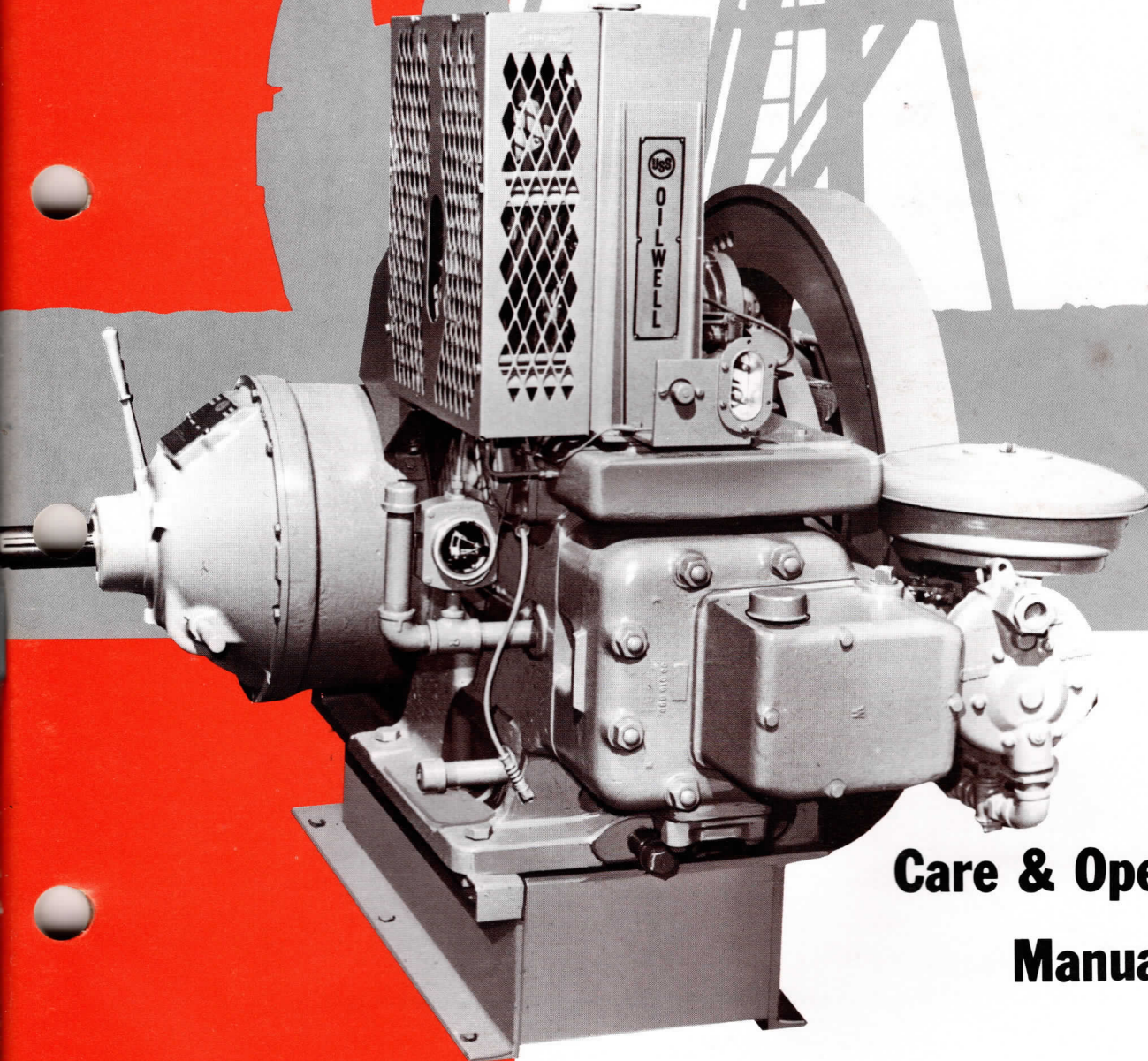




OILWELL ENGINES



**Care & Operation
Manual**

FOREWORD

This manual is published as a guide for the normal installation, care and operation of your OILWELL Engine. We have confined the scope of this presentation to the basic engine and the maintenance normally performed by the operator. If a situation requiring clarification or additional information is encountered, the manufacturer should be consulted.

All specifications and dimensions shown herein are those in effect at the time of publication approval. Illustrations are of typical products. Improvements in design, materials, production methods, etc. may necessitate changes in these products and result in inconsistencies between the contents of this publication and the physical equipment. We reserve the right to make changes in materials, equipment, specifications and models, and to discontinue models, without incurring any obligation for equipment previously or subsequently sold.

THE PICTURES, PHOTOGRAPHS, CHARTS, DIAGRAMS, DRAWINGS, VERBAL CONTENTS AND SPECIFICATIONS CONTAINED HEREIN ARE NOT TO BE CONSTRUED AS GIVING RISE TO ANY WARRANTY ON THE PART OF OILWELL. OILWELL MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, BEYOND THAT STIPULATED IN THE PURCHASE CONTRACT.

SAFETY

The operation and servicing of an engine, as with all machinery, can be hazardous, causing bodily injury or death, if you fail to exercise and maintain safe working practices and conditions:

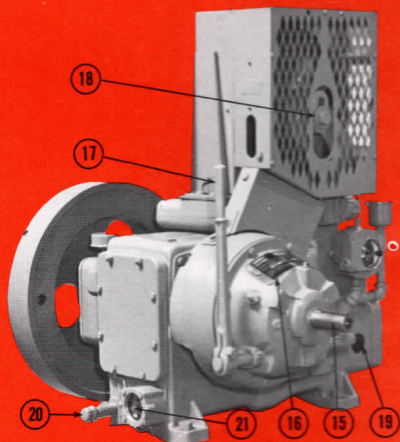
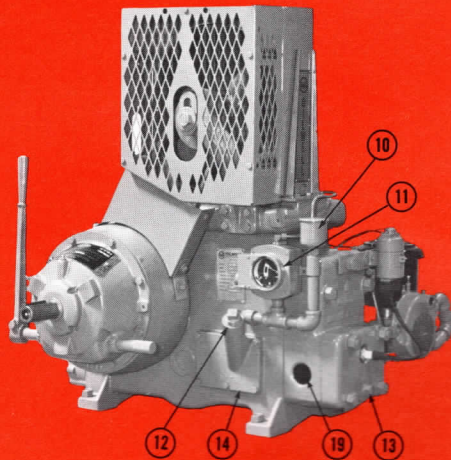
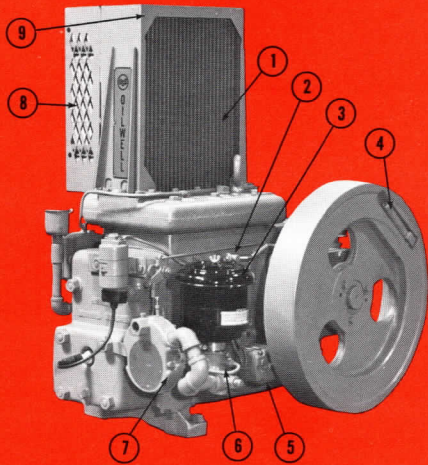
- Do not ignore any safety cautions, use only approved methods, materials and tools.
- Use only safe lifting or hoisting devices of adequate capacity and in good condition.
- Do not use high pressure air, toxic or flammable fluids for cleaning.
- Always wear appropriate safety apparel, avoid loose fitting clothing that could become entangled in moving machinery.
- Always disconnect, and block any driven equipment that could cause "Roll-back" while servicing the engine.



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General Nomenclature Model 98RC



1. Condenser
2. Speeder Knob
3. Carburetor Air Cleaner
4. Crank Handle
5. Magneto
6. Carburetor
7. Gas Regulator
8. Fan Housing
9. Condenser Housing
10. Water Filler
11. Water Level Gauge and Low Level Shut Down Switch
12. Lube Oil Filler
13. Water Drain
14. Valve Tappet Cover
15. Pilot Bearing Grease Fitting
16. Clutch Adjustment Cover
17. Clutch Lever
18. Fan Belt Adjustment
19. Exhaust Connection
20. Lube Oil Drain
21. Lube Oil Level Gauge

