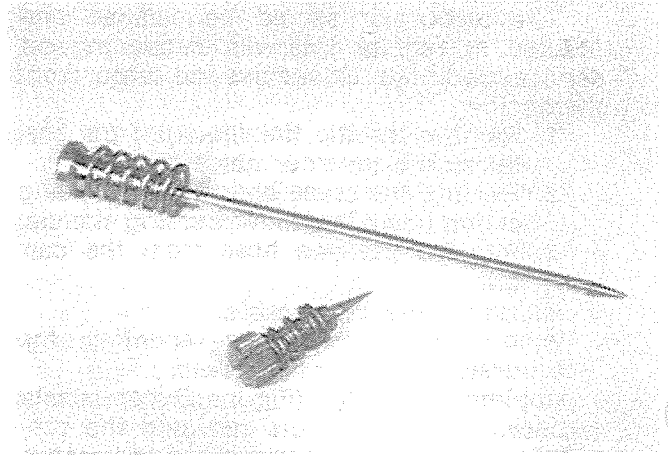


Figure 5

In the Zenith carburetor, there are two adjustment needles, an idle adjustment needle and a high speed adjustment needle. The taper on the end of both needles should be closely examined for rings or a groove worn at the end. The adjustment needles should be replaced when there is no longer a straight, smooth taper. (Figure 5).

The high speed adjustment needle is the most critical. It is a hollow tube which is easily damaged by a screwdriver or pliers. This will affect the idle of the engine since the gasoline flows up through the inside of the needle to the idle port.

Figure 6 shows the fuel entering the carburetor and passing through the needle and seat which is metered by the height of the float. As the float drops closer to the bottom of the bowl, more fuel from the fuel pump will enter the bowl. As the bowl fills to the recommended level, the float will rise closing the needle and seat and thereby preventing more fuel from entering the bowl.

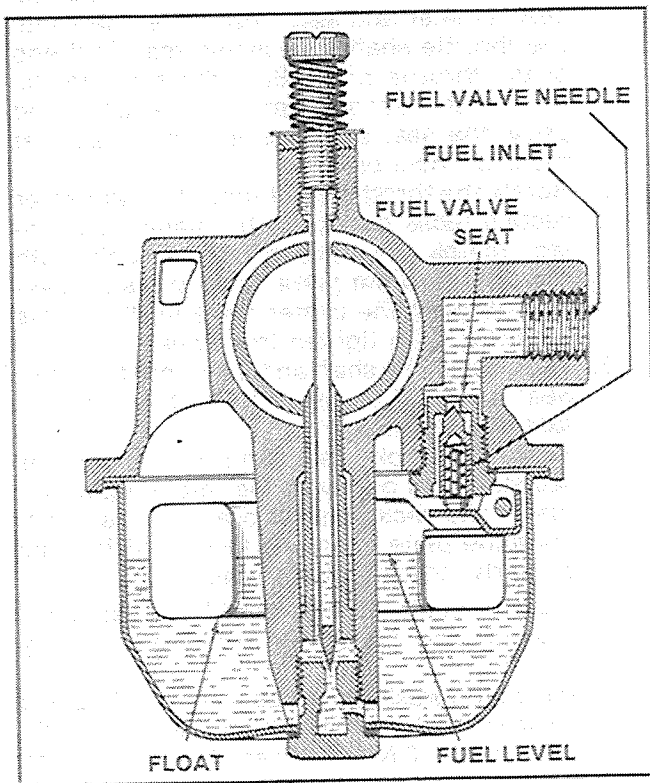


Figure 6

Figure 7 shows the idle system of the carburetor. Fuel is drawn from the main metering well through the idle tube. It is then mixed in the channel leading to the idle discharge hole with air entering through the idle air bleed. At a slow idle speed, the throttle plate is positioned, as shown, to expose only the Number 1 idle discharge hole to engine vacuum. Air is admitted to the idle channel through the Number 2 and 3 idle holes. This air mixes with the fuel/air mixture in the channel and is discharged through the Number 1 idle hole.

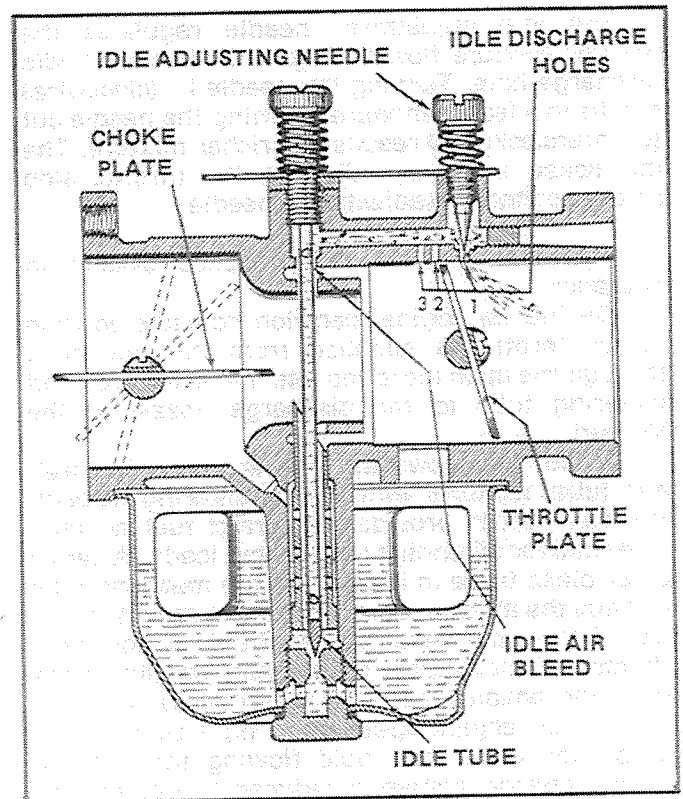


Figure 7

As the throttle plate is opened, the Number 2 hole and then the Number 3 hole begin to discharge fuel/air mixture to supply the increased fuel requirements of the higher engine speed. Further opening of the throttle plate brings the high speed system into operation.

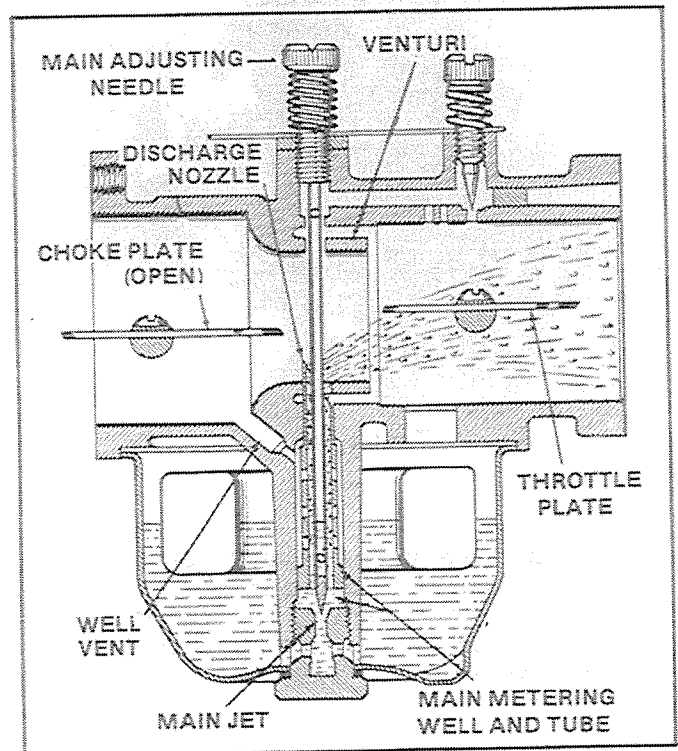


Figure 8

The idle adjustment needle regulates the fuel/air mixture flow through the Number 1 idle discharge hole. Turning the needle in (clockwise) results in a leaner mixture. Turning the needle out (counterclockwise) results in a richer mixture. The idle speed is set by adjusting the throttle stop screw, not the idle adjustment needle.

Figure 8 shows the high speed system in operation.

The fuel for engine operation from idle position to full throttle is supplied from the fuel bowl through the main metering jets, metering well and metering tube to the discharge nozzle in the Venturi.

As the fuel flows through the metering well and tube, it mixes with the air entering through the well vent to provide the correct fuel/air mixture ratio for all engine speeds and loads. A series of air bleed holes in the wall of the metering tube permits the air from the well vents to enter the fuel flow below the level of the fluid in the float chamber. This reduces the average density of the fluid and enables it to flow freely at low suction.

At high engine speeds and high suction, the proportion of air and fluid flowing through the main metering system is reduced to provide the richer discharge mixture needed for peak performance.

Figure 9 shows a closeup view of the carburetor giving correct parts location.

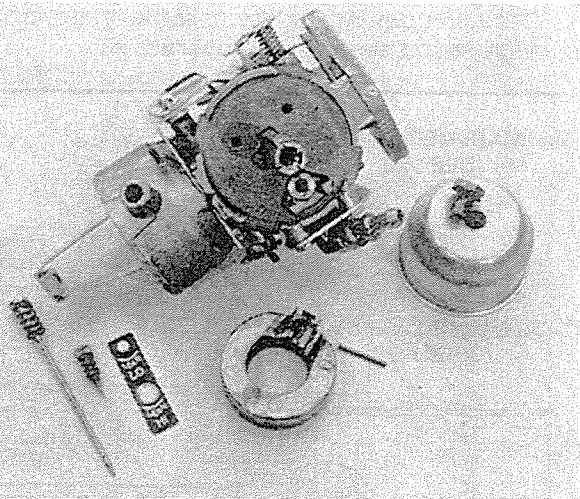


Figure 9

Cleaning

Clean all metal parts thoroughly by rinsing in solvent. Blow out all passages and channels in the castings with compressed air. Reverse the air flow through each passage to help in removal of dirt particles. (Never use a wire or drill to clean out the jets.)

Inspection

Inspect all parts and replace any that are damaged or worn. For the correct repair kit, refer to the parts catalog.



SAFETY WARNING: When replacement parts are required, use genuine OMC parts or parts with equivalent characteristics including type, strength, and material. Failure to do so may result in product malfunction and possible injury to the operator and/or bystanders.

Reassembly

Assembly of the throttle body:

1. Slide the throttle shaft and lever into the seal retainer and seal. Insert the shaft into the throttle shaft hole at the manifold end of the throttle body. Seat the shaft in the hole at the opposite end of the bore and press the seal and retainer firmly against the shaft hole boss.
2. Rotate the throttle shaft until the flat center section faces out from the manifold opening. Install the throttle plate loosely with screws. Snap the plate open and shut several times to the center plate until it seats properly, then tighten the screws.
3. Slide the choke shaft and lever into the hole. Seat the shaft in the hole on the opposite side of the intake.
4. Rotate the choke shaft until the flat center section faces out from the intake opening. Install the choke plate loosely with screws. Snap the plate open and shut until it seats properly, then tighten the screws.
5. Position the throttle body with the fuel bowl side up and install the bowl to the body gasket.
6. Install the washer and fuel valve seat. Use a large screwdriver to tighten the seat to 100 lbs. in. (11.0 N:m). Insert the valve with spring and pin.
7. Install the float and float axle on the support brackets of the throttle body. With the throttle body horizontal and float side up, check the operation of the float to be sure that the hinge and axle do not bind and that the float moves. Adjust to acquire 1/4" (6 mm) clearance between the float and the carburetor body. (See Figure 4).
8. Install the throttle stop screw and spring. Adjust the screw to open the throttle slightly, but not far enough to uncover the Number 2 idle discharge hole. (See Figure 7).

9. Install the idle adjusting needle and spring. Screw the needle in (clockwise) until it seats lightly, then back it out two turns as a preliminary idle adjustment.

Assembly of Bowl to Body

1. Assemble the washer on the main jet screw. Install the fuel bowl.

Screw the main jet into the throttle body boss with a 1/2" wrench. Tighten to 100

lbs. in. (11.0 N:m). Next, install the high speed adjustment needle. Turn the adjustment screw in (clockwise) until it seats lightly, then back the screw out two turns as a preliminary high speed adjustment.

To replace the complete carburetor on the engine, see the Engine Overhaul Section.



NOTE: The float spring end must be placed inside the bowl.

KEIHIN CARBURETOR REPAIR

The engine should operate satisfactorily when the carburetor is adjusted to the following specifications:

Low speed 1 to 2 turns open
 Float setting 0.65" (16.5 mm)

If the engine will not operate with the above settings, the carburetor may need cleaning or some other abnormal condition exists in the engine.

To remove the carburetor from the engine:

1. Remove the air cleaner assembly.
2. Remove the throttle and choke linkage from the carburetor.
3. Remove the crankcase breather hose and fuel hose.



SAFETY WARNING: The fuel hose and carburetor will be full of gasoline and some spillage will occur when the fuel hose is removed. Gasoline is extremely flammable and highly explosive under certain conditions. Do not allow open flames or sparks when performing any maintenance function or repair involving gasoline.

4. Remove the two screws mounting the carburetor to the oil filler base.



NOTE: Some solvents and cleaners will damage the synthetic rubber parts used in the carburetor. If you are in doubt about the solvent you are using, test an old part in it and observe the results.

Clean and dry the outside of the carburetor and check for cracks in the castings, bent or broken shafts, loose levers and/or damaged threads before proceeding with disassembly.

IMPORTANT: The carburetor adjustments made at the factory comply with Federal Specifications regarding exhaust emissions. The limiter cap and idle mixture screw should not be removed or disturbed unless a C.O. meter is available to obtain the correct adjustment after re-assembly.



NOTE: The fuel line fitting cannot be removed from the carburetor body. Turning or twisting may break this part.

Remove the bowl screws and remove the bowl. Remove the float lever pin, the float and inlet needle can now be removed. Inspect the inlet needle and seat. The inlet seat cannot be removed from the carburetor body. If it is damaged the entire carburetor must be replaced. The inlet needle can be replaced if it becomes worn or damaged.

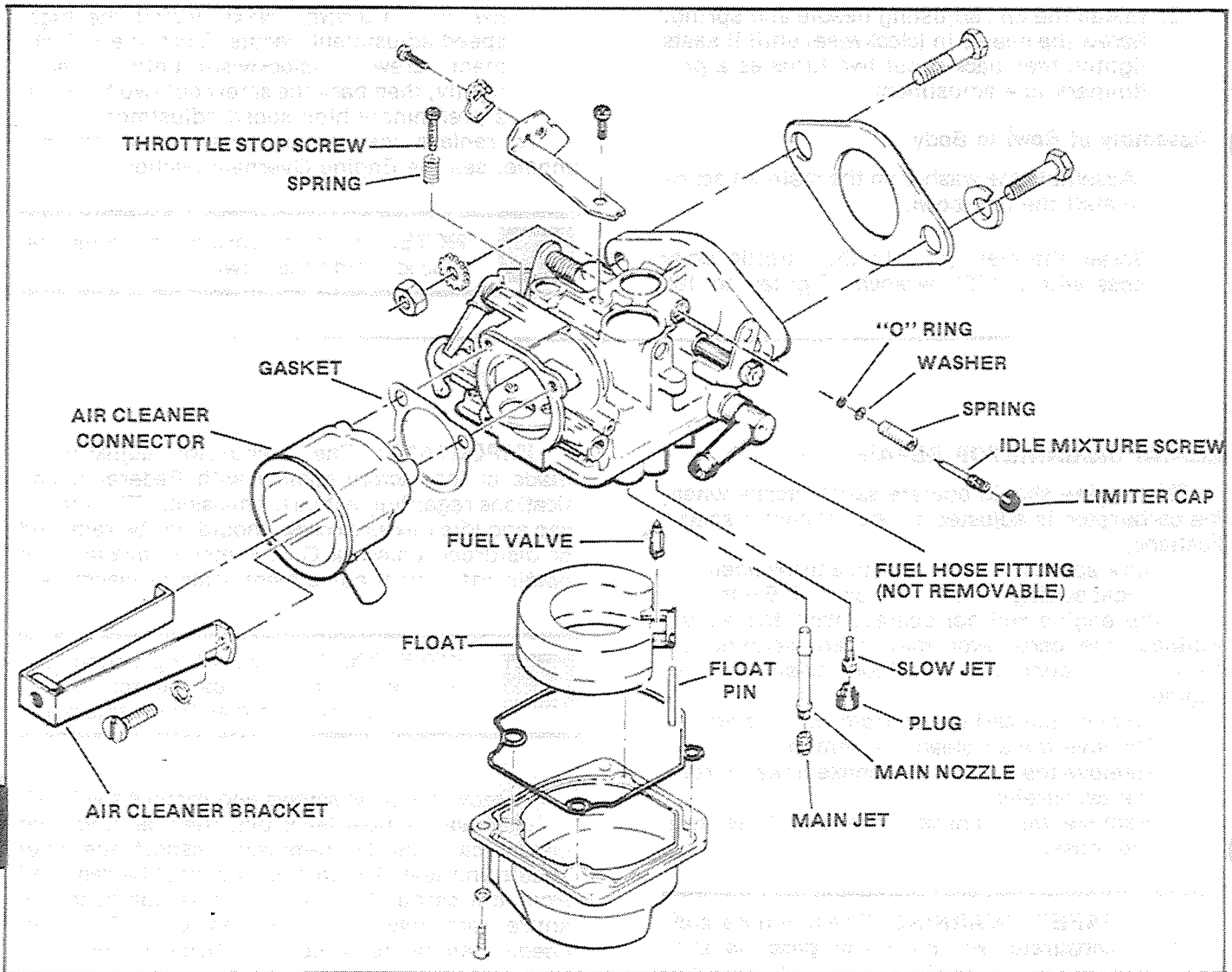
Examine the throttle shaft, choke shaft, fast idle lever and carburetor body for wear. These parts cannot be removed from the body. If replacement is necessary, the entire carburetor must be replaced.

Clean all metal parts thoroughly by rinsing in solvent. Blow out all passages and channels with compressed air. Reverse the air flow through each passage to help in removal of dirt particles. Never use a wire or drill to clean out the jets.

Inspect all parts and replace any that are damaged or worn. Always use new gaskets and "O" rings.



SAFETY WARNING: When replacement parts are required, use genuine OMC parts or parts with equivalent characteristics including type, strength and material. Failure to do so may result in product malfunction and possible injury to the operator and/or bystanders.



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FIGURE 10

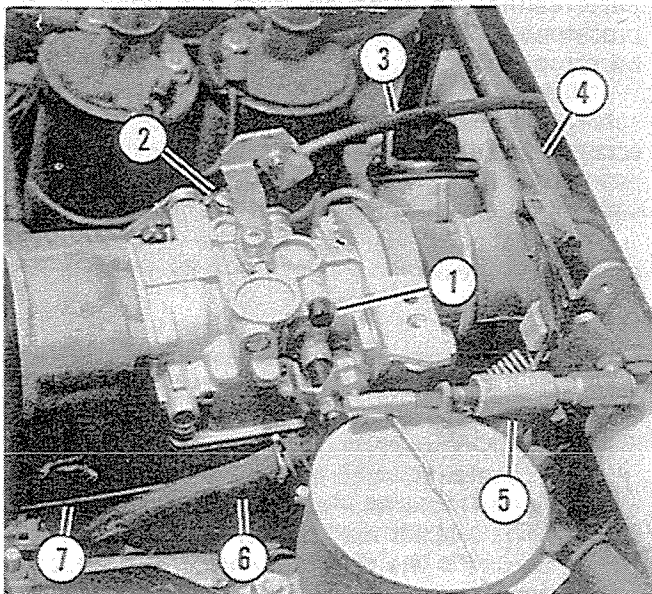


FIGURE 11

The correct float setting is 0.65" (16.5 mm) from the bottom of the float to the bowl mounting surface. Hold the carburetor in an inverted position to check this measurement. The float is not adjustable and must be replaced if necessary to obtain the proper setting.

Assemble the carburetor using all new gaskets. Be sure all gasket surfaces are clean. Install carburetor on engine, reinstall breather hose, choke cable and connect the overtravel link.



NOTE: Route the choke cable over the throttle control arm.

1. Low Speed Idle Mixture Screw
2. Throttle Stop Screw
3. Choke Cable
4. Throttle Control Arm
5. Overtravel Link
6. Fuel Hose
7. Breather Hose

Before installing air filter, check the choke cable adjustment to be sure the choke plate closes completely.

THROTTLE STOP ADJUSTMENT



NOTE: If a new carburetor is installed, there may be interference between the fuel inlet fitting and the timer housing. Material can be removed from the fuel inlet elbow with a file to provide clearance. Caution: Do not remove more than .060" (1.52 mm) material.

The U.S. Environmental Protection Agency (USEPA) regulations require that vehicle exhaust emission be within certain limits as stated in the Federal Register dated Wednesday, January 5, 1977, Part II, Air Pollution Control. The Keihin Carburetor used on "On-the-Road" vehicles manufactured between January 1, 1979, and the start of the 1980 model year is designed to meet these standards.

It will be necessary to check and set exhaust emission levels whenever the carburetor is reworked or replaced. This is accomplished by using an exhaust analyzer to measure the level of carbon monoxide. One type of analyzer is SUN model EPA-75.

Following is the recommended carburetor adjustment procedures:

1. Start engine and allow it to reach normal operating temperature.
2. Make sure the choke is completely off.
3. Adjust the throttle stop screw to provide an engine speed of 900 R.P.M.
4. Connect the CO meter.
5. Remove the limiter cap and adjust the idle mixture screw to give a maximum CO reading of 1.5%.
6. Install the limiter cap with the stop tab pointing straight up. Any adjustment made within the range of the limiter cap will result in an emission level that complies with the Federal Regulations.

For this engine the HC (hydrocarbon) levels as stated in the above mentioned Federal Regulations are met when the CO levels are maintained within the limits specified.

The fast idle should provide an engine speed of 1,800 to 2,000 RPM. Adjustment is made by carefully bending the throttle stop bracket as shown.

Adjust the overtravel link, if required, to obtain 3700 to 3800 RPM with the throttle fully opened.



SAFETY WARNING: The throttle must close freely. Actuate the linkage several times to be sure throttle returns to the idle position without restriction.

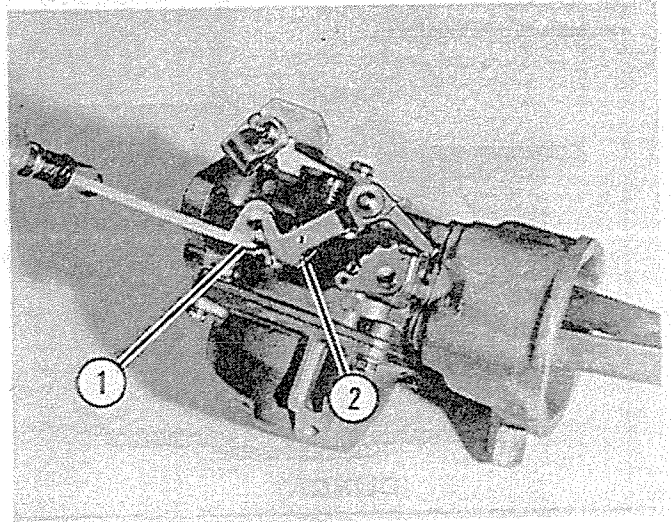


FIGURE 12

1. Throttle Stop Bracket
2. Engaged Position

Figures 13, 14 and 15 illustrate the function of the Keihin carburetor in the various throttle positions.

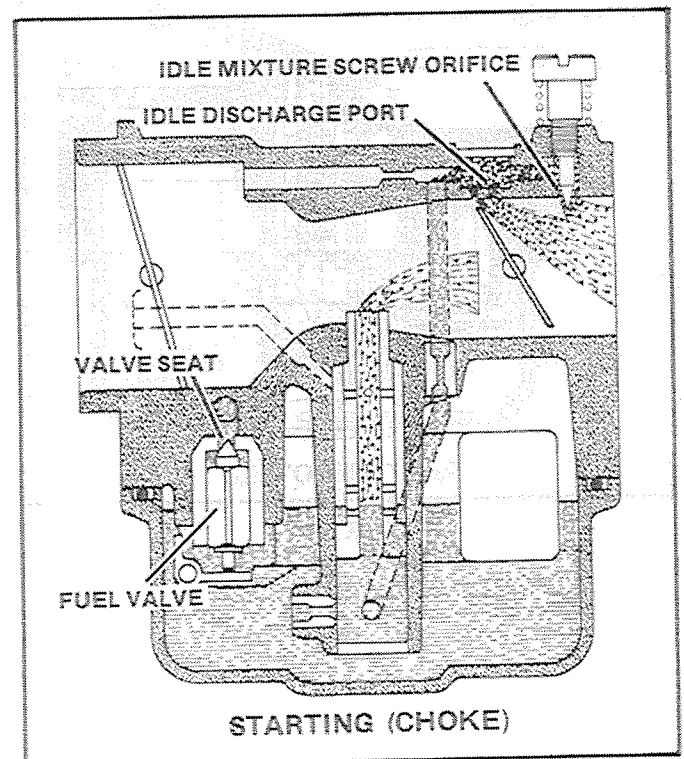


FIGURE 13

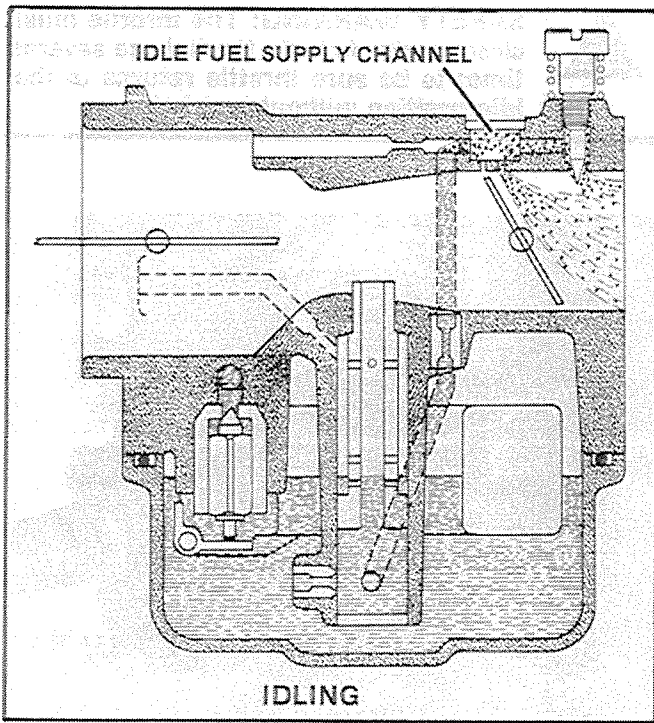


FIGURE 14

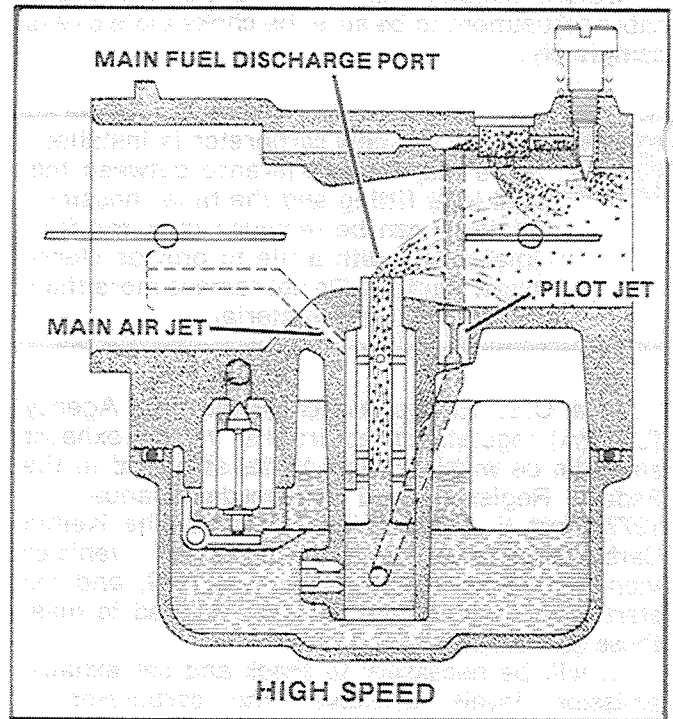


FIGURE 16

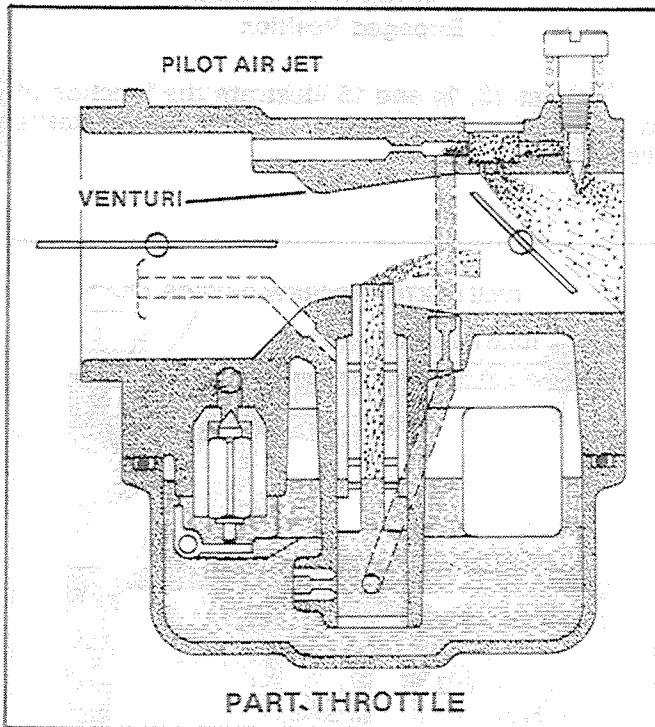


FIGURE 15

FUEL FILTER

An in-line fuel filter is located either under the left side of vehicle frame (Figure 17) or under the seat (Figure 18). This filter removes foreign particles from the fuel and should be replaced twice a year. To replace, unclamp and slide hoses from filter. Install the new filter with the arrow toward the fuel hose leading to the carburetor.

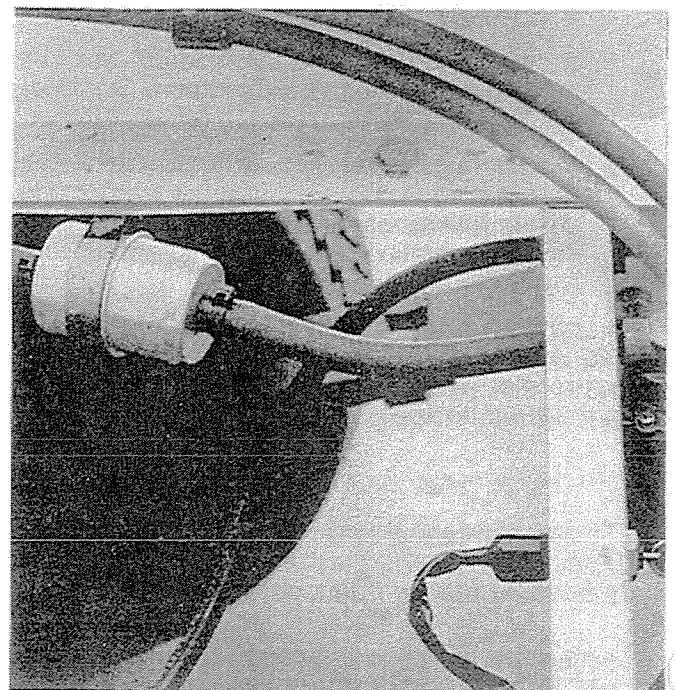


FIGURE 17

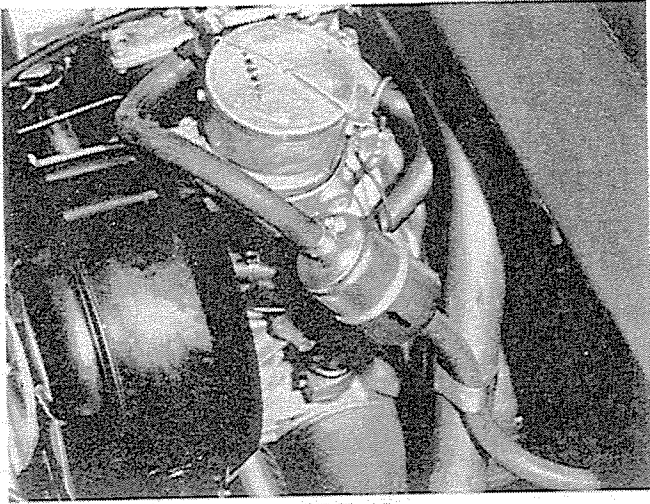


FIGURE 18

FUEL PUMP

All 1978 and later models are equipped with electric fuel pumps. Early 1978 vehicles have the style of pump shown in Figure 19. This pump cannot be repaired if defective, a Fuel Pump Set #884766 is required if replacement is necessary. This set includes the later style pump as shown in Figure 20. On models 898447, 898507, and 898547 the pump is mounted on the chassis frame near the fuel tank. Figure 21. When service or replacement is required, it is recommended that Fuel Pump Relocation Set #885058 be installed to position the pump near the rear of the fuel tank. Figure 22. This set includes only the parts needed to relocate the pump, if a new pump is needed it must be ordered in addition to the set.

It has been established that some of the early electric fuel pumps produced excess pressure which causes crankcase dilution and spark plug fouling. If this is suspected, a fuel pump pressure check should be made.

Connect a pressure gauge between the carburetor and fuel pump by using a tee fitting. The pump must be pumping fuel to obtain an accurate pressure check. Be sure the electrical current to operate the pump is adequate, a minimum of 12V

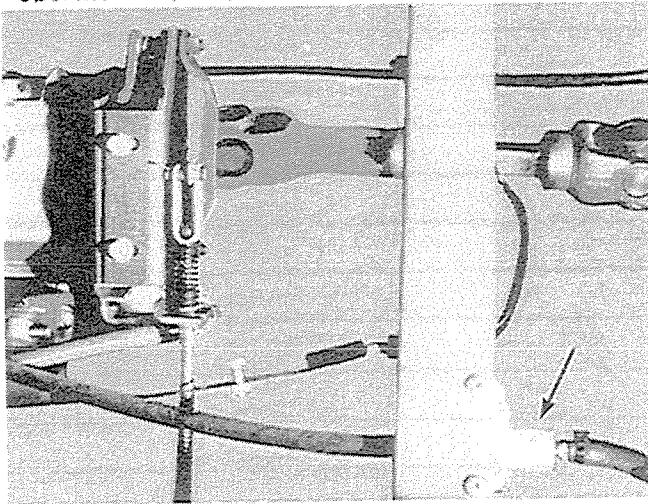


FIGURE 19

D.C. is required. Also be sure that fuel is available to the pump. Check fuel tank for sufficient fuel level and check all fuel hoses and fuel filter for restrictions and leaks.

A good pump should provide 2½ to 3 P.S.I. If pressure within this range cannot be obtained, the fuel pump must be replaced.

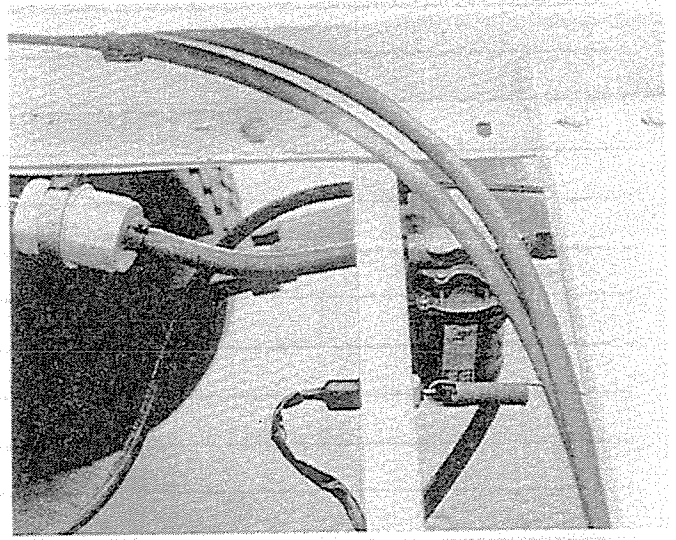


FIGURE 20

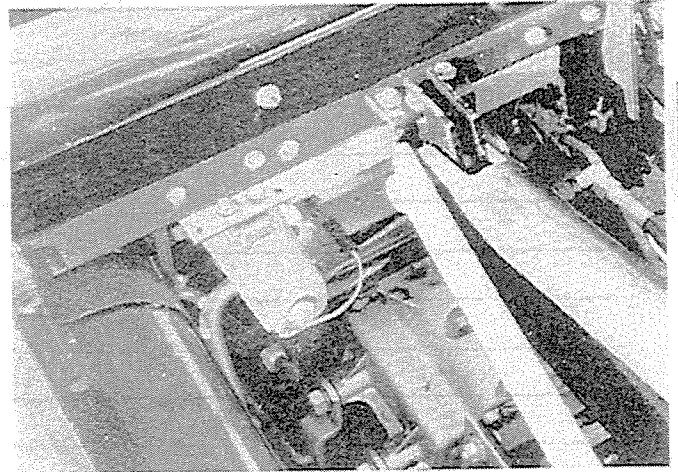


FIGURE 21

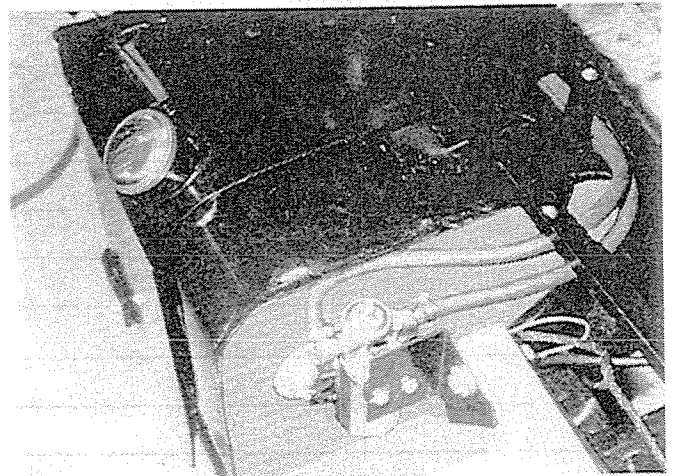


FIGURE 22

NOTES

5

SECTION 6

ELECTRICAL

TIMER AND GOVERNOR OVERHAUL

The timer contains a set of points, a condenser and centrifugal advance weights and is designed to allow voltage to pass from the coil to the spark plug at a preset time. The governor controls the RPM of the engine.

Remove the two nuts, lock washers and clamps that secure the timer assembly. Next, use a 7/16" deep socket to remove the studs holding the governor base to the engine. Gently pull the timer and governor assembly straight up. (See Figure 1).



FIGURE 1

The unit at the left in Figure 2 is the on-road governor and timer assembly, the unit at the right is the off-road or Turf Truckster timer and governor assembly. Both governors may be adjusted to limit engine RPM.

The unit at the right side of Figure 2 will allow the RPM to be controlled from the operator's seat and is most useful when using the power-take-off or other special attachments.

Remove the timer cover retainer and cover. Remove the governor spring and the gasket between the governor body and the crankcase. Discard the gasket.

Use a 5/32" (4 mm) punch to remove the roll pin from the timer drive gear and drive shaft. Remove the gear and spring thrust washer located between the governor timer gear and the inner bearing. (Figure 3).

Next, use the punch to remove the roll pin holding the governor spool assembly to the timer shaft.

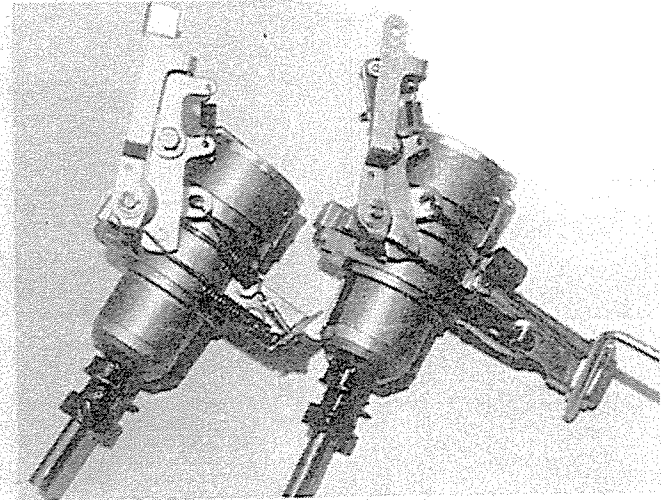


FIGURE 2

The timer assembly may now be pulled from the governor housing. Remove and discard the timer gasket.

TIMER ASSEMBLY

Loosen and remove condenser and breaker point wires from the terminal screw.

Remove the three screws from the breaker base plate and remove the plate from the timer housing.