FIGURE NO. 1

Outline Drawing Model 98RC

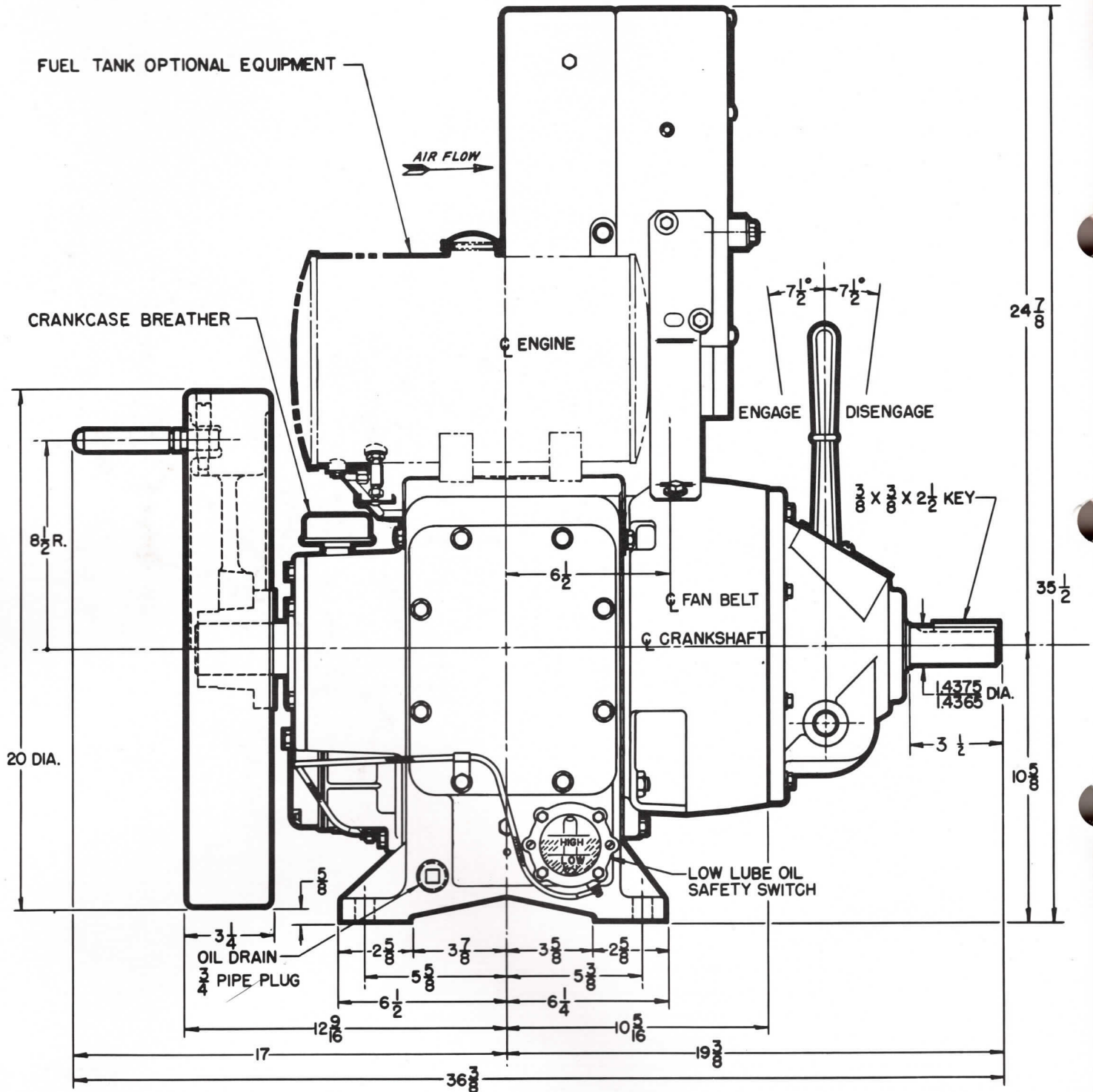


FIGURE NO. 2

Outline Drawing Model 98RC

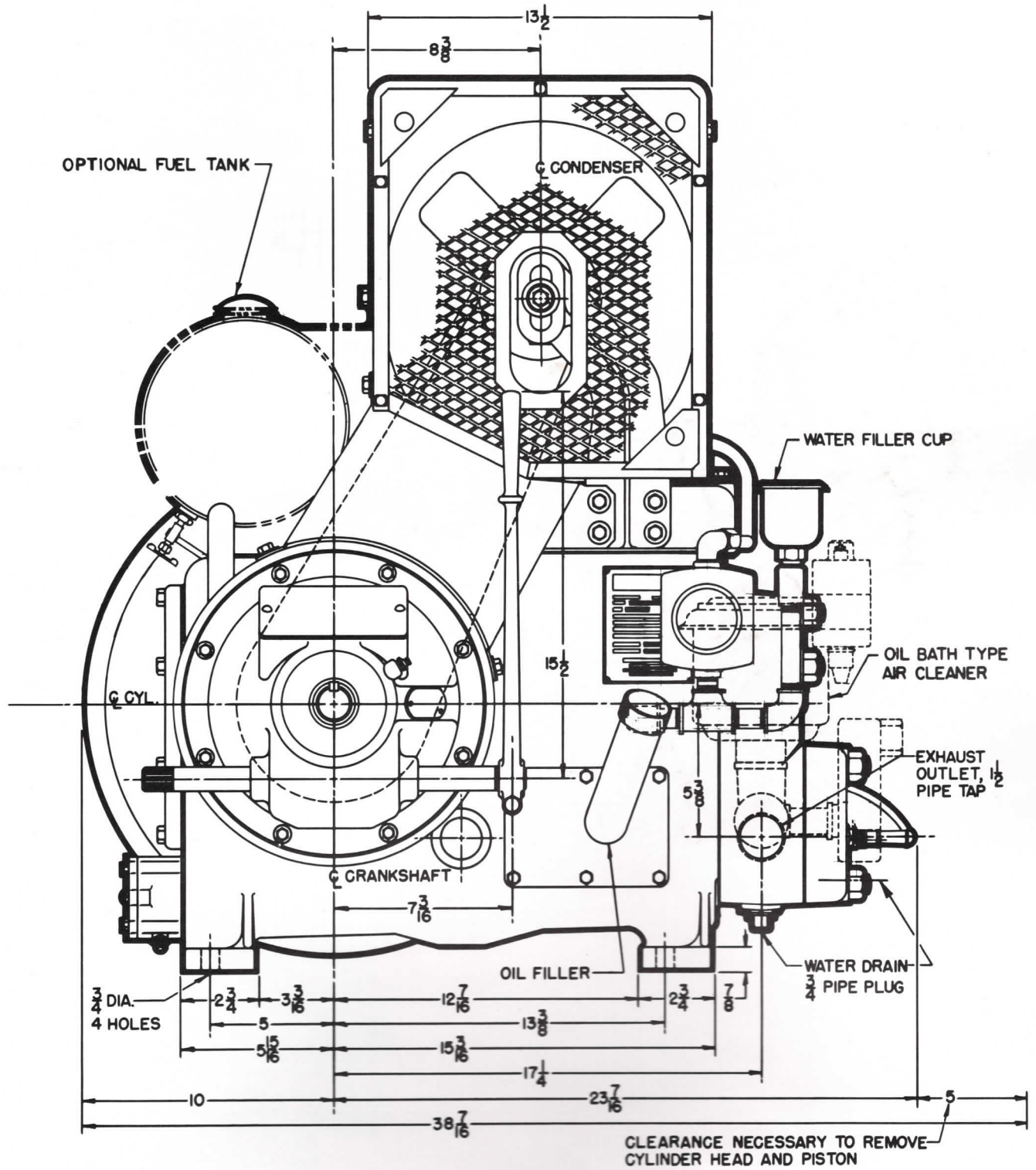
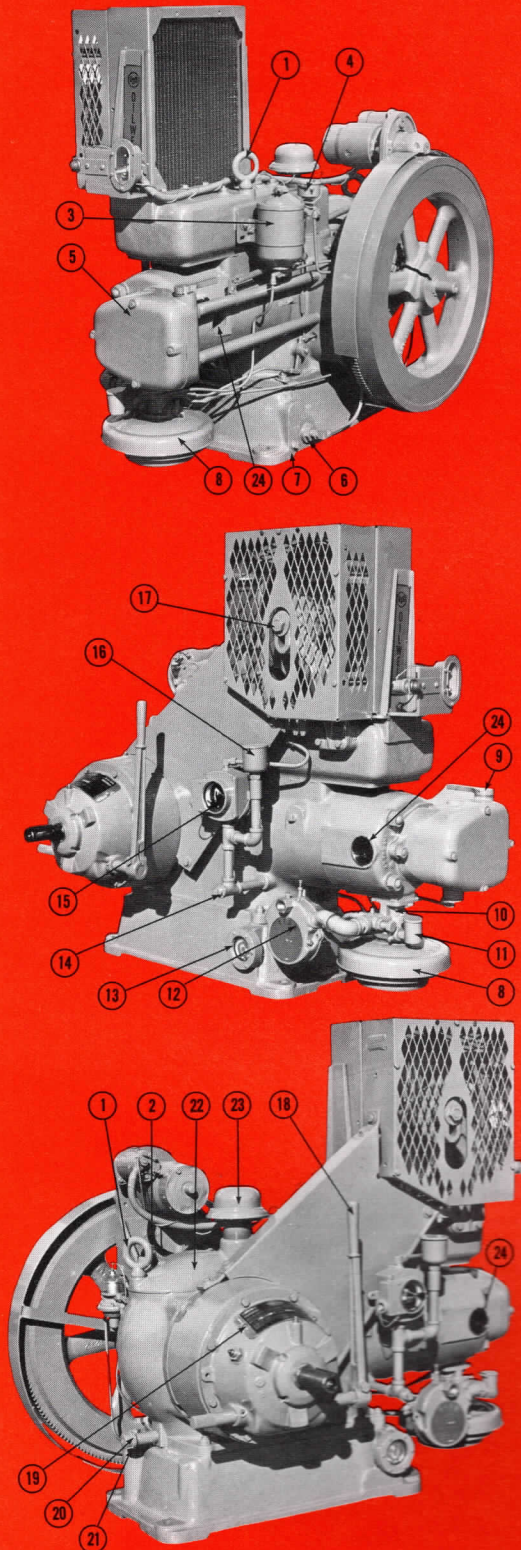


FIGURE NO. 3

General Nomenclature

Model B-12RC



1. Lifting Eyes
2. Lube Oil Filler
3. Lube Oil Filter
4. Lube Oil Pressure Gauge and Low Pressure Shut Down Switch
5. Valve Case Cover
6. Oil Suction Screen
7. Oil Sump Drain
8. Carburetor Air Cleaner
9. Compression Release
10. Carburetor
11. Priming Cup (Gasoline)
12. Gas Regulator
13. Oil Level Gauge
14. Water Drain
15. Water Level Gauge and Low Level Shut Down Switch
16. Water Filler
17. Fan Belt Adjustment
18. Clutch Lever
19. Clutch Adjustment Cover
20. Fuel Tank Filler (Gasoline)
21. Crankcase Oil Drain
22. Crankcase Cover
23. Crankcase Breather
24. Exhaust Connection

SHOWN WITH OPTIONAL
ELECTRICAL STARTING

FIGURE NO. 4

Outline Drawing Model B-12RC

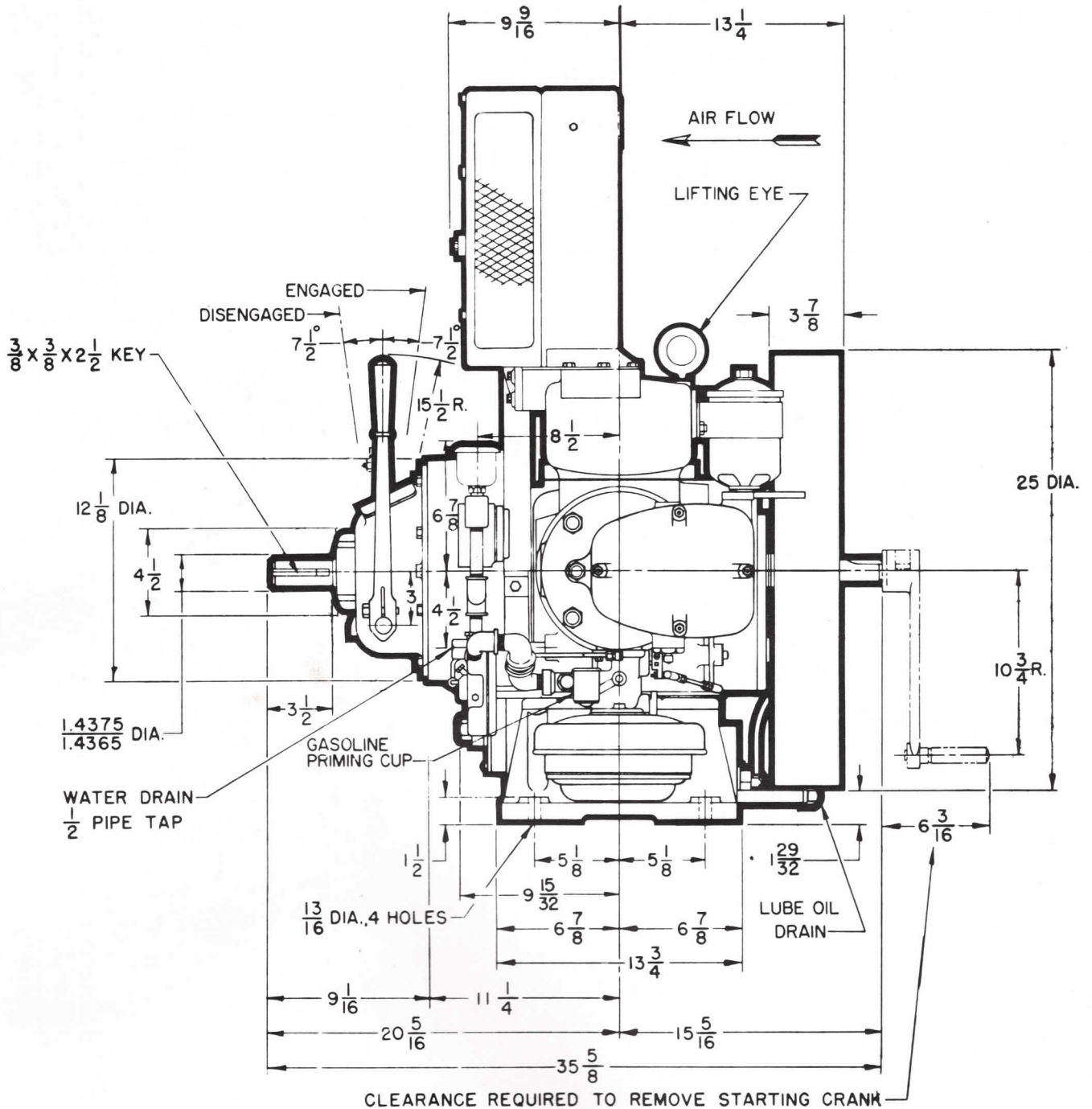


FIGURE NO. 5

Outline Drawing Model B-12RC

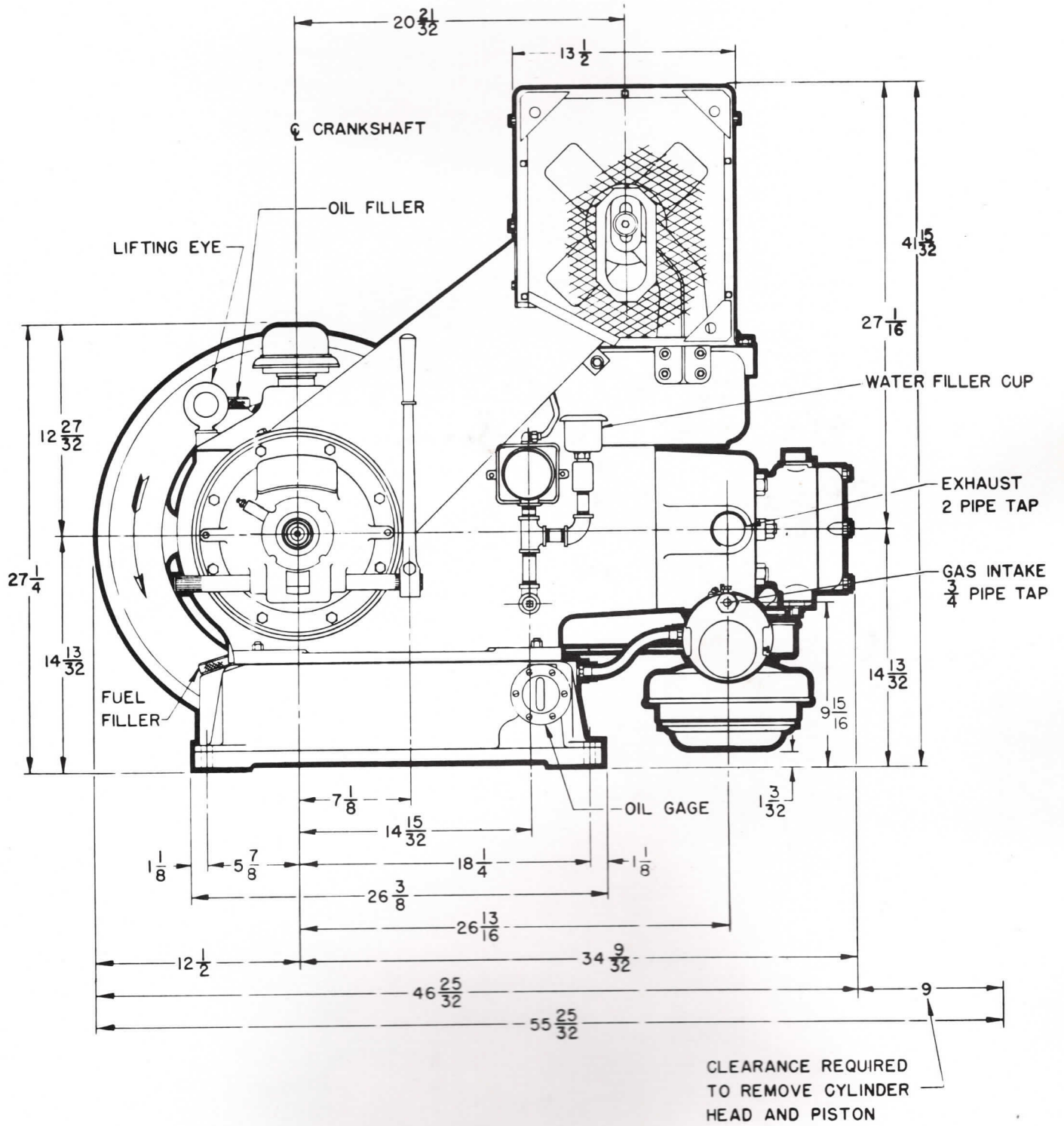
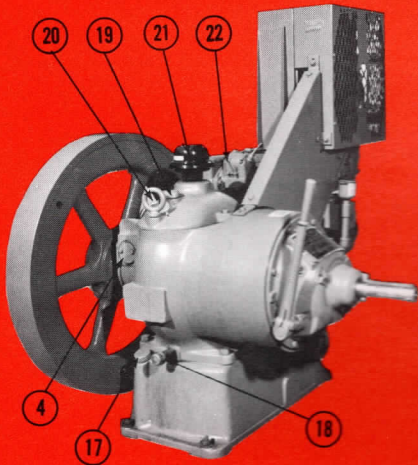
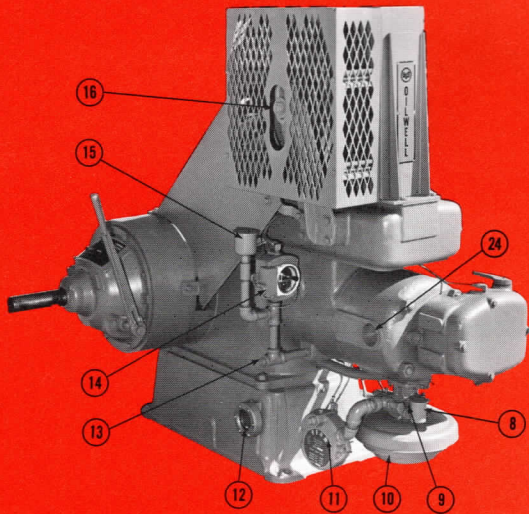
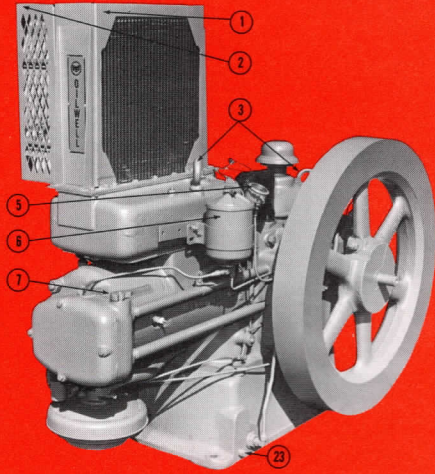


FIGURE NO. 6

General Nomenclature

Model E-15RC



1. Condenser Housing
2. Fan Housing
3. Lifting Eyes
4. Fuel Pump Mounting
5. Lube Oil Pressure Gauge and Low Pressure Shut Down Switch
6. Lube Oil Filter
7. Compression Release
8. Priming Cup (Gasoline)
9. Carburetor
10. Carburetor Air Cleaner
11. Gas Regulator
12. Oil Level Gauge
13. Water Drain
14. Water Level Gauge and Low Level Shut Down Switch
15. Water Filler
16. Fan Belt Adjustment
17. Fuel Filler (Gasoline)
18. Crankcase Oil Drain
19. Crankcase Cover
20. Lube Oil Filler
21. Crankcase Breather
22. Magneto
23. Oil Sump Drain
24. Exhaust Connection

FIGURE NO. 7

Outline Drawing Model E-15RC

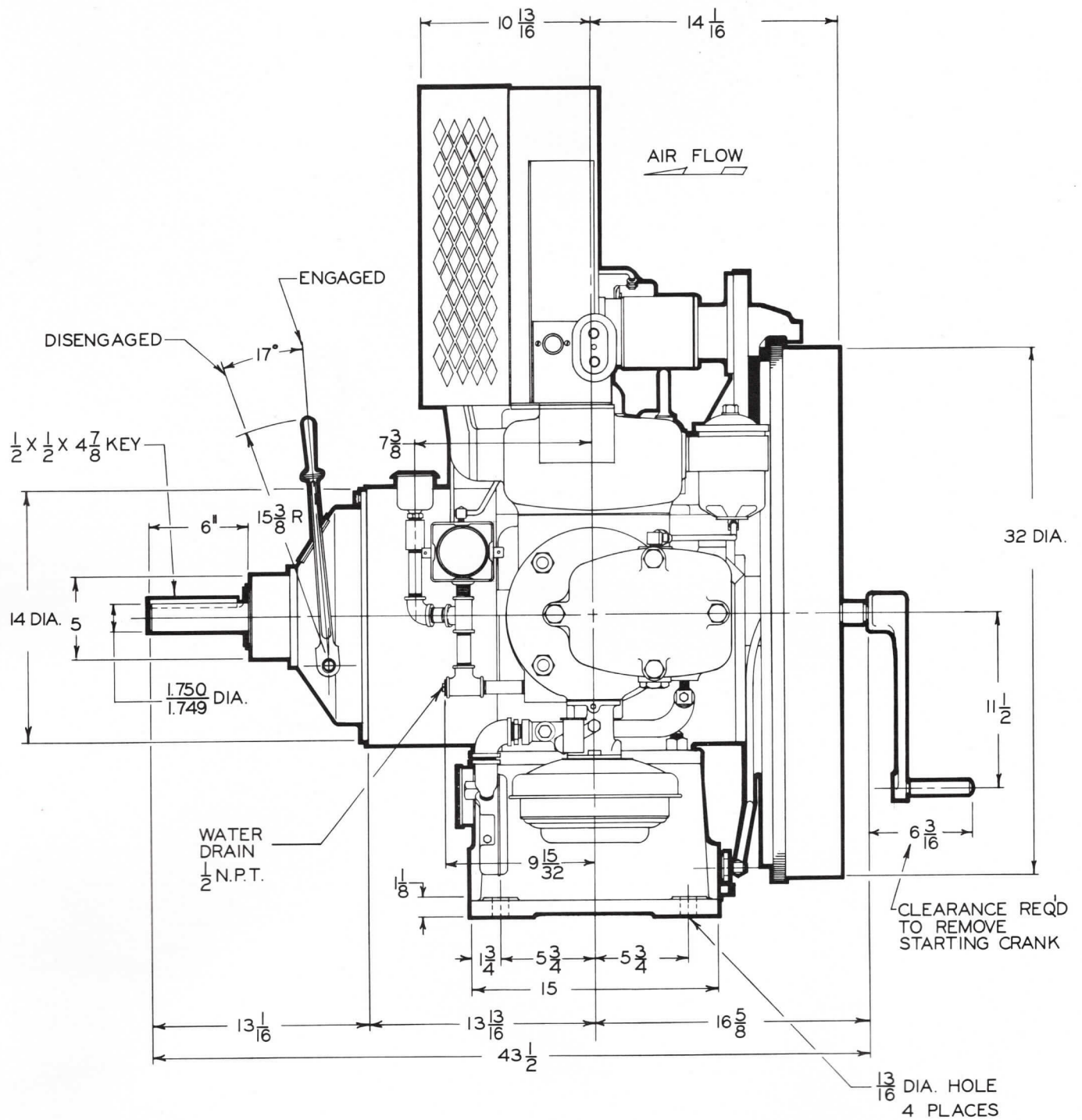


FIGURE NO. 8

Outline Drawing Model E-15RC

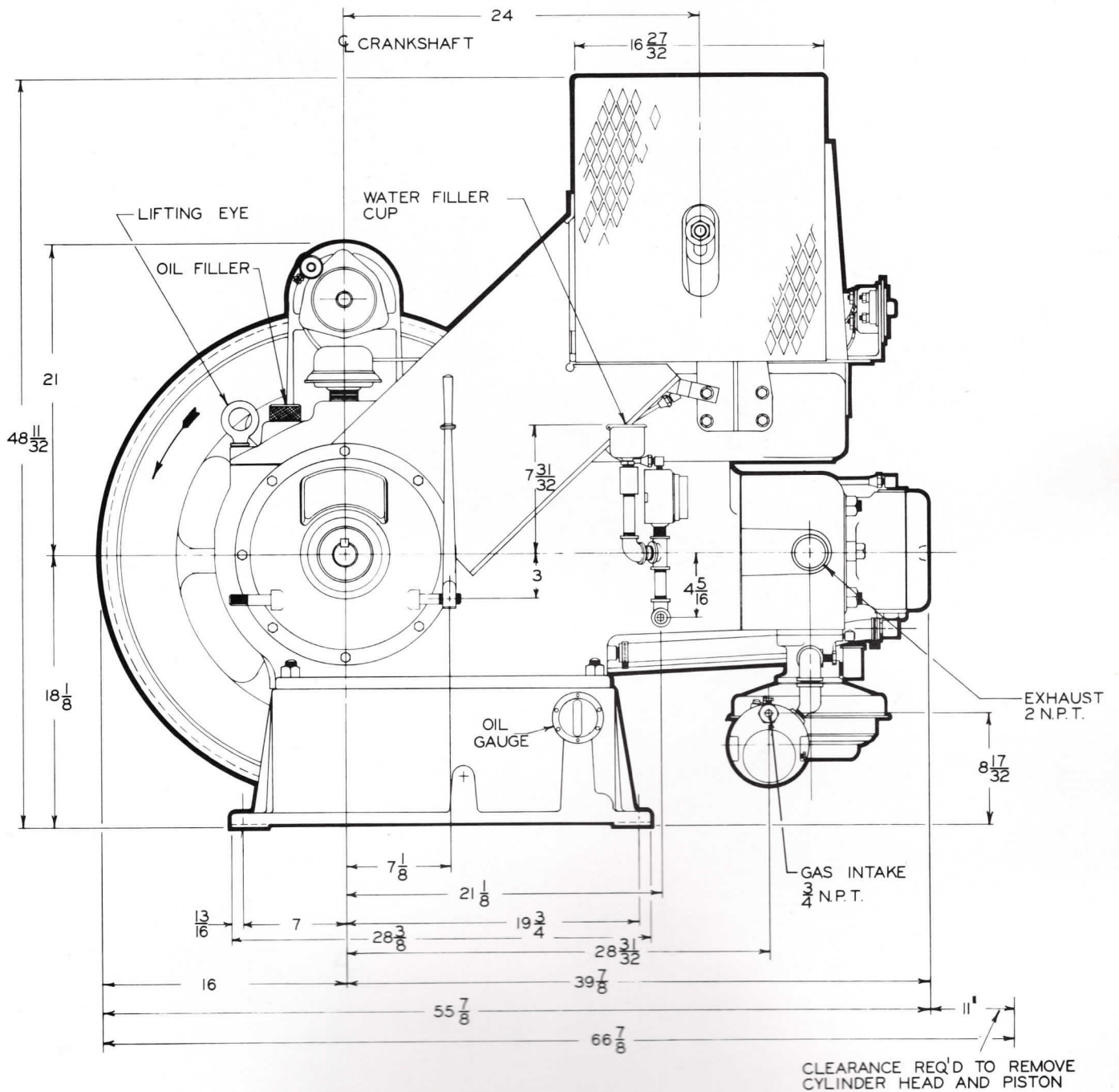
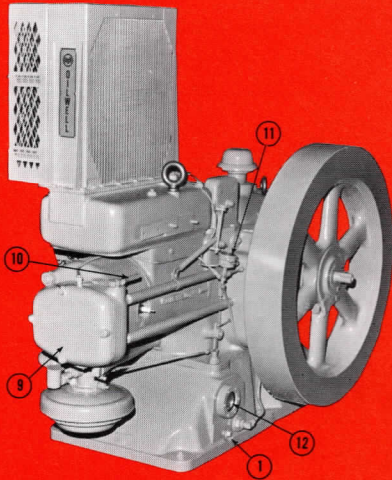