Remove the "E" ring from beneath the timer housing on the shaft and remove the timer shaft from the housing.

Remove and discard the seal located in the timer housing. Whenever the timer shaft is removed from the timer housing, the lip of the seal will roll or be cut by the "E" ring groove in the timer shaft. (See Figure 4).

A new bearing and seal should be installed. This seal may become hard or cracked and allow oil to enter in and around the points, condenser, etc. Oil deposits on the points will cause them to arc and burn.

Use a flat machined bar to press the bearing and seal out of the housing.

There is an oil return hole between the bearing and the seal in the timer housing. This allows the oil entering through the needle bearings to return to the crankcase. Use a small wire to clean this return passage.

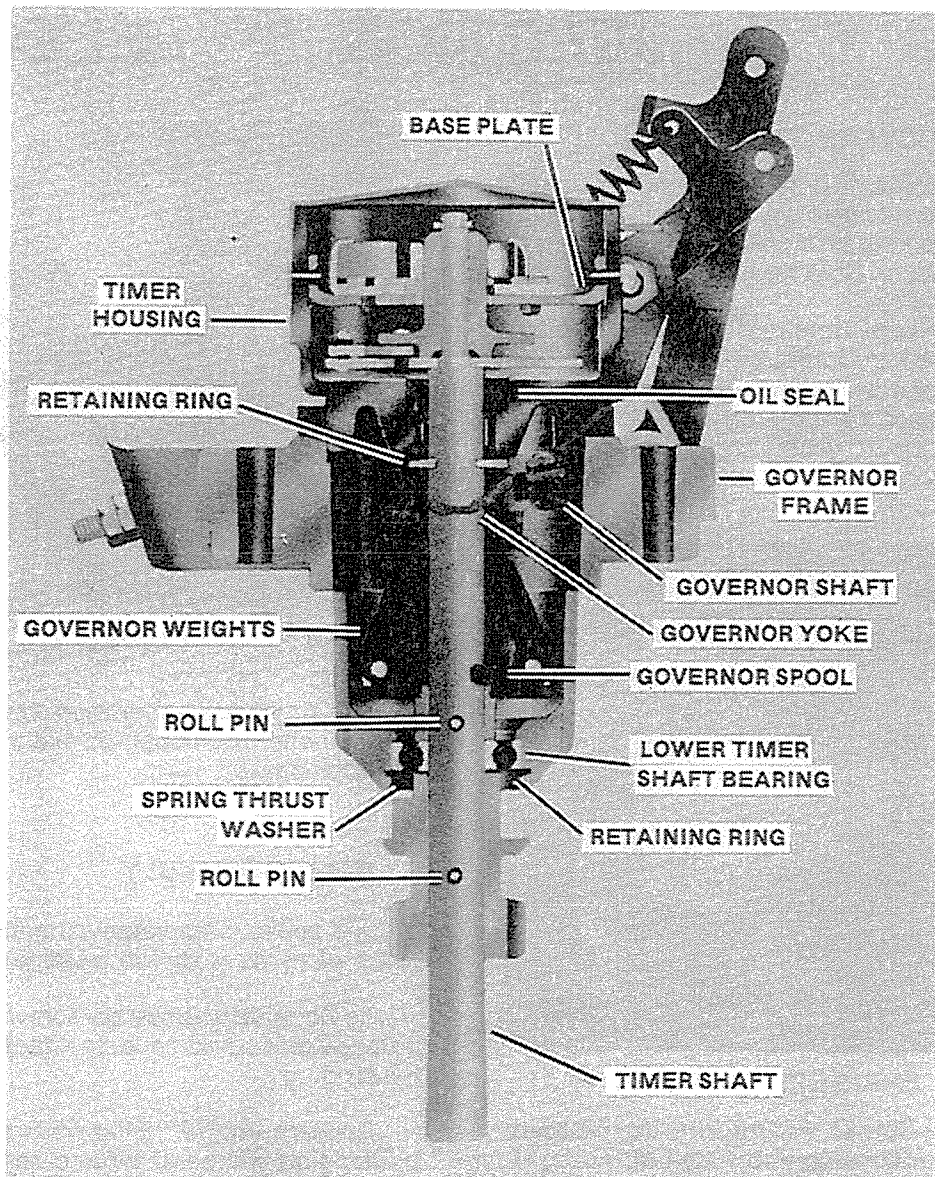


FIGURE 3

6

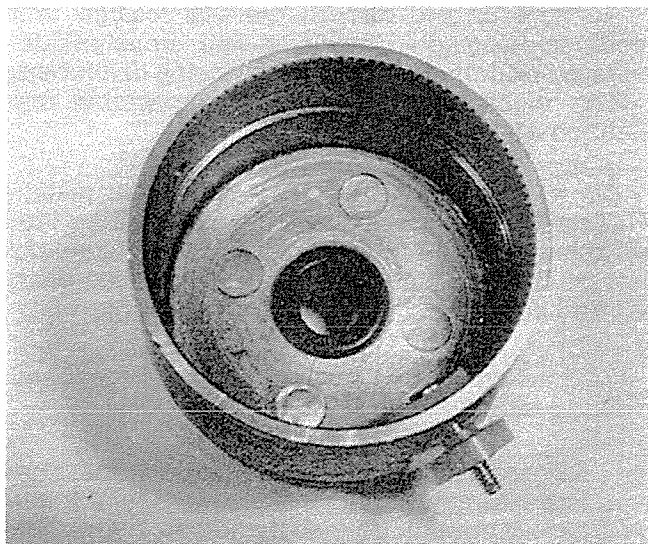


FIGURE 4

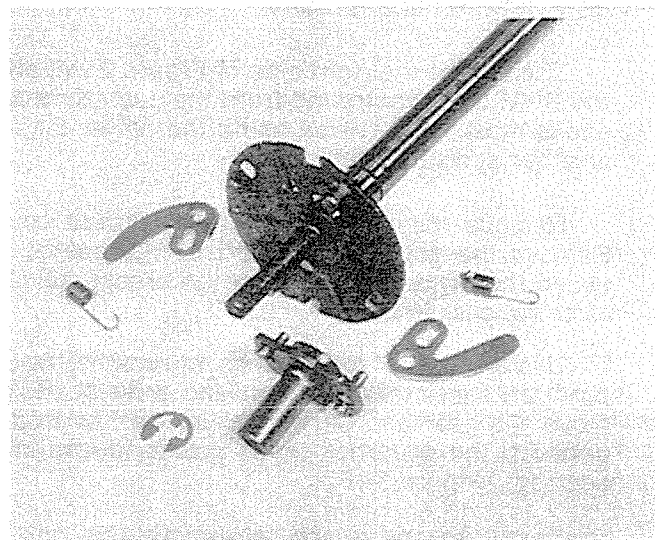


FIGURE 5

Disconnect the timer weight springs from the base of the breaker cam. Remove the snap ring from the upper end of the timer shaft and lift the cam from the shaft.

The centrifugal advance is made up of two timer weights and two timer weight springs. The items just described should be removed and examined carefully. (See Figure 5).

Replacement of the timer weight springs is recommended since they may lose tension.

Thoroughly clean and check all timer parts and replace those that are worn or damaged.

Once all parts are thoroughly cleaned and the necessary parts replaced, the timer is ready for reassembly.

Use a lithium base grease to lubricate the timer weight and pin pivots.

Install the timer weights on the timer base as shown on the right side of Figure 6. It is important to note that parts can be installed either way; however, when installed incorrectly, the ignition timing will not advance properly.

Install the timer weight springs with extreme care. Do not over-stretch the springs or distort them in any way.

The timer weight springs must also be installed correctly. (Figure 7).

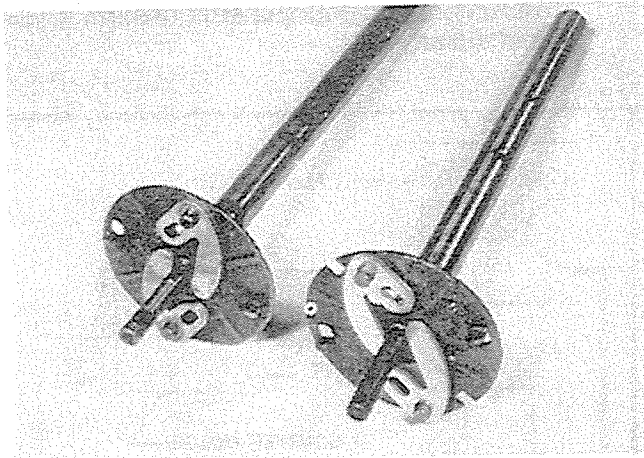


FIGURE 6

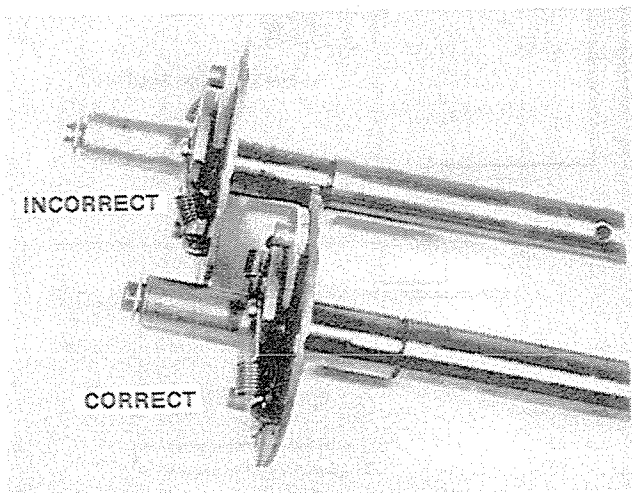


FIGURE 7

GOVERNOR ASSEMBLY

Make a visual inspection of the entire governor before disassembly. The two screws holding the fork on top of the governor spool are the same size screws as the three holding the breaker point base plate. However, these are flathead screws and the base plate screws have rounded heads. Do not interchange them.

Remove the two screws holding the fork to the cross shaft. Observe the position of the governor thrust bearing and washers. Remove the governor weight assembly and the governor spool. (See Figure 8). Always examine the thrust washer, bearings and the governor weight assemblies and replace any worn or damaged parts.

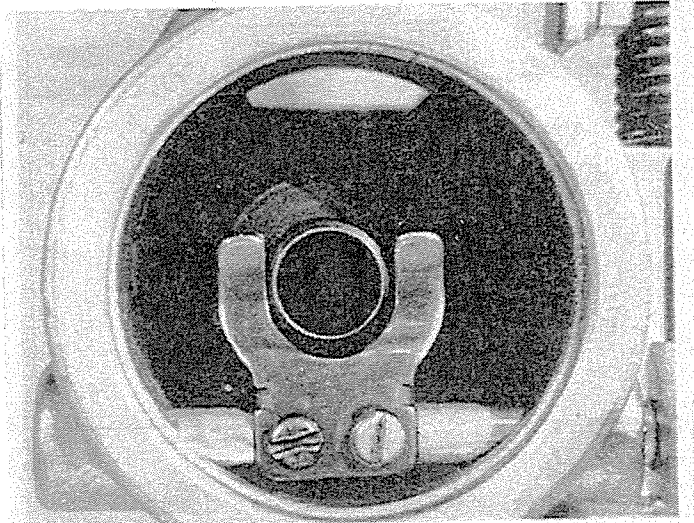


FIGURE 8

Install the spool inside the carrier with the four weights. Place the thin thrust washer against the spool, then install the thrust bearing with the heavy or thick thrust washer on top. Do not interchange the thin and thick washers.

On reassembly, make sure that the fork, which has two locating ears, is pushed back against the cross shaft before tightening the screws.

Make visual inspection of the timer assembly to see that the wires from the condenser and points are correctly routed. Lubricate or replace the oil wick. Replace the points if necessary.

For timer and governor installation, see Engine Overhaul Section.



SAFETY WARNING: The governor controls must not be altered in any manner to increase speeds beyond design operating limits.



SAFETY WARNING: Check all wiring to be sure it is routed and secured properly. The electrical system can cause sparks which could ignite gases or explosive materials.

STARTER SYSTEM

Description

The electric starter system consists of the starter motor, starter solenoid and the necessary cables and wires with their connectors. The starter motor converts electrical energy from the battery into mechanical power which is transmitted to the engine through the starter gear. The ignition switch controls the operation by activating the starter solenoid which makes and breaks the circuit between the battery and the starter motor.

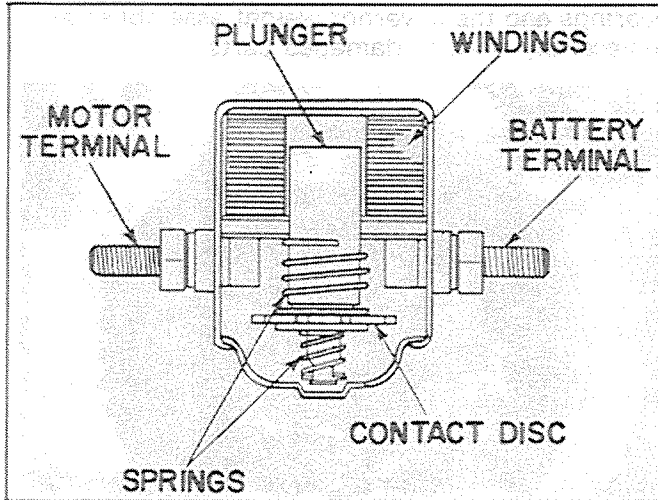


FIGURE 9

The starter solenoid, Figure 9, closes the circuit through a movable contact disc which strikes two terminal contacts that are connected in the starter motor circuit. The solenoid winding, when energized, exerts a magnetic pull on the solenoid plunger causing it to move the contact disc against the terminal contacts.

The starter motor drive is disengaged when at rest and is made to engage the gear on the flywheel by the rotation of the starter motor armature. When the engine has started, the starter pinion is driven faster than the starter motor shaft and becomes disengaged.

Maintenance

The only starter motor maintenance required is periodic lubrication of the starter drive. No periodic lubrication of the starter motor or maintenance of the solenoid is required. Starter motor need be removed for reconditioning only every 1000 hours or if the following tests indicate that the starter is not operating properly. If the starter motor does not crank the engine or if it cranks too slowly, check the battery cables and connections. Inspect all wiring connections in the starter circuit to insure that they are clean and tight. Proceed with the following tests if additional trouble shooting is necessary.

Starter System Testing

The following tests fall into two groups, starter circuit tests and starter motor tests. Starter circuit testing is a quick means of pinpointing causes of hard starting which may result from a faulty electrical component in the starter circuit and can be performed without removing any components from the engine. Starter motor tests are used to determine starter motor condition and most can be performed without removing the starter from the engine. **IMPORTANT:** All starter circuit testing must be done with a fully charged, 12-volt battery that has been load tested to assure it is in good condition.

Starter Circuit Testing

Starter Motor Amperage Draw Test

1. Ground spark plug high tension leads so that engine can be cranked without firing. Place clamp-on ammeter capable of reading at least 200 amperes against starter motor lead. Figure 10.
2. Turn ignition switch to START and observe amperage reading with engine cranking. Current should be between 75 amperes minimum and 140 amperes maximum after initial surge.

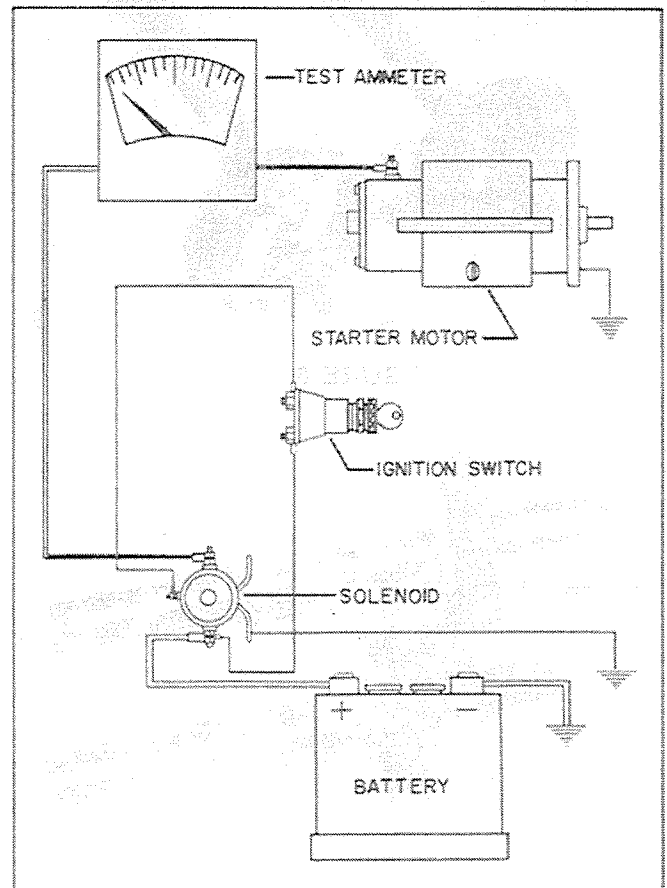


FIGURE 10

NOTE: DO NOT operate starter motor for more than 30 seconds at a time without pausing to allow motor to cool for at least two minutes.

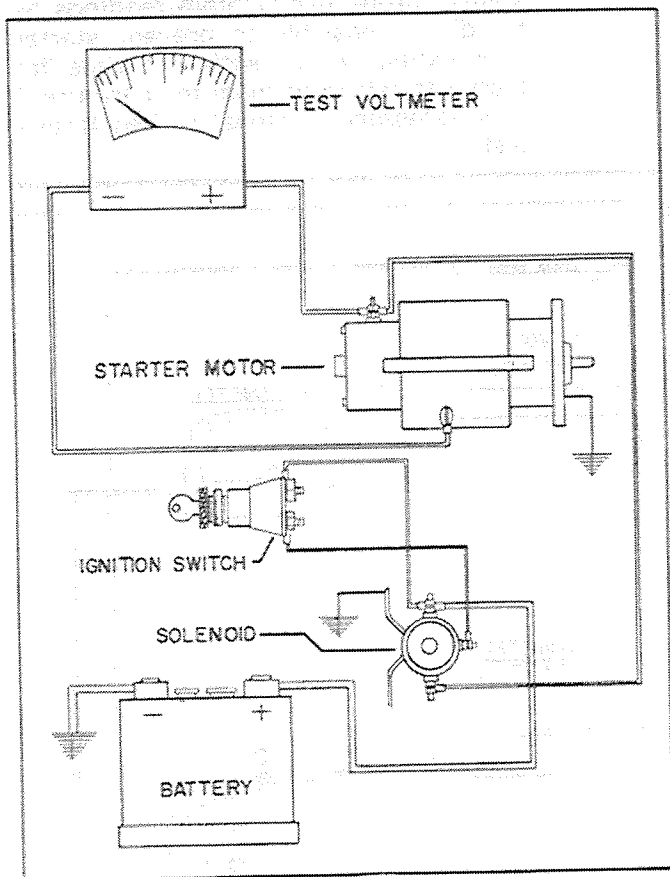


FIGURE 11

Starter Motor Available Voltage Test

1. Inspect battery and cables to make sure that battery has ample capacity for cranking. Engine must be at normal operating temperature when test is made.
2. Ground spark plug high tension leads so that engine can be cranked without firing.
3. Connect a voltmeter across starter motor, Figure 11, with positive (+) lead to starter motor terminal, and negative (-) lead to ground on starter frame.
4. Turn ignition switch to START to crank engine and observe voltmeter reading as quickly as possible.
5. If starter motor turns engine at normal cranking speed with a voltage reading between 9.5 volts minimum and 10.5 volts maximum, starter motor is satisfactory. If available voltage reading at the starter motor is low, review the following chart for probable causes.

Starter System Voltage Drop Test

1. By making a systematic check from the positive battery terminal through the starting circuit and back to the negative battery terminal, any component or electrical connection having excessive resistance, thus causing high voltage drop and subsequent hard starting, can be pinpointed. Figure 12.

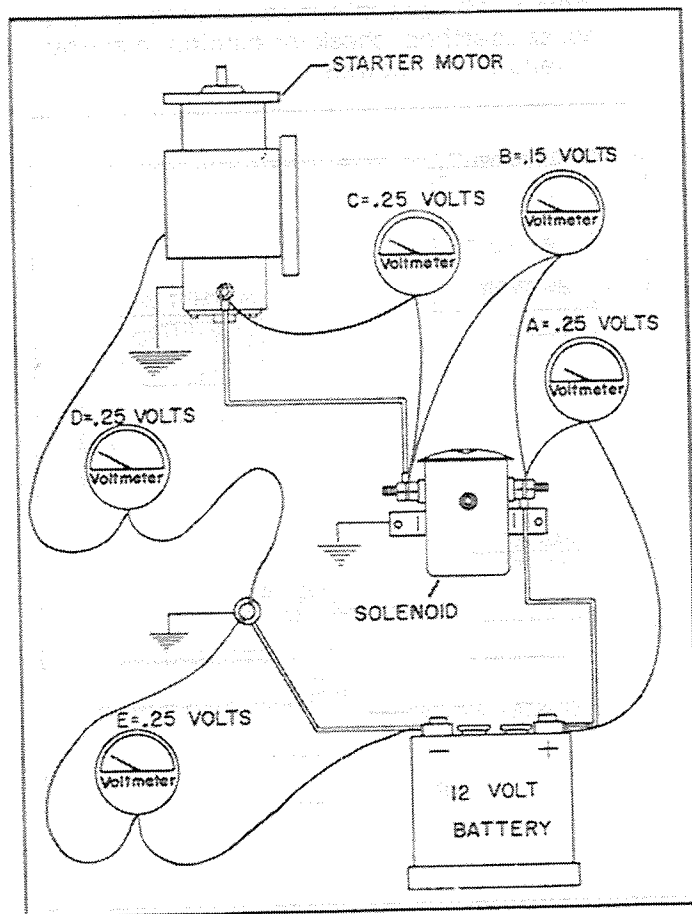


FIGURE 12

2. Ground spark plug high tension leads so that engine can be cranked without firing. Connect voltmeter and turn ignition switch to START to crank engine. By placing voltmeter leads against battery, solenoid and starter motor terminals rather than against connecting cable ends, each connection can be tested for high resistance along with component.
3. Clean and retighten, or replace, any connection, cable, or component having greater than specified voltage drop.

Starter Motor Testing

The no-load test is used to determine quickly the general mechanical and electrical condition of the starter motor. The stalled torque test is used to determine whether or not the starter motor has sufficient torque to crank the engine for fast starting.

No-Load Test

1. Connect starter with an ammeter in series to a 12-volt source. Figure 13. Use a tachometer or r.p.m. indicator to indicate armature speed.
2. Ammeter should indicate 43 amperes maximum; r.p.m. indicator should indicate 9000 or r.p.m. minimum. The voltmeter should indicate 10 volts minimum. If readings are not as specified, check for binding in starter or failure of windings.

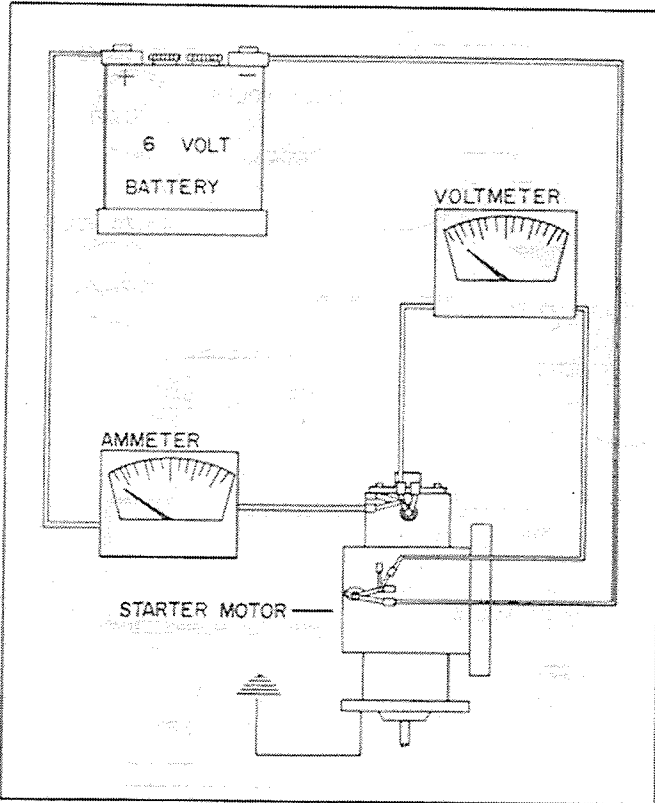


FIGURE 13

NOTE: If starter motor turns slowly, smokes after a very few seconds of running, or gets hot instantly, stop testing. Disassemble starter and check for shorts.

Stalled Torque Test

1. Connect a voltmeter between the starter terminal and motor frame. Using a torque wrench to stall motor armature, Figure 14, connect starter motor through an ammeter to a 12-volt battery.
2. Voltmeter reading should be approximately 4 volts during this test. Torque should be a minimum of 36 lbs in. or 3 lbs. ft. (4.1 N:m) and current should be a maximum of 200 amperes.



NOTE: If motor smokes or gets hot instantly, stop testing, disassemble starter and check for shorts. Use only a fully charged 12-volt battery when making stalled torque test. Obtain readings as rapidly as possible to prevent starter overheating. Allow sufficient time for starter to return to room temperature if it is necessary to repeat stalled torque test.

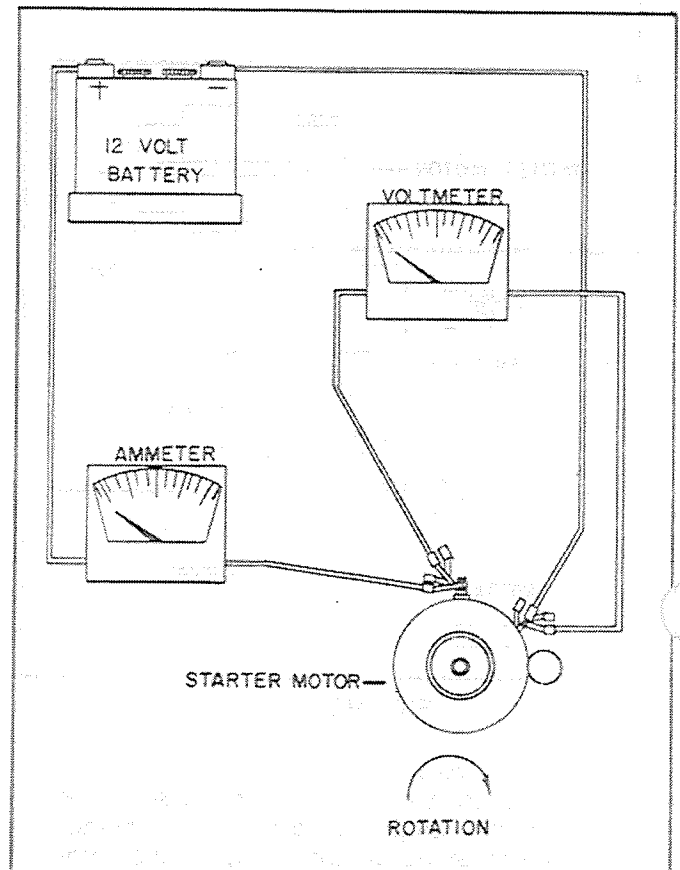


FIGURE 14

3. Check each armature coil for open circuits by rotating torque wrench handle through a 180 degree arc after initial torque reading has been noted. This must be done quickly. Torque should be uniform through this arc, although reading will decrease slightly each time brush moves from one commutator segment to another. If an appreciably wide area is found in which torque is very low, disassemble starter and check armature.

Inspection of Starter Motor

1. Check armature on a growler for shorted turns. Follow operating instructions furnished with armature growler for proper test procedures. Clean between commutator segments of armature and recheck armature on growler. If shorted turns are still indicated, replace armature.

2. Check armature for grounded windings. Rotate one lead of continuity tester (test light or meter) around circumference of commutator while holding other continuity meter lead on the armature core or shaft. An indication of continuity means that the armature windings are grounded and armature must be replaced.
3. Check armature for open windings by using a testmeter. Measure resistance between adjacent commutator segments using LO OHMS scale. Rotate leads around entire circumference of commutator. An open winding is indicated if any one reading is much higher (three times higher or more) than the average reading.
4. Inspect commutator segments. If they are dirty or show signs of wear, turn commutator in a lathe until surface is clean and smooth.
5. Inspect armature insulation for indications of overheating or damaged windings. Clean off any deposits of carbon which may contribute to later failure of the windings.



NOTE: Starter motor components should not be washed off in cleaning solvents. Most solvents will soften varnish insulation used on armature and field windings. All starter motor components can be cleaned adequately with a clean cloth or soft brush. Cleaning end heads in solvent may dissolve the oils that have impregnated into the armature shaft bearings. If these oils are removed, bearing or armature shaft wear can be expected. Cleaning of armature in solvent will leave oily residue on the commutator segments causing arcing between the commutator and brushes.

Brushes

1. Inspect the brushes; replace if worn to a length of 1/4" or less, damaged or cracked. Replace brush springs if weak.
2. Inspect brush springs. Springs should have a tension of 32 to 40 ounces (896 to 1120 Kg) with new brushes. Measure with a spring scale hooked under the brush spring at the brush. Pull the scale on a line opposite the line of force exerted by the brush spring and take the reading just as the spring leaves the brush.

Starter Drive

Clean, inspect and replace any worn parts. Special care must be exercised in reassembling. The starter drive gear can be assembled to the worm drive only one way. The poppet button hole must line up with the button. If this alignment is not acquired upon the first installation of the starter drive gear, remove the gear and turn to the next spiral until the proper location is obtained. There are three spirals in the gear. The poppet button will release itself from the hole in

the gear by centrifugal force when the starter is put into operation.

Lubricate the starter drive with a solution of fast-evaporating, non-flammable solvent and powdered graphite mixed to the approximate consistency of 20-weight oil.

After the solvent has evaporated, a dry lubricant remains. This type of lubricant collects a minimum amount of dirt and dust.

Never use oil or grease on the starter drive.

Connect the starter to a 12-volt battery to be sure it is operating properly.

Starter Gear Replacement

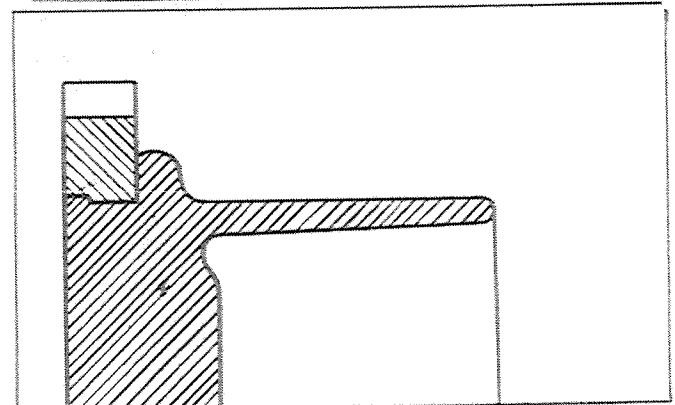
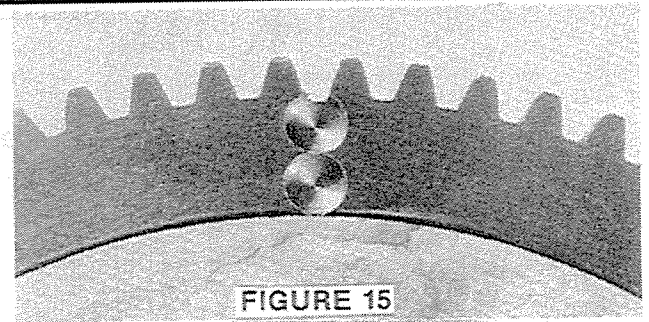
NOTE: The starter ring gear cannot be pressed off of the flywheel. Damage to the flywheel may result.

Place flywheel with the fins down on a flat surface. Between two teeth of the ring gear, mark and drill two 11/32" (9 mm) diameter holes into the steel ring gear. These holes should be about 3/8" (9.5 mm) deep, or so that the point of the bit will just begin to protrude through the other side of the steel ring gear, see Figure 15 for location of holes. This will weaken the ring gear sufficiently to permit it to be broken with a chisel. The ring gear can now easily be removed from the flywheel.

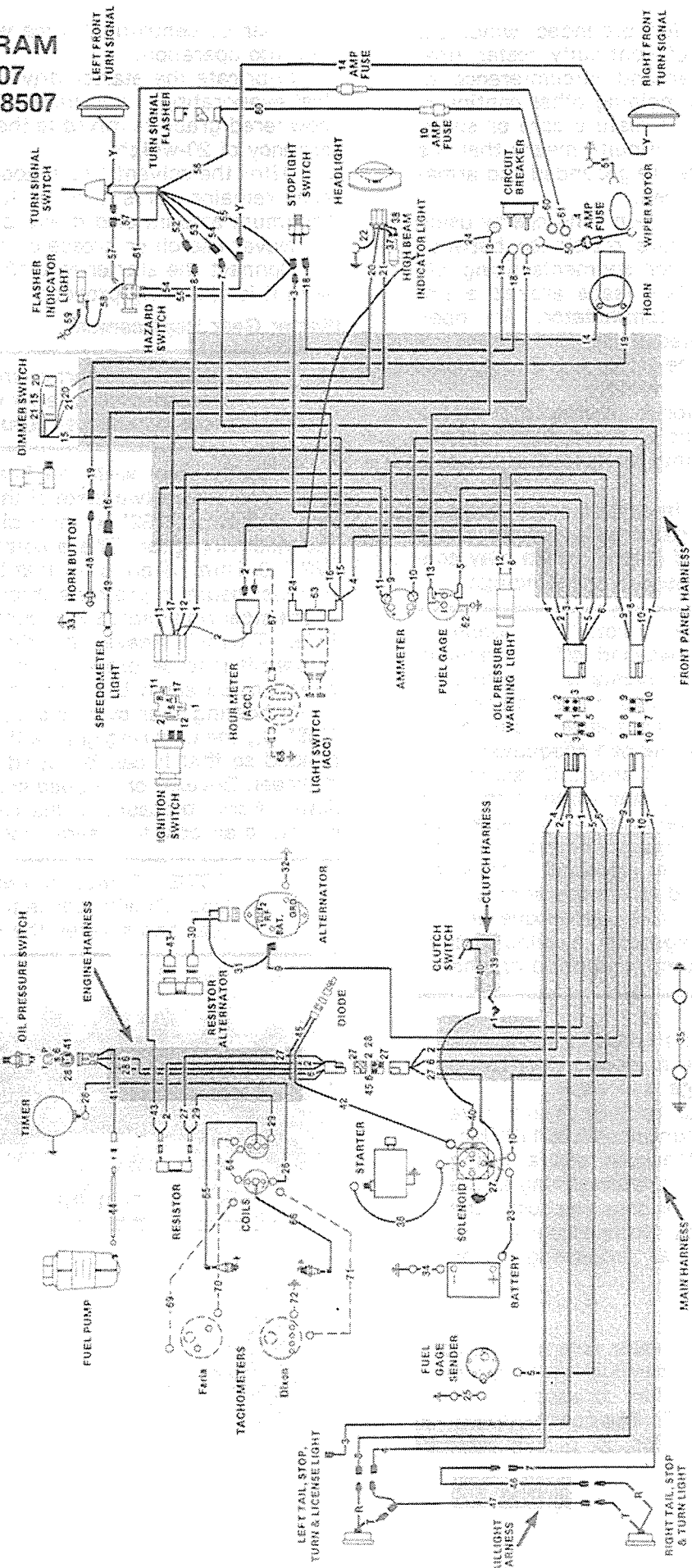
By heating in an oven to approximately 550° F. (288° C), the new ring gear will be sufficiently expanded so that it can be fitted to the aluminum flywheel. Beveled or stepped side of ring must go down. Apply pressure to the ring gear while allowing to air cool to assure proper seating.

NOTE: Temperatures above 550° F. (288° C) will reduce the hardness of the gear and shorten the service life.

6



**WIRING DIAGRAM
MODELS 898407
898415 AND 898507**



WIRES

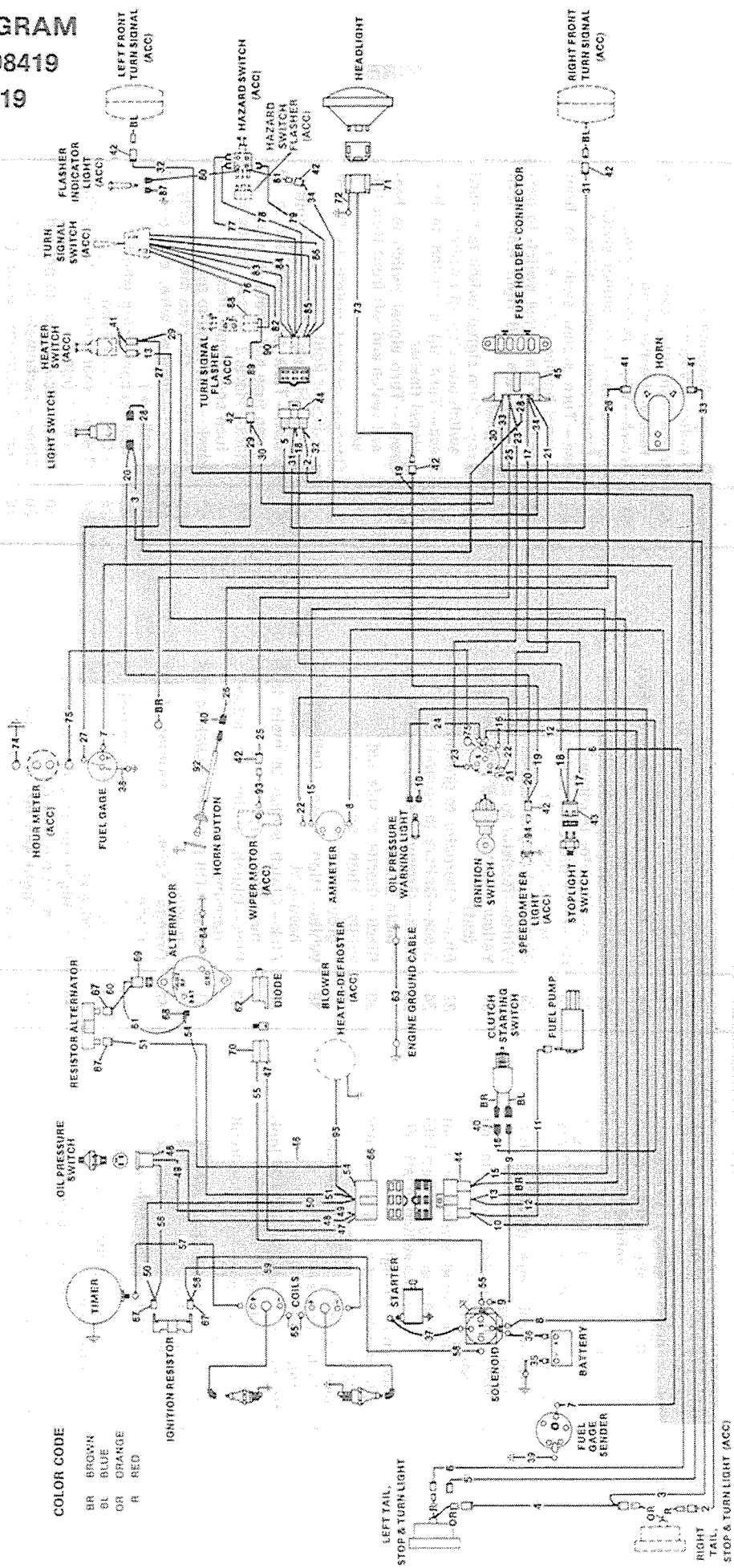
Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	Pink—Ignition switch to clutch switch	23	Black—Battery to solenoid	49	Orange—Speedometer light to light switch (Wire #16)
2	Green—Ignition switch to resistor	24	Purple—Circuit breaker to light switch	50	Brown—Circuit breaker to 4 amp fuse and wiper motor
3	Black—Brake light switch to left taillight (For vehicles without turn signals only)	25	Orange w/Yellow Stripe—Fuel gage sender to ground	51	Brown—Wiper motor to ground
4	Tan—Light switch to left and right tail, stop and turn lights (Wire #47)	26	Black—Coil (+) to timer	52	Light Blue—Turn signal switch to front panel harness (Wire #8)
5	Yellow—Fuel gage (tank) to fuel gage sender	27	Blue—Resistor to solenoid	53	Red—Turn signal switch to front panel harness (Wire #7)
6	White—Oil warning light to oil pressure switch	28	Green—Oil pressure switch to main harness (Wire #2)	54	Yellow—Turn signal switch to hazard switch and right front turn signal
7	Red—Turn signal switch to right tail, stop and turn light (Wire #46)	29	Blue—Alternator to ground	55	Grey—Turn signal switch to hazard switch and stoplight switch
8	Blue—Turn signal switch to left tail, stop and turn light	30	Black—Battery to ground	56	Black—Turn signal switch to turn signal flasher
9	Red—Ammeter (+) to alternator (bat)	31	Black—Ground cable, engine to main frame	57	Green—Turn signal switch to hazard switch and left front turn signal
10	Black—Ammeter (—) to solenoid	32	White—High beam indicator to ground	58	Orange—Hazard switch to flasher indicator light
11	Red—Ignition switch (bay) to ammeter (+)	33	White—High beam indicator to headlight	59	White—Hazard switch to ground
12	White—Oil pressure light to ignition switch (ign)	34	Pink—Clutch switch to main harness (Wire #1)	60	Brown—Turn signal flasher to 10 amp fuse and circuit breaker
13	Purple—Fuel gage (ign.) to circuit breaker	35	Pink—Clutch switch to solenoid (terminal S)	61	Black—Hazard switch to 14 amp fuse and circuit breaker
14	Grey—Horn to circuit breaker	36	Yellow—Oil pressure switch to fuel pump	62	Black—Fuel gage to ground
15	Light Blue—Light switch to dimmer switch	37	Orange—Solenoid (terminal S) to diode	63	Connector—On road models only
16	Orange—Light switch to speedometer light	40	Red—Alternator resistor to resistor	64	Brown—Jumper wire, coil (—) to coil (+)
17	Black—Ignition switch (acc) to circuit breaker	41	White—Diode to main harness (Wire #6)	65	—Coil to spark plug (short)
18	Grey w/Black Stripe—Circuit breaker to stoplight switch	42	Red—Right tail, stop and turn light to main harness (Wire #7)	66	—Coil to spark plug (long)
19	Brown—Horn to horn button	43	Tan—Right and left tail, stop and turn light to main harness (Wire #4)	67	Green—Hour meter to ignition switch (ign.)
20	Light Green—Dimmer switch to headlight	44	Brown—Horn button to horn (Wire #19)	68	Black—Hour meter to ground
21	Ivory—Dimmer switch to headlight			69	Black—Tachometer to coil (—)
22	Black—Headlight to ground			70	Red—Tachometer to coil (+)
				71	Black—Tachometer to coil (+)
				72	White—Tachometer to ground

WIRING DIAGRAM MODELS 898419 AND 898519



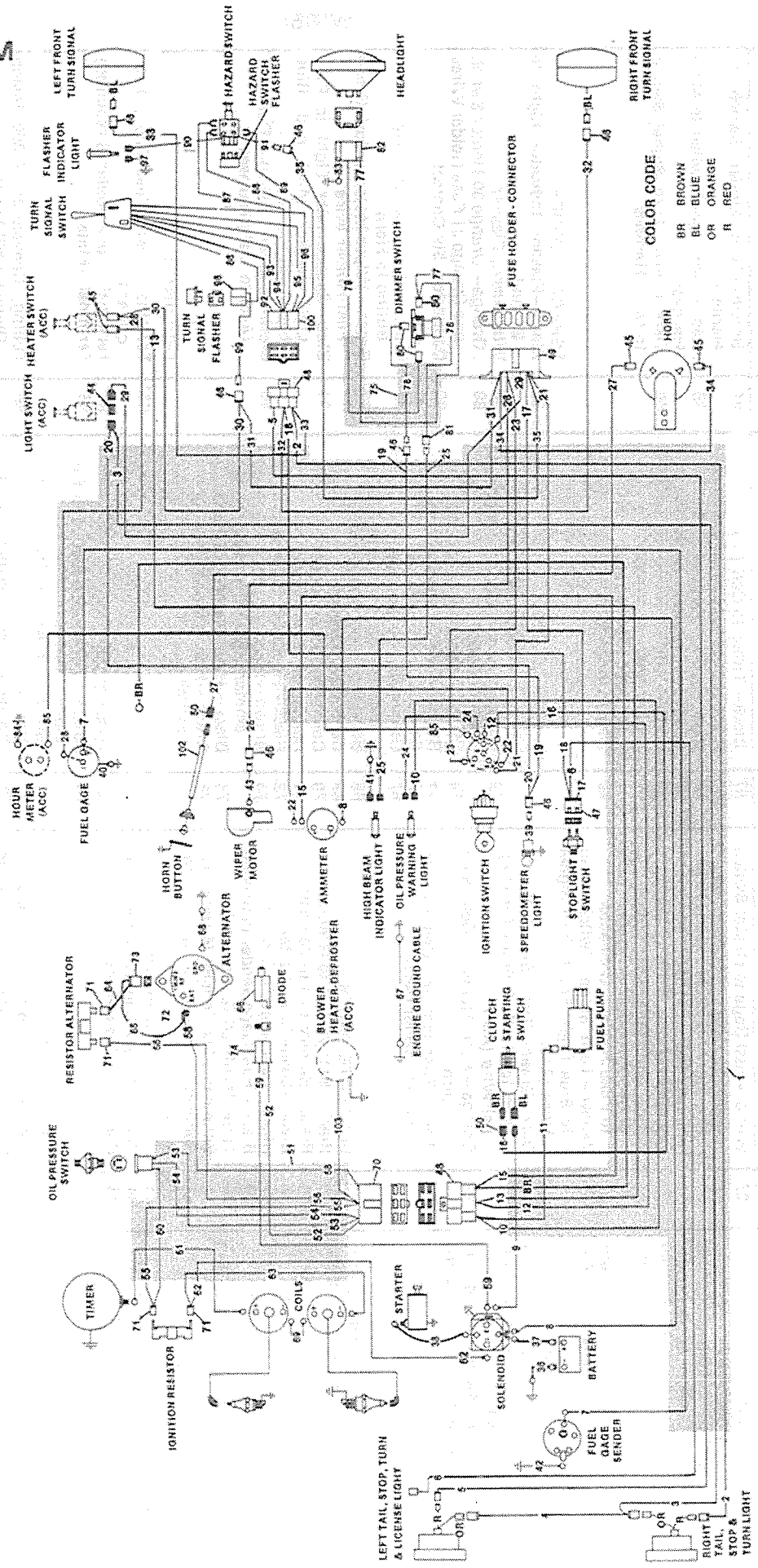
COLOR CODE

- BR BROWN
- BL BLUE
- OR ORANGE
- R RED



Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	27	White—Fuel Gage to Heater Switch (Acc)	57	Black—Timer to Coil (+)	84	Brown—Turn Signal Switch to Harness
2	Red—Turn Signal Switch (Acc) to Red Right Tail, Stop and Turn Light Wire (Acc)	28	Pink—Light Switch to Fuse Holder - Connector	58	Blue—Ignition Resistor to Solenoid	85	Red—Turn Signal Switch to Main Harness
3	Orange—Light Switch to Orange Right Tail, Stop and Turn Light Wire (Acc)	29	Orange—Heater Switch (Acc) to Turn Signal Flasher (Acc)	59	White—Ignition Resistor to Coil (-)	86	Dark Green—Turn Signal Switch to Main Harness
4	Orange—Orange Right Taillight Wire (Acc) to Orange Left Taillight Wire	30	Orange—Turn Signal Flasher (Acc) to Fuse Holder - Connector	60	White—Alternator (R) to Resistor		
5	Blue—Turn Signal Switch (Acc) to Red Left Tail, Stop and Turn Light Wire (For Vehicles with Turn Signals Only)	31	Yellow—Turn Signal Switch (Acc) to Blue Right Front Turn Signal Wire (Acc)	61	Dark Green—Alternator (F) to Alternator (Batt.)		
6	Black—Stoplight Switch to Red Left Tail, Stop and Turn Light Wire (For Vehicles without Turn Signals Only)	32	Dark Green—Turn Signal Switch (Acc) to Blue Left Front Turn Signal Wire (Acc)	62	DIODE ASSEMBLY		
7	Yellow—Fuel Gage Sender to Fuel Gage	33	Orange—Fuse Holder - Connector to Horn	63	SEPARATE WIRES	87	Black—Flasher Indicator Light to Ground
8	Black—Solenoid to Ammeter (-)	34	Black—Fuse Holder - Connector to Hazard Switch (Acc)	64	Black—Ground Cable, Engine to Main Frame	88	Wire Assy., Flasher
9	Pink—Solenoid to Pink Clutch Starting Switch Wire	35	SEPARATE WIRES	65	Black—Alternator to Ground	89	Orange—Orange 30 Heater Switch and Orange 31 Fuse Holder Wires
10	White—Oil Pressure Warning Light to Engine Harness	36	Black—Battery (-) to Ground	66	Brown—Coil (-) to Coil (+)	90	Connector, Six Contact
11	Yellow—Fuel Pump to Engine Harness	37	Black—Solenoid to Starter	67	Connector, Six Contact (4 required)	92	Wire and Connector Assy., Horn Button to Horn
12	Dark Green—Ignition Switch to Engine Harness	38	Black—Fuel Gage to Ground	68	Boot, Ring Terminal	93	Green—Wiper Motor to Dark Green Fuse Holder Wire
13	Black—Heater Switch (Acc) to Engine Harness	39	Black—Fuel Gage Sender to Ground Tube, Insulated (2 required)	69	Connector, Alternator	94	Blue—Speedometer Light to Blue Light Switch (Acc) and Blue Headlight Wires
15	Red—Ammeter (+) to Engine Harness	40	Black—Fuel Gage Sender to Ground Tube, Insulated (4 required)	70	Connector, Two Contact	95	Black—Blower, Heater-Defroster (Acc) to Main Harness
16	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	41	Connector, Six Contact (4 required)	71	Connector, Three Contact		
17	Red—Stoplight Switch to Fuse Holder Connector	42	Connector, Single Contact (7 required)	72	Black—Headlight to Ground		
18	Brown—Stoplight Switch to Turn Signal Switch (Acc)	43	Connector, Stoplight Switch	73	Brown—Headlight to Blue Speedometer Light Wire (Acc)		
19	Blue—Speedometer Light (Acc) to Headlight	44	Connector, Six Contact (2 required)	74	Black—Hour Meter to Ground		
20	Blue—Speedometer Light (Acc) to Light Switch (Acc)	45	Connector, Six Contact (7 required)	75	Green—Hour Meter to Ignition Switch		
21	Red—Ignition Switch to Fuse Holder Connector	46	ENGINE HARNESS				
22	Red—Ignition Switch to Ammeter (+)	47	White—Diode to Main Harness	76	TURN SIGNAL SET	96*	Terminal—1-way Fuse Clip (10 required)
23	Black—Ignition Switch to Fuse Holder - Connector	48	Yellow—Oil Pressure Switch to Main Harness	77	Black—Turn Signal Switch to Turn Signal Flasher	97*	Terminal—Fuse Holder (8 required)
26	Brown—Horn Button to Horn	49	White—Oil Pressure Switch to Main Harness	78	Brown—Hazard Switch to Main Harness	98*	Terminal—Male
		50	Dark Green—Ignition Resistor to Main Harness	79	Green—Hazard Switch to Main Harness	99*	Tubing, Convoluted, 0.350 Inside Diameter 50' length
		51	Red—Resistor Alternator to Main Harness	80	Orange—Hazard Switch to Flasher Indicator Light	100*	Tubing, Convoluted, 0.500 Inside Diameter 25' length
		54	Red—Alternator to Main Harness	81	Black—Hazard Switch to Black Fuse Holder Wire	101*	Tubing, Convoluted, 0.750 Inside Diameter 25' length
		55	Orange—Diode to Solenoid	82	Blue—Turn Signal Switch to Main Harness	102*	Tubing, Convoluted Green, 0.413 Inside Diameter 25' length
		56	Dark Green—Ignition Resistor to Oil Pressure Switch	83	Yellow—Turn Signal Switch to Main Harness		* Not illustrated

WIRING DIAGRAM MODELS 898434 AND 898435



COLOR CODE
 BR BROWN
 BL BLUE
 OR ORANGE
 R RED

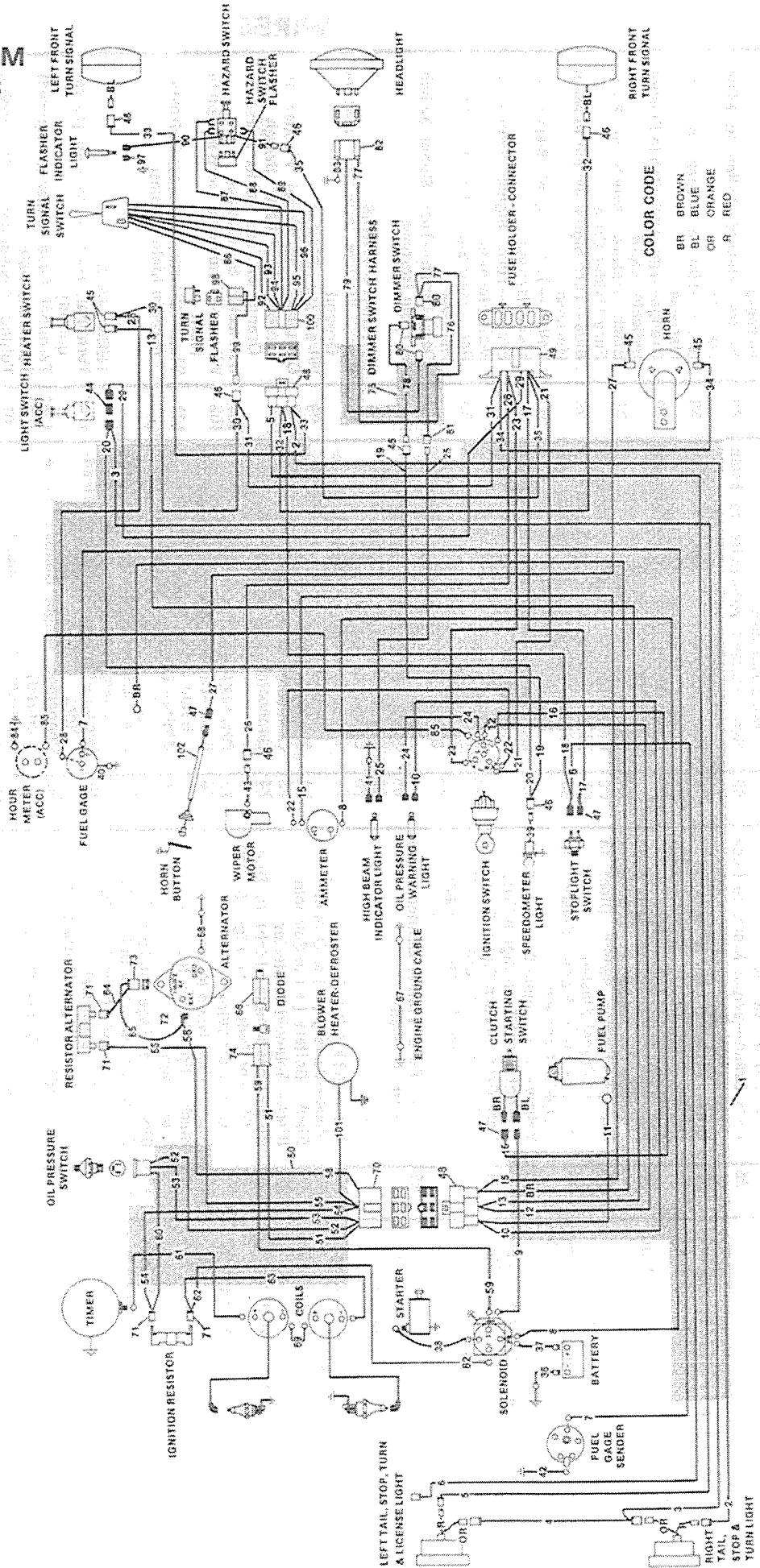


WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	25	Blue—High Beam Indicator Light to Dimmer Switch	55	Dark Green—Ignition Resistor to Main Harness	87	Brown—Hazard Switch to Main Harness
2	Red—Turn Signal Switch to Red Right Tail, Stop and Turn Light Wire	26	Dark Green—Wiper Motor to Fuse Holder-Connector	56	Red—Resistor Alternator to Main Harness	88	Yellow—Hazard Switch to Main Harness
3	Orange—Light Switch (Acc) to Orange Right Tail, Stop and Turn Light Wire	27	Brown—Horn Button to Horn	58	Red—Alternator to Main Harness	89	Green—Hazard Switch to Main Harness
4	Orange—Orange Right Taillight Wire to Orange Left Taillight Wire	28	White—Fuel Gage to Heater Switch (Acc)	59	Orange—Diode to Solenoid	90	Orange—Hazard Switch to Flasher Indicator Light
5	Blue—Turn Signal Switch to Red Left Tail, Stop, Turn and License Light Wire (For Vehicles with Turn Signals Only)	29	Pink—Light Switch (Acc) to Fuse Holder-Connector	60	Dark Green—Ignition Resistor to Oil Pressure Switch	91	Black—Hazard Switch to Black Fuse Holder Wire
6	Black—Stoplight Switch to Red Left Tail, Stop and License Light Wire (For Vehicles without Turn Signals Only)	30	Orange—Heater Switch (Acc) to Turn Signal Flasher	61	Black—Timer to Coil (+)	92	Blue—Turn Signal Switch to Main Harness
7	Yellow—Fuel Gage Sender to Fuel Gage	31	Orange—Turn Signal Flasher to Holder-Connector	62	Blue—Ignition Resistor to Solenoid	93	Yellow—Turn Signal Switch to Main Harness
8	Black—Solenoid to Ammeter (—)	32	Yellow—Turn Signal Switch to Blue Right Front Turn Signal Wire	63	Blue—Ignition Resistor to Solenoid	94	Brown—Turn Signal Switch to Main Harness
9	Pink—Solenoid to Pink Clutch Starting Switch Wire	33	Dark Green—Turn Signal Switch to Blue Left Front Turn Signal Wire	64	White—Alternator to Resistor Alternator	95	Red—Turn Signal Switch to Main Harness
10	White—Oil Pressure Warning Light to Engine Harness	34	Orange—Fuse Holder-Connector to Horn	65	Dark Green—Alternator to Resistor Alternator	96	Dark Green—Turn Signal Switch to Main Harness
11	Yellow—Fuel Pump to Engine Harness	35	Black—Fuse Holder-Connector to Hazard Switch	66	DIODE ASSEMBLY	97	SEPARATE WIRES
12	Dark Green—Ignition Switch to Engine Harness	36	SEPARATE WIRES	67	Black—Ground Cable, Engine to Main Frame	98	Black—Flasher Indicator Light to Ground
13	Black—Heater Switch (Acc) to Engine Harness	37	Black—Battery (—) to Ground	68	Black—Alternator to Ground	99	Wire Assy., Flasher
14	Red—Ammeter (+) to Engine Harness	38	Black—Battery (+) to Solenoid	69	Brown—Coil (—) to Coil (+)	100	Orange—Turn Signal Flasher to Orange 30 Heater Switch and Orange 31 Fuse Holder Wires
15	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	39	Blue—Solenoid to Starter	70	Connector, Six Contact	101	Connector, Six Contact
16	Red—Ignition Switch to Brown Clutch Starting Switch Wire	40	Blue—Speedometer Light to Blue Dimmer Switch and Light Switch Connector Wire	71	Connector, Single Contact (4 required)	102	Wire and Connector, Horn Button to Horn
17	Holder-Connector	41	Black—Fuel Gage to Ground	72	Boot, Ring Terminal	103	Black—Blower, Heater-Defroster (Acc) to Main Harness
18	Brown—Stoplight Switch to Turn Signal Switch	42	Black—High Beam Indicator Light to Ground	73	Connector, Alternator	104*	TERMINALS
19	Blue—Speedometer Light to Dimmer Switch	43	Green—Fuel Gage Sender to Ground	74	Connector, Two Contact	105*	Terminal, 1-way Fuse Clip (10 required)
20	Blue—Speedometer Light to Light Switch (Acc)	44	Green—Wiper Motor to Dark Green Fuse Holder-Connector Wire	75	Dimmer Switch Harness	106*	Terminal, Fuse Holder (8 required)
21	Red—Ignition Switch to Fuse Holder-Connector	45	Connector, Electrical	76	Blue—Dimmer Switch to Blue High Beam Indicator Light Wire	107*	Terminal, male
22	Red—Ignition Switch to Ammeter (+)	46	Connector, Single Contact (4 required)	77	White—Dimmer Switch to Headlight	108*	Tubing, Convoluted, 0.350 Inside Diameter 50' length
23	Black—Ignition Switch to Fuse Holder-Connector	47	Connector, Single Contact (7 required)	78	Blue—Dimmer Switch to Blue Speedometer Light Wire	109*	Tubing, Convoluted, 0.500 Inside Diameter 25' length
24	White—Ignition Switch to Oil Pressure Warning Light	48	Connector, Six Contact (2 required)	79	Brown—Dimmer Switch to Headlight	110*	Tubing, Convoluted, 0.750 Inside Diameter 25' length
		49	Connector, Fuse Holder	80	Connector, Single Contact, (3 required)		Inside Diameter 25' length
		50	Tube, Insulator (2 required)	81	Connector, Single Contact		
		51	ENGINE HARNESS	82	Connector, Three Contact		
		52	White—Diode to Main Harness	83	Black—Headlight to Ground		
		53	Yellow—Oil Pressure Switch to Main Harness	84	SEPARATE WIRES		
		54	White—Oil Pressure Switch to Main Harness	85	Black—Hour Meter to Ground		
				86	Green—Hour Meter to Ignition Switch		
					TURN SIGNAL SET		
					Black—Turn Signal Switch to Turn Signal Flasher		

* Not illustrated.

WIRING DIAGRAM MODEL 898436



COLOR CODE
 BR BROWN
 BL BLUE
 OR ORANGE
 R RED



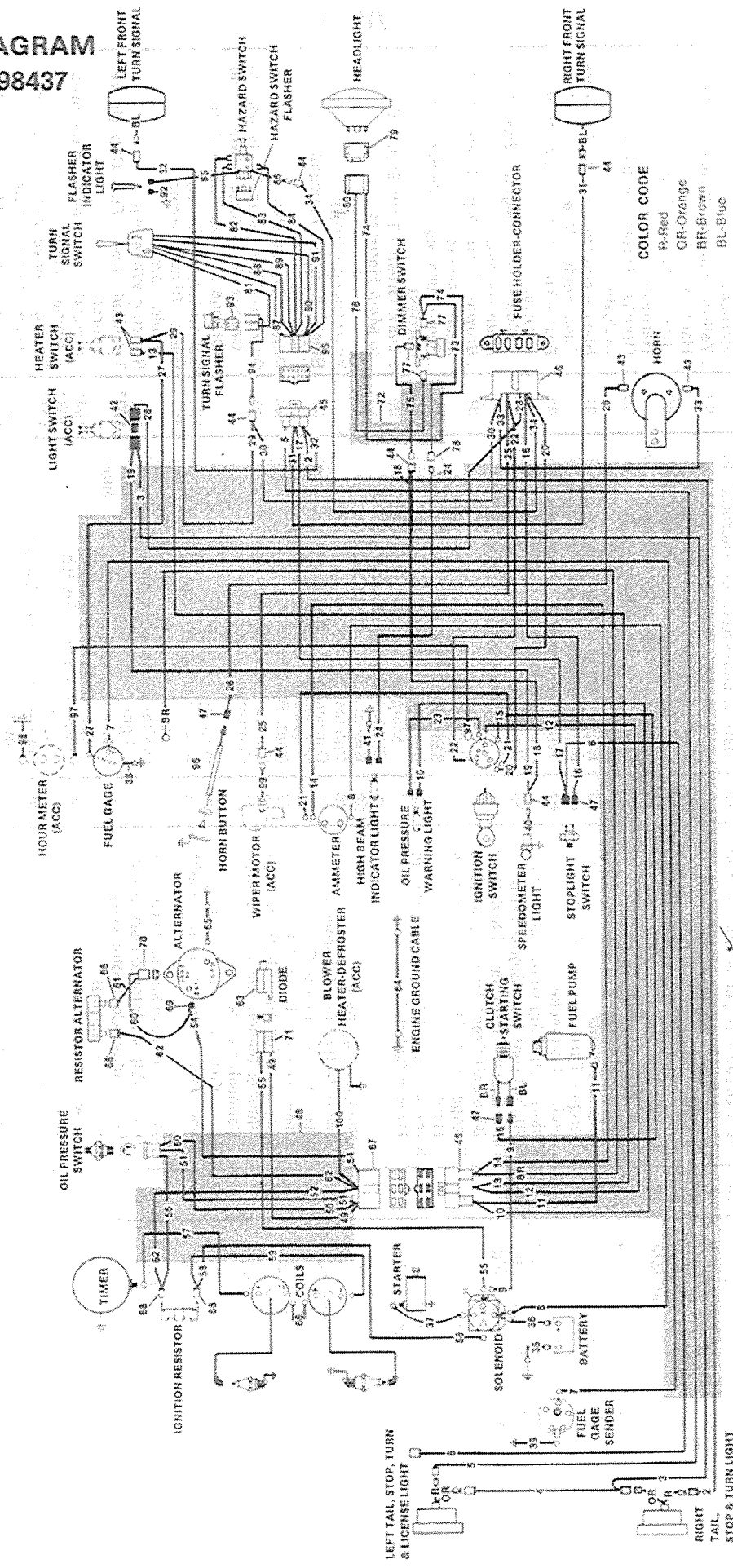
WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	24	White—Ignition Switch to Oil Pressure Warning Light	53	White—Oil Pressure Switch to Main Harness	86	TURN SIGNAL SET Black—Turn Signal Switch to Turn Signal Flasher
2	Red—Turn Signal Switch to Red Right Tail, Stop and Turn Light Wire	25	Blue—High Beam Indicator Light to Dimmer Switch	54	Dark Green—Ignition Resistor to Main Harness	87	Brown—Hazard Switch to Main Harness
3	Orange—Light Switch (Acc) to Orange Right Tail, Stop and Turn Light Wire	26	Dark Green—Wiper Motor to Fuse Holder-Connector	55	Dark Green—Resistor Alternator to Alternator (Bat.)	88	Yellow—Hazard Switch to Main Harness
4	Orange—Orange Right Taillight Wire to Orange Left Taillight Wire	27	Brown—Horn Button to Horn	58	Red—Alternator to Main Harness	89	Green—Hazard Switch to Main Harness
5	Blue—Turn Signal Switch to Red Left Tail, Stop, Turn and License Light Wire (For Vehicles with Turn Signal Only)	28	White—Fuel Gage to Heater Switch	59	Orange—Diode to Solenoid	90	Orange—Hazard Switch to Flasher Indicator Light
6	Black—Stoplight Switch to Red Left Tail, Stop and License Light Wire (For Vehicles without Turn Signals Only)	29	Pink—Light Switch (Acc) to Fuse Holder-Connector	60	Dark Green—Ignition Resistor to Oil Pressure Switch	91	Black—Hazard Switch to Black Fuse Holder Wire
7	Yellow—Fuel Gage Sender to Fuel Gage	30	Orange—Heater Switch to Turn Signal Flasher	61	Black—Timer to Coil (+)	92	Blue—Turn Signal Switch to Main Harness
8	Black—Solenoid to Ammeter (—)	31	Orange—Turn Signal Flasher to Holder-Connector	62	Blue—Ignition Resistor to Solenoid	93	Yellow—Turn Signal Switch to Main Harness
9	Pink—Solenoid to Pink Clutch Starting Switch Wire	32	Yellow—Turn Signal Switch to Blue Right Front Turn Signal Wire	63	Blue—Ignition Resistor to Coil (—)	94	Brown—Turn Signal Switch to Main Harness
10	White—Oil Pressure Warning Light to Engine Harness	33	Dark Green—Turn Signal Switch to Blue Left Front Turn Signal Wire	64	White—Alternator to Resistor Alternator	95	Red—Turn Signal Switch to Main Harness
11	Yellow—Fuel Pump to Engine Harness	34	Orange—Fuse Holder-Connector to Horn	65	Dark Green—Alternator to Resistor Alternator	96	Dark Green—Turn Signal Switch to Main Harness
12	Dark Green—Ignition Switch to Engine Harness	35	Black—Fuse Holder-Connector to Hazard Switch	66	DIODE ASSEMBLY	97	SEPARATE WIRES Black—Flasher Indicator Light to Ground
13	Black—Heater Switch to Engine Harness	36	SEPARATE WIRES	67	Black—Ground Cable, Engine to Main Frame	98	Wire Assy., Flasher
14	Red—Ammeter (+) to Engine Harness	37	Black—Battery (—) to Ground	68	Black—Alternator to Ground	99	Orange—Turn Signal Flasher to Orange 30 Heater Switch and Orange 31 Fuse Holder Wires
15	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	38	Black—Solenoid to Starter	69	Brown—Coil (—) to Coil (+)	100	Connector, Six Contact
16	Red—Stoplight Switch to Fuse Holder-Connector	39	Blue—Speedometer Light to Blue Dimmer Switch and Light Switch Connector Wire	70	Connector, Six Contact (4 required)	101	Black—Blower, Heater-Defroster to Main Harness
17	Brown—Stoplight Switch to Turn Signal Switch	40	Black—Fuel Gage to Ground	71	Connector, Single Contact (4 required)	102	Steering Wheel Kit
18	Blue—Speedometer Light to Dimmer Switch	41	Black—High Beam Indicator Light to Ground	72	Boot, Ring Terminal	103*	Terminal, 1-way Fust Clip (10 required)
19	Blue—Speedometer Light to Light Switch (Acc)	42	Black—Fuel Gage Sender to Ground	73	Connector, Alternator	104*	Terminal, Fuse Holder (8 required)
20	Red—Ignition Switch to Fuse Holder-Connector	43	Green—Wiper Motor to Dark Green Fuse Holder-Connector Wire	74	Connector, Two Contact	105*	Terminal, male
21	Red—Ignition Switch to Ammeter (+)	44	Fuse Holder-Connector Wire	75	DIMMER SWITCH HARNESS	106*	Tubing, Convoluted, 0.350 Inside Diameter 50' length
22	Black—Ignition Switch to Fuse Holder-Connector	45	Connector, Single Contact (4 required)	76	Blue—Dimmer Switch to Blue Beam Indicator Light Wire	107*	Tubing, Convoluted, 0.500 Inside Diameter 25' length
23		46	Connector, Single Contact (7 required)	77	White—Dimmer Switch to Headlight	108*	Tubing, Convoluted, 0.750 Inside Diameter 25' length
		47	Tube, Insulator (3 required)	78	Blue—Dimmer Switch to Blue Speedometer Light Wire	109*	Tubing, Convoluted Green, 0.413 Inside Diameter 25' length
		48	Connector, Six Contact (2 required)	79	Brown—Dimmer Switch to Headlight	110*	Inside Diameter 25' length
		49	Connector, Fuse Holder	80	Connector, Single Contact, (3 required)		
		50	ENGINE HARNESS	81	Connector, Single Contact		
		51	White—Diode to Main Harness	82	Connector, Three Contact		
		52	Yellow—Oil Pressure Switch to Main Harness	83	Black—Headlight to Ground		
				84	SEPARATE WIRES		
				85	Black—Hour Meter to Ground		
					Green—Hour Meter to Ignition Switch		

* Not Illustrated.



WIRING DIAGRAM MODEL 898437



COLOR CODE
 R-Red
 OR-Orange
 BR-Brown
 BL-Blue

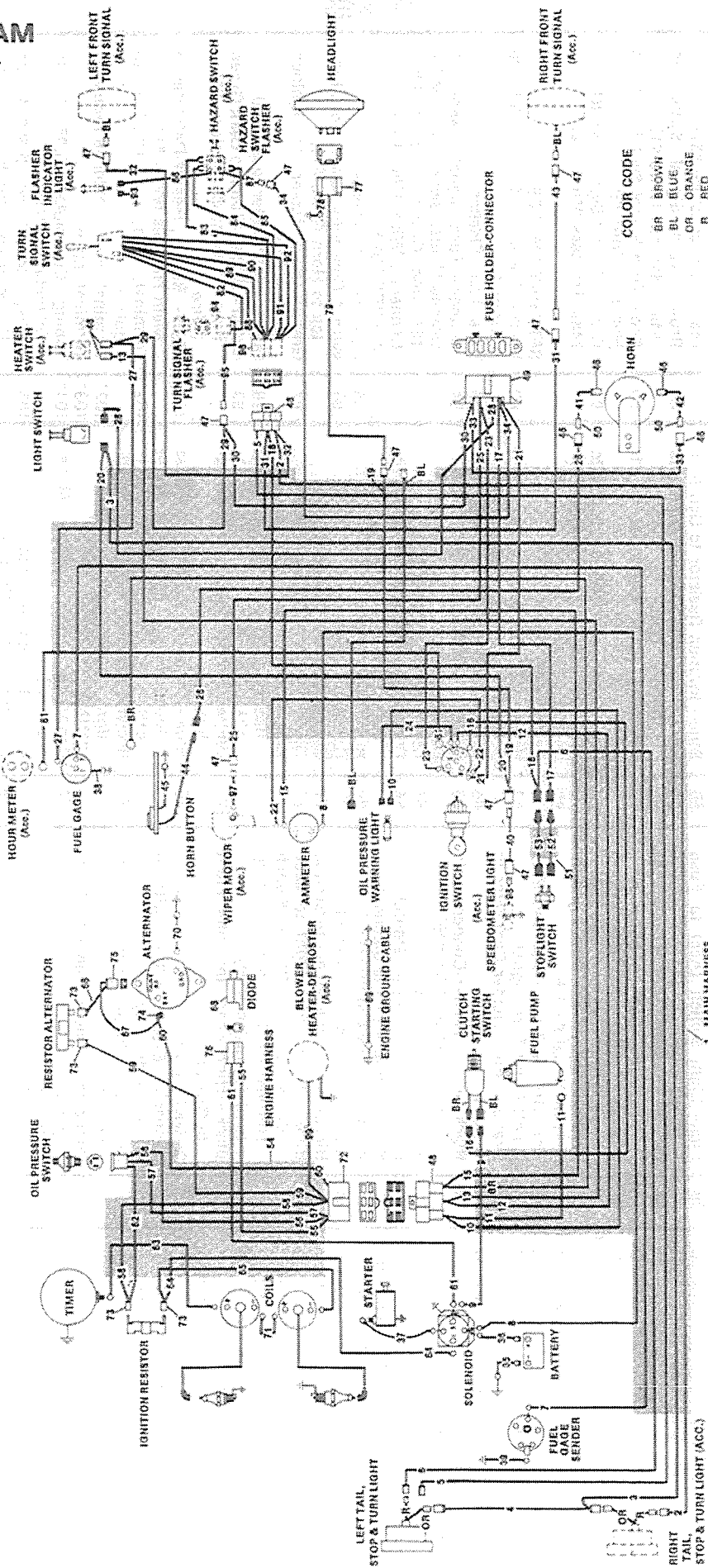
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WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	24	Blue—High Beam Indicator Light to Dimmer Switch Harness (Wire #73)	54	Red—Alternator (Batt) to Main Harness (Wire #14)	85	Orange—Hazard Switch to Flasher Indicator Light
2	Red—Turn Signal Switch to Red Right Tail, Stop and Turn Light Wire	25	Dark Green—Wiper Motor (Acc) to Fuse Holder-Connector	55	Orange—Diode to Solenoid (Start) Dark Green—Oil Pressure Switch to Ignition Resistor	86	Black—Hazard Switch to Black Fuse Holder-Connector (Wire #34)
3	Orange—Light Switch (Acc.) to Orange Right Tail, Stop and Turn Light Wire	26	Brown—Horn Bulb to Horn Switch (Acc)	56	Black—Timer to Coil (+)	87	Blue—Turn Signal Switch to Main Harness (Wire #5)
4	Orange—Orange Right Tail, Stop and Turn Light Wire to Orange Left Tail, Stop and Turn Light Wire	27	White—Fuel Gage (Ign) to Heater Switch (Acc)	57	Blue—Ignition Resistor to Solenoid (Ign)	88	Yellow—Turn Signal Switch to Main Harness (Wire #31)
5	Blue—Turn Signal Switch to Red Left Tail, Stop and Turn Light Wire (For vehicles with turn signals only)	28	Pink—Light Switch (Acc) to Fuse Holder-Connector	58	Blue—Ignition Resistor to Solenoid (Ign)	89	Brown—Turn Signal Switch to Main Harness (Wire #17)
6	Black—Stoplight Switch to Red Left Tail, Stop and Turn Light Wire (For vehicles without turn signal only)	29	Orange—Heater Switch (Acc) to Turn Signal Flasher (Wire #94)	59	Blue—Ignition Resistor to Coil (—)	90	Red—Turn Signal Switch to Main Harness (Wire #2)
7	Yellow—Fuel Gage Sender to Fuel Gage	30	Orange—Fuse Holder-Connector to Turn Signal Flasher (Wire #94)	60	Dark Green—Resistor Alternator to Alternator (1R)	91	Green—Turn Signal Switch to Main Harness (Wire #32)
8	Black—Solenoid to Ammeter (—)	31	Yellow—Right Front Turn Signal to Turn Signal Switch	61	White—Resistor Alternator to Alternator (2F)	SEPARATE WIRES	
9	Pink—Solenoid to Blue Clutch Starting Switch Wire	32	Dark Green—Turn Signal Switch to Left Front Turn Signal	62	Dark Green—Resistor Alternator to Alternator (Batt)	Black—Flasher Indicator Light to Ground	
10	White—Oil Pressure Warning Light to Engine Harness (Wire #49 & 51)	33	Orange—Fuse Holder-Connector to Horn	63	DIODE ASSEMBLY	Wire Assy, Flasher	
11	Yellow—Fuel Pump to Engine Harness (Wire #50)	34	Black—Fuse Holder-Connector to Hazard Switch (Wire #86)	64	SEPARATE WIRE	Orange—Turn Signal Flasher to Orange Heater Switch Wire (Wire #29) and Orange Fuse Holder-Connector Wire (Wire #30)	
12	Dark Green—Ignition Switch (Ign) to Engine Harness (Wire #52)	35	Black—Battery (—) to Ground	65	Black—Ground Cable, Engine to Main Frame	CONNECTORS	
13	Black—Heater Switch (Acc) to Engine Harness (Wire #100)	36	Black—Battery (+) to Solenoid	66	Black—Alternator to Ground	Connector, Six Contact	
14	Red—Ammeter (+) to Engine Harness (Wire #54)	37	Black—Solenoid to Starter	67	Brown—Coil (—) to Coil (+)	Wire & Connector Assy., Horn Button to Horn (Wire #26)	
15	Pink—Ignition Switch (Start) to Brown Clutch Starting Switch Wire	38	Black—Fuel Gage to Ground	68	CONNECTORS	Green—Hour Meter to Ignition Switch (Ign)	
16	Red—Stoplight Switch to Fuse Holder-Connector	39	Black—Fuel Gage Sender to Ground	69	Boot, Ring Terminal	Black—Hour Meter to Ground	
17	Brown—Stoplight Switch to Turn Signal Switch	40	Blue—Speedometer Light to Blue Wire #18 going to Dimmer Switch Harness and Blue Wire #19 going to Light Switch (Acc)	70	Connector, Alternator	Green—Wiper Motor to Dark Green Fuse Holder-Connector Wire (Wire #25)	
18	Blue—Speedometer Light to Dimmer Switch Harness (Wire #75)	41	Black—High Beam Indicator Light to Ground	71	Connector, Two Contact	Black—Blower, Heater-Defroster to Main Harness (Wire #13)	
19	Blue—Speedometer Light to Light Switch (Acc)	42	CONNECTORS	72	Blue—Fuel Gage to Ground	Terminal, 1-way Fuse Clip (10 required)	
20	Red—Ignition Switch (Batt) to Fuse Holder-Connector	43	Connector, Electrical (Used with on road model only)	73	Blue—Speedometer Light to Blue Wire #18 going to Dimmer Switch	Terminal, Fuse Holder (8 required)	
21	Red—Ignition Switch (Batt) to Ammeter (+)	44	Connector, Single Contact (4 required)	74	White—Dimmer Switch to Headlight	Terminal, male	
22	Black—Ignition Switch (Acc. Side) to Fuse Holder-Connector	45	Connector, Single Contact (7 required)	75	Blue—Dimmer Switch to Blue Speedometer Light Wire (Wire #18)	Tubing, Convoluted, 0.350 Inside Diameter 50' length	
23	White—Ignition Switch (Ign) to Oil Pressure Warning Light	46	Connector, Six Contact (2 required)	76	Brown—Dimmer Switch to Headlight	Tubing, Convoluted, 0.500 Inside Diameter 25' length	
		47	Tube, Insulator (3 required)	77	CONNECTORS	Tubing, Convoluted, 0.750 Inside Diameter 25' length	
		48	ENGINE HARNESS	78	Connector, Single Contact	Tubing, Convoluted, 0.413 Inside Diameter 25' length	
		49	White—Diode to Main Harness (Wire #10)	79	Connector, Three Contact		
		50	Yellow—Oil Pressure Switch to Main Harness (Wire #11)	80	Black—Headlight to Ground		
		51	White—Oil Pressure Switch to Main Harness (Wire #10)	81	TURN SIGNAL SET		
		52	Dark Green—Ignition Resistor to Main Harness (Wire #12)	82	Black—Turn Signal Switch to Turn Signal Flasher		
				83	Signal Flasher		
				84	Brown—Hazard Switch to Main Harness (Wire #17)		
					Yellow—Hazard Switch to Main Harness (Wire #31)		
					Green—Hazard Switch to Main Harness (Wire #32)		