FIGURE NO. 9

General Nomenclature Model E-20RC



1. Lube Oil Sump Drain
2. Lube Oil Filter
3. Clutch Adjustment Cover
4. Lube Oil Filler
5. Crankcase Breather
6. Air Cleaner
7. Carburetor
8. Primer Cup (Gasoline)
9. Valve Lever Case
10. Compression Release Lever
11. Lube Oil Pressure Gauge and Low Pressure Shut Down Switch
12. Lube Oil Level Sight Gauge
13. Crankcase Lube Oil Drain
14. Magneto
15. Gas Regulator
16. Fan Belt Adjustment
17. Water Level Low Level Shut Down Switch
18. Water Filler Cup
19. Exhaust Connection
20. Water Jacket Drain

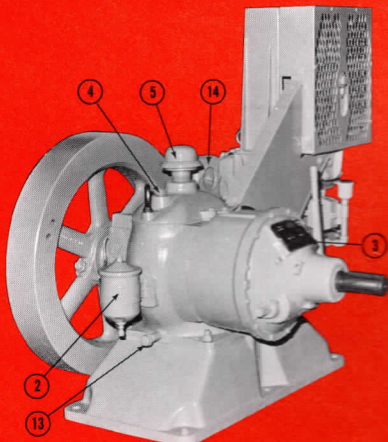
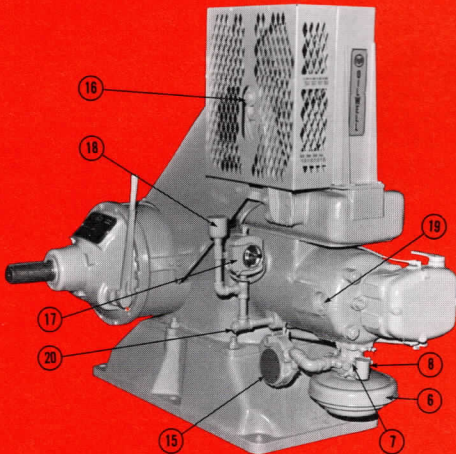


FIGURE NO. 10

Outline Drawing Model E-20RC

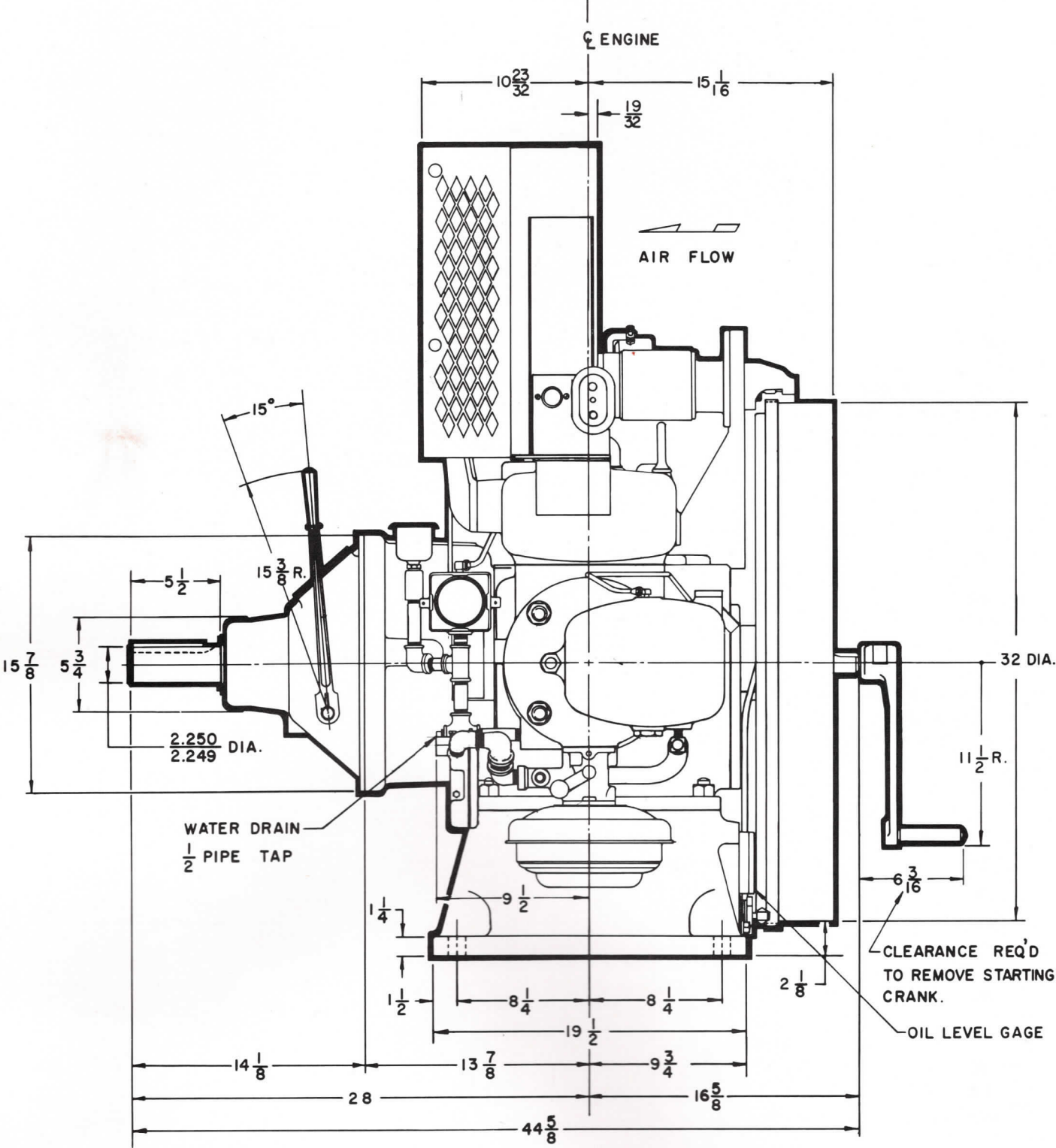


FIGURE NO. 11

Outline Drawing Model E-20RC

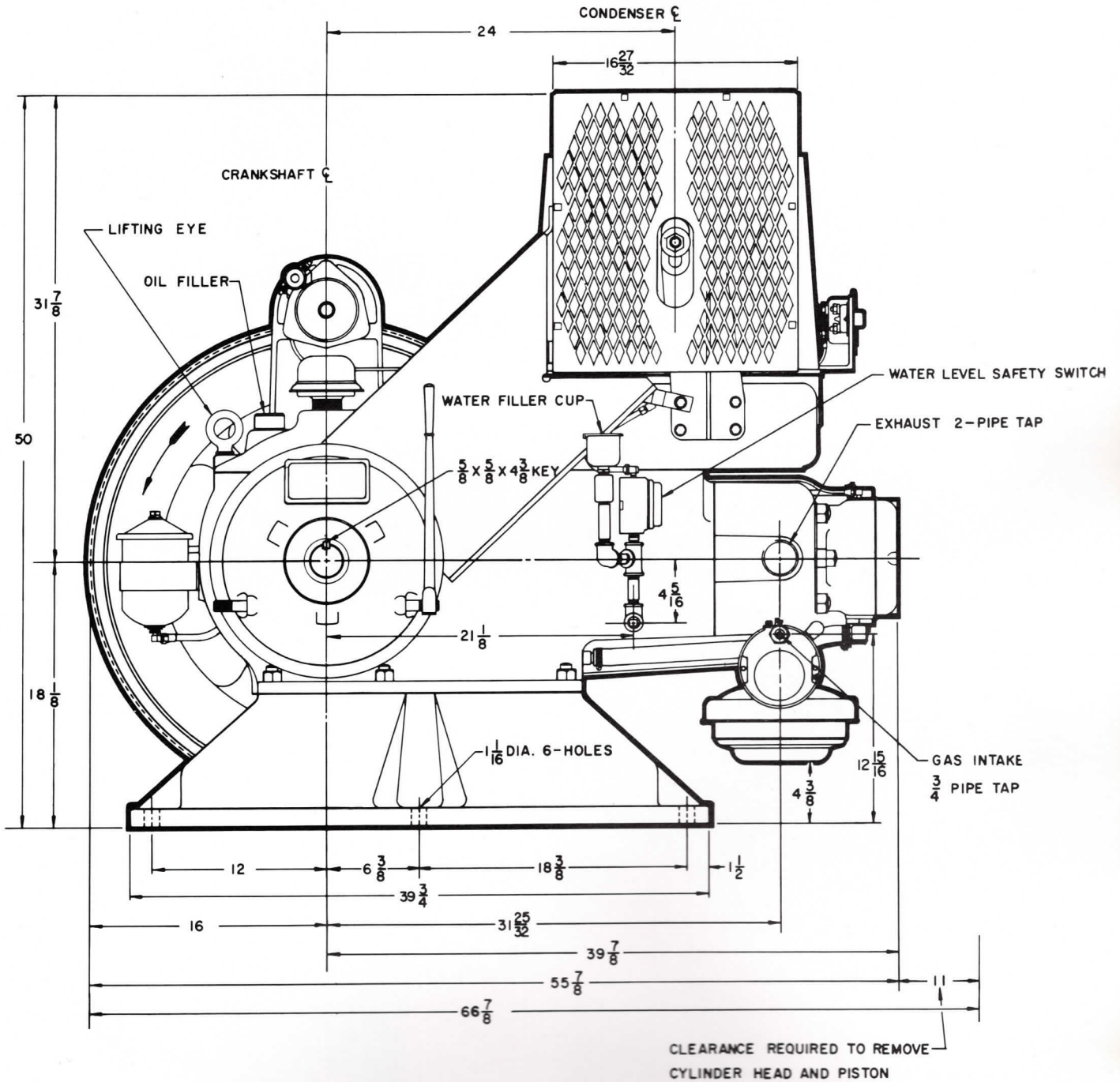
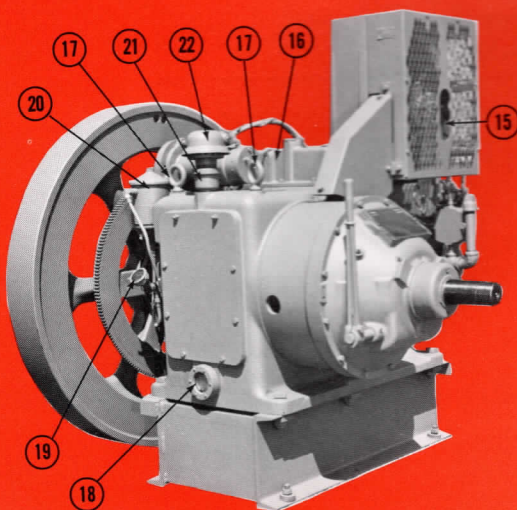
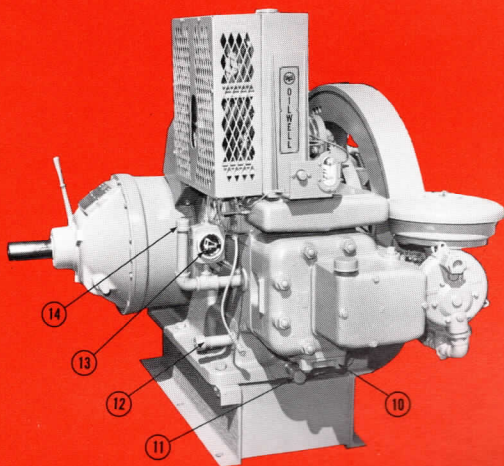
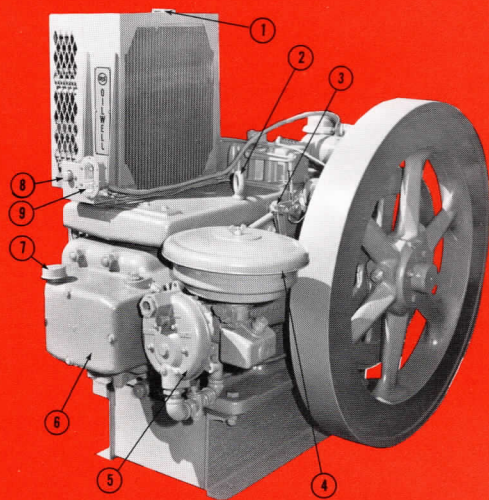