* Not illustrated

WIRING DIAGRAM MODEL 898444



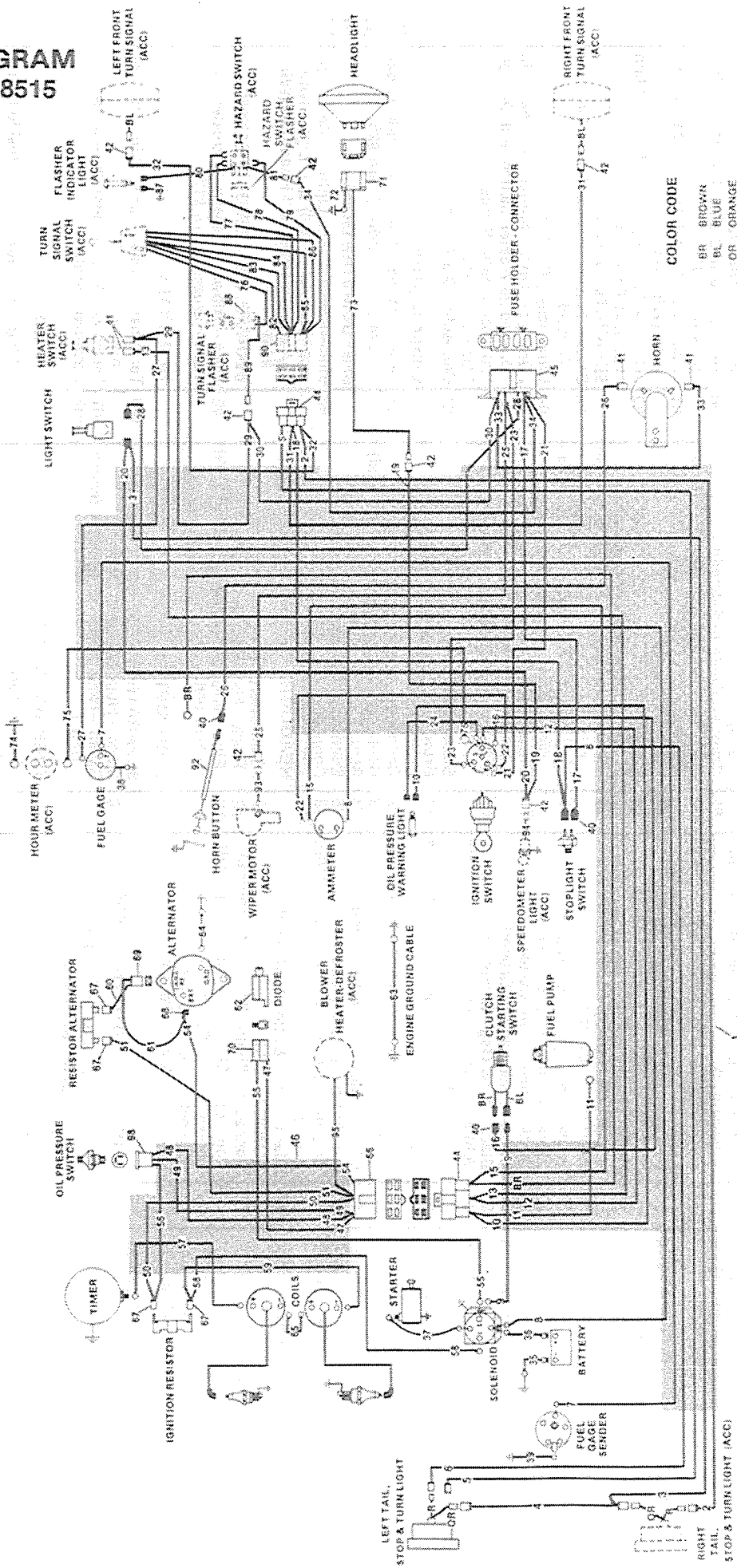
COLOR CODE
 BR BROWN
 BL BLUE
 OR ORANGE
 R RED



WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	29	Orange—Heater Switch (Acc) to Turn Signal Flasher (Acc)	58	Dark Green—Ignition Resistor to Main Harness (Wire #12)	87	Black—Hazard Switch to Black Fuse Holder (Wire #34)
2	Red—Turn Signal Switch (Acc) to Red Right Tail, Stop and Turn Light Wire (Acc)	30	Orange—Turn Signal Flasher (Acc) to Fuse Holder - Connector	59	Red—Resistor Alternator to Main Harness (Wire #12)	88	Blue—Turn Signal Switch to Main Harness (Wire #5)
3	Orange—Light Switch to Orange Right Rail, Stop and Turn Light Wire (Acc)	31	Yellow—Turn Signal Switch (Acc) to Right Front Turn Signal (Acc) Jumper Wire #43)	60	Red—Alternator to Main Harness (Wire #15)	89	Yellow—Turn Signal Switch to Main Harness (Wire #31)
4	Orange—Orange Right Taillight Wire to Orange Left Taillight Wire (Acc)	32	Dark Green—Turn Signal Switch (Acc) to Left Front Turn Signal (Acc)	61	Orange—Diode to Solenoid	90	Brown—Turn Signal Switch to Harness (Wire #18)
5	Blue—Turn Signal Switch (Acc) to Red Left Tail, Stop and Turn Light Wire (For Vehicles with Turn Signals Only)	33	Orange—Fuse Holder - Connector to Horn	62	Dark Green—Ignition Resistor to Oil Pressure Switch	91	Red—Turn Signal Switch to Main Harness (Wire #2)
6	Black—Left Tail, Stop and Turn Light Wire (RED WIRE) to Stoplight Switch (Wire #53) (For Vehicles without Turn Signals Only)	34	Black—Fuse Holder - Connector to Hazard Switch (Acc)	63	Black—Timer to Coil (+)	92	Green—Turn Signal Switch to Main Harness (Wire #32)
7	Yellow—Fuel Gage Sender to Fuel Gage	35	Black—Battery (-) to Ground	64	Blue—Ignition Resistor to Solenoid	93	SEPARATE WIRES
8	Black—Solenoid to Ammeter (-)	36	Black—Battery (+) to Solenoid	65	Blue—Ignition Resistor to Coil (-)	94	Black—Flasher Indicator Light to Ground
9	Pink—Solenoid to Blue Clutch Starting Switch Wire	37	Black—Solenoid to Starter	66	White—Alternator (F) to Resistor Alternator	95	Wire Assy., Flasher
10	White—Oil Pressure Warning Light to Engine Harness (Wire #55 & #57)	38	Black—Fuel Gage to Ground	67	Dark Green—Alternator (R) to Alternator (Batt.)	96	Orange—Turn Signal Flasher to Orange 29 Heater Switch and Orange 30 Fuse Holder Wires
11	Yellow—Fuel Pump to Engine Harness (Wire #56)	39	Black—Fuel Gage Sender to Ground	68	DIODE ASSEMBLY	97	CONNECTORS
12	Dark Green—Ignition Switch to Engine Harness (Wire #58 & #59)	40	White—Speedometer Light to Main Harness (Wires #19 & #20)	69	Black—Ground Cable, Engine to Main Frame	98	WIPER MOTOR
13	Black—Heater Switch (Acc) to Engine Harness (Wire #99)	41	Brown—Horn to Main Harness (Wire #26)	70	Black—Alternator to Ground	99	Green—Wiper Motor to Dark Green Fuse Holder Wire (Wire #25)
14	Red—Ammeter (+) to Engine Harness (Wire #60)	42	Orange—Horn to Main Harness (Wire #33)	71	Brown Coil (-) to Coil (+)	100	SPEEDOMETER LIGHT
15	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	43	White—Right Front Turn Signal (Acc) to Main Harness (Wire #31)	72	CONNECTORS	101	Blue—Speedometer Light White Jumper Wire (Wire #40) and Light Switch (Acc) (Wire #20) and Headlight (Wire #19)
16	Red—Fuse Holder-Connector to Stoplight Switch Harness (Wire #52)	44	Brown—Horn Button to Horn (Wire #26)	73	Connector, Six Contact	102	BLOWER, HEATER-DEFROSTER
17	Brown—Turn Signal Switch (Acc) to Stoplight Switch Harness (Wire #53)	45	Black—Horn Button to Ground	74	Connector, Single Contact	103	Black—Blower, Heater-Defroster to Main Harness (Wire #13)
18	Blue—Speedometer Light (Acc) to Headlight (Wire #79)	46	CONNECTORS	75	Connector, Ring Terminal	104	TERMINALS
19	Blue—Speedometer Light (Acc) to Light Switch	47	Connector, Single Contact (6 required)	76	Connector, Alternator	105	Terminal—1-way Fuse Clip (10 required)
20	Red—Ignition Switch to Fuse Holder Connector	48	Connector, Single Contact (9 required)	77	Connector, Two Contact	106	Terminal—Fuse Holder (8 required)
21	Red—Ignition Switch to Fuse Holder Connector	49	Connector, Six Contact (2 required)	78	HEADLIGHT		Terminal—Male
22	Black—Ignition Switch to Fuse Holder Connector	50	Connector, Single Contact (2 required)	79	Connector, Three Contact		TUBING
23	White—Ignition Switch to Oil Pressure Warning Light	51	STOPLIGHT SWITCH HARNESS	80	Black—Headlight to Ground		Tubing, Convoluted, 0.350 Inside Diameter 50' length
24	Dark Green—Wiper Motor (Acc) to Holder - Connector	52	STOPLIGHT SWITCH HARNESS	81	Blue—Headlight to Speedometer Light (Acc) (Wire #19)		Tubing, Convoluted, 0.500 Inside Diameter 25' length
25	Brown—Horn Button to Horn	53	Red—Stoplight Switch to Main Harness (Wire #17)	82	Hour Meter		Tubing, Convoluted, 0.750 Inside Diameter 25' length
26	White—Fuel Gage to Heater Switch (Acc)	54	Black—Stoplight Switch to Main Harness (Wires #6 & #18)	83	SEPARATE WIRES		Tubing, Convoluted Green, 0.413 Inside Diameter 25' length
27	Pink—Light Switch to Fuse Holder Connector	55	ENGINE HARNESS	84	Black—Hour Meter to Ground		* Not illustrated.
28		56	White—Diode to Main Harness (Wire #10)	85	Green—Hour Meter to Ignition Switch (Ign.)		
		57	Yellow—Oil Pressure Switch to Main Harness (Wire #11)	86	TURN SIGNAL SET		
			White—Oil Pressure Switch to Main Harness (Wire #10)		Black—Turn Signal Switch to Turn Signal Flasher		
					Brown—Hazard Switch to Main Harness (Wire #18)		
					Yellow—Hazard Switch to Main Harness (Wire #31)		
					Green—Hazard Switch to Main Harness (Wire #32)		
					Orange—Hazard Switch to Flasher Indicator Light		

WIRING DIAGRAM MODEL 898515

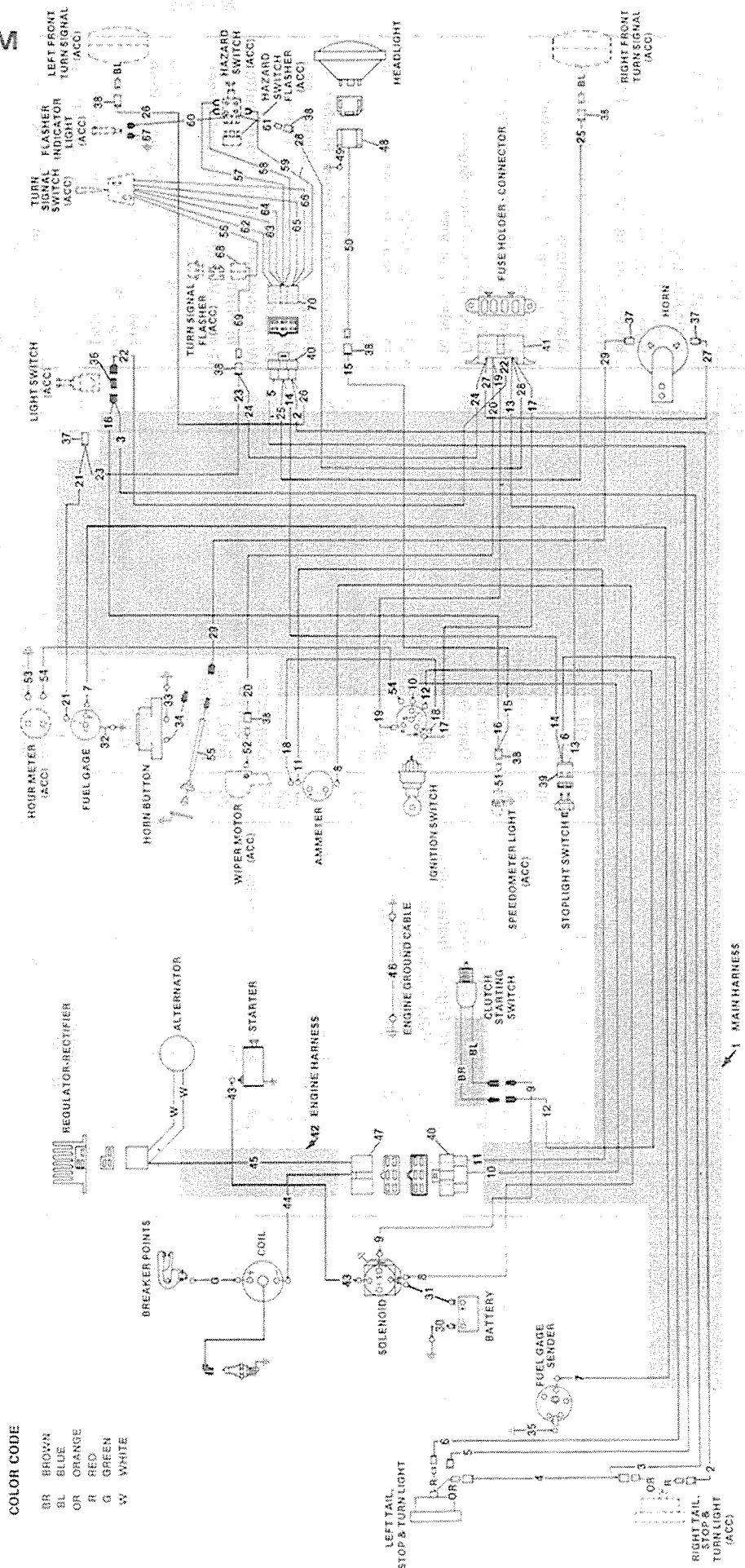


WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	23	Black—Ignition Switch to Fuse Holder - Connector	51	Red—Resistor Alternator to Main Harness	80	Orange—Hazard Switch to Flasher Indicator Light
2	Red—Turn Signal Switch (Acc) to Red Right Tail, Stop and Turn Light Wire (Acc)	24	White—Ignition Switch to Oil Pressure Warning Light	54	Red—Alternator to Main Harness (Wire #15)	81	Black—Hazard Switch to Black Fuse Holder Wire
3	Orange—Light Switch to Orange Right Tail, Stop and Turn Light Wire (Acc)	25	Dark Green—Wiper Motor (Acc) to Fuse Holder - Connector	55	Orange—Diode to Solenoid	82	Blue—Turn Signal Switch to Main Harness
4	Orange—Orange Right Tail Light Wire (Acc) to Orange Left Tail Light Wire	26	Brown—Horn Button to Horn	56	Dark Green—Ignition Resistor to Oil Pressure Switch	83	Yellow—Turn Signal Switch to Main Harness
5	Blue—Turn Signal Switch (Acc) to Red Left Tail, Stop and Turn Light Wire (For Vehicles with Turn Signals Only)	27	White—Fuel Gage to Heater Switch (Acc)	57	Black—Timer to Coil (+)	84	Brown—Turn Signal Switch to Main Harness
6	Black—Stoplight Switch to Red Left Tail, Stop and Turn Light Wire (For Vehicles without Turn Signals Only)	28	Pink—Light Switch to Fuse Holder - Connector	58	Blue—Ignition Resistor to Solenoid	85	Red—Turn Signal Switch to Main Harness
7	Yellow—Fuel Gage Sender to Fuel Gage	29	Orange—Heater Switch (Acc) to Turn Signal Flasher (Acc)	59	Blue—Ignition Resistor to Coil (-)	86	Dark Green—Turn Signal Switch to Main Harness
8	Black—Solenoid to Ammeter (-)	30	Orange—Turn Signal Flasher (Acc) to Fuse Holder - Connector	60	White—Alternator to Resistor Alternator		
9	Pink—Solenoid to Blue Clutch Starting Switch Wire	31	Yellow—Turn Signal Switch (Acc) to Blue Right Front Turn Signal Wire (Acc)	61	Dark Green—Alternator to Resistor Alternator		
10	White—Oil Pressure Warning Light to Engine Harness (Wire #49 & #47)	32	Dark Green—Turn Signal Switch (Acc) to Blue Left Front Turn Signal Wire (Acc)	62	DIODE ASSEMBLY		
11	Yellow—Fuel Pump to Engine Harness (Wire #48)	33	Orange—Fuse Holder - Connector to Horn	63	SEPARATE WIRES		
12	Dark Green—Ignition Switch to Engine Harness (Wire #50 - 51)	34	Black—Fuse Holder - Connector to Hazard Switch (Acc)	64	Black—Ground Cable, Engine to Main Frame	87	SEPARATE WIRES
13	Black—Heater Switch (Acc) to Engine Harness (Wire #52)	35	SEPARATE WIRES	65	Black—Alternator to Ground	88	Black—Flasher Indicator Light to Ground
14	Red—Ammeter (+) to Engine Harness (Wire #54)	36	Black—Battery (-) to Ground	66	Orange—Turn Signal Flasher to Brown Coil (-) to Coil (+)	89	Orange—Turn Signal Flasher to Orange 29 Heater Switch and Orange 30 Fuse Holder Wires
15	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	37	Black—Battery (+) to Solenoid	67	Orange—Turn Signal Switch (4 required)	90	Wire and Connector, Horn Button to Horn
16	Red—Stoplight Switch to Fuse Holder Connector	38	Black—Solenoid to Starter	68	Black—Ring Terminal	91	Green—Wiper Motor to Dark Green Fuse Holder Wire
17	Brown—Stoplight Switch to Turn Signal Switch (Acc)	39	Black—Fuel Gage Sender to Ground	69	Connector, Alternator	92	Blue—Speedometer Light to Blue Light Switch (Acc) and Blue Headlight Wires
18	Blue—Speedometer Light (Acc) to Headlight	40	Black—Fuel Gage to Ground	70	Wire Assy., Headlight	93	Black—Blower, Heater-Defroster (Acc) to Main Harness (Wire #13)
19	Blue—Speedometer Light (Acc) to Light Switch	41	Black—Insulator (3 required)	71	Black—Headlight to Blue Speedometer Light Wire (Acc)	94	Terminal—1-way Fuse Clip (10 required)
20	Red—Ignition Switch to Fuse Holder Connector	42	Connector, Six Contact (4 required)	72	SEPARATE WIRES	95	Terminal—Fuse Holder (8 required)
21	Red—Ignition Switch to Ammeter (+)	43	Connector, Six Contact (7 required)	73	Black—Hour Meter to Ground	96*	Terminal—Male
		44	Connector, Fuse Holder	74	Green—Hour Meter to Ignition Switch	97*	Tubing, Convoluted, 0.350 Inside Diameter 50' length
		45	ENGINE HARNESS	75	TURN SIGNAL SET	98*	Tubing, Convoluted, 0.500 Inside Diameter 25' length
		46	White—Diode to Main Harness (Wire #10)	76	Black—Turn Signal Switch to Turn Signal Flasher	99*	Tubing, Convoluted, 0.750 Inside Diameter 25' length
		47	Yellow—Oil Pressure Switch to Main Harness (Wire #11)	77	Brown—Hazard Switch to Main Harness	100*	Tubing, Convoluted Green, 0.413 Inside Diameter 25' length
		48	White—Oil Pressure Switch to Main Harness (Wire #10)	78	Yellow—Hazard Switch to Main Harness	101*	
		49	Dark Green—Ignition Resistor to Main Harness (Wire #12)	79	Green—Hazard Switch to Main Harness	102*	

WIRING DIAGRAM MODELS 898425 AND 898525

6



- COLOR CODE**
- BR BROWN
 - BL BLUE
 - OR ORANGE
 - R RED
 - G GREEN
 - W WHITE

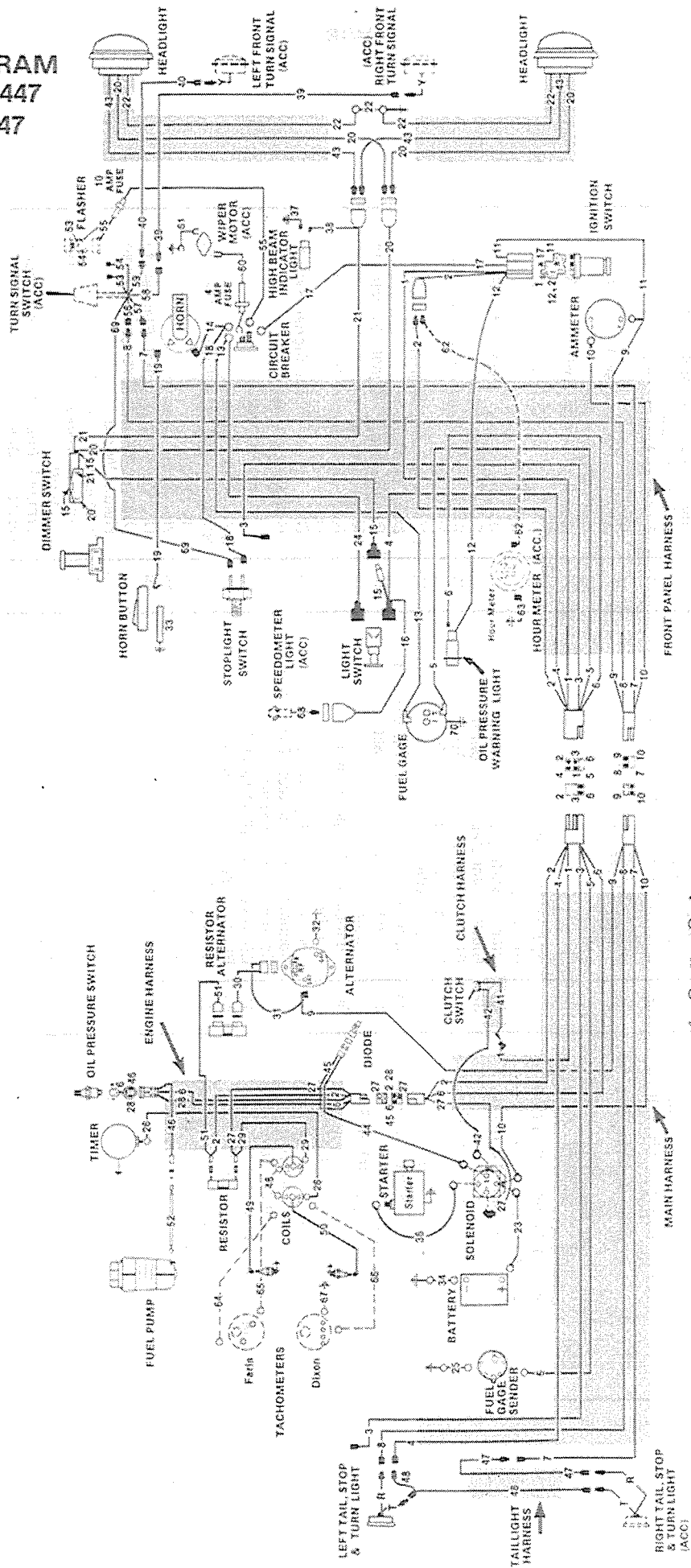
WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	MAIN HARNESS	24	Orange—Turn Signal Flasher (Acc) to Fuse Holder - Connector	54	Green—Hour Meter to Ignition Switch
2	Red—Turn Signal Switch (Acc) to Red Right Tail, Stop, and Turn Light Wire (Acc)	25	Yellow—Turn Signal Switch (Acc) to Right Front Turn Signal (Acc)	55	Horn Button to Horn Wire & Connector
3	Orange—Light Switch to Orange Right Tail, Stop, and Turn Light Wire (Acc)	26	Dark Green—Turn Signal Switch (Acc) to Left Front Turn Signal (Acc)	56	TURN SIGNAL SET (Accessory)
4	Orange—Orange Right Taillight Wire (Acc) to Orange Left Taillight Wire	27	Orange—Fuse Holder to Horn	57	Black—Turn Signal Switch to Turn Signal Flasher
5	Blue—Turn Signal Switch (Acc) to Red Left Tail, Stop and Turn Light Wire (For Vehicles with Turn Signals Only)	28	Black—Fuse Holder to Hazard Switch (Acc)	58	Brown—Hazard Switch to Main Harness
6	Black—Stoplight Switch to Red Left Tail, Stop and Turn Light Wire (For Vehicles without Turn Signals Only)	29	Brown—Horn to Horn Button	59	Yellow—Hazard Switch to Main Harness
7	Yellow—Fuel Gage Sender to Fuel Gage	30	SEPARATE WIRES	60	Green—Hazard Switch to Main Harness
8	Black—Solenoid to Ammeter	31	Black—Battery (—) to Ground	61	Orange—Hazard Switch to Flasher Indicator Light
9	Pink—Solenoid to Pink Clutch Starting Switch Wire	32	Black—Battery (+) to Solenoid	62	Black—Hazard Switch to Black Fuse Holder Wire
10	Dark Green—Ignition Switch to Engine Harness	33	Black—Horn Button to Ground	63	Blue—Turn Signal Switch to Main Harness
11	Red—Ammeter to Engine Harness	34	Brown—Horn Button to Brown Horn Wire	64	Yellow—Turn Signal Switch to Main Harness
12	Pink—Ignition Switch to Brown Clutch Starting Switch Wire	35	Black—Fuel Gage Sender to Ground	65	Brown—Turn Signal Switch to Main Harness
13	Red—Stoplight Switch to Fuse Holder - Connector	36	Connector, Single Contact (3 required)	66	Red—Turn Signal Switch to Main Harness
14	Brown—Stoplight Switch to Turn Signal Switch (Acc)	37	Connector, Single Contact (7 required)	67	Dark Green—Turn Signal Switch to Main Harness
15	Blue—Speedometer Light (Acc) to Headlight	38	Connector, Single Contact (2 required)	68	SEPARATE WIRES
16	Blue—Speedometer Light (Acc) to Light Switch (Acc)	39	Connector, Six Contact (2 required)	69	Black—Flasher Indicator Light to Ground
17	Red—Ignition Switch to Fuse Holder - Connector	40	Connector, Fuse Holder	70	Wire Assy., Flasher
18	Red—Ignition Switch to Ammeter (+)	41	ENGINE HARNESS 12 H.P.	71	Orange—Turn Signal Flasher to Orange 23 and Orange 31 Fuse Holder Wires
19	Blue—Ignition Switch to Fuse Holder - Connector	42	Black—Solenoid to Starter	72	Terminal, Six Contact
20	Dark Green—Wiper Motor (Acc) to Fuse Holder - Connector	43	Dark Green—Coil (—) to Main Harness	73	Terminal, 1-way Fuse Clip (10 required)
21	White—Fuel Gage to Heater Switch (Heater Switch Used For 18 H.P. Only)	44	Red—Regulator-Rectifier to Main Harness	74	Terminal, Fuse Holder (8 required)
22	Pink—Light Switch to Fuse Holder - Connector	45	SEPARATE WIRES	75	Terminal Male
23	Orange—Turn Signal Flasher (Acc) to Heater Switch (Heater Switch Used For 18 H.P. Only)	46	Ground Cable, Engine to Main Frame	76	Tubing, Convoluted, 0.350 Inside Diameter 50' length
		47	Connector, Six Contact	77	Tubing, Convoluted, 0.500 Inside Diameter 25' length
		48	Connector, Three Contact		Tubing, Convoluted, 0.750 Inside Diameter 25' length
		49	Black—Headlight to Ground		Tubing, Convoluted Green, 0.413 Inside Diameter 25' length
		50	Blue—Headlight to Blue Speedometer Light Wire		
		51	Blue—Speedometer Light to Blue Light Switch (Acc) and Blue Headlight Connector		
		52	Green—Wiper Motor to Dark Green Fuse Holder Wire		
		53	Black—Hour Meter to Ground		

* Not illustrated



WIRING DIAGRAM MODELS 898447 AND 898547



WIRES

Ref. No.	Description	Ref. No.	Description	Ref. No.	Description
1	Pink—Ignition switch (S) to clutch switch	22	Black—Headlight to ground	47	Red—Right tail light red wire to main harness (Wire #7)
2	Green—Ignition switch (IGN) to resistor	23	Black—Battery (+) to solenoid	48	Tan—Right and left light tan wire to main harness (Wire #4)
3	Black—Stoplight switch to brake light (For vehicles without turn signals)	24	Purple—Circuit breaker to light switch	49	—Coil to spark plug
4	Tan—Light switch to tail lights (Wire #48)	25	Orange/Yellow—Fuel gauge sender to ground	50	—Coil to spark plug
5	Yellow—Fuel gauge to fuel gauge sender	26	Black—Coil to timer	51	Red—Alternator resistor to resistor
6	White—Oil pressure, light to switch	27	Blue—Resistor to solenoid (I)	52	Yellow—Fuel pump to oil pressure switch (Wire #46)
7	Red—Turn signal switch (Wire #57) to right tail, stop & turn light (Wire #47)	28	Green—Oil pressure switch to main harness (Wire #2)	53	Black—Turn signal switch to flasher
8	Blue—Turn signal switch (Wire #56) to left tail, stop & turn light	29	Blue—Resistor to coil	54	Dark Blue—Turn signal switch to flasher
9	Red—Ammeter (+) to alternator (B.A.T.)	30	White—Alternator (R) to alternator resistor	55	Brown—Flasher to 10 amp fuse and circuit breaker
10	Black—Ammeter (—) to solenoid (B.A.T.)	31	Green—Alternator (B.A.T.) to alternator (F)	56	Light Blue—Turn signal switch to front panel harness (Wire #8)
11	Red—Ignition switch (B.A.T.) to ammeter (+)	32	Blue—Alternator to ground	57	Red—Turn signal switch to front panel harness (Wire #7)
12	White—Oil pressure warning light to ignition switch (IGN)	33	Copper Strip—Horn switch to ground	58	Red—Turn signal switch to right front turn signal (Jumper Wire #39)
13	Purple—Fuel gauge (IGN) to circuit breaker	34	Black—Battery (—) to ground	59	Green—Turn signal switch to left front turn signal (Jumper Wire #40)
14	Grey—Horn to circuit breaker	35	Black—Engine to ground	60	Brown—Wire motor to 4 amp fuse and circuit breaker
15	Light Blue—Light switch to dimmer switch	36	Black—Solenoid to starter	61	Brown—Wire motor to ground
16	Orange—Light switch to speedometer light	37	White—High beam indicator to ground	62	Green—Hour meter to ignition switch (Wire #2)
17	Black—Ignition switch (ACC) to circuit breaker	38	White—High beam indicator to headlight	63	Black—Hour meter to ground
18	Grey—Circuit breaker to stoplight switch	39	Red—Turn signal switch (Wire #58) to right front turn signal	64	Black—Tachometer to coil (—)
19	Black—Horn to horn button	40	Blue—Turn signal switch (Wire #59) to left front turn signal	65	Red—Tachometer to coil (+)
20	Yellow—Dimmer switch to headlight	41	Pink—Clutch switch to main harness (Wire #1)	66	Black—Tachometer to coil (+)
21	Ivory—Dimmer switch to headlight	42	Pink—Clutch switch to solenoid (S)	67	White—Tachometer to ground
		43	White—Headlights to dimmer switch (Wire #21)	68	Orange—Speedometer light to light switch (Wire #16)
		44	Orange—Diode to solenoid (S)	69	Grey w/Black Stripe—Turn signal switch to stoplight switch
		45	White—Diode to main harness (Wire #6)	70	Black—Fuel gage to ground
		46	Yellow—Oil pressure switch (P) to fuel pump (Wire #52)		

NOTES

6

Clutch Overhaul

Remove the engine and clutch assembly from the vehicle.

Remove the clutch cover. Disconnect the clips holding the throwout bearing, and remove the throwout bearing from the clutch.

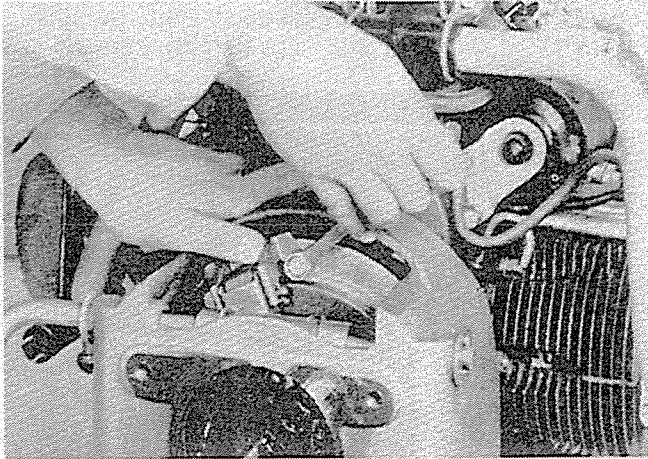


FIGURE 1

Remove the screws securing the clutch pressure plate assembly to the clutch drive plate, two from each clutch release arm bracket. See Figure 1. The pressure plate and disc can now be removed from the clutch housing. Remove the retaining screws from the drive plate and remove

from the clutch drive hub. It is not necessary to remove the housing from the engine or the drive hub from the crankshaft when performing a clutch overhaul.

Inspect the condition of the throwout bearing and the pilot bearing, also the release arms and the splines of the disc. Inspect the face of the pressure plate and the drive plate. Replace any worn or damaged parts. It is not advisable to reface either the pressure plate or the drive plate. Worn parts should always be replaced.

When performing a complete clutch overhaul it is always advisable to replace the clutch lining or disc, the pressure plate springs and the throwout bearing. When replacing the clutch linings note that each rivet supports only one lining, while the next rivet supports the opposite lining. This staggered sequence is followed around the complete circumference of the disc.

Mount the drive plate to the drive hub, be sure retaining screws are securely tightened. Install the pilot bearing and the retaining ring. With the release arm brackets, arms and springs assembled to the pressure plate, install the pressure plate and disc to the drive plate. Install all screws but do not tighten. Insert a pilot shaft aligning tool or transmission main drive gear through the disc into the pilot bearing and tighten all the pressure plate retaining screws.

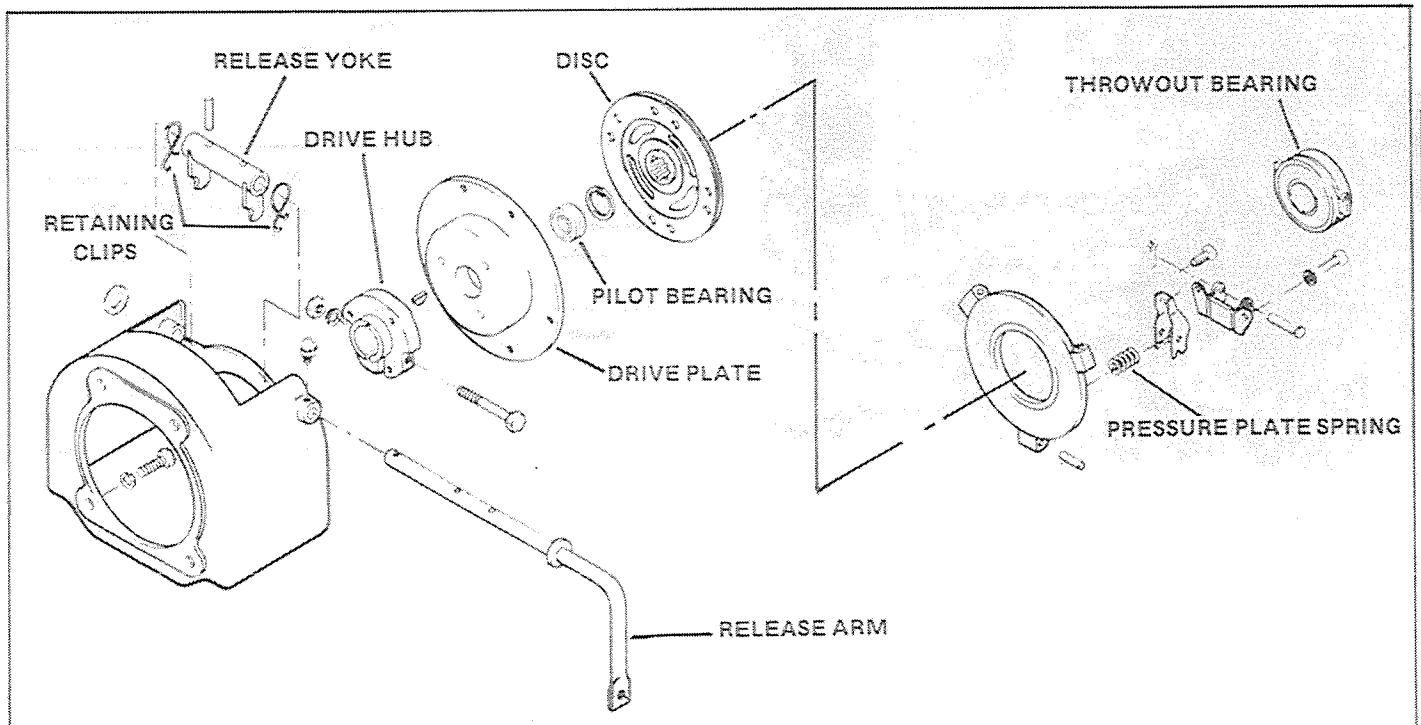


FIGURE 2

Pack the recess on the inside of the throwout bearing collar with lithium base grease. Figure 3. Position the throwout bearing and secure it by installing the retaining clips.

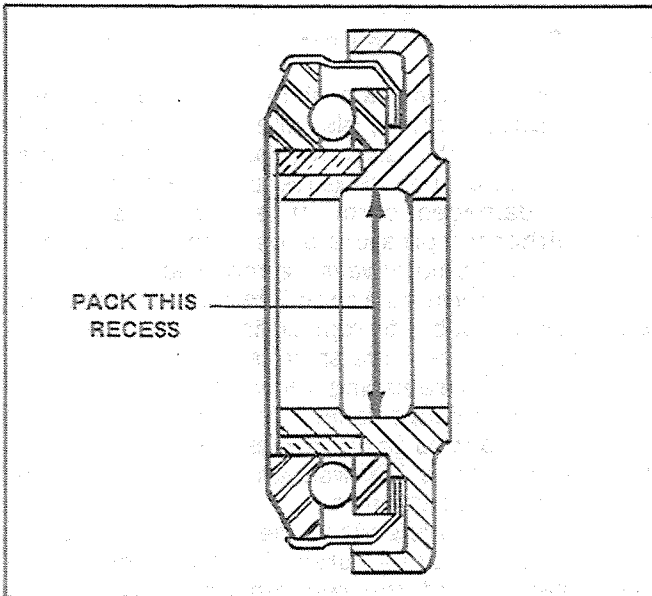


FIGURE 3

ADJUST RELEASE ARM SCREWS TO OBTAIN EQUAL TENSION ON PRESSURE PLATE SPRINGS.

Replace the clutch cover.

The engine and the clutch assembly are now ready to be replaced in the vehicle.

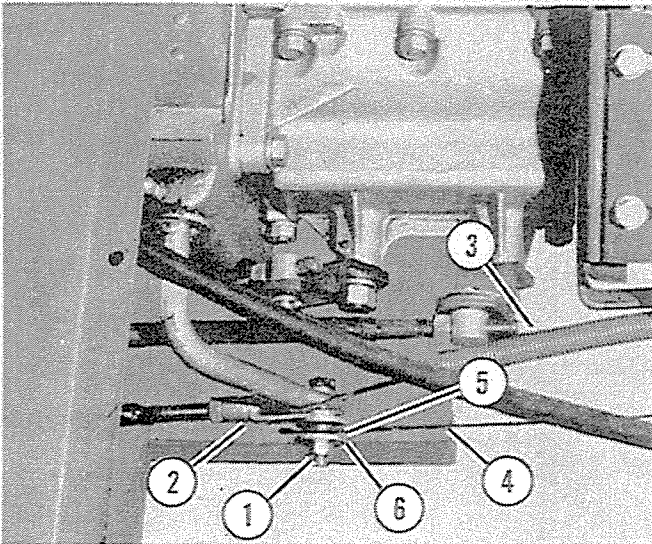


FIGURE 4

- | | |
|------------------|---------------------|
| 1. Lock nut | 4. Interlock spring |
| 2. Yoke | 5. Spacer |
| 3. Return spring | 6. Washers |

Clutch Pedal Adjustment (Radial Frame Haulsters)

Clutch pedal adjustment is made by moving the adjustable yoke at the end of the clutch rod. Adjustment should be made so that the pedal has from 1" to 1-1/4" (25-31 mm) free travel.

Clutch Pedal Adjustment (Except Radial Frame Haulsters)

Clutch pedal adjustment is made by moving the adjustable yoke at the end of the clutch rod. Adjustment should be made so that the pedal has from 1" (25 mm) to 1 1/4" (32 mm) free travel.

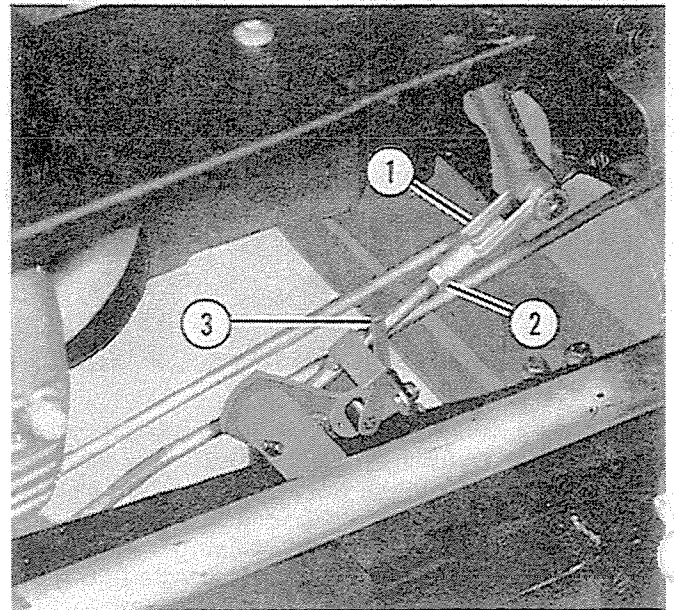


FIGURE 5

- | | |
|----------------------------|------------|
| 1. Clutch Adjusting Yoke | 2. Locknut |
| 3. Clutch Interlock Switch | |



SAFETY WARNING: To insure proper clutch interlock switch function, all parts must be correctly positioned.



NOTE: The clutch adjustment requires disassembly of the yoke. Note position of parts and make sure all parts are reassembled in their proper position.



SAFETY WARNING: If the engine will start without depressing the clutch pedal, the clutch interlock switch should be adjusted immediately to prevent unexpected operation of vehicle upon starting.

Clutch Interlock Switch

The clutch interlock switch prevents the engine from starting unless the clutch pedal is depressed.

Adjustment (Radial Frame Haulsters)

Adjustment is accomplished by moving the two locking nuts on the switch threaded shaft so the switch comes "on" when the clutch pedal is between 3/8" (9 mm) and 7/8" (22 mm) of the end of its downward travel. Measure by placing a ruler perpendicular to the pedal arm and measuring to the front of the slot in the floorboard. Check to be sure switch does not come "on" when the clutch is engaged. Figure 6.

Adjustment (Except Radial Frame Haulsters)

Position switch and bracket assembly on power frame, forward or back, as required so the switch comes "on" when the clutch pedal is the following distance from the floor mat:

- 1/4" (6 mm) to 3/4" (19 mm) on 3 wheel Haulsters
- 2" (50 mm) to 3" (75 mm) on 4 wheel Haulsters

Measure from the bottom of clutch pedal arm to floor mat. Starting circuit should remain actuated when the clutch pedal arm is pressed to the floor.

The clutch should not engage until the clutch pedal arm is above the upper dimensional limit specified. Figure 5.

TROUBLESHOOTING

Clutch Slips

1. Insufficient pedal travel, linkage adjustment needed
2. Worn clutch lining
3. Clutch lining contaminated

Clutch Will Not Release

1. Clutch facing adhered to clutch plate by ice, chemicals, etc.

Clutch Chatters

1. Warped clutch disc
2. Unequal adjustment of clutch release arms
3. Broken or damaged clutch lining
4. Broken or loose engine and/or transmission mounts

SECTION 8 TRANSMISSION

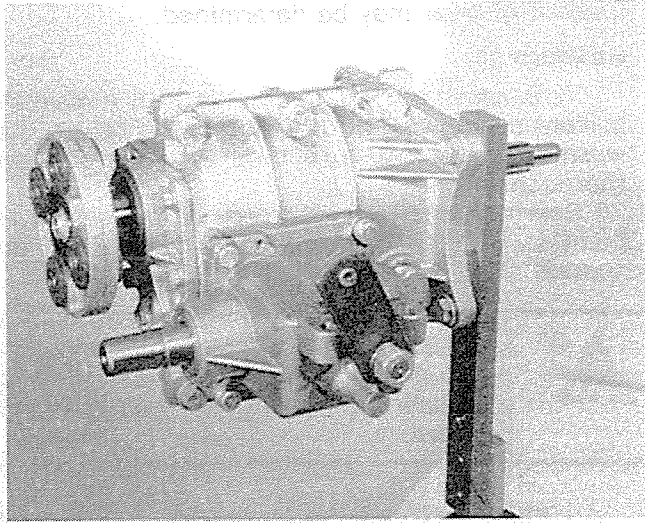


FIGURE 1

Disassembly

1. Drain lubricant from transmission and clean case with a solvent.
2. Remove Power Take-off or side cover.
3. Remove coupling or drive shaft.
4. Remove front and rear bearing retainers. Figure 2.

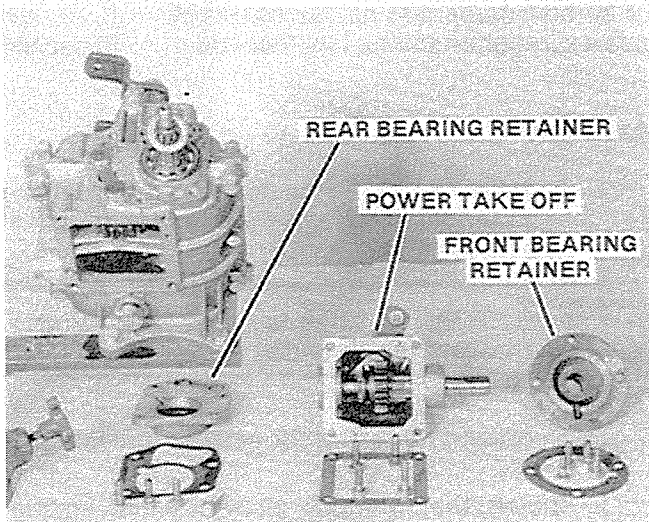


FIGURE 2

5. Remove both tapered locating pins from case. See A in Figure 3.
6. Position transmission so that power take-off opening is facing down.
7. Remove the eight (8) retaining nuts and six (6) retaining screws that hold the two case halves together.
8. Separate the two halves. Do not insert any tool between case halves. Use hammer on separating tabs. Figure 4.
9. Remove the shifter arms from the shifter levers.

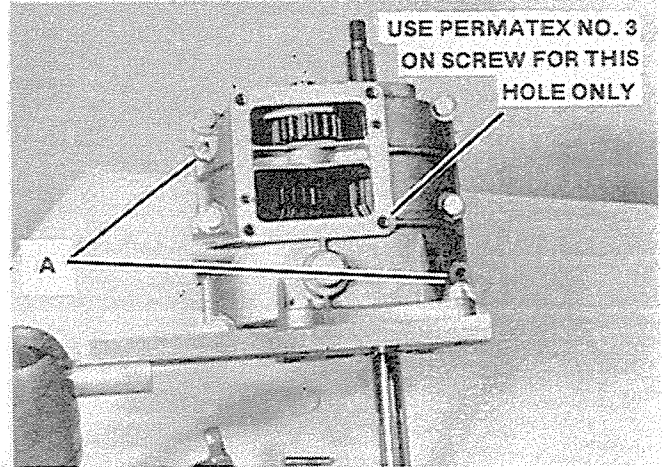


FIGURE 3

10. Using a straight punch, drive out the shifter lever retaining spiral pins. Figure 5.

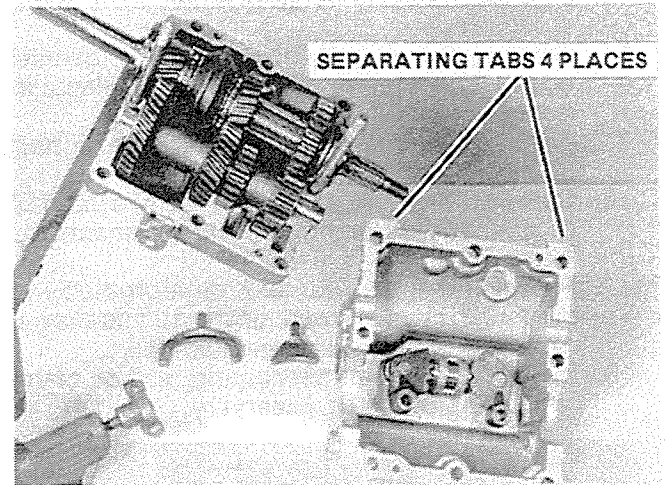


FIGURE 4

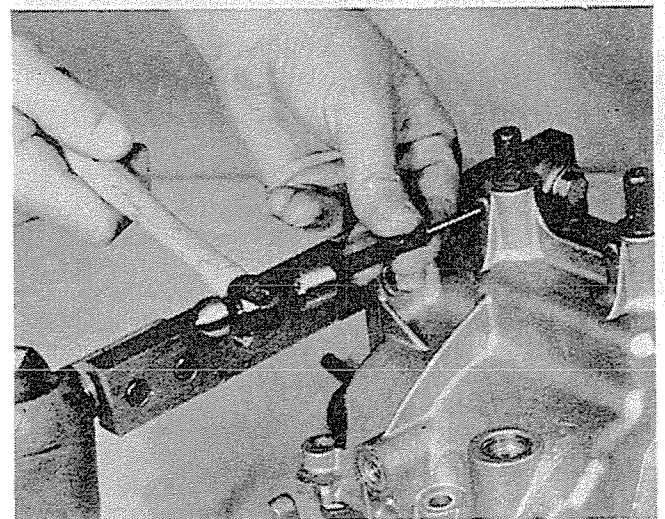


FIGURE 5

11. Remove shifter levers, interlock sleeve, balls, spring and spacer. Figure 6.

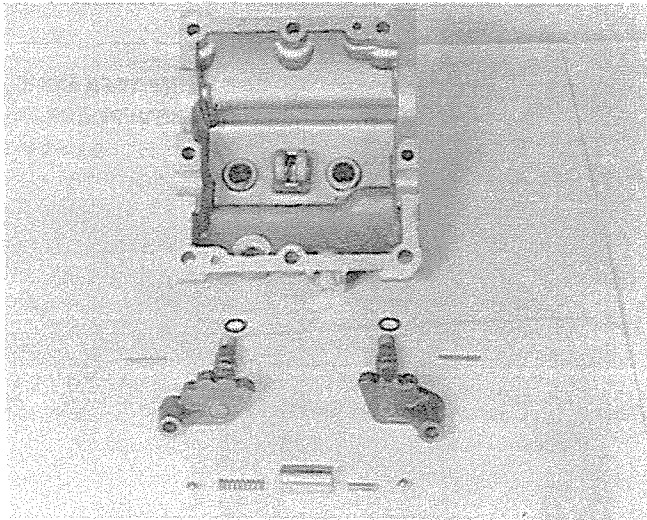


FIGURE 6

12. Lift out cluster gear assembly and main drive assembly.
13. Separate main drive gear from main shaft assembly.
14. Inspect caged ball bearings and needle bearings of main drive gear. Replace if necessary.
15. Remove clutch sleeve and the three shifter plates.
16. Remove the retaining ring that retains the second and high hub to the main shaft. Figure 7.
17. Remove the second and high hub, synchronizer ring, second gear, and low and reverse gear from the main shaft.
18. Inspect caged ball bearing on end of main shaft. Replace if necessary.

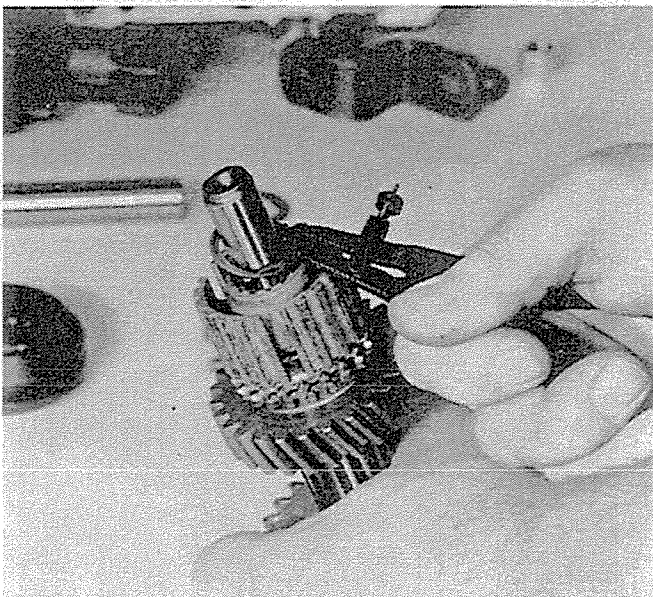


FIGURE 7

Gears

Wash all gears in a cleaning solvent. Inspect for worn or chipped teeth. It is advisable to slide each gear onto a new shaft so that the exact amount of wear may be determined.

Bearings

To wash a bearing, submerge it in a cleaning solvent that is free of dirt. Rotate the bearings to wash away any oil and dirt. Dry the bearings thoroughly.

Bearings must be handled with care. Wrap them in a clean cloth or paper until they are needed.



SAFETY WARNING: When using compressed air to dry the ball bearings, do not allow the bearings to spin freely in the race.

Carefully examine each bearing for cracked races, worn or scored balls.

Transmission Case

Examine the surfaces of the bearing recesses in the transmission case for wear or scoring which would indicate that the bearings have been revolving in their housings. Examine the case for cracks or other damage.

Using a lacquer thinner or other suitable solvent, remove old cement from mating surfaces of both transmission halves. **IMPORTANT:** Never use a scraper or any tool that will mar the surfaces.

Assembly

1. Install a new "O" ring on each shifter lever. Insert the second and high shifter lever in the transmission half.



NOTE: "O" ring is installed in groove nearest the threaded end.

Lubricate "O" ring for ease of installation.

2. Install the interlock sleeve, balls, spring and spacer, and position transmission half as illustrated in Figure 8.
3. Insert the other shifter lever into the housing, but before pushing it all the way in, insert a .018" (0.46 mm) feeler gauge between the top ball and the shifter lever. Then push shifter lever in. Figure 9.
4. Check interlock sleeve for correct clearance in all four gear positions. Figure 10.
5. Install shifter lever spiro pins with slots toward the threaded end of the shifter levers.

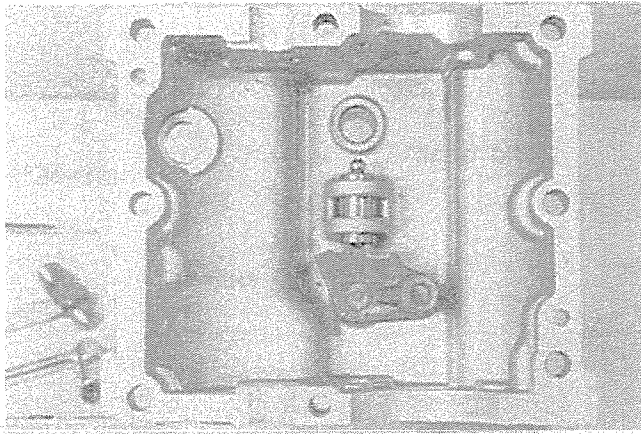
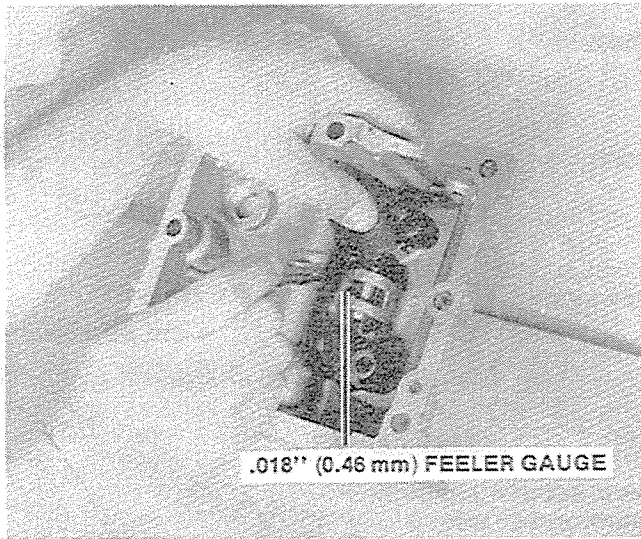


FIGURE 8



.018" (0.46 mm) FEELER GAUGE

FIGURE 9

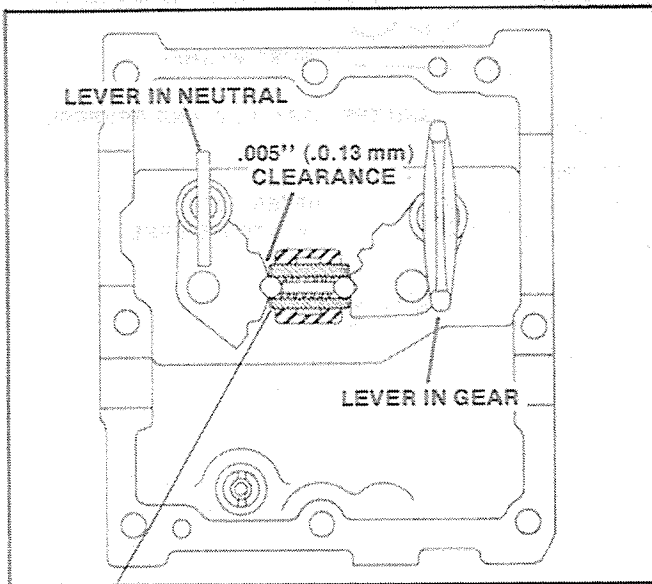


FIGURE 10

815139	1.259"	USE AS REQUIRED TO PROVIDE
815140 "A"	1.255"	.005" (0.13 mm) CLEARANCE BE-
815141 "B"	1.251"	TWEEN END OF INTERLOCK
815142 "C"	1.247"	SLEEVE AND SHIFT LEVER
815143 "D"	1.243"	WHEN ONE IS IN NEUTRAL AND
822238 "E"	1.263"	THE OTHER IN GEAR
822239 "F"	1.267"	



NOTE: Coat each spiral pin with EC847 before installation.

6. Install shifter arms to shifter levers.

Reverse Idler Gear

Assemble the reverse idler gear, shaft, and thrust washer as shown in Figure 12. Select one of the following thrust washers to give .005" to .017" (0.13 to 0.43 mm) clearance: 815150 - .024" (0.61 mm), 815154 - .036" (0.91 mm) or 816503 - .048" (1.22 mm). The thrust washer is keyed to the case by a tab. A notch in the case is provided to accept this tab.

Cluster Gear Assembly

Insert countershaft into cluster gear assembly (slot in end of shaft is next to low and reverse gear). Select 815154 or 816503 thrust washer and install on the counter shaft at the rear of the cluster gear. Select 815150 or 815154 thrust washer and install on the countershaft at the front of the cluster gear. The selection of the thrust washer is to satisfy clearance and location of cluster gear.

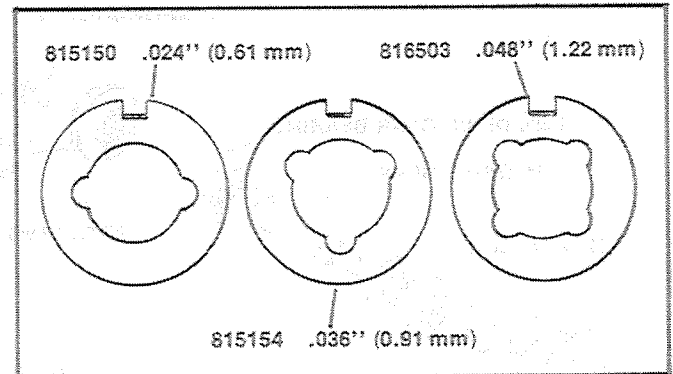


FIGURE 11

The clearance for this assembly is specified in Figure 13. The thrust washer is keyed to the case by a protruding tab. A notch in one of the case halves is provided to accept this tab. Locate tab as illustrated in Figure 14.

Assembly of Synchronizer Unit

The synchronizer unit assembly consists of the following:

- 1 - Second and high clutch hub
- 1 - Second and high clutch sleeve
- 3 - Shifting plates
- 2 - Synchronizer springs

Assemble as illustrated in Figure 15.

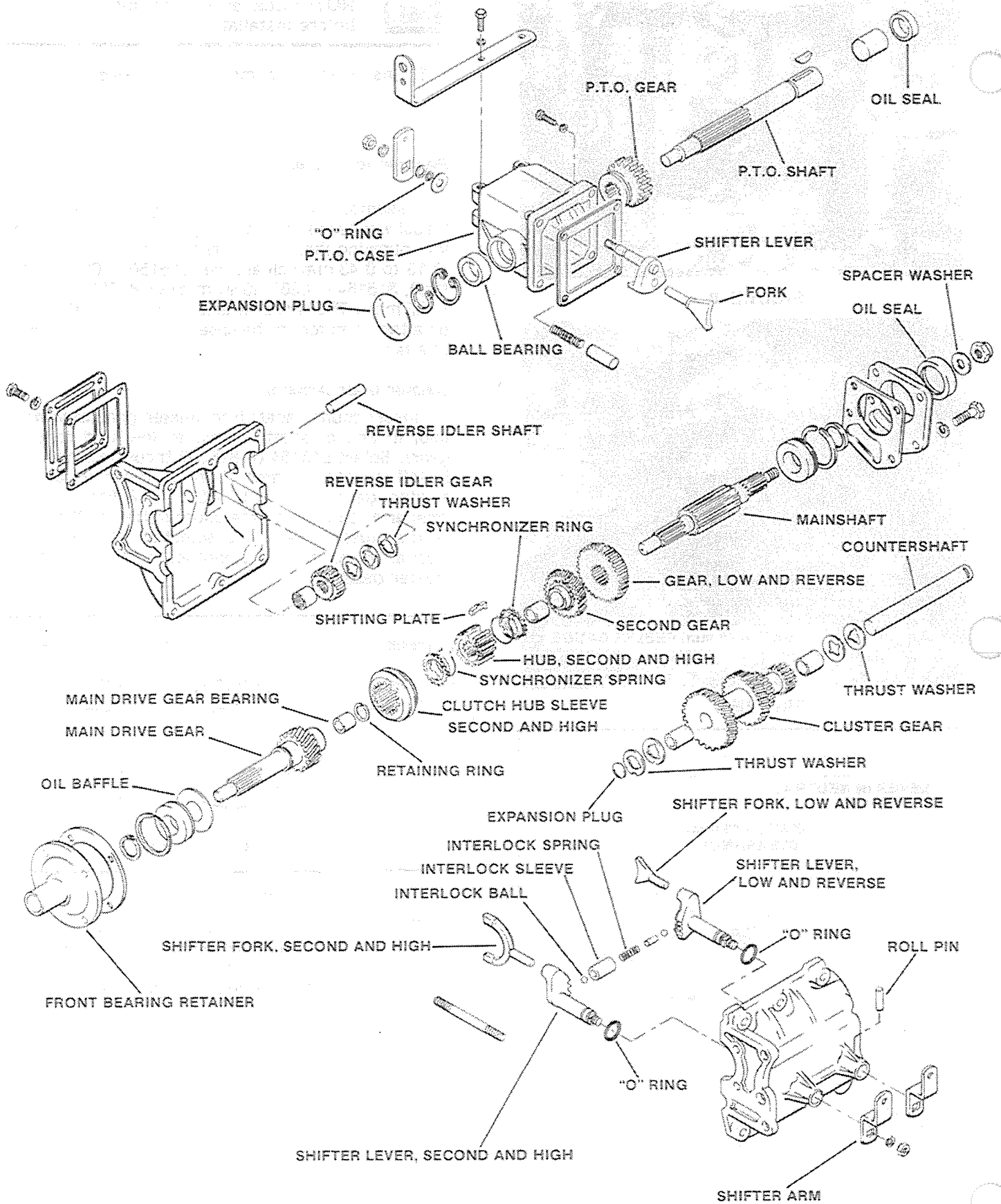
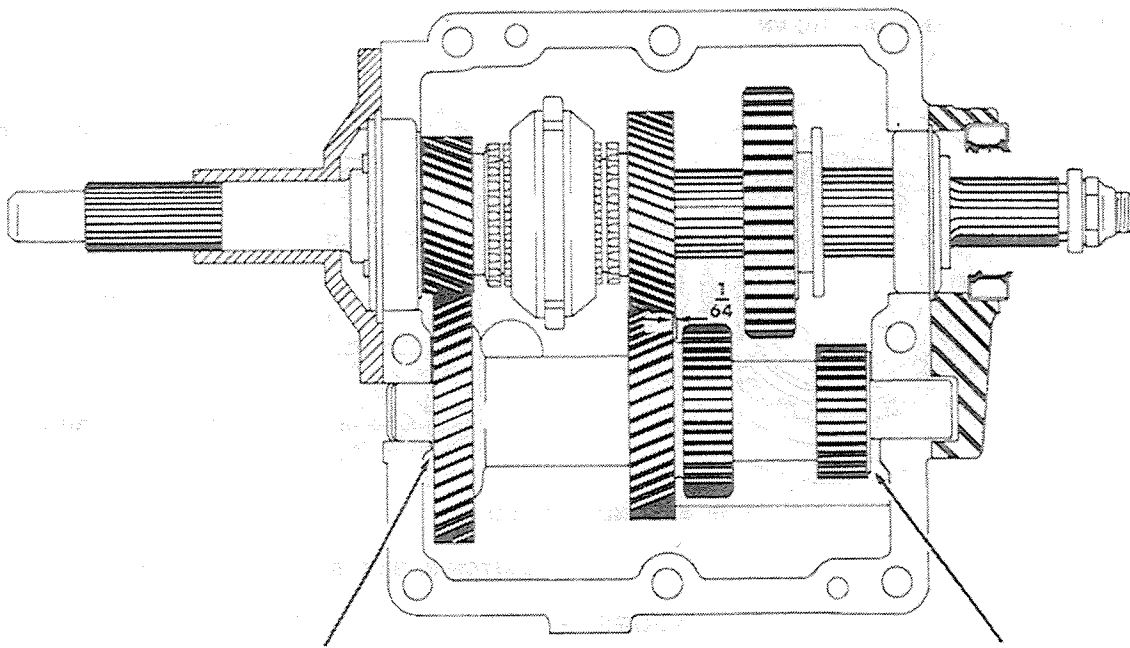


FIGURE 12

8



SELECT WASHER TO LOCATE CLUSTER GEAR TO DIMENSION SHOWN AT SECOND GEAR.

USE 815154 AND 816503 AS REQUIRED TO GIVE .005" TO .017" (0.13 to 0.43 mm) CLEARANCE

FIGURE 13

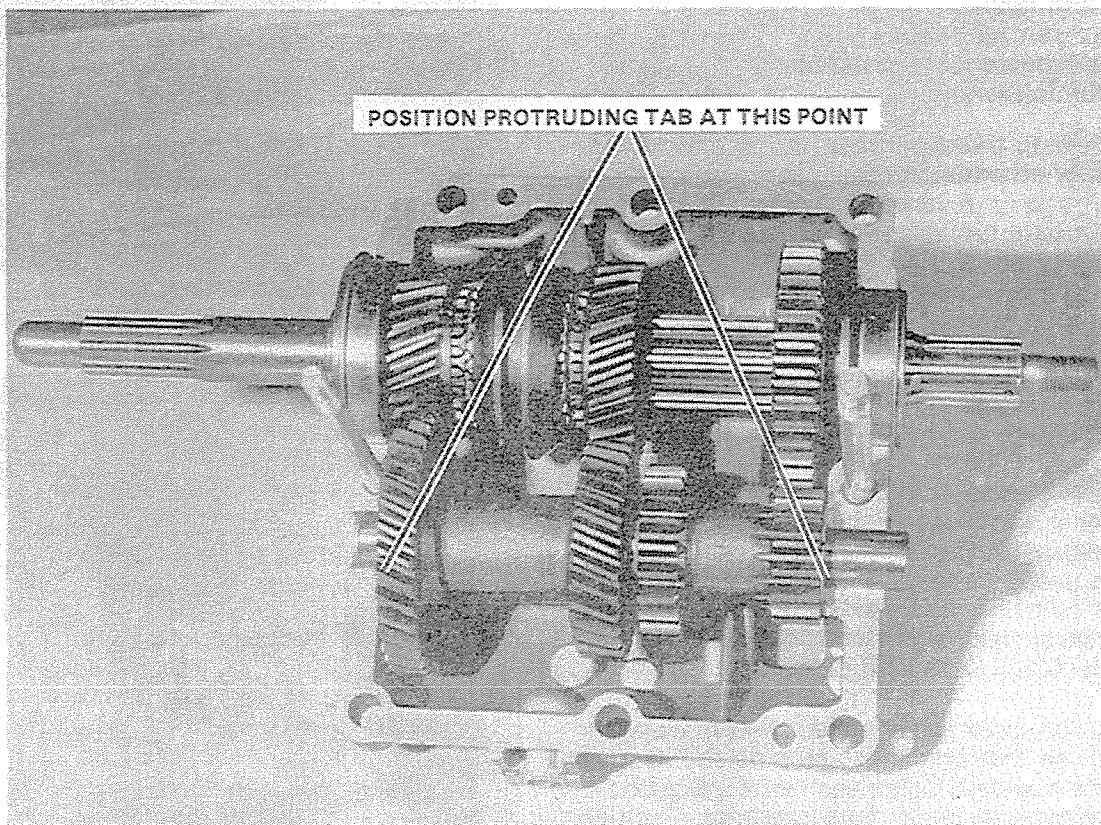


FIGURE 14

END OF EACH SPRING TO BE ASSEMBLED IN SAME SHIFTING PLATE WITH FREE ENDS AS SHOWN.

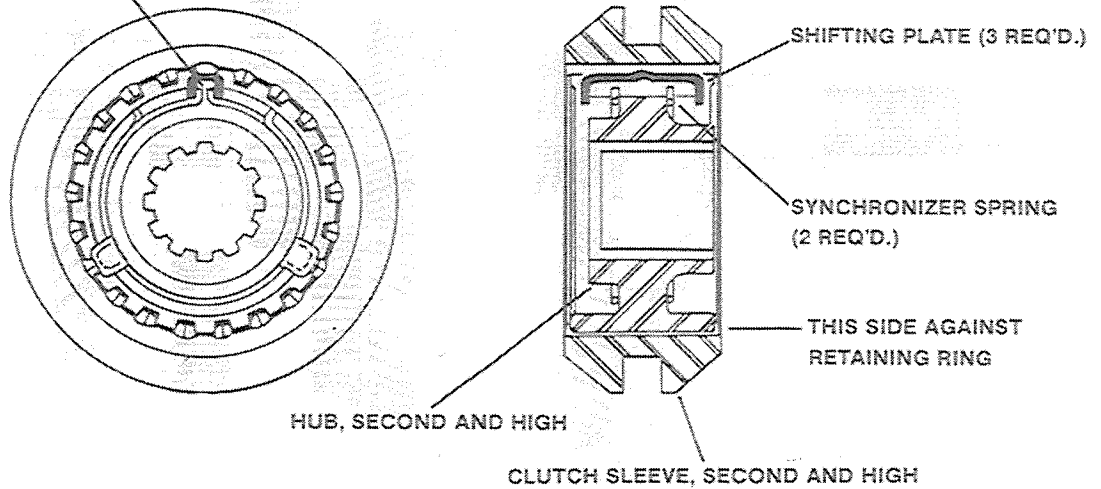


FIGURE 15

Main Shaft

Press ball bearing onto main shaft. Assemble to the main shaft the following parts (in sequence illustrated in Figure 12);

- Low and reverse gear
- Second gear
- Synchronizer ring
- Synchronizer unit assembly
- Retaining ring

After installing these parts on the main shaft, the second gear assembly must be free turning on the shaft. Low and reverse gear must be free sliding on the external spline of the main shaft. Lubricate synchronizer unit parts with engine oil. Press ball bearings onto main drive gear assembly with oil slinger between shoulder of main drive gear and ball bearing. Press caged needle bearings into end of shaft. Install synchronizer ring. Assemble main shaft to main drive gear assembly. Install the assembly into the transmission half.

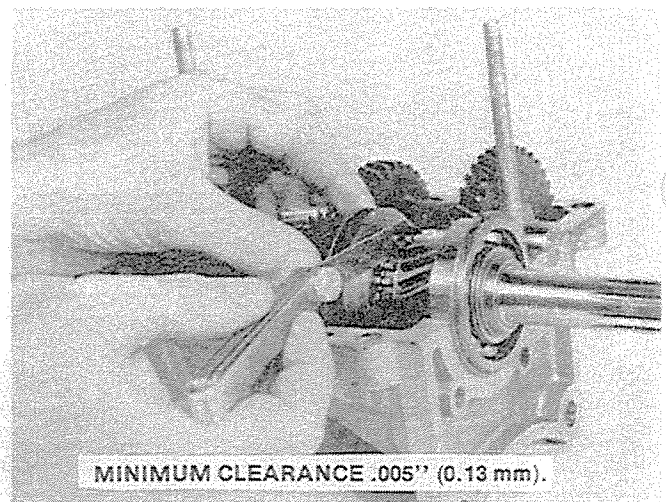


FIGURE 16

8

1. Check clearance between bronze synchronizer ring (both rings should be checked) and gear. Although transmission will function properly as long as there is clearance at this point, it is advisable to replace the synchronizer rings if the clearance is less than .005" (0.13 mm). Figure 16.
2. Position counter shaft and reverse idler shaft so that end slots are outside the rear of the case and facing each other. Figure 17. Lubricate all gears and bearings. Position shifter forks as shown in Figure 18.

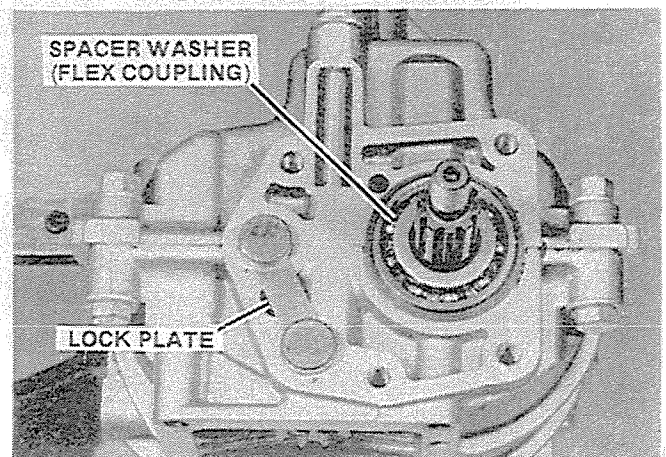


FIGURE 17

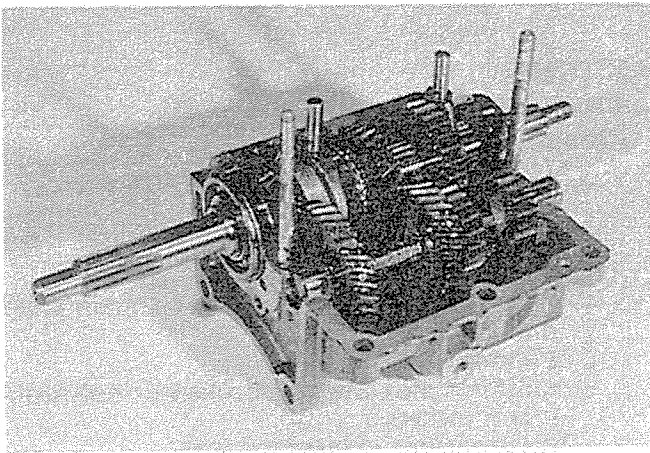


FIGURE 18

3. Place a bead of Minnesota Mining Sealer No. EC847 approximately 1/8" (3 mm) wide on one of the transmission halves. After the sealer has been applied, the two transmission halves should be assembled as quickly as possible before the sealer dries. The shifter forks must be guided into their respective levers during assembly of the two halves.
4. Insert two retaining screws and nuts until they lightly compress the lockwasher.
5. Drive in the two tapered locating pins.
6. Install the remaining retaining screws and nuts. Snug up all screws and nuts using a criss-cross pattern starting with the screws next to the locating pins. Use the same procedure for tightening the screws to the recommended torque specifications. Figure 19.
7. After the halves are fastened together, remove the excess sealer from the front and rear machined surfaces. These are gasket surfaces and must be free of sealer.

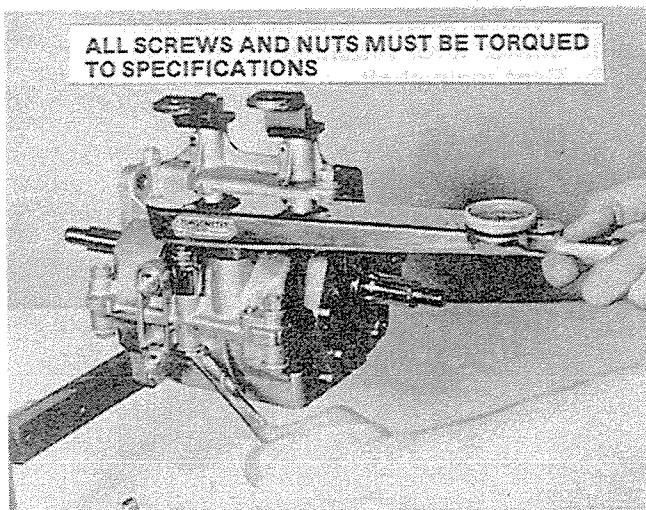


FIGURE 19

8. Install countershaft and reverse idler shaft lockplate, Figure 17. The lockplate must be centered. Do not install rear bearing retainer.
9. Coat expansion plug OD with sealer 3M #EC847. Install in front countershaft hole and set. Rear of countershaft must rest against a flat solid surface so that when expansion plug is being set countershaft will not move.
10. Install front and rear bearing retainers using the proper gaskets. Apply a light coat of Permatex #3 on both sides of the gaskets. Coat the front and rear bearing retainer screws with Permatex #3 before installing. Torque to specifications.
11. Place a small amount of grease between the dual lips of the rear seal. Install coupling or driveshaft carefully so that the oil seal is not injured. Ascertain that spacer washer is installed between the rear bearing and coupling (Figure 17). Use flat washer and special lock nut. Torque to specifications. After the transmission is assembled, less the power take-off or side cover (for visual observation), make the following checks:

With the transmission in neutral, the low and reverse sliding gear must be centered between the low gear on the cluster and the reverse idler gear.

With the transmission in neutral, the main shaft and main drive gear shaft must turn freely.

Shift into gear (reverse, low, second and high).

When in gear, the transmission must drive through without binding. Check to make certain the transmission cannot be shifted into two gears at the same time by attempting to move both control levers out of neutral position simultaneously or by attempting to move one control lever when the other control lever is shifted into gear.

12. Using Permatex #3 on the threads of one screw ONLY (Figure 3) and 3M #EC847 sealer on the gasket surfaces, install power take-off unit or side cover, whichever the case may be. Tighten to proper torque specifications.

IMPORTANT: When power take-off assembly is used in conjunction with this transmission, use .003 to .005" (0.08 to 0.13 mm) thick gasket. When the side cover is used, use 1/16" (1.59 mm) thick gasket.