FIGURE NO. 12

General Nomenclature

Model F-32ARC & F-42ARC



1. Condenser Pressure Vent Cap
2. Lifting Eye
3. Speeder Knob
4. Carburetor Air Cleaner
5. Gas Regulator
6. Valve Cover
7. Crankcase Breather (Inlet)
8. Start Button
9. Start Cable Receptacle
10. Exhaust Pipe Flange
11. Lube Oil Drain
12. Water Drain
13. Water Level Gauge and Low Level Shut Down Switch
14. Water Filler
15. Fan Belt Adjustment
16. Governor Housing
17. Lifting Eyes
18. Oil Level Sight Gauge
19. Lube Oil Pressure Gauge and Low Pressure Shut Down Switch
20. Lube Oil Filter
21. Lube Oil Filler
22. Crankcase Breather

FIGURE NO. 13

Outline Drawing Model F-32ARC & F-42ARC

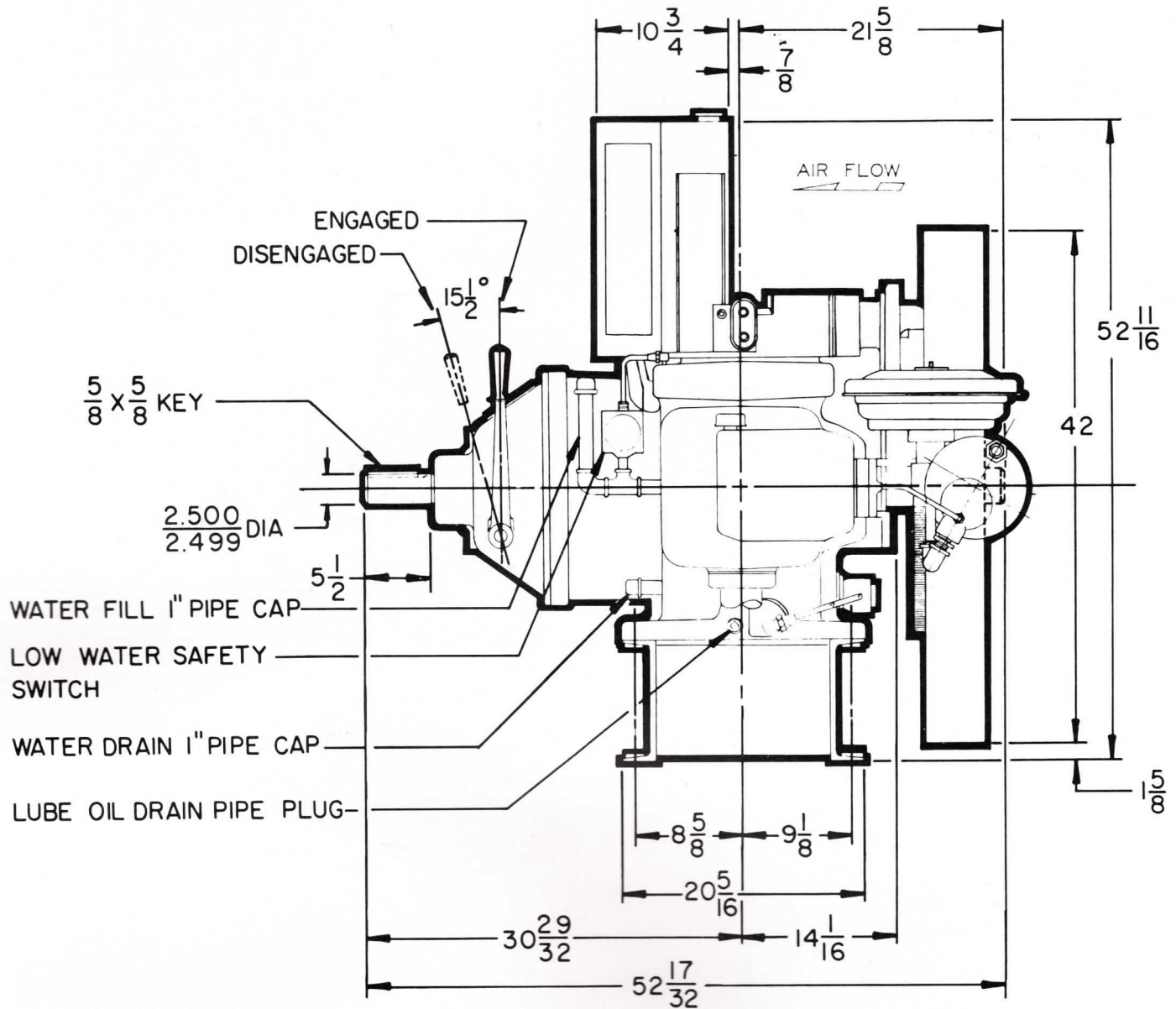


FIGURE NO. 14

Outline Drawing Model F-32ARC & F-42ARC

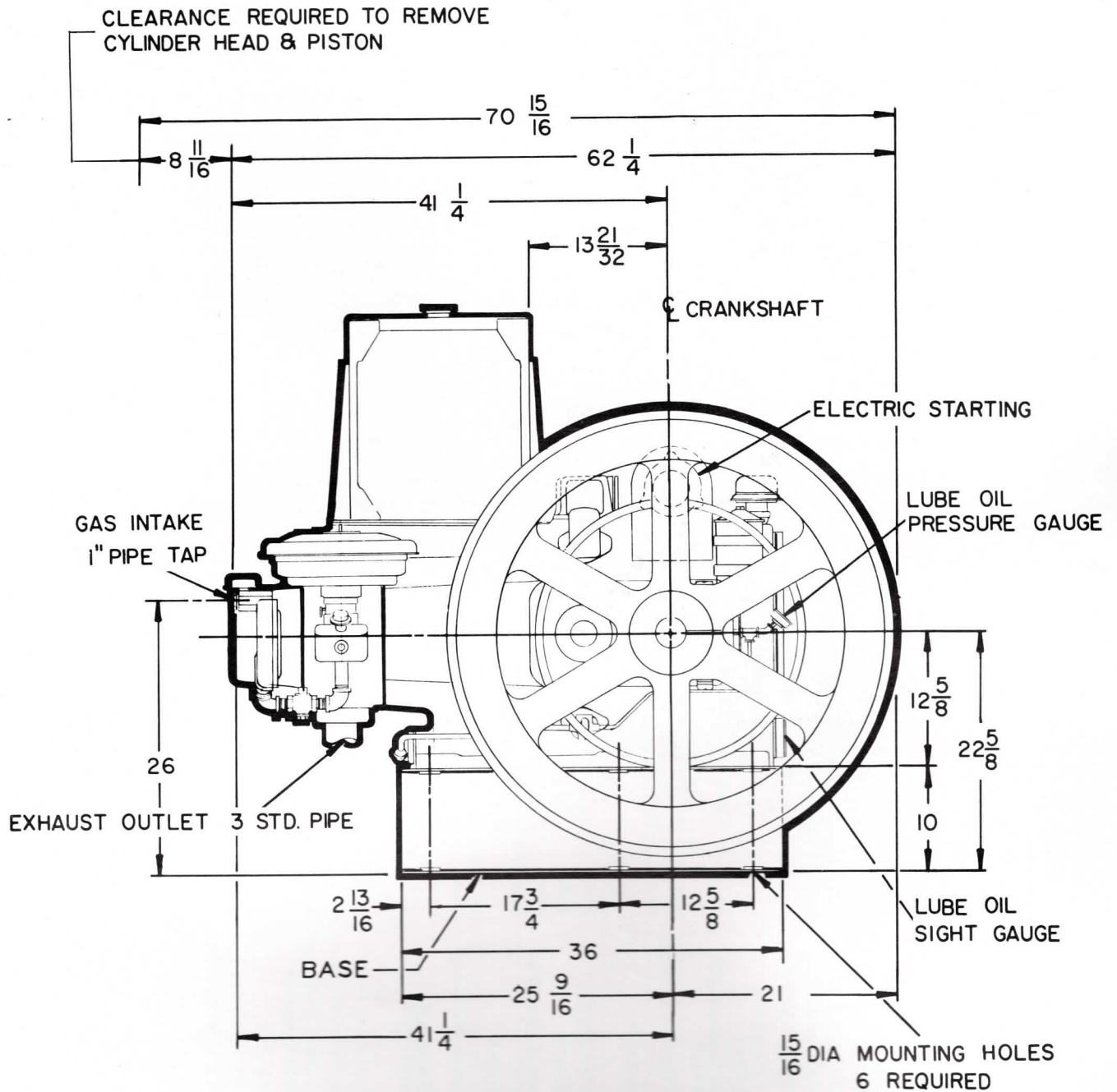


FIGURE NO. 15

Specifications

ENGLISH

DESCRIPTION	MODEL 98RC	MODEL B-12RC	MODEL E-15RC	MODEL E-20RC	MODEL F-32ARC	MODEL F-42ARC
Bore and Stroke	5" x 5"	5" x 6"	6" x 8"	6 1/4" x 8"	8" x 8"	8 3/4" x 8"
Piston Displacement Cu. In.	98	118	226	245	402	481
Recommended Speed Range (RPM)	500-1200	600-1000	350-750	450-750	400-750	400-750
Horsepower at Max. Rated Speed (Nat. Gas)	9	12	15	20	32	42
Cooling System Capacity (U.S. Gals.)	2 3/4	2 1/4	3 1/4	3 1/4	7 1/2	7
Lube Oil Capacity (U.S. Qts.)	4	7	11	12	16	16
Recommended Lube Oil Pressure (PSI)	—	20-35	20-35	20-35	35-45	35-45
Spark Plug Gap	.023"-.028"	.018"-.023"	.018"-.023"	.018"-.023"	.018"-.023"	.018"-.023"
Magneto Breaker Point Gap (When Used)	.014"-.016"	.014"-.016"	.014"-.016"	.014"-.016"	.014"-.016"	.014"-.016"
Valve Tappet Clearance (Cold)						
Intake	.010"	.005"	.005"	.005"	.006"	.006"
Exhaust	.015"	.015"	.015"	.015"	.030"	.030"
Valve Guide Bore (Reamer)	.375"	.375"	.4375"	.4375"	.5625"	.5625"
Piston to Liner Clearance (At Max. Dia.)	.004"-.006"	.0045"-.0065"	.0045"-.007"	.005"-.007"	.005"-.007"	.005"-.007"
Piston Ring End Gap						
Comp. Ring	.013"-.023"	.017"-.027"	.015"-.025"	.024"-.034"	.023"-.033"	.023"-.033"
Oil Ring	.013"-.023"	.013"-.023"	.015"-.025"	.024"-.034"	.023"-.033"	.023"-.033"
Piston Ring Groove Clearance						
No. 1 Comp. Ring	.003"-.0045"	.0035"-.005"	.003"-.005"	.003"-.005"	.0035"-.0055"	.0035"-.0055"
No. 2 & 3 Comp. Ring	.002"-.0035"	.0035"-.005"	.003"-.005"	.003"-.005"	.0025"-.0045"	.0025"-.0045"
Oil Ring	.002"-.0035"	.0015"-.003"	.0015"-.0035"	.0015"-.0035"	.002"-.004"	.002"-.004"
Piston Pin Diameter	1.4996"-.1.4999"	1.8115"-.1.812"	1.8115"-.1.812"	1.8115"-.1.812"	2.2497"-.2.2499"	2.2497"-.2.2499"
Piston Pin to Rod Bushing Clearance	.0005"	.0006"-.0015"	.0008"-.0015"	.0008"-.0015"	.0016"-.0023"	.0016"-.0023"
Piston Pin to Piston Clearance	.0002"-.0003"	.0002"-.0003"	.0002"-.0003"	.0002"-.0003"	.0001"-.0006"	.0001"-.0006"
Conn. Rod Bearing Journal Diameter	2.249"-.2.250"	2.249"-.2.250"	2.874"-.2.875"	2.999"-.3.000"	3.999"-.4.000"	3.999"-.4.000"
Conn. Rod Bearing to Journal Clearance	.002"-.005"	.002"-.005"	.003"-.006"	.0018"-.0048"	.003"-.006"	.003"-.006"
Conn. Rod Bearing Side Clearance	.008"-.012"	.008"-.012"	.005"-.008"	.008"-.012"	.005"-.013"	.005"-.013"
Conn. Rod Cap Nut Torque Lbs./Ft.	65-75	65-75	75-85	75-85	125-150	125-150
Cyl. Head Nut Torque Lbs./Ft.	100-110	160-170	160-170	300-325	200-225	200-225
Crankshaft Bearings End Clearance	.000"-.003"	.002"-.004"	.002"-.004"	.002"-.004"	.001"-.002"	.001"-.002"
	End Play	Preload	Preload	Preload	Preload	Preload

Specifications

METRIC

DESCRIPTION	MODEL 98RC	MODEL B-12RC	MODEL E-15RC	MODEL E-20RC	MODEL F-32ARC	MODEL F-42ARC
Bore and Stroke	127 x 127	127 x 152	152 x 203	159 x 203	203 x 203	222 x 203
Piston Displacement	1606	1934	3703	4015	6588	7882
Recommended Speed Range	500 - 1200	600 - 1000	350 - 750	450 - 750	400 - 750	400 - 750
Kilowatt at Max. Rated Speed (Nat. Gas)	7	9	11	15	24	31
Cooling System Capacity	10	9	12	12	28	26
Lube Oil Capacity	15	26	42	45	61	61
Recommended Lube Oil Pressure	—	138 - 241	138 - 241	138-241	241 - 310	241 - 340
Spark Plug Gap	.5842 - .7112	.4572 - .5842	.4572 - .5842	.4572 - .5842	.4572 - .5842	.4572 - .5842
Magneto Breaker Point Gap (When Used)	.3556 - .4064	.3556 - .4064	.3556 - .4064	.3556 - .4064	.3556 - .4064	.3556 - .4064
Valve Tappet Clearance (Cold)						
Intake	.254	.127	.127	.127	.1524	.1524
Exhaust	.381	.381	.381	.381	.762	.762
Valve Guide Bore (Reamer)	9.525	9.525	11.1125	11.1125	14.2875	14.2875
Piston to Liner Clearance (At Max. Dia.)	.1016 - .1524	.1143 - .1651	.1143 - .1778	.1270 - .1778	.1270 - .1778	.1270 - .1778
Piston Ring End Gap						
Intake	.3302 - .5842	.4318 - .6858	.3810 - .6350	.6096 - .8636	.5842 - .8382	.5842 - .8382
Oil Ring	.3302 - .5842	.3302 - .5842	.3810 - .6350	.6096 - .8636	.5842 - .8382	.5842 - .8382
Piston Ring Groove Clearance						
No. 1 Comp. Ring	.0762 - .1143	.0889 - .1270	.0762 - .1270	.0762 - .1270	.0889 - .1397	.0889 - .1397
No. 2 & 3 Comp. Ring	.0508 - .0889	.0889 - .1270	.0762 - .1270	.0762 - .1270	.0635 - .1143	.0635 - .1143
Oil Ring	.0508 - .0889	.0381 - .0762	.0381 - .0889	.0381 - .0889	.0508 - .1016	.0508 - .1016
Piston Pin Diameter	38.089 - 38.097	46.012 - 46.025	46.012 - 46.025	57.142 - 57.147	57.142 - 57.147	57.142 - 57.147
Piston Pin to Rod Bushing Clearance	.0127	.01524 - .03810	.02032 - .03810	.02032 - .03810	.04064 - .05842	.04064 - .0023
Piston Pin to Piston Clearance	.00508 - .00762	.00508 - .00762	.00508 - .00762	.00508 - .00762	.00254 - .01524	.00254 - .01524
Conn. Rod Bearing Journal Diameter	57.125 - 57.150	57.125 - 57.250	73.000 - 73.025	76.175 - 76.200	101.575 - 101.600	101.575 - 101.600
Conn. Rod Bearing to Journal Clearance	.0508 - .1270	.0508 - .1270	.0762 - .1524	.04572 - .12192	.0762 - .1524	.0762 - .1524
Conn. Rod Bearing Side Clearance	.2032 - .3048	.2032 - .3048	.1270 - .2032	.2032 - .3048	.1270 - .3302	.1270 - .3302
Conn. Rod Cap Nut Torque	7 - 8	7 - 8	8 - 10	8 - 10	14 - 17	14 - 17
Cyl. Head Nut Torque	11 - 12	18 - 19	18 - 19	34 - 37	33 - 25	23 - 25
Crankshaft Bearings End Clearance	.0 - .076	.051 - .102	.051 - .102	.051 - .102	.025 - .051	.025 - .051
	End Play	Preload	Preload	Preload	Preload	Preload

Brief Description

Your OILWELL Engine is designed to furnish either intermittent or continuous 24-hour-per-day service over a wide range of applications. All models are four-cycle, horizontal, water-cooled engines and will operate on Gasoline or Natural Gas.

These engines are designed to give you efficient service at minimum maintenance costs.

SPECIAL DESIGN FEATURES

1. Renewable wet-type liner construction which facilitates easy liner replacement.
2. All functional parts are completely enclosed making them dust and weatherproof.
3. Extra heavy duty counterbalanced crankshaft.
4. Positive splash and/or pressure lubrication, assuring adequate lubrication of all moving parts.
5. Condenser cooling provides for uniform operating temperature.
6. Fan belt readily accessible.
7. Clutch power take-off shaft overhang is reduced to absolute minimum. Clutch housing is drip proof.
8. Wide sturdy engine base mounting pads.

Installation

A. CAST IRON SLIDE RAILS:

Heavy, cast iron slide rails provide the best means of securing the engine to the base of the pumping unit. These rails give the engine a solid foundation which is rigid throughout its entire length and should be as low and as wide as possible.

Most pumping unit manufacturers have cast iron rails available for their units. Wherever possible, it is recommended that the slide rails be installed parallel to the cylinder bore (90° (1.571 rad.) to the crankshaft centerline). This method of installation permits belt tightening without disturbing engine alignment.

On installations where the slide rails are installed across the main skids of the pumping unit, extra heavy, cast iron rails are to be used.

The engine should be mounted preferably between the two main skids or over one of them. No part of engine should be allowed to overhang the skids unless adequately supported. The skids themselves must be evenly supported at all points to insure adequate stability.

IMPORTANT: Regardless of the arrangement of slide rails or base plates, all hold-down bolts and nuts must be kept tight. They should be checked and tightened at regular intervals.

B. HOW TO AVOID EXCESSIVE AND HARMFUL VIBRATIONS:

Looseness in any of the mountings, excessive overhang, inadequate rigidity of the slide rails, improperly secured base extension or other structural weakness will result in damaging vibration. If vibration is encountered immediate improvements in the installation must be made to provide the necessary rigidity.

It is essential that engine be bolted down securely. This requires the pumping unit frame or concrete mounting pad to be flat and level. If it is not, it will be necessary to resort to shimming to avoid putting a twist in engine block.

Whenever a pumping unit is mounted on a concrete base the same care should be taken to make sure full seating is acquired through either providing a flat surface or shimming. Another factor, sometimes overlooked, is to place base tie downs at the location which produce minimum vibration. There is no firm rule and the optimum tie down locations will have to be determined by trial and error whenever excessive vibrations are encountered.

C. OPERATING SPEEDS

All OILWELL engines are designed to run continuously at the rated speed at either full or part loads. It is better to run the engine at rated speeds where the engine torque curve is most favorable rather than drop to the minimum speed that the engine will handle the load involved. Therefore, it is important to select the proper sheave size for the engine. If for some reason, such as a desire to maintain a certain number of strokes per minute, a sheave size cannot be worked out to run the engine at its rated speed and if the engine is pulling a load at less than its continuous rating, the sheave size should be selected to maintain as high an engine RPM as possible. This will allow the engine to operate in the most favorable portion of its torque curve.

Always operate the engine at sufficient speed to avoid "lugging" the engine. Over-loading the engine or operating at speeds just sufficient to meet the horsepower load can cause premature clutch wear, connecting rod bearing wear and other associated problems.

D. POSITION OF SHEAVE ON POWER TAKE OFF:

Install drive sheave on the clutch shaft as close as possible to clutch housing to minimize load overhang. Figure No. 16.

Side loading, with possible distortion of the clutch housing, increases rapidly as the "X" distance (the distance between the clutch shaft shoulder and the center of the drive sheave) is increased. Never move the sheave outward on the clutch shaft to obtain belt alignment, always move the complete engine as required, keeping the sheave in against the shaft shoulder.

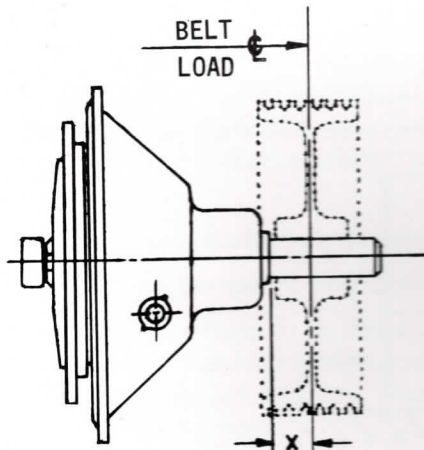


FIGURE NO. 16

E. DRIVE BELTS:

The selection of the correct number of drive belts must be considered carefully to assure good belt life and to prevent clutch damage by the use of an excessive number of belts. No more than the required number of belts (as determined by the actual engine load) should be installed as each belt imposes a side load on the clutch and if excessive, will result in premature wear and possible failure of the clutch. Only matched belts must be used to prevent overtightening to produce proper tightness in longest belt of unmatched set.

To check belt tension proceed as follows:

1. Measure center to center distance.
2. Place a straight edge or a string drawn taut along the top of the belt as indicated by "T". Figure 17, to serve as a reference point.
3. Refer to the chart, Figure 18, and determine the force to be applied at the center of the belt span to deflect belt 1/64" (.397 mm) for every inch (25.4 mm) of belt span.
4. Using a hook type spring scale, pull downward until the specified pull is reached. Hold this pull and measure the belt deflection (do not include the normal belt sag as part of the deflection measurement).

BELT DEFLECTION

1/64" (.397 mm) PER INCH (25.4 mm) OF SPAN

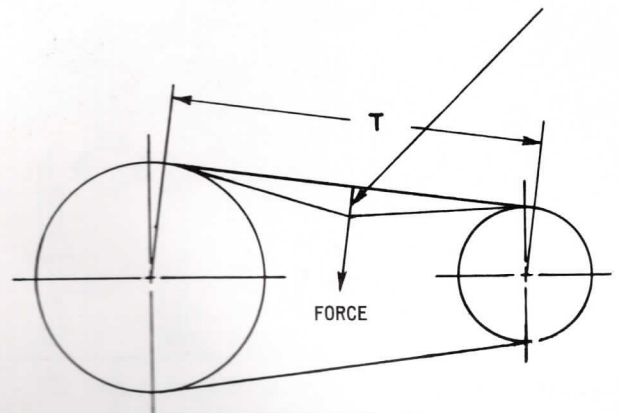


FIGURE NO. 17

FORCE TO DEFLECT BELT

Belt Cross Section	Readjustment of Belts		First Adjustment of New Belts	
	Pounds	Newtons	Pounds	Newtons
B	4	18	5½	24
C	8¾	39	12	53
D	17	76	23	102

FIGURE NO. 18

5. Repeat procedure for each belt.
6. Never overtighten belt adjustment to compensate for a loose belt. Replace mismatched belts to assure uniform loading of all belts.

F. EXHAUST ARRANGEMENT:

The usual exhaust system used with the engine out-of-doors, consists of a muffler attached to the exhaust connections in the cylinder head by a short length of pipe.

An exhaust pipe installed in a vertical position must be equipped with a muffler or a rain trap to prevent moisture from entering the exhaust stack and causing serious damage to the engine.

If an alternate exhaust pipe system is required, it should be planned to keep the overall pipe length to a minimum. For systems to 10 ft. (3.048 m) in length, use the same size pipe as the exhaust port in the cylinder head. If more than 10 ft. (3.048 m) length is required the next larger size pipe should be used. In no instance should the exhaust pipe diameter be reduced from the size of pipe thread of the cylinder-head-exhaust port, or a back pressure will be built up and cause reduction in power and unnecessary wear to engine parts. Further, where 90° (1.571 rad) turns are required, use a long sweep elbow or two 45° (.0785 rad) elbows to eliminate sharp bends in the pipe. Regular pipe elbows will cause excessive back pressure.