TROUBLESHOOTING

Leaks Oil

1. Oil level too high
2. Oil too thin
3. Low grade oil—oil foams excessively
4. Leakage at rear oil seal because of wear or loose bearing
5. Drain and/or filler plug damaged or loose
6. Crack in transmission case
7. Shifter lever "O" rings damaged or worn or installed in wrong groove
8. Power take-off or opening cover loose or gasket damaged
9. Power take-off case or opening cover retaining screw (upper front) will leak if improperly sealed or has not been sealed.
10. Leak between case halves due to improper sealer or marred mating surfaces or unmatched case halves
11. Oil return passage in front bearing retainer clogged
12. Front or rear bearing retainer loose or gasket damaged
13. Expansion plugs in front of transmission damaged or improperly installed
14. Insufficient amount of sealer on spirol pins.

Slips Out of Low or Reverse

1. Shifter linkage travel incomplete due to excessive wear or need of adjustment
2. Interlock spring is weak or broken
3. Interlock ball broken, worn or stuck
4. Notches on shifter lever worn
5. Shifter fork worn
6. Shifter lever retaining pin broken
7. Worn low and reverse sliding gear

Slips Out of Second Only

1. Second speed gears worn
2. Synchronizer ring teeth that engage second gear are worn

Gears Clash When Shifted

1. Misalignment between transmission and clutch housing
2. Dragging clutch
3. Synchronizer rings worn or damaged
4. Second and high hub loose on main shaft due to wear
5. Lubricant too heavy
6. Shifter plates worn or broken or not properly installed
7. Synchronizer springs broken
8. Oil level too low

Slips Out of Second or High

1. Shifter linkage travel incomplete due to excessive wear or need of adjustment
2. End play in main shaft and main gear assembly due to loose front and/or rear bearing retainers or worn bearing housing "case"
3. Clutch teeth of main drive gear and/or the second speed gear worn
4. Splines on second and high hubs worn
5. Main shaft splines worn
6. Main drive gear and/or main shaft bearings worn
7. Snap ring that holds clutch sleeve in place broken
8. Shifter fork worn
9. Interlock spring weak or broken. Interlock ball worn or broken. Notches on shifter lever worn.
10. "Clutch plate" pilot bearing worn
11. Shifter lever retaining pin broken
12. Bent main shaft

POWER TAKE-OFF ASSEMBLY

Drain oil from transmission and remove power take-off assembly.

Disassembly

1. Remove expansion plug from front of assembly.
2. Remove snap ring from PTO shaft. See Figure 20.

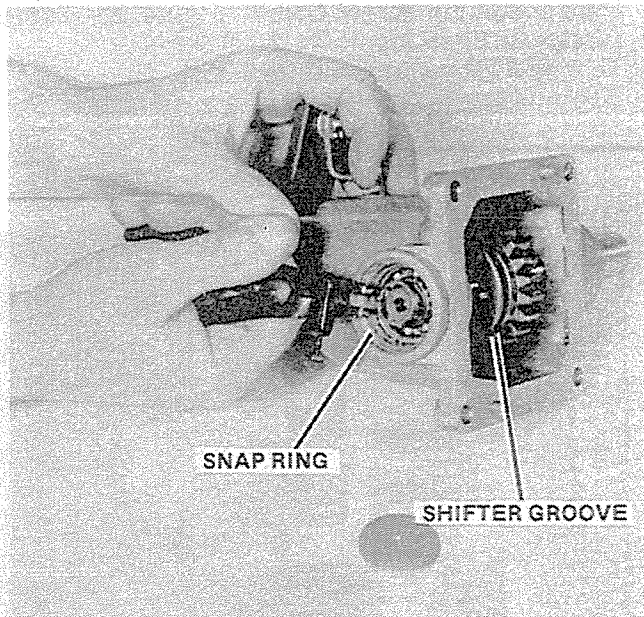


FIGURE 20

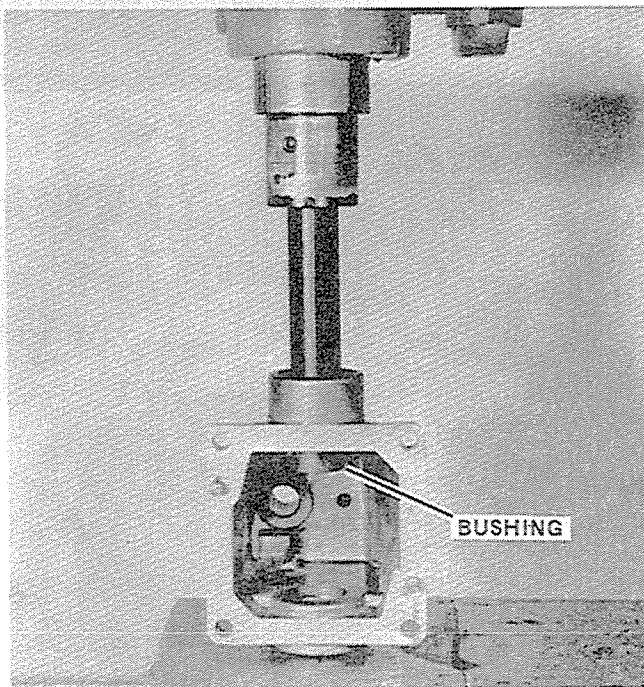


Figure 21

3. Remove PTO shaft, gear and shifter fork from case.
4. Remove shifter arm from shifter lever.
5. The shifter lever, shifter lever shim, interlock button and interlock spring may now be removed from the case.

PTO Case

1. Wash case with solvent and inspect for any cracks, marred or uneven mating surfaces.
2. Remove oil seal.
3. Check bearing and replace if necessary.
4. Measure the inside diameter of the rear PTO shaft bushing. The correct measurement is .9394 to .9374" (23.86 to 23.80 mm). If worn, it must be removed with a press (Figure 21) and a new bushing installed. It is not necessary to ream a new bushing to size.

Assembly of Power Take-Off

Regardless of appearance, all gaskets, "O" rings and oil seals should be replaced.

Reverse the order of the foregoing procedure to assemble the power take-off assembly, observing the following:

1. Shifter lever shim, Part No. 812419, is installed between shifter lever and inside of case.
2. Shifter lever end play is .005 to .030" (0.13 to 0.76 mm). Use one or two shims, Part No. 805307, between outside of case and shifter arm to achieve this end play.
3. Shifter groove of PTO gear should face front of case. See Figure 20.
4. Place a small amount of grease on the lips of the oil seal before installing PTO shaft.
5. Coat expansion plug OD with 3M #EC847 sealer before setting plug.

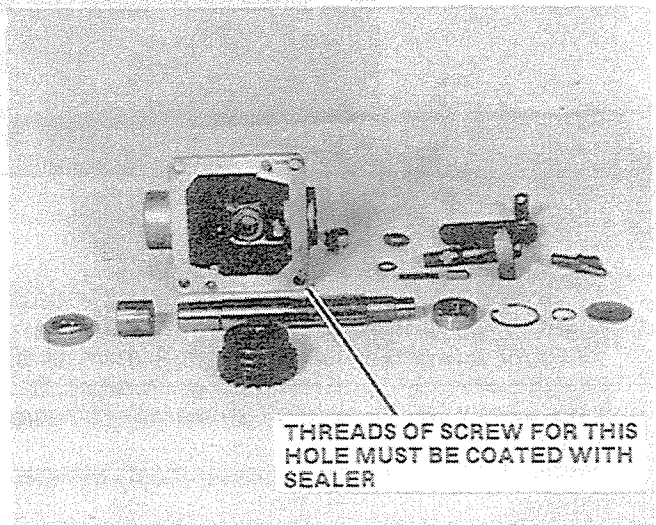


Figure 22

Installing Power Take-Off Assembly to Transmission



NOTE: If, before overhaul of assembly, foreign matter or metal particles were found in case, the transmission also must be flushed and checked for foreign matter.

Coat the gasket surfaces of the PTO assembly and transmission with 3M #EC847 sealer.

Install PTO assembly to transmission with paper gasket .003-.005" (0.08-0.13 mm) thick.



NOTE: The clearance or mesh between the PTO gear and the reverse idler gear of the transmission is critical, therefore, a thicker sealer than mentioned above should not be used.

Use Permatex No. 3 on threads of the upper front mounting screw ONLY. Figure 20. Torque screws to 10-15 lbs.-ft. (1.2-1.6 N:m).

The PTO reduction ratio 2.45:1.

AUXILIARY TRANSMISSION

Overhaul Procedure

Drain transmission oil.

Remove drive shaft and coupling.

Disconnect shift rod at transmission lever.

Remove shift positioning plug and spring.

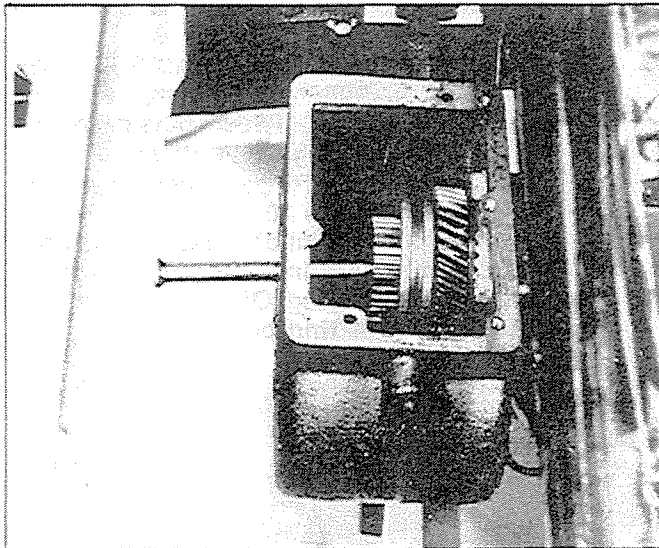


Figure 23

Remove transmission cover assembly.

With the bearing retainer removed, the drive gear and bearing may be pulled from the case.

Remove nut and washer and pull main shaft and shifter collar from differential worm shaft. See Figures 23 and 24. Be sure all shims are removed from the worm shaft.

Remove transmission case from differential housing.

With transmission case on a work bench, remove expansion plugs at each end of the jackshaft. See Figure 25.

Drive out the roll pin retaining the jackshaft in the case and drive jackshaft from case. See Figures 26 and 27.

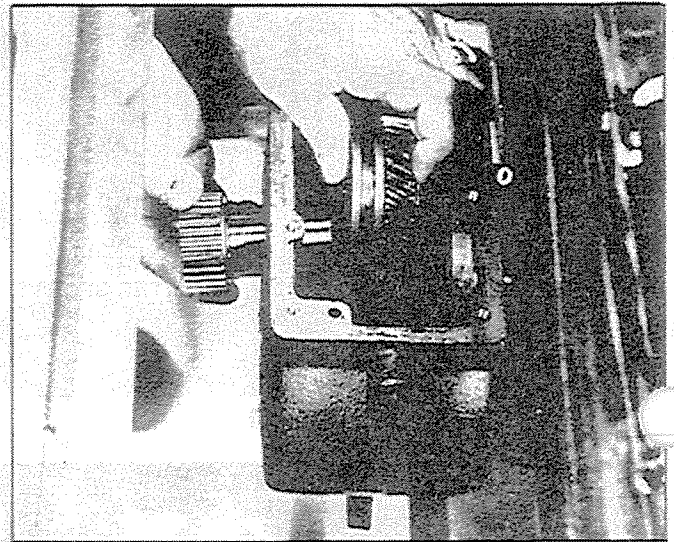


Figure 24

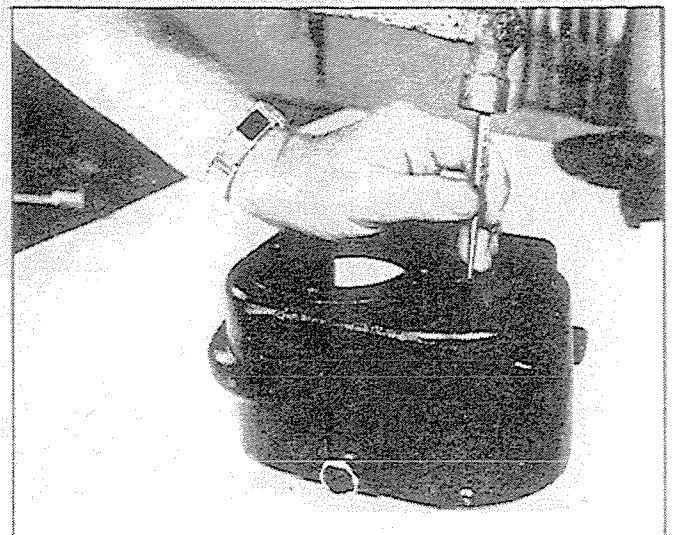


Figure 25

The cluster gear assembly can now be lifted from the case. See Figure 28.

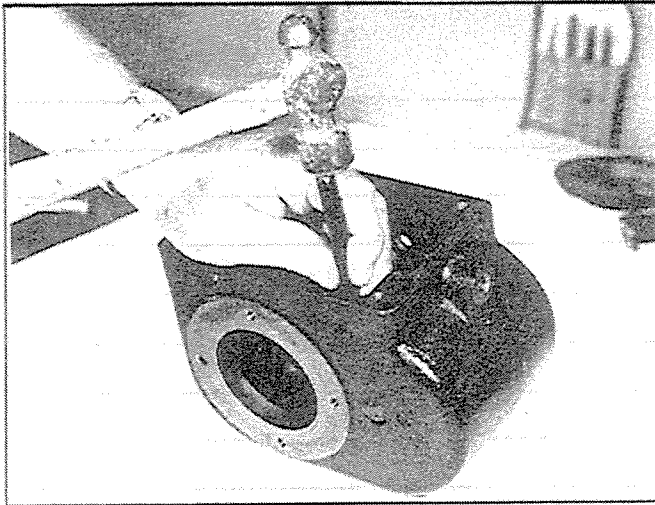


Figure 26

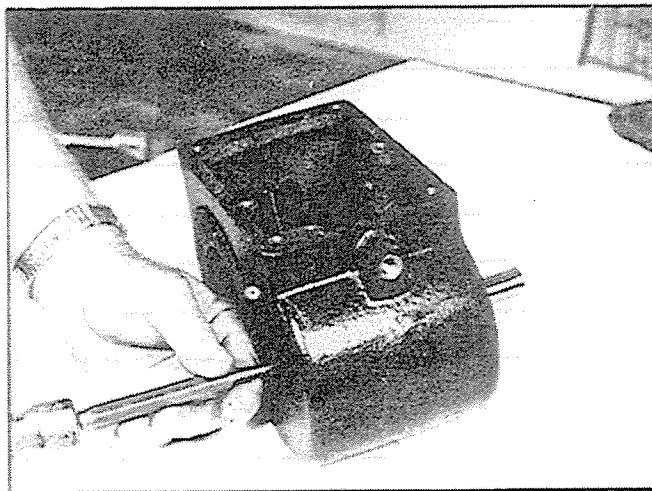


Figure 27

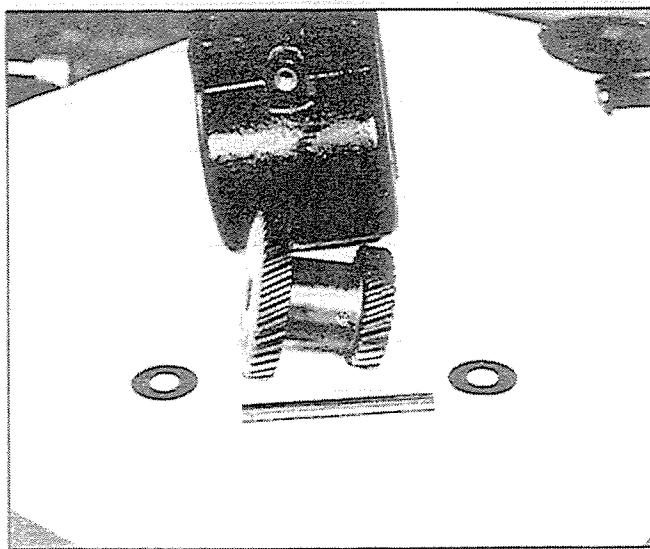


Figure 28

Inspect all parts carefully and replace any that show wear or damage. Never attempt to reuse oil seals or gaskets.

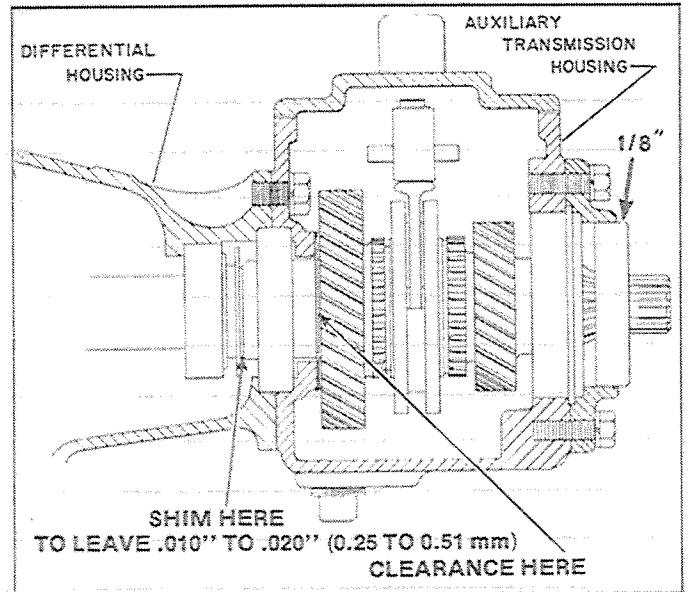


Figure 29

Reassembly

Install cluster gear and jackshaft. Use one shim between cluster gear and rear of case. Install necessary shims between cluster gear and front of case to provide .005" to .032" (0.127 to 0.812 mm) end play. Install expansion plugs.

Mount the transmission case to the differential housing, using the four 3/8" (9.53 mm) cap screws, flat washers and new copper gaskets. Be sure the pinion flange gasket is in position. Tighten screws to 20-25 lbs. ft. (27-34 N:m) torque.

Install sufficient shims over the worm shaft, behind the driven gear to allow .010" to .020" (0.25 to 0.51 mm) clearance between the driven gear and the brass thrust washer when the worm shaft nut has been securely tightened (Figure 29). This can best be accomplished by installing approximately .070" (1.78 mm) shims. Tighten the worm nut securely and measure the distance between the gear and brass thrust washer; then removing sufficient shims to acquire the proper clearance. This will eliminate the necessity of several installation and removing operations to acquire the desired clearance. Install shifter collar on main shaft prior to final installation as this collar cannot be installed after the worm nut has been torqued. Worm shaft nut must be tightened to 40-45 lbs. ft. (54-60 N:m) torque.

Install new oil seal in retainer. See Figure 29 for proper position.

Install the drive gear assembly and the oil seal retainer. Be sure the gasket is in position and the cap screws are tight.

Install the transmission cover and gasket. Be sure the shifter fork is seated in the shifter collar groove.

Install the shifter positioning button, spring and adjusting screws.

Install the drive shaft and coupling.

Connect shift rod to transmission.

NOTES

8

SECTION 9 DIFFERENTIAL

Worm Gear Differential

1. Remove the eight nuts and lockwashers (four on each end of axle housing), which secure the axle seal retainers and brake dust shields, then remove axle seal retainers, brake dust shields, endplay shims and gaskets. Keep shims in their respective positions for reassembly.
2. Remove both axle shafts. A slide-hammer puller, Figure 1, may be needed.

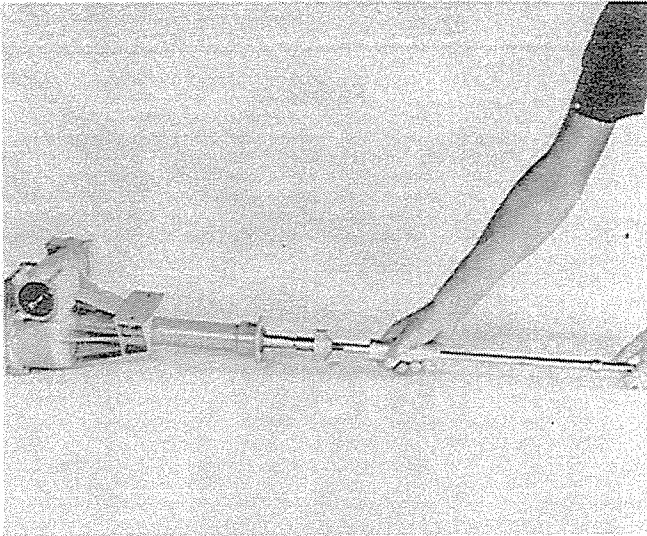


Figure 1

3. Inspect wheel bearings and replace if necessary.
4. Clamp differential in vise or holding fixture with the small half up. Remove the six nuts and bolts that hold the axle housing halves together.
5. Separate the housing halves, by tapping with a mallet to break the sealer bond.
6. The complete differential carrier may now be lifted from the lower axle housing.
7. Remove the inner wheel bearing seals from both housing halves.
8. Using a suitable bearing puller, remove the two bearings from the carrier. Figure 2. Flatten the tops of the three lock plates and remove the six screws that hold the worm gear to the differential carrier.
9. Using a piece of chalk, mark the position of the planet gears on the differential carrier housing as illustrated in Figure 3.
10. Remove the two screws that hold the planet shaft retainers in place.
11. Remove the two planet shaft retainers, four planet gear shafts, four planet gears, two axle gears, four spacers and the axle end-play spacer from the differential carrier housing. **DO NOT REMOVE THE WORM GEAR FROM THE DIFFERENTIAL CARRIER HOUSING AT THIS POINT.**

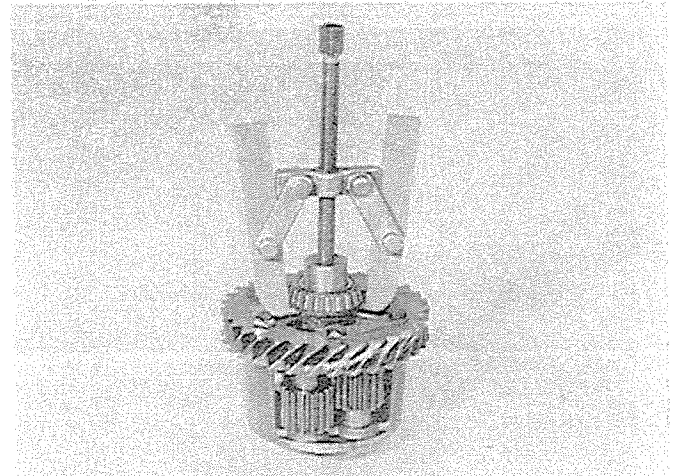


Figure 2

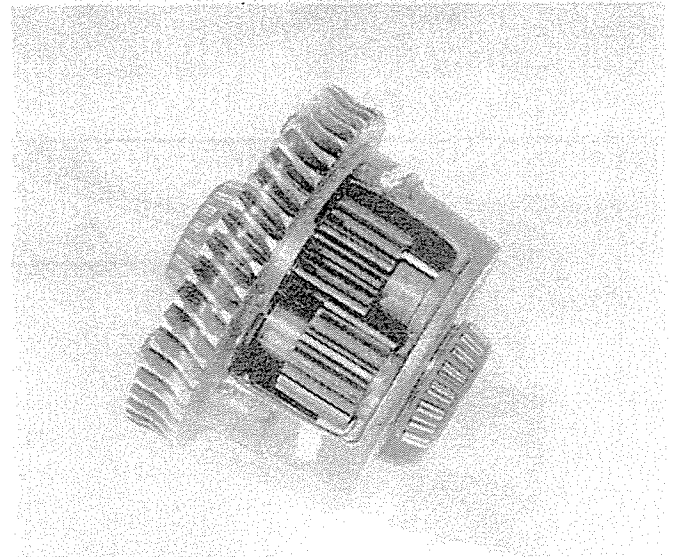


Figure 3

12. Remove the four screws holding the worm bearing retainer, shims and gaskets from the axle housing.
13. The worm may now be removed from the housing.
14. Remove the two bearings and the oil slinger from the worm. Two clearance notches may be cut in the oil slinger to provide clearance for a bearing puller. Figure 4. Note which way the oil slinger is curved.
15. Thoroughly wash all parts in a clean solvent.
16. Do not remove bearing cups at this time.

Replacing Differential Carrier

Instructions for using Surface Locator:
Following is the proper procedure for checking the distance between A and B: All measurements must be recorded.

Set-up surface locator, Part No. 880028, as illustrated in Figure 5. Using a micrometer measure the distance from the B side of the worm gear to the A side of the surface locator, Figure 6.

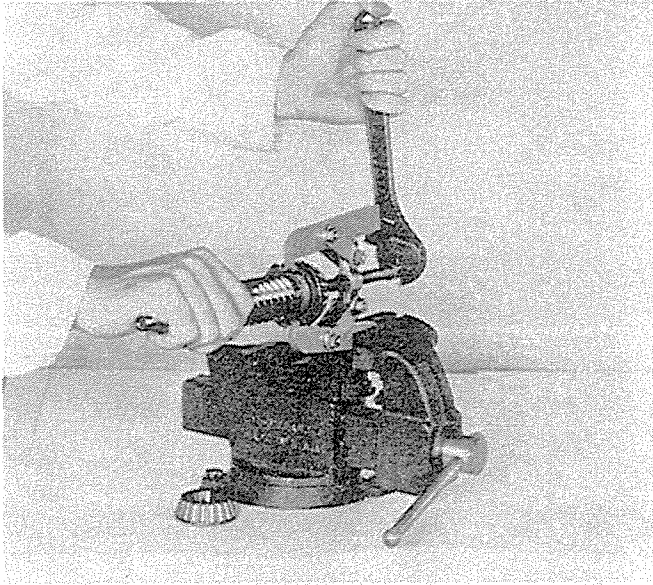


Figure 4

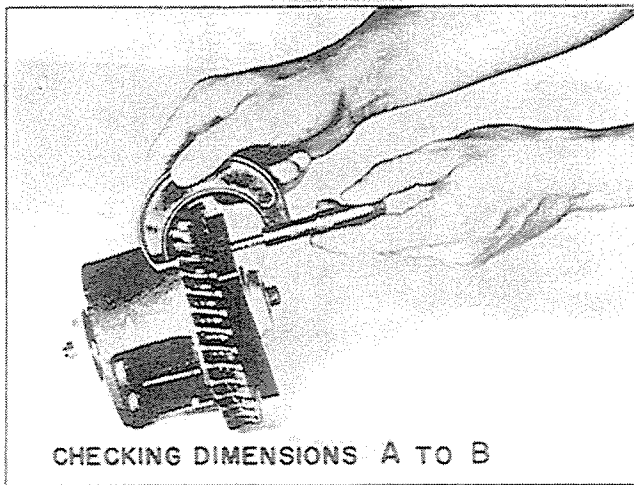


Figure 5

Following is the proper procedure for determining the distance between A and E:

Set-up surface locator, Part No. 880028, as illustrated in Figure 7. Using a micrometer measure the distance between the E side of the differential carrier and the A side of the surface locator, Figure 6.

1. Using surface locator, Part No. 880028, measure from point A to B on old carrier.
2. Check same dimensions on new carrier.
3. Using surface locator, Part No. 880028, measure from point A to E on old carrier.
4. Check same dimensions on new carrier.
5. If the dimensions A to B and A to E are the same on both carriers then the new carrier assembly will fit into the axle housing with no shim changes.

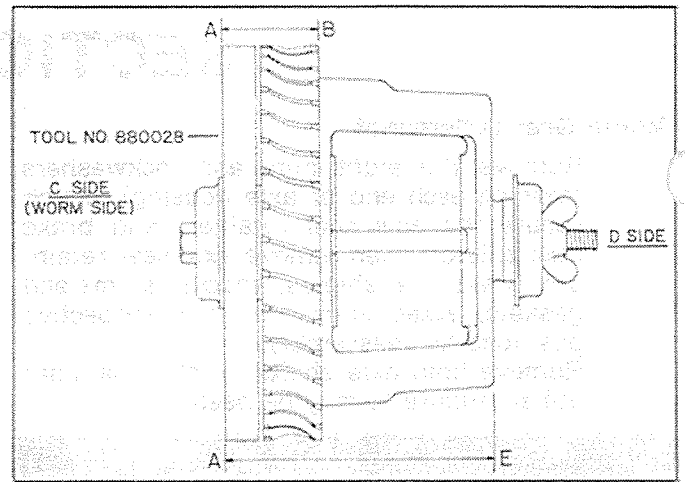


Figure 6

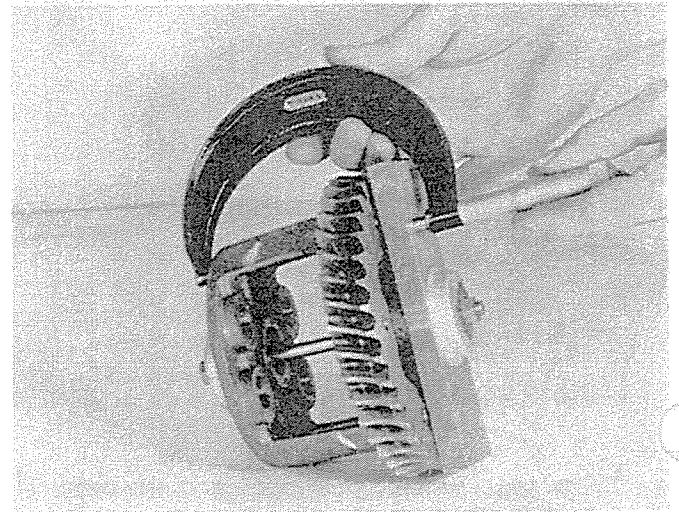


Figure 7

Shim Adjustment

1. If the dimension A to B is less on the new carrier, shims equal to the difference should be removed from the D side housing and added to the C side. Figure 9.
2. If the dimension A to B is greater on the new carrier, shims equal to the difference should be removed from the C side and added to the D side.
3. If the dimension between A to E on the new carrier is less, shims totaling the difference between the two must be added to the D side.
4. If the dimension A to E on the new carrier is greater, remove shims equal to the difference from the D side ONLY and discard.

Worm Gear Replacement

After all dimensions of the differential carrier have been measured and checked, the worm gear may be removed from the carrier housing using a press.

If shim adjustment is necessary, remove bearing cup and shims from the axle housing using a bearing cup puller. Figure 8. Lay on table as shown in Figure 9, so that they will not be mixed, noting which is the C side and which is the D side.

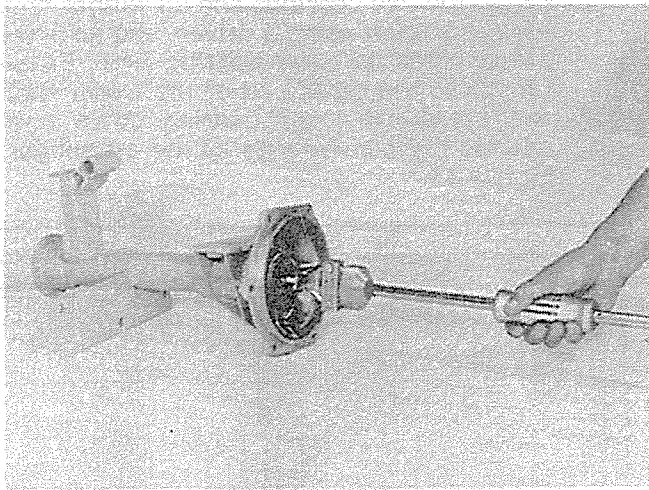


Figure 8

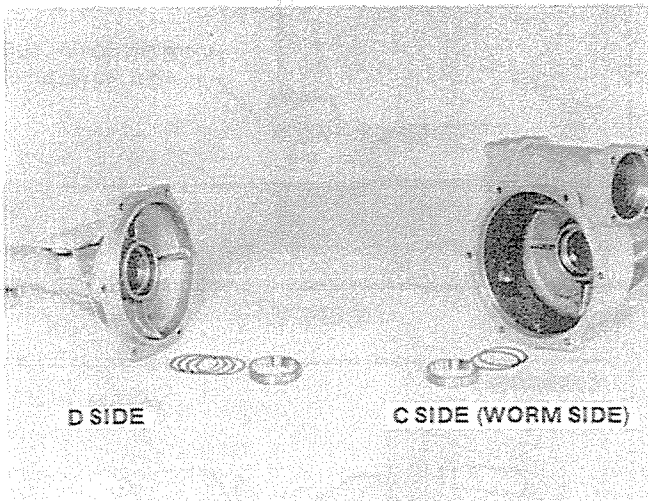


Figure 9

Before reinstalling cups, remove any burrs from the ridge of the axle housing where the cup is to bottom. These burrs may have accidentally been created when removing the cups. Shims that are to be added or replaced should not be damaged. When installing either of the two carrier bearing cups, a driver should be used. Figure 10.

Installation of a New Worm Gear

1. Heat the bronze worm gear in an oven (do not use an open flame) to 300° F (150° C).
2. With the differential carrier housing in an upright position, set the heated worm gear onto the differential carrier housing with the chamfered side of the gear down. Numbers stamped on the gear should show. Be sure that the worm gear is seated square and even against the carrier flange. Allow to air cool after assembly.

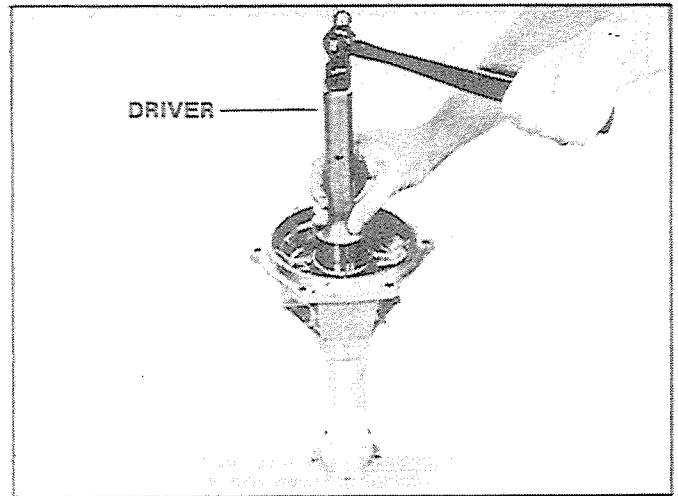


Figure 10



NOTE: Do not press the worm gear into place. If it does not drop on, it has not been heated sufficiently or there is a burr or other obstruction on the gear or housing.

3. Center punch six marks on the line that divides the worm gear from the carrier housing. See Figure 11 for location of center punch marks.
4. Rigidly attach differential carrier housing to the base plate of a drill press. It is very important that the flat of the worm gear is perpendicular to the chuck shaft of the drill press.
5. The holes that are to be drilled into the differential carrier and worm gear should be 5/16" in diameter and 1-3/4" deep. After each hole is drilled and before differential carrier is moved to the next hole, remove the 5/16" bit from the drill press chuck and install in its place a 3/8-16 U.N.C. tap. Tap the hole 1-1/2" deep. This will insure a perfectly straight tapped hole. **WHEN TAPPING, TURN THE PRESS CHUCK OR TAP BY HAND; DO NOT USE POWER.** Figure 12. Repeat this procedure until all holes are drilled and tapped.
6. Thoroughly wash the differential carrier housing and worm gear in a clean solvent.
7. Place the three lock plates in position, each covering two holes, and screw the Part No. 816812, screws, into the differential carrier housing and worm gear.



NOTE: Part No. 816812 is a special machined screw. Do not substitute standard hardware in its place.

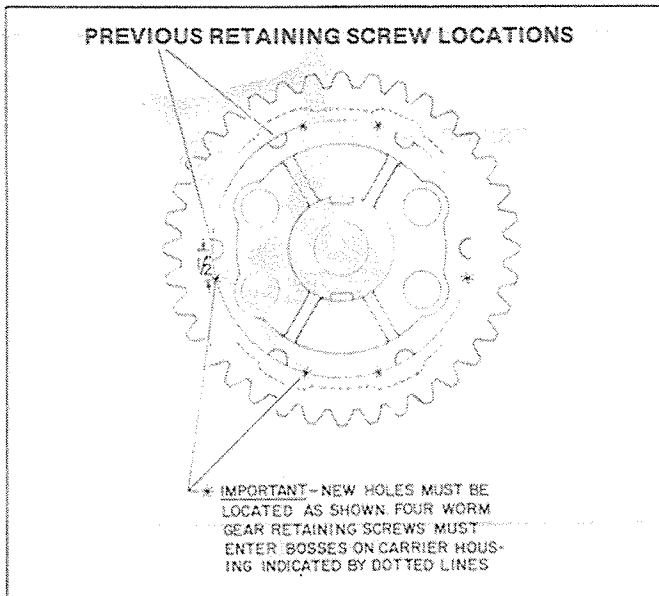


Figure 11

It will be necessary to modify one of the lock plates due to the fact that the distance between two of the retaining screws is now different than originally. Tighten screws to 38-45 lbs. ft. (52-60 N:m). Bend corners of lock plates against flats and over top of bolt heads.

8. Install the planet gears and shafts into the differential housing, being sure that the planet gears are aligned with the chalk marks that were marked opposite the gears before the assemblies were removed. Clean the two 5/16" (7.94 mm) screws that hold the planet shaft retainers and treat with Lock-Tite Sealant, Grade D. Install the lock plates and tighten to 20 to 25 lbs. ft. (27 to 34 N:m).

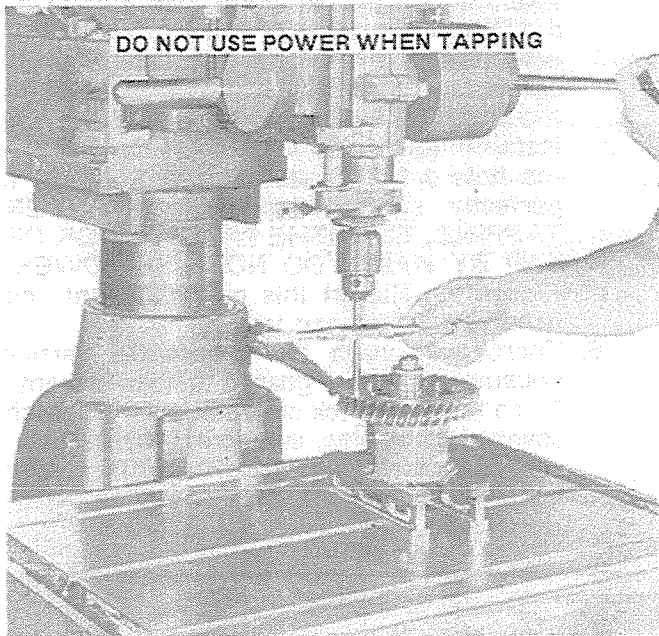


Figure 12

Installation and Repair of Worm

1. Clean the bearings in a cleaning solvent. Inspect bearings and cups for any damage or blue marks indicating overheating and softening of the bearing.
2. Install the two bearings and oil slinger onto the worm shaft using a driver, and an arbor press, press on outer bearing first. Fit oil slinger to the other end of the worm shaft and press the inner bearing down tight against the convex side of the oil slinger. Figure 13.

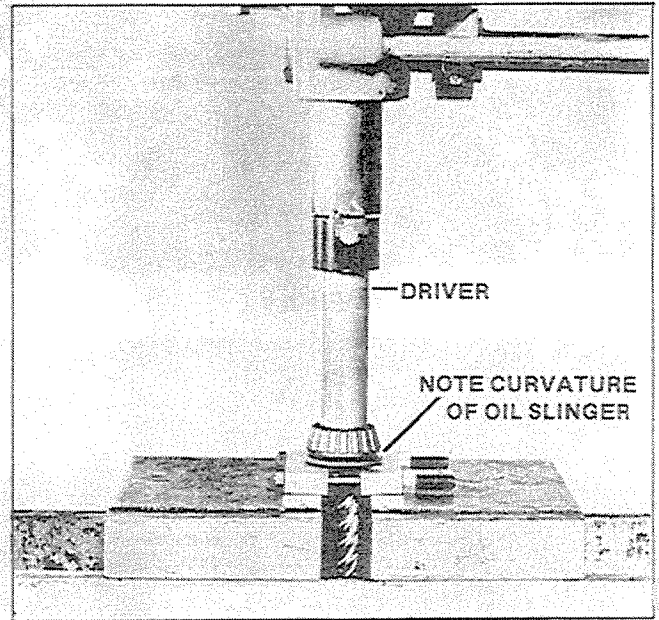


Figure 13

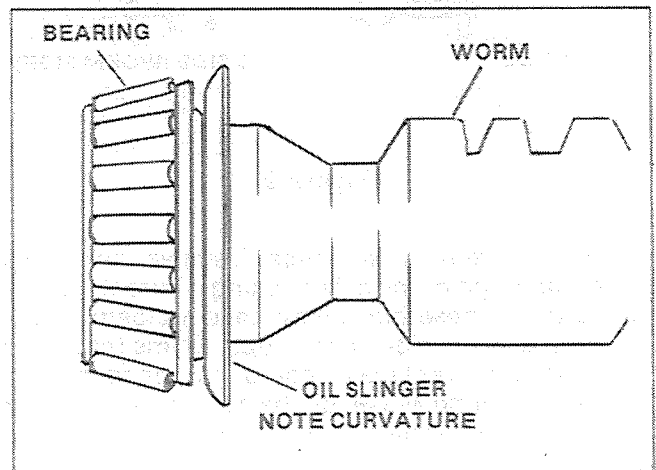


Figure 14

3. If it is necessary to replace the worm shaft bearing cups, first drive out the 2-3/8" diameter expansion plug located at the rear of the axle housing. The cup that is pressed into the rear of the axle housing can now be removed using a brass drift and hammer. The same method can be used to remove the cup from the worm bearing retainer.