G. FUEL SYSTEM

1. Always use volume tank in gas supply line and have connection from volume tank to carburetor inlet as short as practical. Use flexible hose or flexible coupling in line from volume tank to carburetor. See Figure No. 19.
2. Connection from volume tank to carburetor should never be smaller than the gas inlet pipe size of the carburetor regulator.
3. Pressure in volume tank should be regulated so as not to exceed 3 to 5 oz./sq. in. (0.834 to 1.39 kPa) (Equiv. to 5.2 to 8.7 inches (132 to 221 mm) of water column pressure).
 - A. Field experience has shown that high gas pressure is a common cause of hard starting.
4. Volume tank and lines to tank should have sediment blow-down valves located in bottom of tank and in low spots in lines to remove accumulation of moisture and crude oil.
5. As a safety feature, a dial cock should be installed between the volume tank and the carburetor regulator. The dial cock can also be used to quickly correct an over rich mixture in the carburetor if incorrect starting procedures are used.

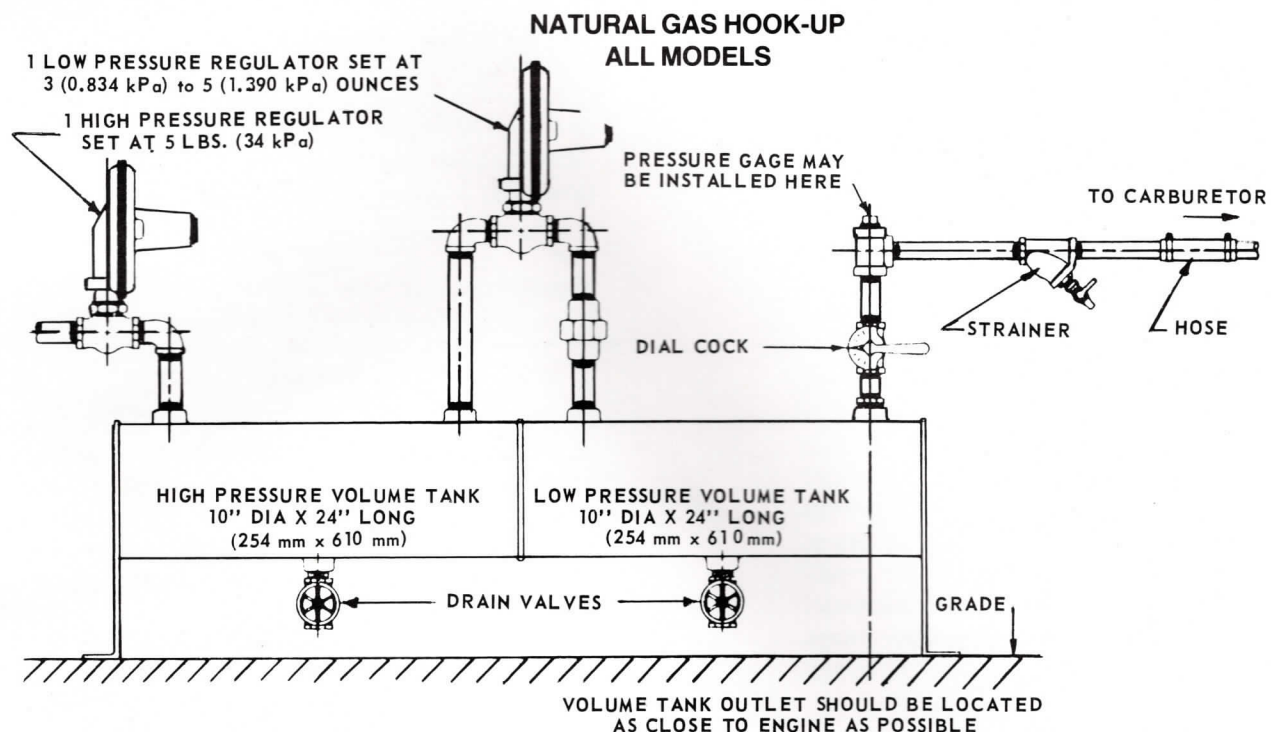


FIGURE NO. 19

Before Operation Checks

A. ALL MODELS:

1. See that the engine is secure on its foundation.
2. Fill the crankcase with the correct grade and weight of lubricating oil, see lubricating oil specifications.
3. Fill cooling system (see anti-freeze recommendations). NOTE — Do not fill beyond the bottom of the fill cup.

B. USING GASOLINE

1. Fill the fuel tank with gasoline. DO NOT USE LOW OCTANE GASOLINE. The use of low grade fuel will result in detonation and severe engine damage.
2. Magneto Timing must be retarded for gasoline operation. The degree of retard will be determined by the octane grade of the fuel and the engine load.

If detonation is encountered with retarded magneto timing, and using the highest octane fuel available the engine load must be reduced. See "Operating Speeds", paragraph "C", page 25.

Placing In Operation

A. USING NATURAL GAS

1. Disengage Clutch.
2. Depress button on low oil pressure shut down switch to "lock-out" the switch while engine is coming up to speed.
3. Operating with natural gas, first time, set the gas-metering screw by screwing it down tight which is its shut-off position. Then turn it counterclockwise approximately 1½ turns and lock in this position by means of the lock nut located at the base of the screw.
4. Release compression on engines equipped with a compression release.
5. Turn on gas supply.
6. Close choke lever.
7. Depress the primer button (on engines equipped with gas regulator) which provides the small quantity of gas initially required to start the engine. Care should be taken not to over prime.
8. Crank engine until momentum is obtained.
9. Close compression-release while cranking.
10. When the engine starts to fire, open the carburetor choke approximately half way and hold until the engine fires regularly, then place choke in full open position.
11. After engine starts, allow it to warm up before engaging clutch.

MODEL 98RC CARBURETOR

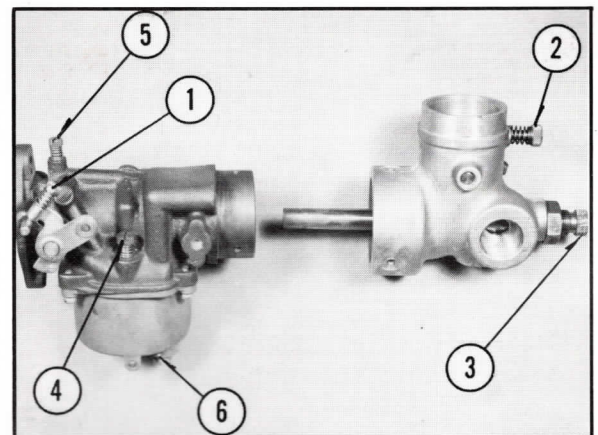


FIGURE NO. 20

1. Throttle Stop Screw
 2. Choke Valve Stop Screw
 3. Gas Metering Valve
 4. Main Power Needle
 5. Idle Valve (Gasoline)
 6. Drain
12. After engine is running, the gas-metering screw can be adjusted as explained in (3) so that the engine will run smoothly at its full continuous rated load. This adjustment need not be changed, regardless of the load, unless the gas pressure is changed.

STOP the engine by shutting off gas supply. KEEP GAS SUPPLY CLOSED when the engine is not running or when operating on gasoline.

**MODEL 98RC CARBURETOR AND
GAS REGULATOR**

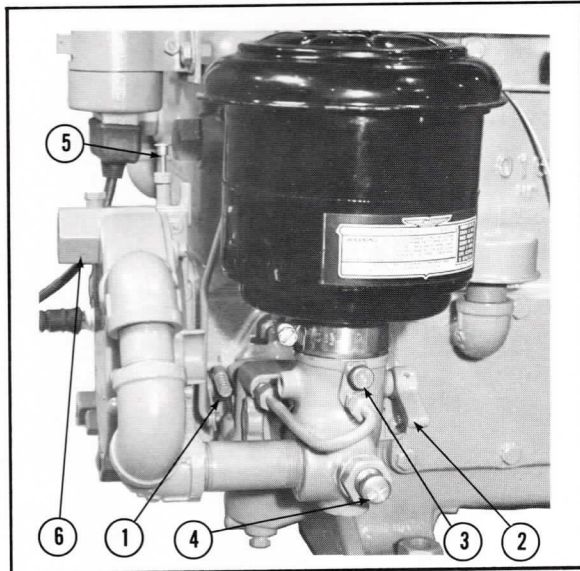


FIGURE NO. 21

1. Idle Speed Stop Screw
2. Choke Lever
3. Choke Stop Screw
4. Gas Metering Valve
5. Gas Primer Button
6. Gas Supply Connection

**MODEL B-12RC, E-15RC AND E-20RC
CARBURETOR AND GAS REGULATOR**

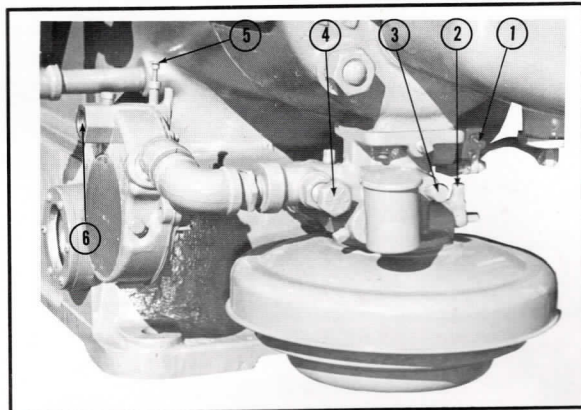


FIGURE NO. 22

1. Idle Speed Stop Screw
2. Choke Lever
3. Gasoline Metering Valve
4. Gas Metering Valve
5. Gas Primer Button
6. Gas Supply Connection

B. USING GASOLINE

1. Shut off natural gas supply at the dial cock, if there is a natural gas connection. Without a natural gas connection, the gas-intake opening should be closed to prevent dirt from entering the engine. Open the gasoline-needle valve $\frac{3}{4}$ to 1 turn.

**MODEL F-32ARC AND F-42ARC
CARBURETOR AND FUEL CONNECTIONS**

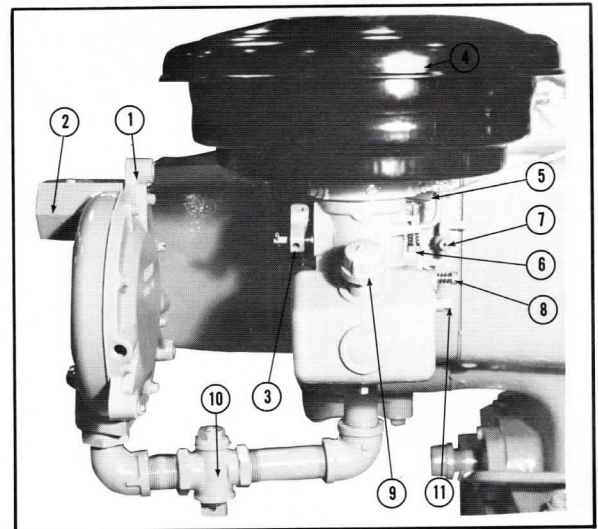


FIGURE NO. 23

- | | |
|--------------------------|-------------------------------------|
| 1. Primer | 7. Compression Release |
| 2. Gas Supply Connection | 8. Gasoline Metering Valve |
| 3. Choke Lever | 9. Carb. Filler (Gasoline) |
| 4. Air Cleaner | 10. Gas Metering Valve |
| 5. Throttle Spring | 11. Gasoline Return Line Connection |
| 6. Choke Stop Adjustment | |

2. Disengage clutch.
3. Depress button on low oil pressure shut down switch to "Lock-out" the switch while engine is coming up to speed.
4. Fill fuel tank and open fuel shut-off valve. NOTE: All models, (except the "98" engine) are equipped with a small auxiliary fuel reservoir either on or within the carburetor for starting purposes only.
5. Release compression on engines equipped with a compression release.
6. Close choke valve.
7. Crank engine until momentum is obtained. Close compression release. Quickly place choke in open position except on "F" models. On models F-32ARC and F-42ARC, and intermediate choke stop is provided for gasoline operation.
8. After starting the engine, allow it to warm up before engaging clutch.
9. Adjustment of the gasoline-needle valve is required for proper fuel and air mixture to reach the point where the engine will run and accelerate smoothly.

Lubrication

A. GENERAL DESCRIPTION: ALL MODELS

1. Model 98RC: The oil is picked up from the main supply by the camshaft gear, the lower portion of which is submerged in the lubricant. The action of the cam gear conveys the oil to the remainder of the gear train.

All other internal moving parts are lubricated by a splasher on the connecting rod cap. Baffles are installed or cast into the cylinder block to collect and direct the lubricant to the critical areas.