4. Before either cup is replaced, it is imperative that all mating surfaces be checked for burrs, nicks and mars that would interfere with the proper seating of the cup.
5. The worm bearing cups are installed by using a bearing cup driver as shown in Figure 15.
6. Install worm shaft assembly (oil slinger end first) into axle housing half.
7. Insert the worm bearing retainer, over worm shaft, into housing opening, using shim pack and two or more gaskets (with minimum of one on each side of shim pack).

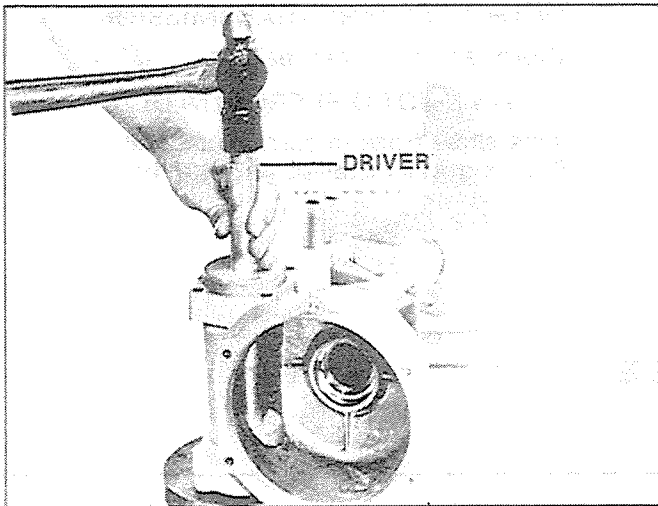


Figure 15



NOTE: Do not lubricate bearings until preload and endplay adjustments have been made.

The worm shaft assembly must be shimmed to obtain zero end play to a preload of 5 lbs. in. (0.6 N:m).

Endplay must be checked with a dial indicator. See Figure 16. Preload must be checked by attaching an in.-lbs. torque wrench. See Figure 17. The endplay and preload must be checked and determined with only the worm assembly in the axle housing half. The 3/8-16 threaded retaining screws must be drawn up equally and tightened to 20 to 25 lbs. ft. (27 to 34 N:m) torque.

Apply sealant, Part No. 112008, to edge of expansion plug and install into axle housing.

Use SAE 30 oil to lubricate the bearings and planet gears of the differential carrier. Install the carrier into the differential case.

Apply sealant, Part No. 112008, to the small housing half and fit housing halves together. Tighten screws to 12 to 15 lbs. ft. (16 to 20 N:m) torque. Under one of the screws, install the nameplate that designates the proper gear ratio.

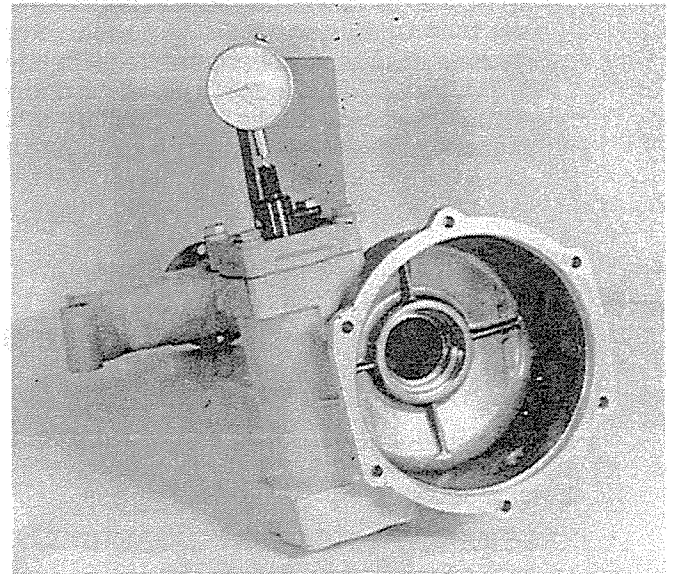


Figure 16

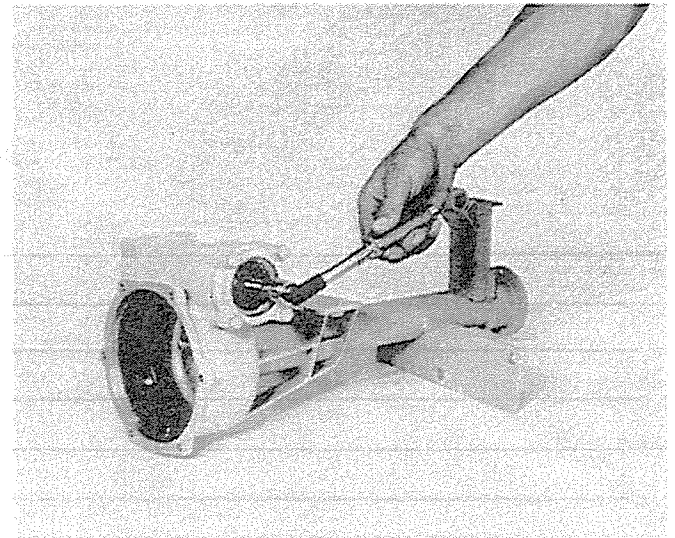


Figure 17

Installation of Axles into Housings and Adjustment

1. Install axle seals in the ends of axle housing using a seal driver.
2. Press axle bearing cones onto both axles. Be sure the bearing seats against the collar on the axle.
3. Pack axle bearing cones to fill all voids around rollers with lithium base pressure gun grease, also apply small amount of grease to lip axle seals.
4. Insert axle shaft into housing and place bearing cup in position over bearing cone.
5. Drive bearing cups into position.
6. The axle shaft endplay and bearing adjustment is controlled by shims located between the wheel bearing retainer or brake dust shield and the flange of the axle housing.
7. To check axle endplay, install the wheel bearing retainers or brake dust shields,

shim packs, gaskets and seal retainers with seals, then tighten securely. Tap the end of each axle with a soft hammer to seat the bearing cup. The amount of shaft endplay can then be determined by using a dial indicator. The endplay of each axle shaft

must be .001" (0.03 mm) minimum, with the sum total endplay of both axle shafts not to exceed .010" (0.25 mm).
When holding one axle shaft, and turning the other, overall torque should not exceed 13 lbs. ft. (17.5 N:m).

TROUBLESHOOTING

NOISE UNDER POWER

1. Worm shaft bearing bad or adjusted too tight
2. Low oil level

NOISE WHEN VEHICLE IS COASTING

1. Worm shaft bearing adjusted too loose
2. Low oil level

HIGH OIL LEVEL IN DIFFERENTIAL WITH AUXILIARY TRANSMISSION

1. Worm shaft oil seal leaking

WILL NOT DIFFERENTIATE

1. Axle shaft froze in carrier housing
2. Planet gears installed improperly

NOTES

SECTION 10 STEERING

STEERING GEAR SERVICE

DISASSEMBLY

With the horn wire disconnected, remove the horn button and lift wire from the pinion shaft.

Remove the steering wheel retaining nut and lift the wheel from the shaft.

Remove the top idler bolt nut and washer and the gear case retaining screws. The case may now be lifted off.

Remove the driven gear nut. The gear may now be removed by the use of a 1/2 x 20 knockoff.

Remove the lower idler bolt nut and washer and lift the cluster gear and idler bolt from the lower case.

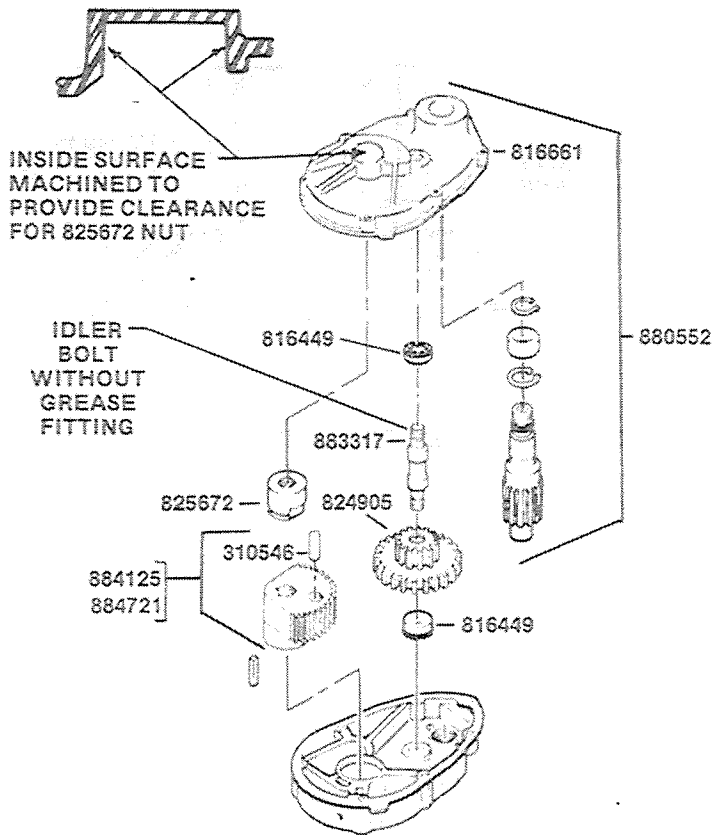
Both styles of steering gears are illustrated for identification and assembly sequence. Refer to reassembly section for "NEW DESIGN GEARS" or "ORIGINAL DESIGN GEARS". Figures 1 and 2.



SAFETY WARNING: Some components of the steering gear on 1979 models are different from other models which also require a different assembly sequence. Be sure to correctly identify which style of gear is being serviced and refer to that section of the instructions. Incorrect parts or assembly procedures can cause failure of the steering gear.

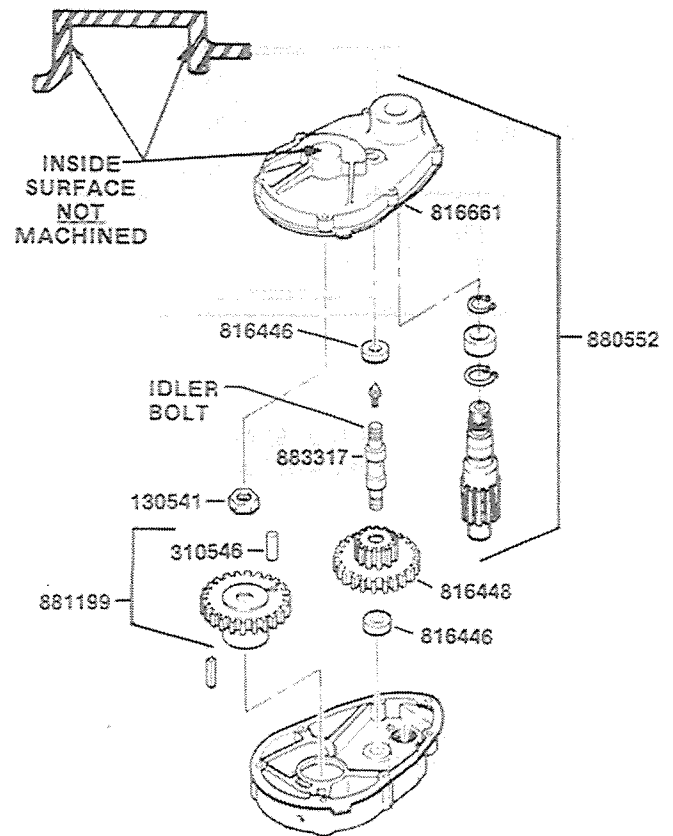


SAFETY WARNING: Inspect all gears and splines for wear or damage. If the wear or damage is excessive, replace with new parts. Also inspect the pinion shaft bearing for wear.



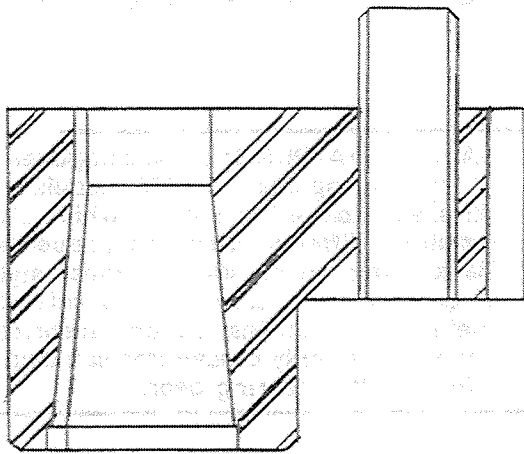
MODEL YEAR
7910 AND 7920
AS INDICATED
"NEW DESIGN GEARS"

FIGURE 1

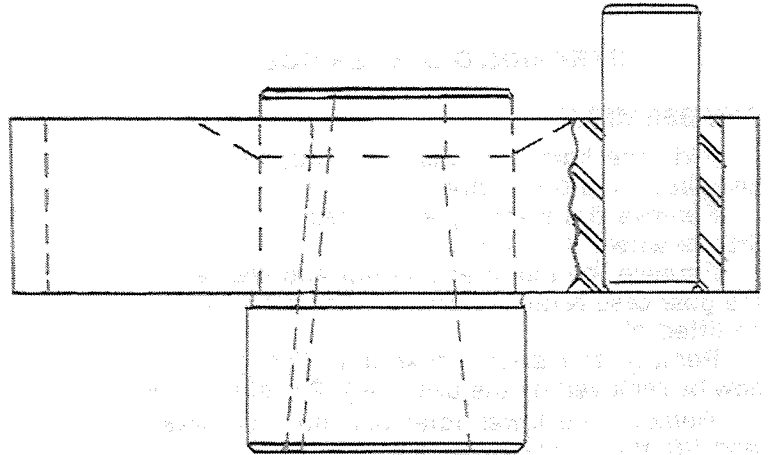


7810 AND PRIOR
"ORIGINAL DESIGN
GEARS"

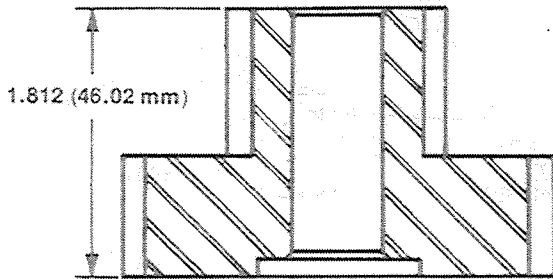
FIGURE 2



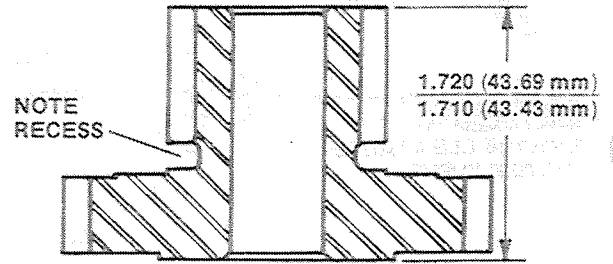
PART NO. 884125
884721
(NOT AVAILABLE)



USE PART NO. 881199



PART NO. 824905
(NOT AVAILABLE)



USE PART NO. 816448

SIDE VIEW

FIGURE 3

“NEW DESIGN” part numbers 824905, 884125 and 884721 are not available for replacement. Substitutions are as follows:

824905 use 816448 (Figure 3)

884125/884721 use 881199 (Figure 3).

Locating washer, part number 816449 (inside the housing) and bushing nut, part number 825672, must be used when gears #824905, 884125 or 884721 are used. If all “NEW DESIGN” gears

have been replaced, use shim #816446 inside the housing in place of locating washers. Figure 2. Either the bushing nut #825672 or hex nut #130541 can be used to secure the driven gear.

The upper housing has been revised to provide clearance for the bushing nut #825672. The revised housing can be used on all models.

The revised idler bolt #883317 without a lubrication fitting can be used on all models.

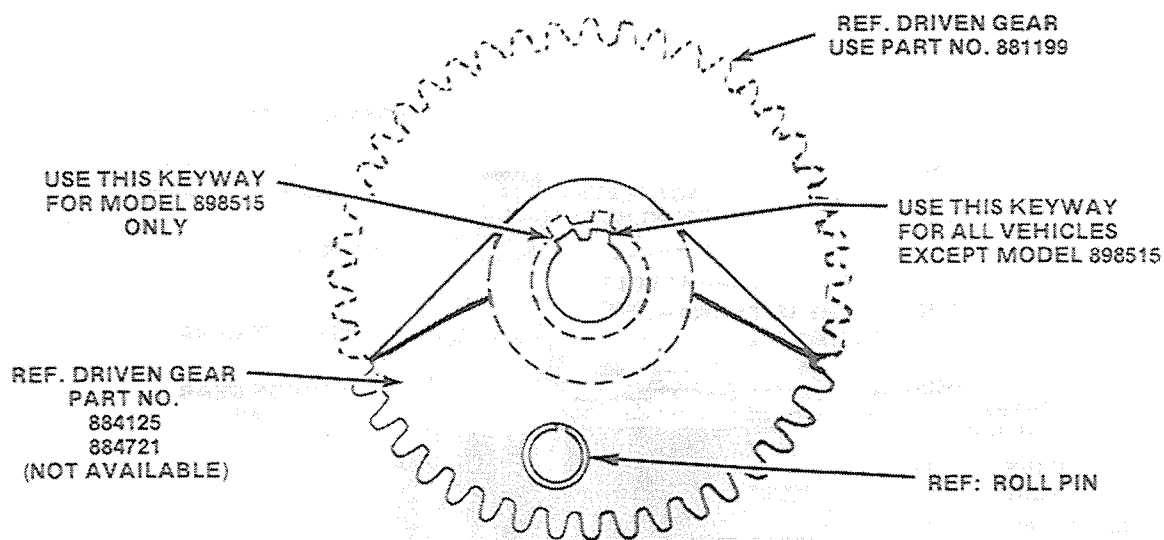


FIGURE 4

REASSEMBLY - "NEW DESIGN" GEARS

Place a locating washer, with the knurled side down, over the hole for the idler adjustment bolt. Insert the adjustment bolt, add another locating washer on the outside of the housing with the knurled side against the housing. Secure with a nut and tighten finger tight. Figure 5.

Place a liberal amount of grease in recess of idler adjusting bolt and place the cluster gear over the idler adjusting bolt.

Determine the correct keyway in the driven gear and install gear. Figure 4. Torque the steering bushing nut 40 to 50 lbs. ft. (54 to 70 N:m). Apply a liberal amount of lithium-base grease to the gear teeth and all bearing surfaces.

Adjust the height of the lower housing as shown in Figure 5. Tighten the support mounting screws.

Place one locating washer, knurled side up, over the idler adjustment bolt. Assemble upper housing to lower housing. Place another locating washer over the adjustment bolt with the knurled side against the upper housing. Secure with a nut and tighten finger tight. Figure 5. Tighten housing attaching screws to 8 to 10 lbs. ft. (11 to 14 N:m) torque.

Tighten the five lower housing and support bracket screws to 20 to 25 lbs. ft. (27 to 34 N:m) torque.

Rotate front fork from side to side to check gear alignment. If a smooth, free-turning movement is not achieved, loosen the top three mounting screws of support brackets and adjust housing assembly until free movement is achieved. Tighten bolts and recheck. Further adjustment is allowed by loosening bottom two mounting bolts, however, it may then be necessary to remove the upper housing and reset the height of the lower housing as specified.

BACKLASH ADJUSTMENT

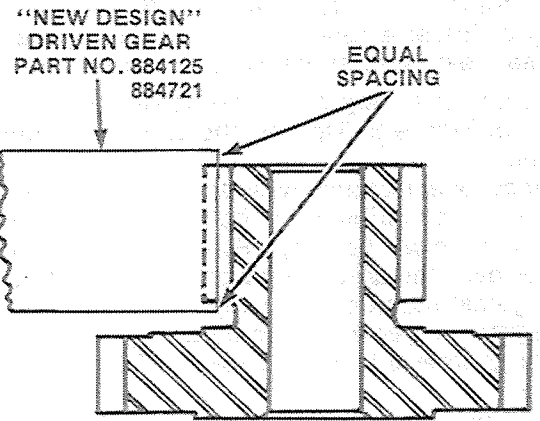
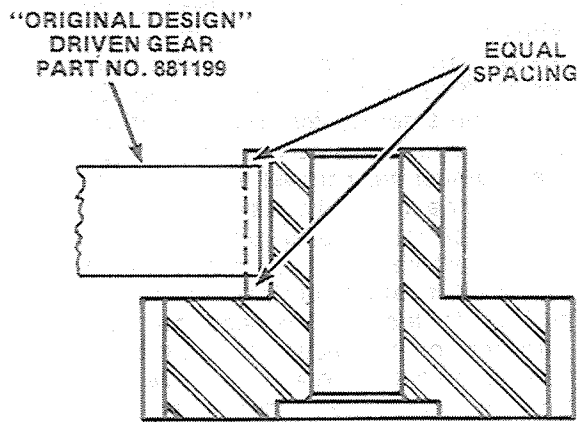
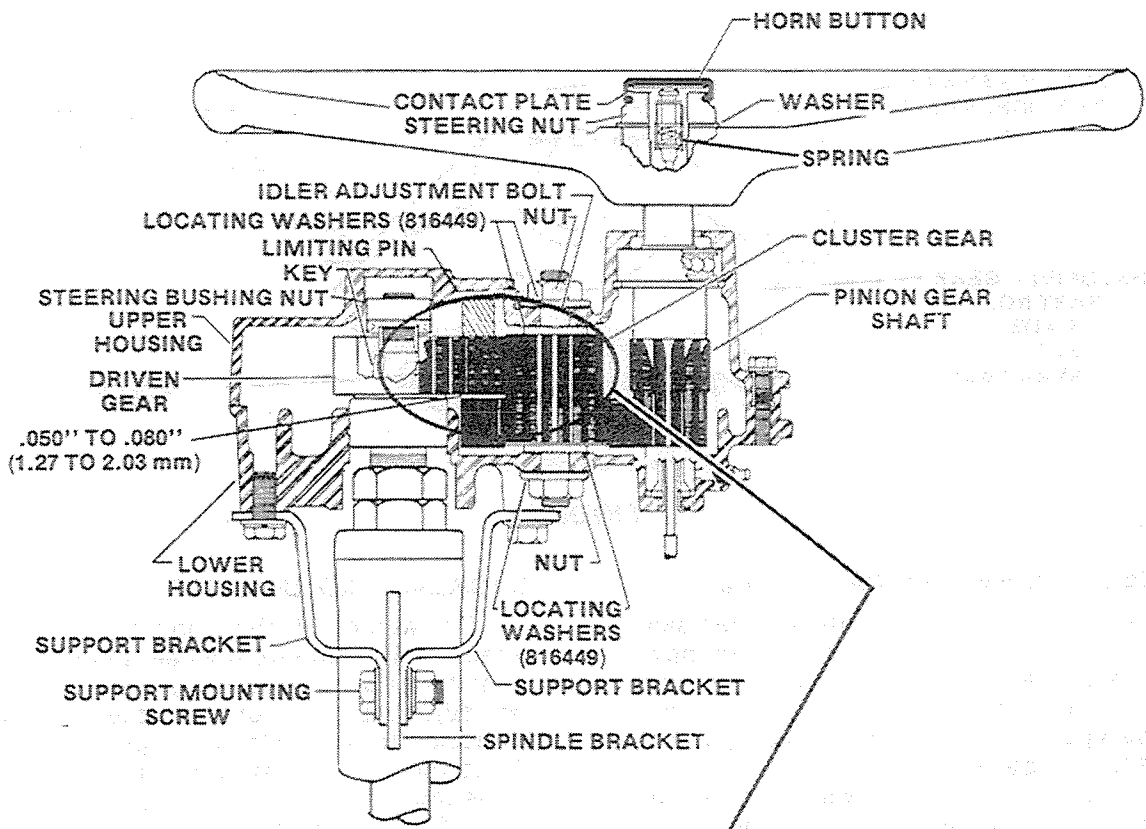
The weight of the vehicle must be on the wheels or hold the front wheel to prevent the fork from turning. Loosen the upper and lower idler bolt adjusting nuts, turn the steering wheel counterclockwise and hold with light pressure. Snug the lower idler adjusting nut and then the upper adjusting nut. Use a socket wrench and at least a 4" (102 mm) extension. Care **MUST** be exercised to avoid cocking the idler bolt. With slight pressure on the steering wheel in counterclockwise direction, tighten lower nut 40 to 50 lbs. ft. (54 N:m to 70 N:m) torque. Check backlash for a maximum of 1/4" (6 mm) travel of the steering wheel rim, then tighten upper adjusting nut 40 to 50 lbs. ft. (54 N:m to 70 N:m) torque. Check operation of the steering for free operation. A slight amount of roughness is permitted after the front fork and wheel has rotated either direction 15°. It is better to have the allowable roughness than the maximum permitted backlash. If it is necessary to readjust the idler bolt, the locating washers (Part No. 816449) must be rotated to prevent the serrations from falling into the same marks.

Tighten the nut securing the steering wheel to the steering shaft before the vehicle is placed into service. The correct torque is 40 lbs. ft. (54 N:m).



SAFETY WARNING: Failure to tighten the steering nut to the torque specified may allow the steering wheel to become disengaged from the shaft with resulting loss of steering control.

Install the horn wire assembly and related parts. Connect the wire to the brown wire coming from the front main wiring harness.



SIDE VIEW

"NEW DESIGN" CLUSTER GEAR
PART NO. 824905

"ORIGINAL DESIGN" CLUSTER GEAR
PART NO. 816448

FIGURE 5

REASSEMBLY - "ORIGINAL DESIGN" GEARS

Assemble the lower housing and idler adjusting bolt. Place one shim over the hole on the inside of the housing and insert the adjusting bolt. Place one locating washer on the adjusting bolt, knurled side against the housing outside surface. Secure with a nut and tighten finger tight. Attach the lower housing to the steering housing support brackets. Tighten attached hardware FINGER TIGHT. Figure 5.

Place the cluster gear over the idler adjusting bolt.

Install the driven gear assembly. Make sure the limiting pin is located so that it will be within the limiting pocket cast into the upper housing. Tighten the driven gear nut to 40 lbs. ft. (54 N:m) minimum, 50 lbs. ft. (70 N:m) maximum torque. Apply a liberal amount of lithium-base grease to the gear teeth and all bearing surfaces.

Adjust the height of the lower housing as shown in Figure 5. Tighten the support attaching hardware.

Install the horn button seal [1/16" (3 mm)] wide on the horn wire housing. Insert the horn wire housing upward through the hole in the lower housing. Retain the housing in position by attaching the shifter support bracket (Part No. 816668) to the lower housing.

Use the retainer plate (Part No. 823932) to retain the housing on Model 898525.

Install the horn wire housing seal, [3/16" (5 mm)] wide, on the wire housing and position the seal in the lower housing (Figure 5). This step is important and necessary to avoid grease seepage.

Place one shim over the idler adjusting bolt. Assemble the upper housing assembly to the lower housing. Place one locating washer over the idler adjusting bolt. Make sure the knurled side is placed against the housing outside surface. Tighten the housing attaching hardware FINGER TIGHT.

Tighten the hardware securing the lower housing to the support brackets to 3-4 lbs. ft. (4 N:m to 5 N:m) torque. Rotate the front fork and wheel to check the gear alignment. If a smooth, free-turning movement is NOT achieved, loosen the three screws attaching the lower housing and adjust the housing until a smooth turning fork is achieved. Tighten the hardware as indicated above and recheck by rotating the fork and wheel.

Additional adjustment is allowed by loosening the hardware attaching the supports to the spindle brackets; however, when the adjustment is required, it may be necessary to remove the upper housing assembly and readjust the lower housing to provide the flush requirement between the top of the idler gear and spindle gear.

Tighten the seven 1/4-20 upper housing to lower housing screws to 8 lbs. ft. (11 N:m) minimum, 10 lbs. ft. (14 N:m) maximum torque.

Tighten the five 3/8-16 lower housing and support bracket screws to 20 lbs. ft. (27 N:m) minimum, 25 lbs. ft. (34 N:m) maximum torque.

Place the steering wheel in position on the pinion gear shaft. Secure with washer and steering nut. DO NOT TIGHTEN nut.

BACKLASH ADJUSTMENT

Lower the vehicle to the surface or hold the front wheel to prevent the fork from turning. Loosen the upper and lower idler bolt adjusting nuts, turn the steering wheel counterclockwise and hold with light pressure. Snug the lower idler adjusting nut and then the upper adjusting nut. Use a socket wrench and at least a 4" (102 mm) extension. Care MUST be exercised to avoid cocking the idler bolt. With slight pressure on the steering wheel in counterclockwise direction, tighten lower nut to 35 lbs. ft. (48 N:m) minimum, 50 lbs. ft. (70 N:m) maximum torque. Check backlash for a maximum of 1/4" (6 mm) travel of the steering wheel rim, then tighten upper adjusting nut to 35 lbs. ft. (48 N:m) minimum, 50 lbs. ft. (70 N:m) maximum torque. Check operation of the steering for free operation. A slight amount of roughness is permitted after the front fork and wheel has rotated either direction 15°. It is better to have the allowable roughness than the maximum permitted backlash. If it is necessary to readjust the idler bolt, the locating washers (Part No. 816449) must be rotated to prevent the serrations from falling into the same marks.

Apply 2-3 "shots" of lithium-base pressure gun grease to all grease fittings.



NOTE: Do not exceed the amount of grease specified. Excessive grease can cause permanent damage to the gear housings.

Tighten the nut securing the steering wheel to the steering shaft before the vehicle is placed into service. The correct torque is 40 lbs. ft. (54 N:m).



SAFETY WARNING: Failure to tighten the steering nut to the torque specified may allow the steering wheel to become disengaged from the shaft with resulting loss of steering control.

Install the horn wire assembly and related parts. Connect the wire to the brown wire coming from the front main wiring harness.

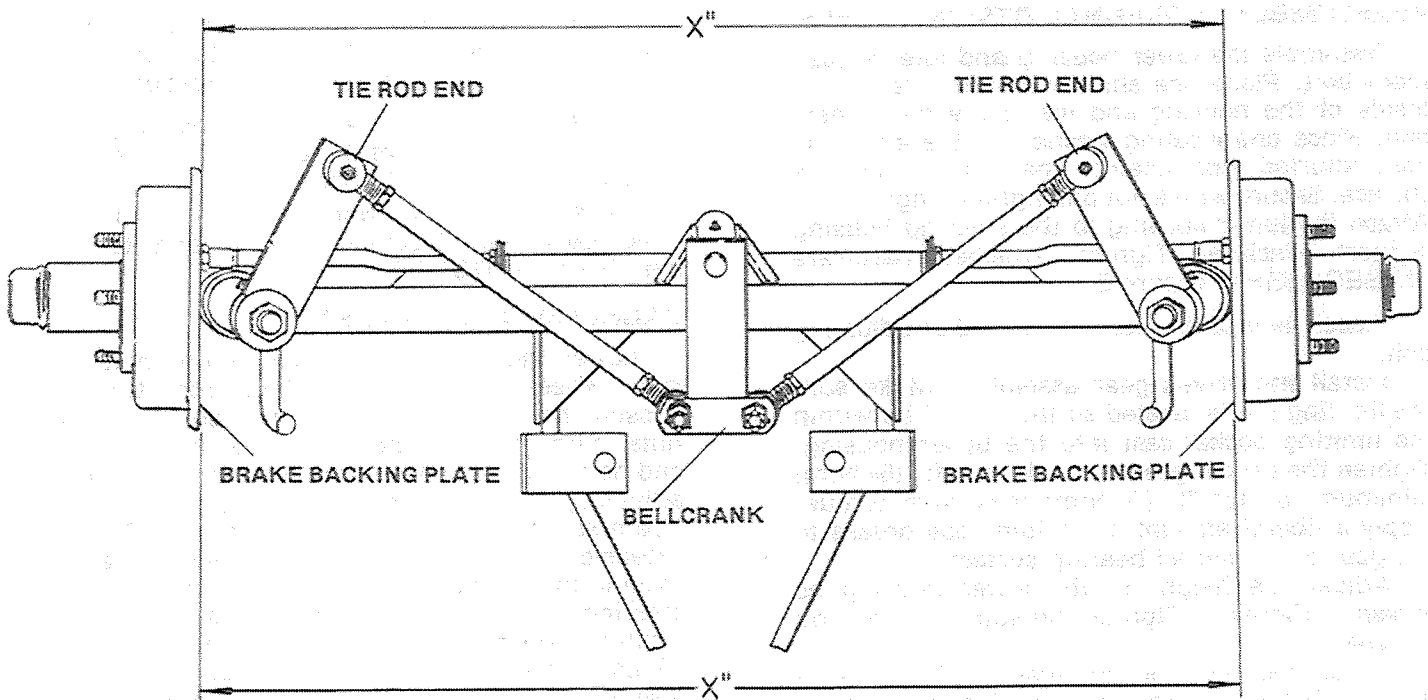


FIGURE 6

FRONT END ALIGNMENT 4-WHEEL HAULSTER-TRUCKSTER

Before attempting a front end alignment, check for worn spindle bushings, worn arm bushings or worn tie rod ends. Excessive wear at any of these points will make an accurate front end alignment impossible.

Find the center of the travel in the steering gear. With the steering gear in this position, the bellcrank should be pointing straight forward. Adjustment is made by removing the drag link from the bellcrank and rotating the drag link end until the proper adjustment is obtained.

Measure the distance between the brake backing plates at both the rear and front of the plates. If these two measurements are the same, the front end will have zero toe-in.

Making the adjustment so the distance between the brake backing plates is $5/32''$ (3.97 mm) less at the front than at the rear, sets the front end at one degree toe-in. The toe-in must never exceed one degree.

Adjustment is made by removing the tie rods from the bellcrank and turning the tie rod ends until the proper adjustment is obtained. After adjustment, be sure tie rod nuts are securely tightened and keyed (Figure 6).

cotter pin hole lines up and install the cotter pin. Spin the wheel to be sure that it is free from drag. Tighten the axle clamp nut.

The bearings should be repacked yearly with a lithium-base pressure gun grease. Remove the wheel assembly from the front fork. To remove the grease seals, use a long punch and drive out from the opposite side. It is not advisable to reuse grease seals after they have been removed. Clean the bearing with a solvent and repack. When reassembling, adjust the bearings so the wheel is free from drag with a minimum amount of end play.

FRONT WHEEL INSTALLATION

A. WITHOUT FRONT BRAKE

Reinstall the entire wheel, hub and axle assembly. Make sure all parts are properly positioned (Figure 7).

Tighten the axle locknuts to 70 lbs. ft. (95 N:m) torque minimum, 100 lbs. ft. (140 N:m) maximum.

10

FRONT WHEEL BEARINGS (3-WHEEL)

The front wheel is mounted on taper roller bearings. The bearings must be checked periodically for the proper operation and durability. Loosen the axle clamp nut on threaded end of axle and turn the castle nut down until there is no end play in the hub. Turn the castle nut back until



NOTE: On a vehicle without front brakes, install the wheel and hub assembly with the bearing adjusting nuts and valve stem on the right side.



NOTE: The large flat washers located on the ends of the axle must be positioned on the inside of the sidearm assembly.

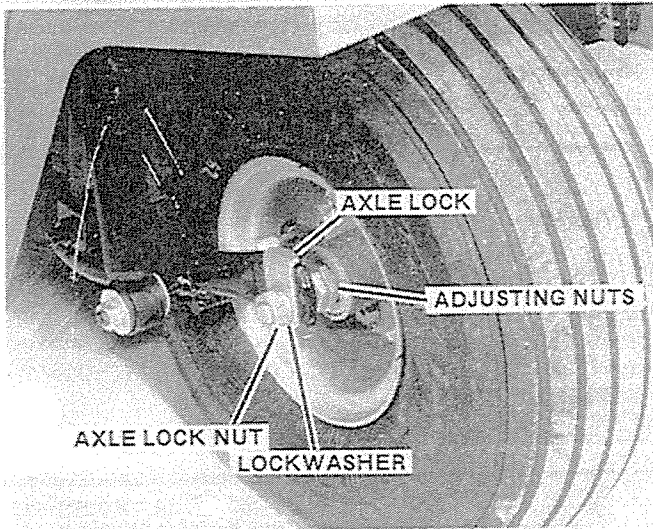


FIGURE 7



SAFETY WARNING: When reinstalling the front wheel and axle assembly to the fork side arm, the front axle lock must be positioned over the side arm (as shown) and the axle nuts tightened. Failure to follow the procedure may cause erratic steering and/or loss of control of the vehicle.

B. WITH FRONT BRAKE

Reinstall the entire wheel, hub, brake and axle assembly. Make sure all parts are properly positioned (Figure 8). Tighten the axle locknuts to 70 lbs. ft. (95 N:m) torque minimum, 100 lbs. ft. (140 N:m) maximum.

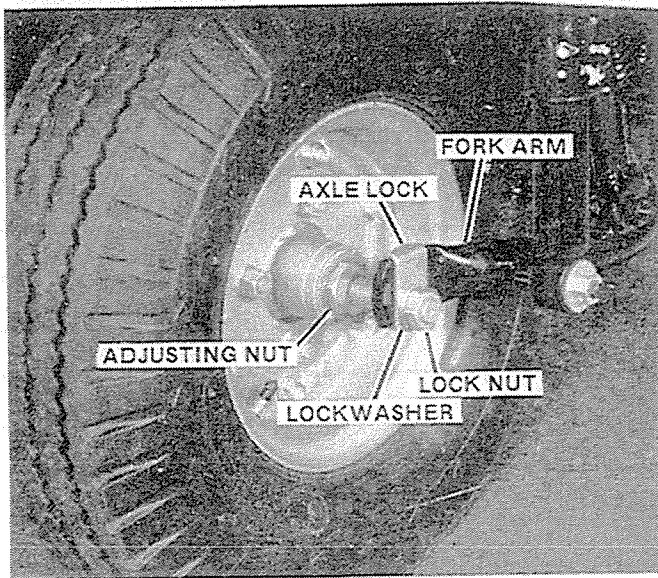


FIGURE 8



NOTE: The large flat washers located on the ends of the axle must be positioned on the inside of the sidearm assembly.



SAFETY WARNING: When reinstalling the front wheel and axle assembly to the fork side arm, the front axle lock must be positioned over the side arm (as shown) and the axle nuts tightened. Failure to follow this procedure may cause erratic steering and/or loss of control of the vehicle.

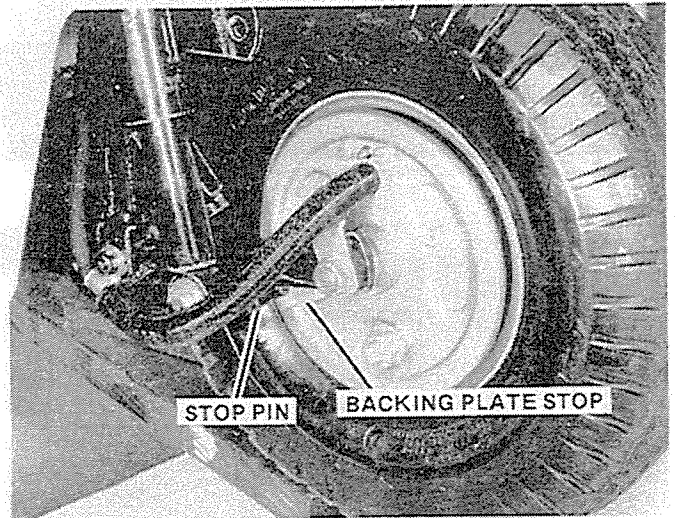


FIGURE 9



SAFETY WARNING: Make sure the backing plate stop is secured over the stop pin when reinstalling the backing plate. This will prevent the backing plate from turning, which could result in brake hose damage and complete brake failure. Refer to Figure 9.

FORK DAMPER ADJUSTMENT

The handle bar is attached to the steering pivot shaft.

A friction type fork damper is attached to the upper end of the steering pivot shaft. The damper is designed to control the front fork side movement. Figure 10.

Should it be necessary to adjust the damper, the recommended torque setting for the adjusting screws is 5 to 7 inch pounds (0.56 to 0.78 N:m). This torque should provide the tension necessary for proper steering control.



NOTE: The vehicle should track in a straight line with no drift or shimmy when damper is properly adjusted.

FORK BEARING ADJUSTMENT

Handle Bar Steering

Tighten the fork damper to 15 lbs. ft. (20 N:m) torque. Hold the nut or damper to keep it from turning and tighten the locking nut to 91 lbs. ft. (120 N:m) minimum, 109 lbs. ft. (150 N:m) maximum torque. Figure 11.

SECTION 11 BRAKES

HYDRAULIC BRAKES

Cushman vehicles use an automotive type brake system, service procedures are much the same as most automobiles. The brake linings on the Cushman Brake are riveted to the shoe and can be replaced or complete shoes with lining are available as service parts. The bendix front brake is serviced with shoe and lining assemblies only.



SAFETY WARNING: To prevent brake malfunction or failure, the vented master cylinder cap must be used to replace the non-vented cap used for shipping purposes.

BRAKE SHOE REPLACEMENT: FRONT (CUSHMAN BRAKE)

Raise the front of the vehicle off the floor.



SAFETY WARNING: To avoid injury, use jack stands to support the raised vehicle. Do not rely on hydraulic or mechanical jacks.

Remove axle nuts and drop wheel assembly. **DO NOT DISCONNECT HYDRAULIC BRAKE LINE.** (Figures 1 and 2). Remove the wheel bearing adjusting nut and separate the wheel and drum assembly from the brake backing plate and shoe assembly.

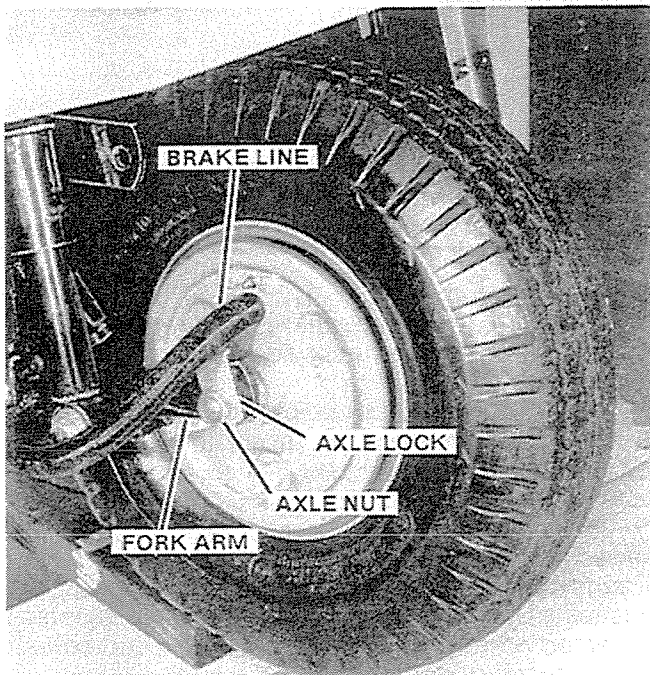


FIGURE 1

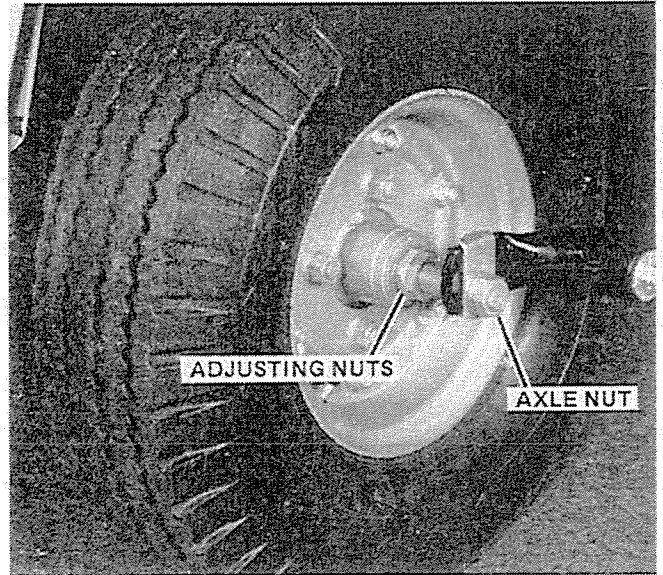


FIGURE 2



NOTE: Make sure brake hose and protector are positioned to avoid being damaged while wheel and axle are disassembled.

The shoes can now be removed from the backing plate. Care must be taken not to disturb the hydraulic wheel cylinder. Disconnect the return spring from each shoe. An automotive type spring tool can be used. Remove the retaining ring securing the shoes to the heel pin. Remove the shoes from the backing plate.

Clean the backing plate, use emery cloth to remove rust or burrs from the heel pin. Loosen both adjustment pins and the heel pin to facilitate installation of the new shoes.

Place the new shoes over the heel pin.



NOTE: The ends of the shoes that fit over the heel pin are offset and must be installed as shown. Figure 3. The shoes must fit freely into the guides.

Replace the retaining ring, be sure the upper ends of the shoes fit into the wheel cylinder and replace the return spring. Repack wheel bearings.

Install the brake assembly into the hub and drum assembly. Install the axle and adjust bearings.

Position the hub and wheel assembly into the fork and tighten axle nuts finger tight.

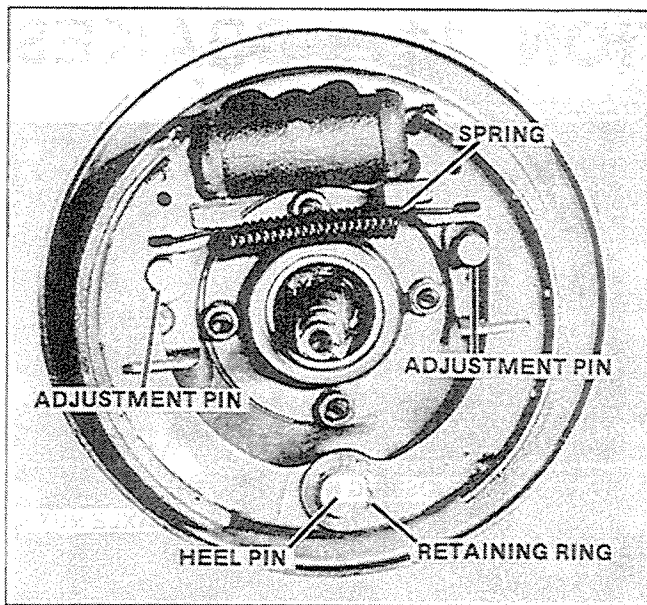


FIGURE 3



NOTE: The large flat washers located on the ends of the axle must be positioned on the inside of the sidearm assembly.



SAFETY WARNING: Insure that the backing plate stop is secured over the stop pin when reinstalling the backing plate. This will prevent the backing plate from turning, which could result in brake hose damage and complete brake failure.



SAFETY WARNING: When reinstalling the front wheel and axle assembly to the fork side arm, the front axle lock must be positioned over the side arm (as shown) and the axle nuts tightened. (Figure 1.) Failure to follow the procedure may cause erratic steering and/or loss of control of the vehicle.

Lower the unit to the floor so the weight of the vehicle is on the front wheel. Tighten axle nuts to 70-100 lbs. ft. (95-100 N:M).

Raise front of vehicle and adjust wheel bearings. Tighten the adjusting nut until a slight drag is felt and then loosen until wheel rolls freely. Hold adjusting nut and tighten lock nut against it.

Be sure both rear brakes are assembled.

Press brake pedal firmly to expand and center the shoes in the drum. Tighten heel pin nut while maintaining pedal pressure. Release pressure on pedal to allow brake shoes to retract.

Adjust each brake shoe by placing a wrench on the adjusting nut and turning wrench up (both sides) until shoes are tight against the drum, then

back off slightly. Turn wheel to be sure the shoes are not dragging. Hold the adjusting pins and tighten the lock nuts.

BRAKE SHOE REPLACEMENT: FRONT (BENDIX BRAKE)

Raise the front of the vehicle off the floor.



SAFETY WARNING: To avoid injury, use jack stands to support the raised vehicle. Do not rely on hydraulic or mechanical jacks.

Do not disconnect the brake line. Remove cotter pins and castle nuts attaching brake anchor link to front fork and brake arm. Pull link straight off of studs.

Remove the wheel bearing adjusting nuts and separate the drum and wheel assembly from the backing plate.

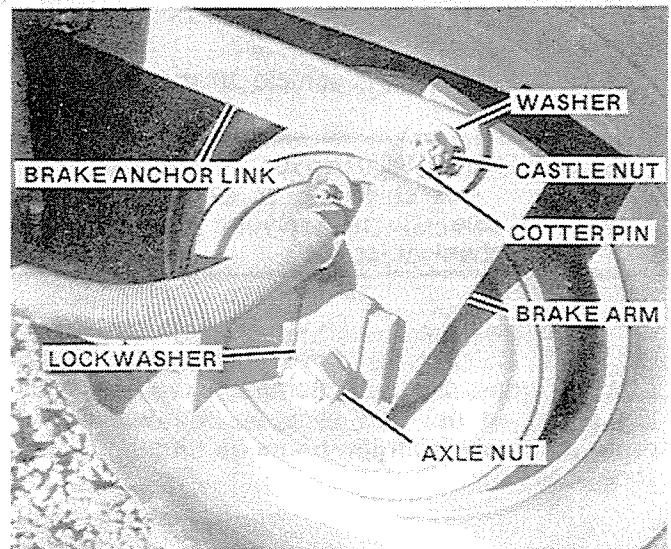


FIGURE 4



NOTE: A brake link bushing is located in the hole at each end of brake anchor link. These bushings must be retained.

Remove the wheel bearing adjusting nuts and separate the drum and wheel assembly from the backing plate.

The shoes can now be removed from the backing plate. Care must be taken not to disturb the hydraulic wheel cylinder. Do not press the brake pedal while the brake is disassembled.

Remove adjuster spring and return springs from each shoe. The shoes and adjuster can now be removed from the backing plate. Disassemble adjuster, clean parts thoroughly and reassemble in a retracted position. Place new shoes and adjuster on backing plate assembly. Be sure adjuster star wheel is positioned in line with the opening in the dust cover.



NOTE: Initial Bendix replacement shoe sets included color coded components. These sets must be installed as shown to prevent premature wear. Later sets are not color coded and the shoes can be installed in either position. Figure 5.

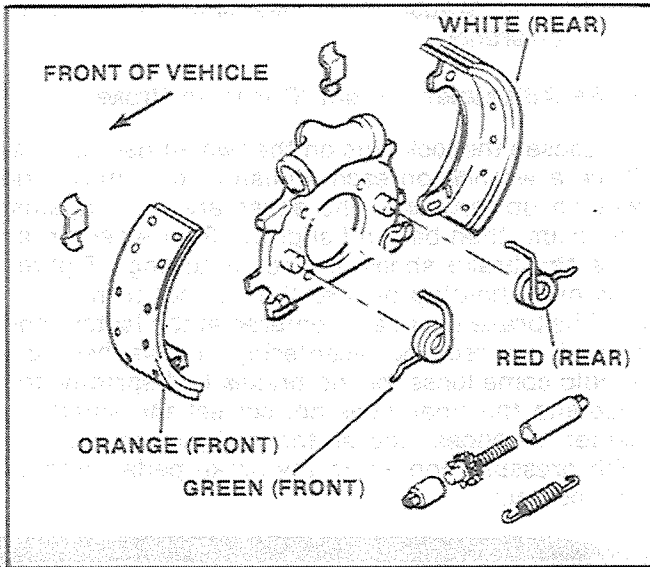


FIGURE 5

Install the shoe return springs, hold-down springs and the adjuster spring.

Repack wheel bearings.

Install the brake assembly into the hub and drum assembly. Install the axle and adjust bearings.

Position the hub and wheel assembly into the fork and tighten axle nuts finger tight.



SAFETY WARNING: The brake link bushings must be inserted in the brake anchor link and the link reinstalled, to prevent the brake stator and drum assembly from turning, which could result in brake hose damage and complete brake failure.



SAFETY WARNING: When reinstalling the front wheel and axle assembly to the fork side arm, the front axle lock must be positioned over the side arm (as shown) and the axle nuts tightened. Failure to follow the procedure may cause erratic steering and/or loss of control of the vehicle. Figure 6.



NOTE: Position the large flat washer located on ends of axle, on the inside of the sidearm assembly.

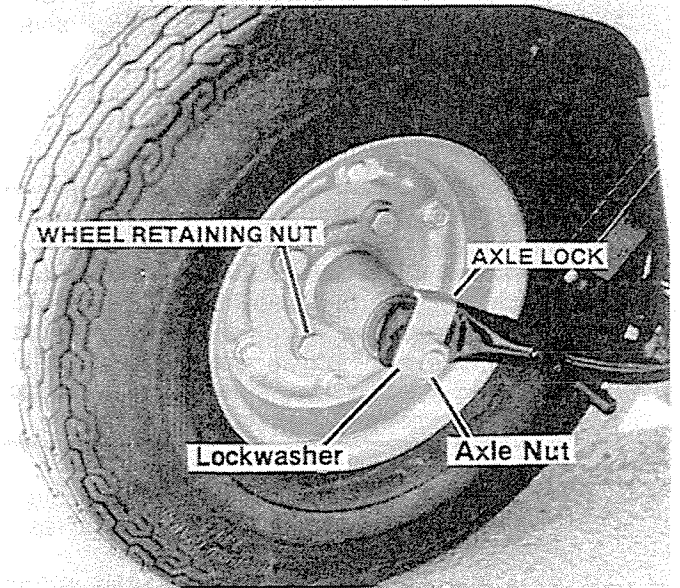


FIGURE 6

Lower the unit to the floor so the weight of the vehicle is on the front wheel. Tighten axle nuts to 70-100 lbs. ft. (95-140 N:M). Raise front of vehicle and adjust wheel bearings. Tighten the adjusting nut until a slight drag is felt and then loosen until wheel rolls freely. Hold adjusting nut and tighten lock nut against it. Remove adjuster hole plug. Adjust the brake shoes by turning the adjuster star wheel down to move the shoes out. Adjust until a slight drag is felt while turning the wheel. Re-install adjuster hole plug. Figure 7.

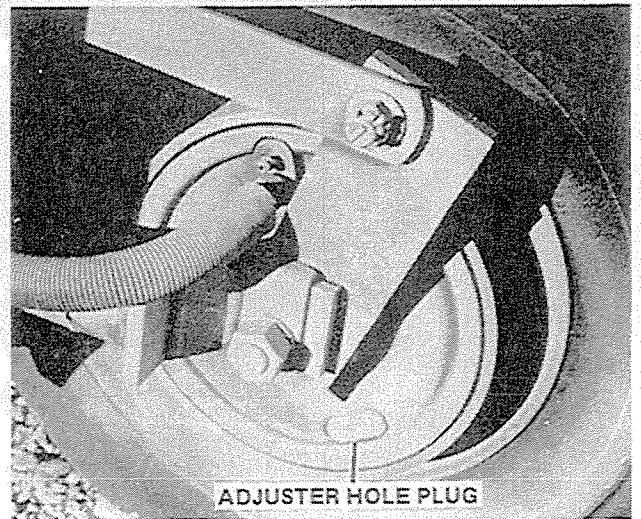


FIGURE 7

BRAKE SHOE REPLACEMENT: REAR

Remove axle nut and install a knockout. Be sure it is tight against the end of the axle to avoid damage to the threads. Hit the knockout with a sharp blow with a heavy hammer to loosen the hub from the axle. Refer to BRAKE SHOE REPLACEMENT: FRONT (CUSHMAN BRAKE) for shoe replacement and adjustment.

Bleeding Hydraulic System



SAFETY WARNING: Should it be necessary to add fluid to maintain the correct level in the master cylinder, use only dot (3) brake fluid. To avoid fluid contamination, clean filler cap before removing. If an unexplained loss of brake fluid occurs, determine the cause to prevent possible loss of brakes.

1. Fill master cylinder with brake fluid (replace master cylinder cap to avoid splashing).
2. Attach small clear tube to the bleeding nipple. This nipple is on the back side of the wheel cylinder and protrudes through a hole in the top of the brake dust shield (do not mistake it for a lubrication fitting). The nipple is threaded and must be turned to the left slightly to allow air trapped in the brake line to escape. Place the free end of the bleeder tube in a container, making sure there is enough brake fluid in the container to seal the end of the tube.

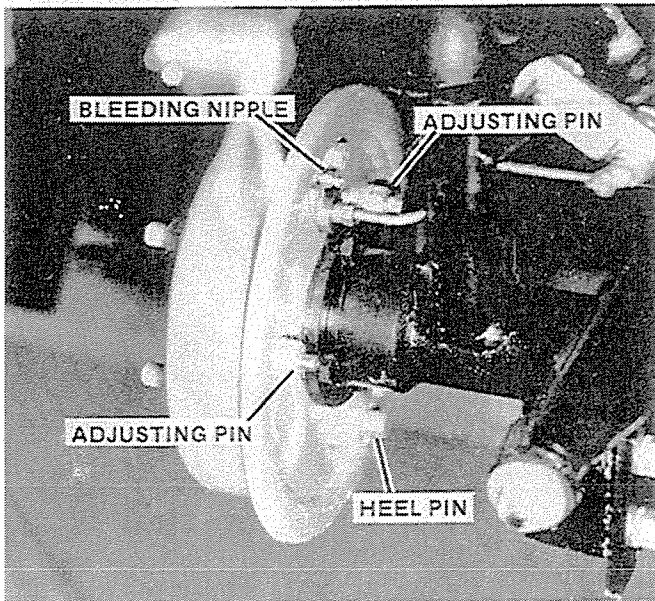


FIGURE 8

3. Pump brake pedal slowly until fluid coming from the bleeder fitting is clear and free of air bubbles. (By using clear tubing you can see when only brake fluid is passing through the tubing.) When all the air is out

of brake line, tighten the bleeding nipple while holding the brake pedal in the down position. Repeat the above operation for each brake line. After a brake line is bled, refill the master cylinder, making sure it is full before starting the bleeding operation of each brake line.

4. When all brake lines are full of fluid, and are completely free of any air, the next step is to adjust the brake shoes for proper clearance.

Brake Adjustment, Front (Cushman Brake)

Loosen the lock nuts on the two adjusting pins. Place a wrench on each adjusting pin, move the wrench upward until the shoes are tight against the drum, then back off slightly. Spin wheel to be sure the brake shoes are not dragging. Tighten lock nuts, holding pins so they do not turn.

The brake shoes are centered at the factory and should not require recentering. If the heel pin should come loose, or the brakes feel springy and bleeding the lines does not correct the situation, center the shoes. Loosen the heel pin lock nut and with pressure applied to the brake pedal, tighten the lock nut.

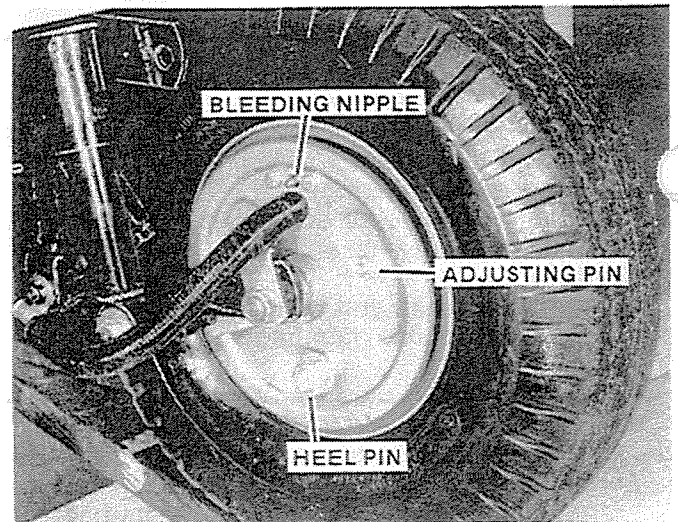


FIGURE 9

Brake Adjustment, Front (Bendix Brake)

Remove adjuster hole plug. Adjust the brake shoes by turning star wheel down to tighten brake. Adjust shoes until slight drag is felt between the shoes and drum when the drum is turned. Reinstall adjuster hole plug.

Brake Adjustment, Rear

Loosen the lock nuts on the two adjusting pins. Place a wrench on each adjusting pin, move the wrench upward until the shoes are tight against the drum, then back off slightly. Spin wheel to be sure the brake shoes are not dragging. Tighten lock nuts, holding pins so they do not turn.

The brake shoes are centered at the factory and should not require recentering. If the heel pin

should come loose, or the brakes feel springy and bleeding the lines does not correct the situation, center the shoes. Loosen the heel pin lock nut and with pressure applied to the brake pedal, tighten the lock nut.

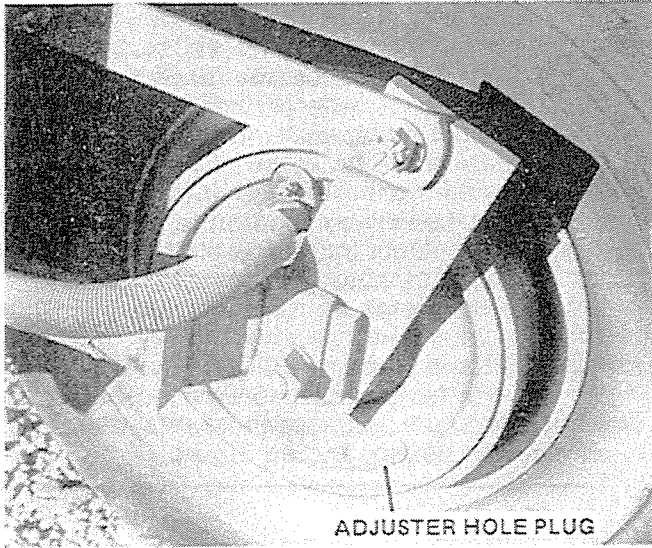


FIGURE 10

Parking Brake Adjustment (Radial Frame Vehicles)

Inspect the lining on calipers, replace when worn to within 1/64" (0.4 mm) of rivets.

Minor adjustment can be made as follows: Apply parking brake, position clamp on brake caliper (as shown). The clamp will act as a stop to prevent the activating lever from releasing and will provide free travel for adjustment at lever end. Release lever, adjust nuts as required. Engage parking brake and remove clamp. The parking brake should hold the vehicle and stall the engine when the transmission is in low gear and the engine is accelerated 2200 to 2800 RPM (1/2 to 3/4 throttle).

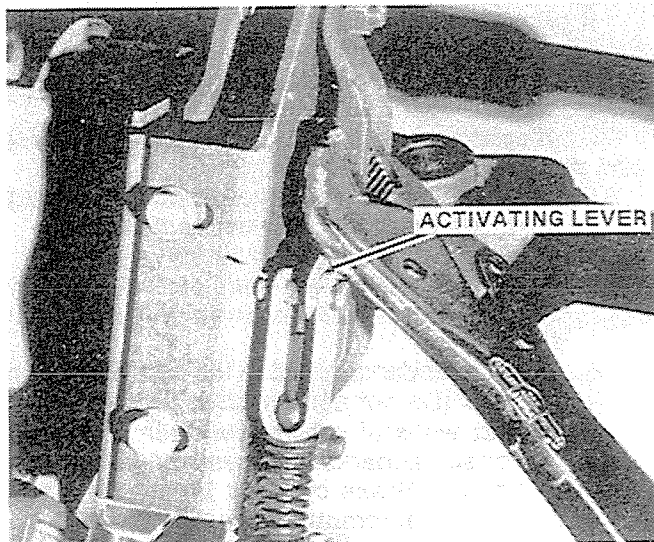


FIGURE 11

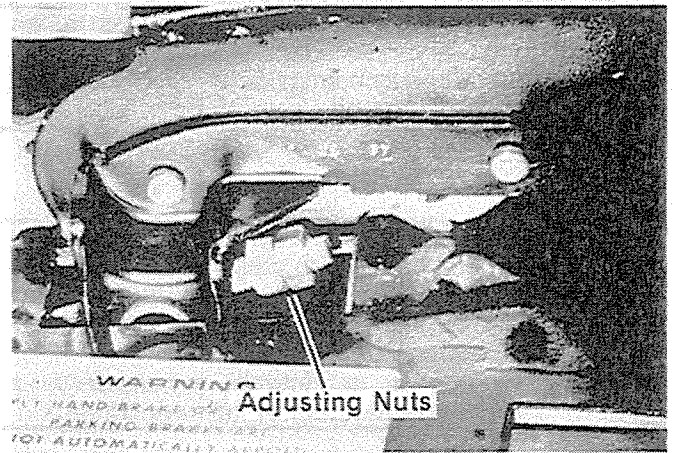


FIGURE 12



NOTE: There should be no contact between brake disk and lining in released position when brake is properly adjusted.



SAFETY WARNING: To avoid brake failure, make sure all hardware is tight after adjusting brake.



SAFETY WARNING: The parking brake cable must travel freely to provide proper operation of the brake. Be sure the cable is free of rust and is not kinked.

Parking Brake Adjustment (Non-Radial Frame Vehicles)

Adjustment can be made by adjusting the nut on the linkage rod to compress or release the spring (as shown) to maintain 25 to 45 pounds (11.3 to 20.5 kg) of pull on the parking brake handle.

The parking brake should hold the vehicle and stall the engine when the transmission is in low gear and the engine is accelerated 2200 to 2800 RPM (1/2 to 3/4 throttle).

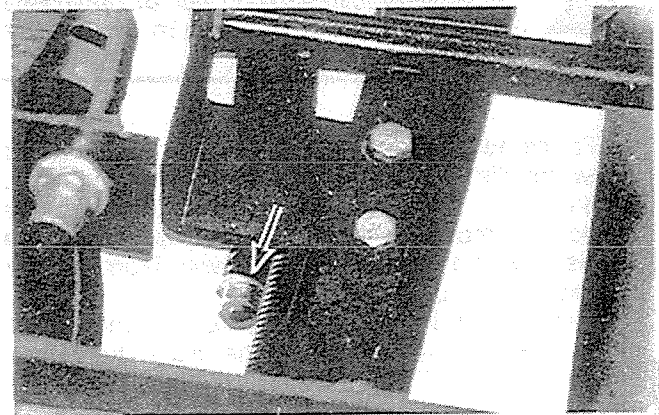


FIGURE 13



NOTE: A vehicle equipped with an auxiliary transmission must have the auxiliary transmission in high range to perform the above test.



SAFETY WARNING: If the parking brake handle requires less than 25 pounds (11.3 kg) of pull or fails to stall the engine as stated, a need for servicing is indicated. Failure to service as required, may cause malfunction of parking brake.



NOTE: There should be no contact between brake disk and lining in released position when brake is properly adjusted.



SAFETY WARNING: To avoid brake failure, make sure all hardware is tight after adjusting brake.

Master Cylinder

Master cylinder failures may usually be recognized by repeated loss of brake fluid or by brake pedal fading gradually while brakes are applied. Check master cylinder and immediate area for signs of leaking fluid. If leakage is found on the end of cylinder where brake lines are attached, check for loose or broken lines or loose brass "U" fitting. Repair as necessary. If leakage is found on opposite end, around the boot, it is necessary to replace or repair the master cylinder. If pedal fades while brakes are applied, and there is no leak in the lines or at the wheel cylinders, master cylinder must be replaced or rebuilt.



SAFETY WARNING: Pedal fading may be experienced with no loss of fluid, due to defective internal parts in the master cylinder.

To remove master cylinder, remove fitting screw holding brass fitting to master cylinder. (Brake lines need not be removed from brass fitting.) Remove two cylinder mounting screws and remove cylinder by pulling away from master cylinder push rod.

Replace cylinder in reverse manner. Fill cylinder with fluid and bleed the brake system as explained in BLEEDING HYDRAULIC SYSTEM section.

Brake Pedal Free Travel

7910 AND 7920 SERIES OF MODELS 898419, 898425, 898434, 898435, 898436 AND 898525 SHIPPED FROM THE FACTORY PRIOR TO NOVEMBER 1, 1978.

The above models may have been assembled with insufficient free travel of the brake pedal. This condition may cause the brakes to drag, resulting in poor vehicle performance and premature brake lining wear.

Free travel of the brake pedal can be checked by removing the master cylinder filter plug. Press the brake pedal slowly by hand while watching the surface of the fluid for bubbles or slight turbulence which indicates adequate free travel.

No disturbance on the fluid surface indicates insufficient free travel and the linkage between the pedal and master cylinder must be adjusted.

Loosen the locknut between the pushrod and brake rod and turn the pushrod into the brake rod to shorten the length. See Figure 14.

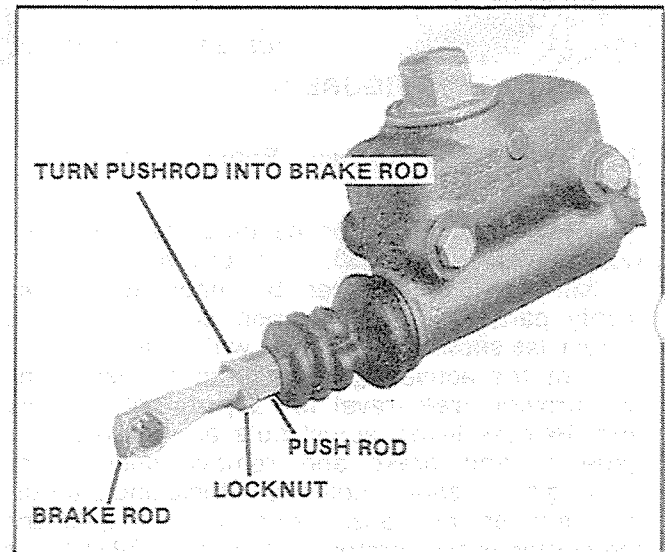


FIGURE 14

If proper adjustment cannot be obtained it will be necessary to remove the brake rod from the vehicle and shorten it by removing 1/16" from the threaded end.

If cylinder is to be rebuilt, remove from vehicle and proceed as follows:

1. Remove filler cup and gasket and pour fluid from reservoir. (Do not reuse fluid.)
2. Remove boot from cylinder.
3. Remove lock ring, washer, piston, primary cup, spring, valve and valve seat from cylinder.
4. Clean cylinder and filler cap thoroughly in alcohol. (Do not use gasoline or kerosene.)
5. Inspect walls of master cylinder barrel for rust or score marks; if necessary recondition by honing. Brake cylinder hones are available from automotive supply distributors.hone only enough to clean up the wall.

Clean cylinder again with alcohol, dry with compressed air.

6. Reassemble in reverse order. Dip all in-

ternal parts in brake fluid prior to assembly.
7. Install the master cylinder in the vehicle, fill with fluid, and bleed the brake system.

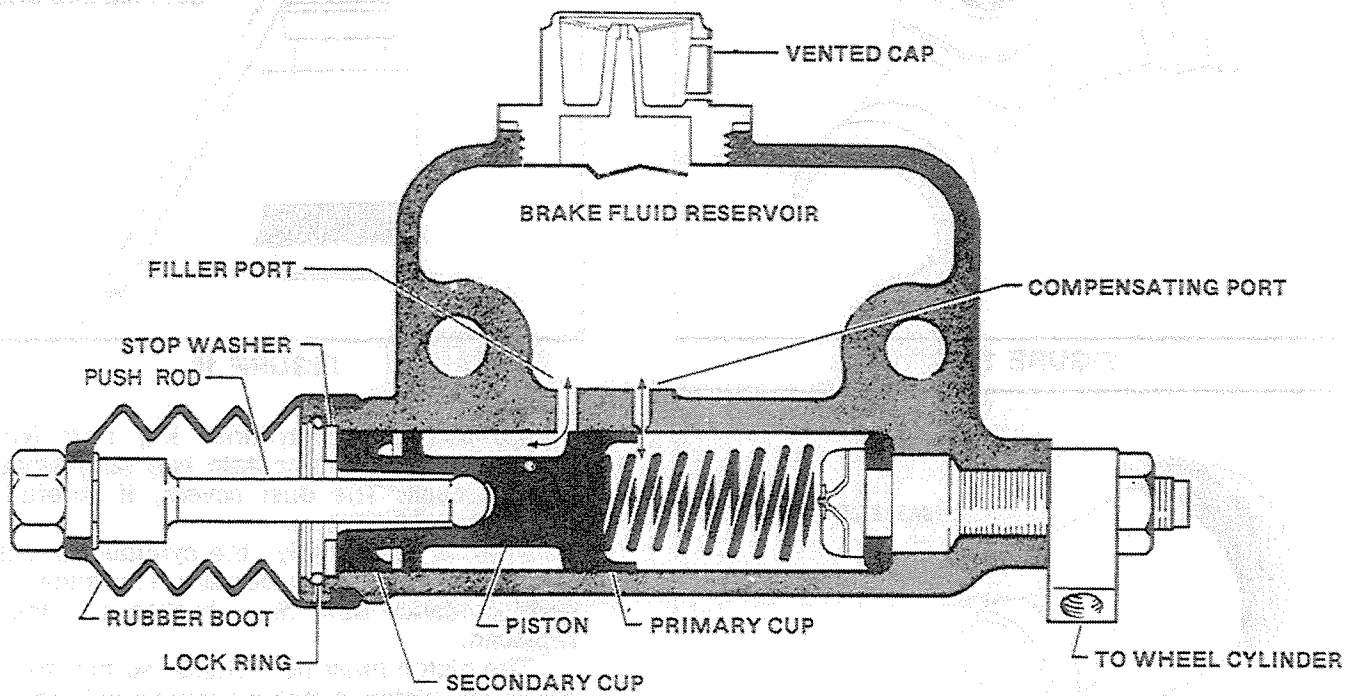


FIGURE 15

Wheel Cylinders

Disconnect brake line and brake shoes and remove the wheel cylinder from the brake backing plate. Remove the boot from each end of the cylinder, push the pistons, rubber cups and spring from the cylinder. Wash cylinder in alcohol. Examine walls for rust or score and hone if necessary. Dip cups and pistons in brake fluid and reassemble parts into the cylinder. Install the wheel cylinder on the vehicle and connect the brake line. Bleed the entire brake system as explained in BLEEDING HYDRAULIC SYSTEM section.

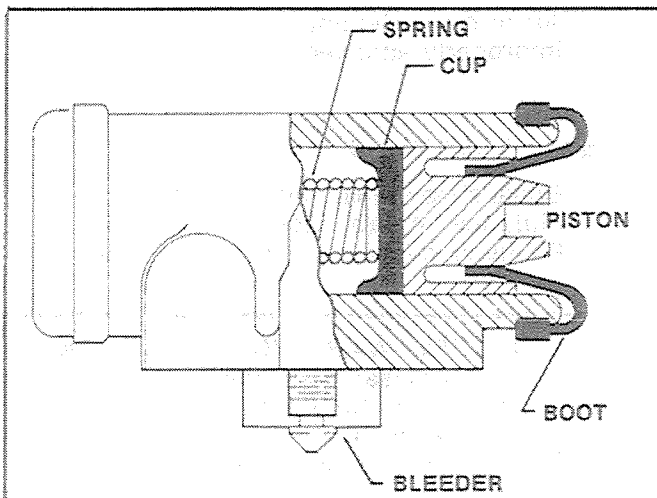


FIGURE 16

Front Wheel Brake Cylinders On-Road Haulsters MODELS 898407-408-409 7720 AND 7810 AND 898434-435 7810

The above models all of which have a Bendix front wheel brake may have been equipped with brake cylinder pistons in the front brake that could cause abnormal brake lining wear, fluid seepage or allow a shoe guide (part of the spider) to break off after extended use. In some cases, pistons may have been installed backward in the cylinders. This condition may also cause fluid seepage.

We request that each front wheel cylinder assembly be inspected during initial disassembly for service, i.e., relining.

The new, improved pistons can be identified by one of the following methods:

1. All brake assemblies with an "X" stamped adjacent to the bleeder valve have been equipped with the improved piston.
2. All pistons ordered from Mail Order and identified with red dykem are the new, improved piston.
3. The new, improved piston is a one-piece, hardened steel detail and can be checked with a file on an edge (see sketch below for test surface). A file should not cut the hardened piston.

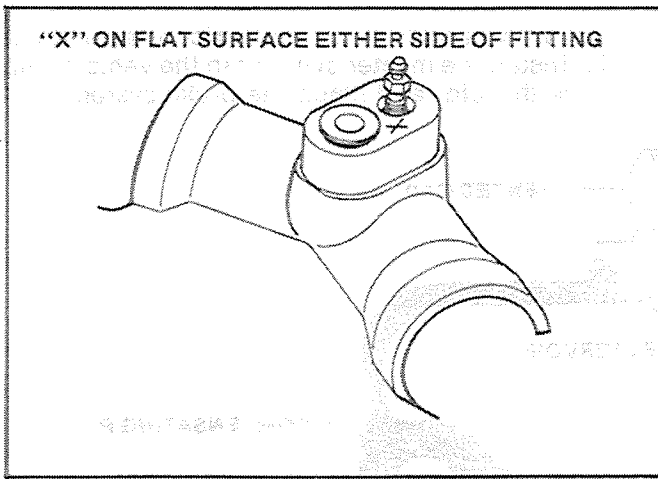


FIGURE 17

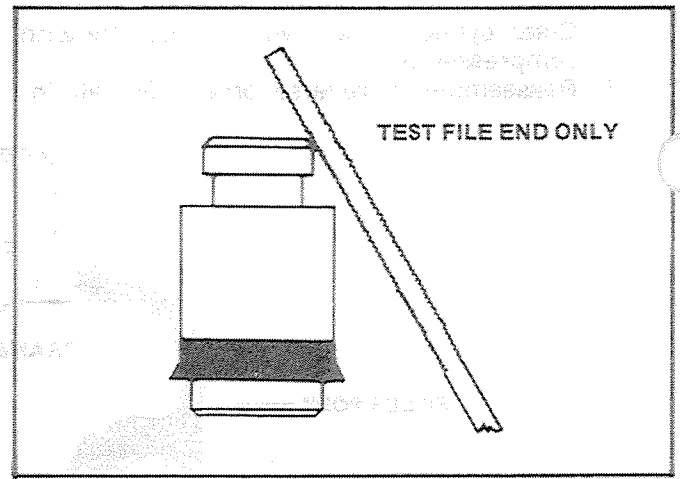


FIGURE 19

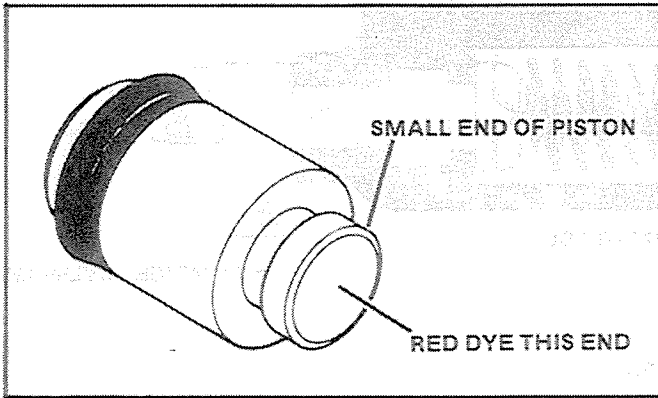


FIGURE 18

All pistons that cannot be identified with one of the above methods or that is a two-piece (aluminum/steel) detail should be discarded and re-

placed with wheel cylinder kit, Part Number 884871. This kit will contain two (2) pistons and two (2) cups. The dust covers, if carefully removed, can be reused.

Prior to reassembly, the cylinders should be checked and honed if necessary. The spider, if any shoe guidance ears have broken off, must be replaced.

The piston must be installed so that the small end of the piston is making contact with the brake shoe.

In addition to the above, the front axle and bushing in the brake arm assembly should be checked for wear. A new, improved bushing is available and should be installed if the existing bronze bushing is worn. A hardened axle is also available should the axle show signs of wear.

TROUBLESHOOTING

Brakes Drag

1. Improper brake shoe adjustment
2. Improper adjustment of master cylinder
3. Brake shoes froze to heel pin
4. Corrosion between parking brake, cable and cable housing
5. Broken brake lever spring
6. Loose wheel bearings
7. Wheel cylinders stuck

Brakes Grab

1. Leaking wheel cylinder
2. Brake drum scored
3. Grease or oil on lining
4. Air in lines
5. Wheel cylinder stuck
6. Lining loose on shoe

Spongy Brake Pedal

1. Air in hydraulic line
2. Improperly adjusted heel pin

Excessive Pedal Travel

1. Brake shoe adjustment needed
2. Fluid low in master cylinder
3. Faulty or misadjusted master cylinder



SAFETY WARNING: If brake pedal travels closer than one inch to vehicle floorboard, the brakes must be adjusted or repaired. Failure to adjust or repair as needed may cause loss of brakes. (Refer to Brake Adjustment.)

NOTES