2. Models B-12RC and E-15RC: The lubrication system is simple in construction. Oil is circulated, under pressure, by a positive-displacement, lubricating-oil pump, which transfers the oil from the main oil sump in the engine subbase to the oil filter. From the filter, the oil flows to the valve lever case for lubrication of the valves and levers. An additional quantity of oil is continuously delivered to the engine crankcase; maintaining a constant level and providing ample oil for splash lubrication of the connecting-rod bearing, piston pin, piston, main bearings and other internal parts.

3. Model E-20RC: Oil is circulated under pressure, by a positive displacement lubricating oil pump from the oil sump in the engine subbase, to the full flow oil filter. From the filter, the oil flows to the oil distributor ring on the crankshaft for connecting rod bearing lubrication, and to the valve lever case for lubrication of valves and levers. An additional quantity of oil is continuously delivered for camshaft lubrication and to the engine crankcase; maintaining a constant level for splash lubrication of cylinder walls, piston pin and other internal parts.

4. Models F-32ARC and F-42ARC: The engine is lubricated by a combination pressure-splash system. Oil is circulated, under pressure, by a positive-displacement pump which transfers the oil from the crankcase sump to the full-flow oil filter. From the filter oil flows under pressure to the connecting rod bearing, piston pin and to the valve mechanism for lubrication of the valves and valve levers. All other internal moving parts are lubricated by an oil splasher attached to the connecting rod cap and by oil conveyed by the gear train. Baffles are installed or cast into the cylinder block to collect and direct the lubricant to critical areas.

CLUTCH LUBRICATION — ALL MODELS

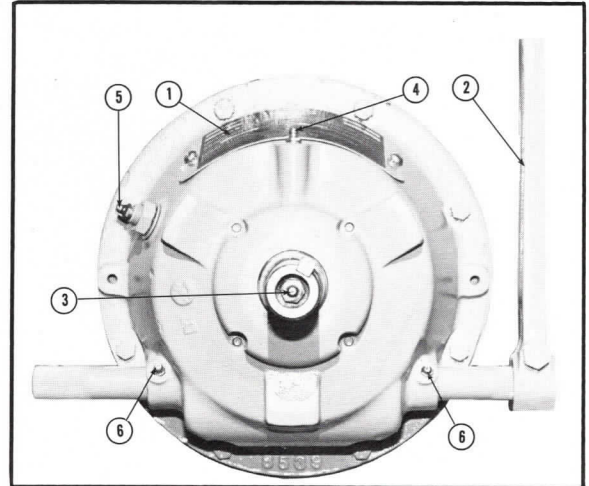


FIGURE NO. 24

1. Inspection and adjustment cover
2. Operating lever
3. Pilot bearing lubrication fitting
4. Shaft bearing lubrication fitting
5. Throw-out bearing lubrication fitting
6. Cross shaft lubrication fitting

B. LUBRICATION REQUIREMENTS: ALL MODELS

1. Crankcase Lub Oil — use a reliable brand of lubricating oil meeting API specifications MS, DG or better. For temperatures below 55°F (13°C) use SAE 20; above 55°F (13°C) use SAE 30. For continuous cold weather use 10W30 or 10W.

When the engine is used on known light loads, the first week of operation should be with ML or MM grade, SAE 20 to assure proper "break-in" and seating of the piston rings.

2. Clutch Lubrication — Use a high grade, multi-purpose Lithium-Base, grease or equivalent, which is recommended for use in connection with antifriction bearings.

Lubricate clutch throw-out bearing, shaft-bearing, pilot bearing (unless sealed type) and operating shaft after each week of operation, through fittings provided. Do not over grease. Excessive lubrication may result in grabbing or slipping of the clutch.

3. Fan Lubrication — a. Repack sealed bearing type fan bearings every 12 months. b. Use special purpose grease made to Military Specification MIL-G-7711A. (The grease is adapted to extreme variations in temperature.)

C. CRANKCASE BREATHER: ALL MODELS

All engines are equipped with one of several types of crankcase ventilating systems. Each system uses one or more breather assemblies to effectively remove moisture and vapors from the engine.

These breathers normally require no attention other than periodically washing with solvent. It is recommended this be done each time the crankcase lubricant is changed. It is not necessary to oil the breather after washing.

D. LUBE OIL CHANGE ALL MODELS

Oil change should be made every week during the first month of operation. After the breaking-in period, lubricating oil should be changed approximately every 30 days or as required, depending upon individual operating conditions.

Oil changes should always be made while the engine is hot, as any carbon and sludge will be in suspension and the hot oil will drain quickly from the engine. The crankcase should be flushed out with a suitable solvent periodically as required to eliminate carbon and sludge accumulation.

NOTE: On all models B-12RC, E-15RC and E-20RC engines it is necessary to remove two drain plugs to completely drain crankcase. One is located at the bottom of the engine base near the lube oil suction line. The other is located at the rear of the cylinder block.

The following should be done each time the oil is changed.

1. Install a new filter cartridge in the oil-filter assembly. (Models B-12RC, E-15RC, E-20RC, F-32ARC and F-42ARC).
2. Clean the air filter and refill with fresh oil.
3. Clean crankcase breather.

Clean the lubricating-oil-suction-screen assembly periodically. Any restrictions in this screen seriously limits the oil flow to the oil pump and may result in a damaged engine.

Lube oil level should be checked daily and maintained within the range of the sight gauge.

E. LUBE OIL PRESSURE GAUGE: ALL MODELS EXCEPT 98RC

This gauge serves to indicate that oil is being circulated from the pump to all points of the engine and will indicate the proper setting of both the high-pressure-relief valve and the low-pressure shut down switch.

1. Normal pressure: Gauge should register 55 psi (379 kPa) when engine starts and drop to approximately 25 to 45 psi (172 to 310 kPa) after engine is warmed up.
2. Abnormally high pressure: When the pressure continues to register 55 psi (379 kPa) or above after the engine has warmed up, it is an indication that the filter cartridge in the oil-filter assembly or the oil lines have become clogged and need to be checked. An indicated high pressure may also be due to a defective oil-pressure gauge.
3. Abnormally low pressure: insufficient oil pressure may be due to loose connections in the oil lines, a broken oil line, pressure-relief valves not functioning, clogged suction screen or mechanical failures of the lubricating-oil pump. Low oil pressure on models E-20RC, F-32ARC and F-42ARC engines may also be due to worn connecting rod bearings or lube oil distributor ring. An indicated low oil pressure may also be due to a defective oil-pressure gauge.

Cooling System

A. CONDENSER COOLING: ALL MODELS

1. Description: OILWELL engines are designed to operate at the boiling temperature of the coolant, so a condenser-type cooling system is employed.

Heat from the engine turns the coolant into steam which rises in the condenser core.

It is cooled there by air from the fan mounted in the condenser housing and is condensed into liquid form. The coolant then runs back into the expansion tank to be reheated and the cycle repeated.

2. Water Level Gauge: This gauge is located on clutch side or cylinder head end of cylinder block and serves to indicate water level by visual check.

The gauge has a built-in provision to ground the magneto in the event of low water level. Circuit is opened as coolant is added.

3. Filling System: All condenser cooling systems are equipped with a fill pipe located near the head end of the cylinder block on the PTO side. On models equipped with a filler cup, coolant should be added until the level reaches the bottom of this cup.

On models F-32ARC and F-42ARC remove the 1" (25 mm) pipe cap and fill to the top of the pipe nipple.

NOTE: Do not attempt to add coolant through the opening in the top of the conden-

ser. DO NOT OVER-FILL.

See antifreeze recommendations:

4. Condenser Vent Tube: Models F-32ARC and F-42ARC are equipped with a pressure vent tube at the top of the condenser just below the pressure cap. On all other models, the center vertical tube of the condenser on the flywheel side serves as the vent tube. At its base is a small vent hole. Liquid or steam coming out of the vent hole is an indication of trouble, and could be due to one or more of the following causes:

1. Fan belt loose.
2. Fully loaded engine shut down without sufficient time being allowed for cooling.
3. Defective cylinder-head gasket which may allow exhaust gases to enter the cooling system.
4. Too much coolant in water jacket:
 - (1) Open plug on side of block and drain out excess coolant.
5. Ratio of anti-freeze to water too high. See recommendations for coolant, pages 39 & 40.
6. When dirt fills up the space between the condenser fins, the flow of air through the condenser will be restricted, causing the engine to become over-heated, and steam or liquid will be forced out of the vent hole.

Operator's Maintenance

A. DAILY MAINTENANCE SCHEDULE: ALL MODELS

1. Check coolant, fuel and lubricating oil levels.
2. Keep engine clean.
3. **Air Cleaner — Dry Type**

Clean when dirty. Under heavy dust conditions, the air cleaner should be cleaned every day. To clean, remove air cleaner element and shake or blow free of dirt, and replace on engine. Make sure all connections are tight. Remember a dirty air cleaner results in loss of power and unnecessary

wear. Replace punctured or damaged element immediately.

Air Cleaner — Oil Bath Type

Clean when dirty. Under heavy dust conditions, the air cleaner should be cleaned every day. To clean, remove bowl and drain oil. Wash the element and bowl with solvent, removing all dirt and sediment. Refill with clean engine oil to the level indicated on bowl, and replace on engine. Make sure all connections are tight. Remember, a dirty air cleaner cannot remove all the dirt from the air and results in unnecessary engine wear.

B. EVERY WEEK:

1. Lubricate clutch throw-out bearing, shaft bearing, pilot bearing (unless sealed type) and operating shaft. (Do not over lubricate.)
2. Remove and clean air cleaner.
3. Lubricate governor linkage.
4. Change oil on a new engine.

C. EVERY TWO WEEKS:

Fuel transfer pump. The glass bowl should be removed and cleaned (when using gasoline).

CAUTION: BE SURE, WHEN REPLACING BOWL, THAT IT MAKES A PERFECT SEAL WITH THE GASKET.

D. EVERY THIRTY DAYS:

1. Change lube oil.
2. Change oil filter cartridge. (Models B-12RC, E-15RC, E-20RC, F-32ARC & F-42ARC).
3. Check and adjust inlet and exhaust valve tappet clearance.
4. Clean and adjust spark plug. Replace as required.

E. EVERY TWELVE MONTHS:

1. Repack fan bearings.

Operator's Adjustments AND SETTINGS

A. GENERAL:

This section is for the guidance of the operator and covers the adjustments and settings which can be made in the field.

B. INTAKE AND EXHAUST VALVES: ALL MODELS

There must always be a tight seal between the face of valve and seat. If there is evidence of low compression, it may be that the valves require attention. A defective valve can usually be detected by listening for the compression escape. Disconnect the spark plug cable and listen for a hissing sound through the exhaust or back through the carburetor while rotating the flywheel at cranking speed.

VALVE TAPPET ADJUSTMENT MODEL 98RC

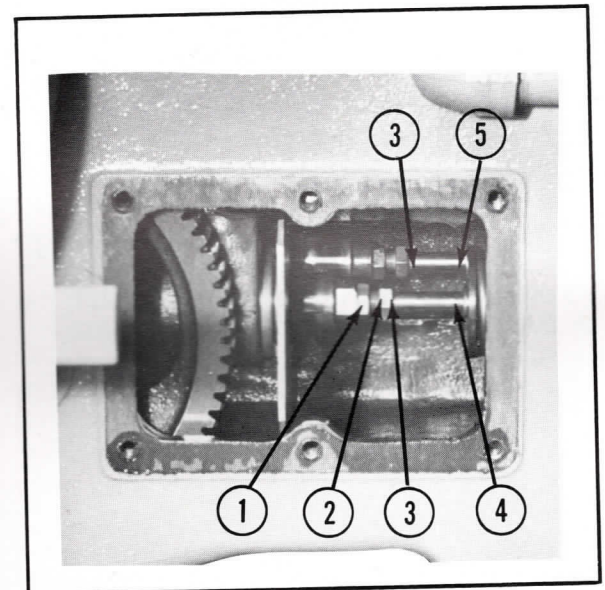


FIGURE NO. 25

1. Adjusting-screw-lock nut
2. Adjusting screw
3. Point of clearance between tappet and valve stem.
4. Exhaust Valve
5. Intake Valve

VALVE ADJUSTMENT — MODEL 98RC

1. Remove inspection cover and oil filler plate.
2. Rotate the flywheel until the piston is at top dead center of the compression stroke.
3. Check clearance at point between the tappets and the valve stems with a feeler gauge for the correct clearance (see specifications).
4. Adjust to these clearances, if necessary, by means of the adjusting screws.
5. When adjustment is completed, tighten locking nuts securely.
6. Replace inspection cover and oil filler plate.
7. If low compression is still evident, have a qualified mechanic check the valves for possible regrinding.

Adjust valves as follows (All Models except 98RC):

1. Remove the cylinder head cover or valve lever case cover.
2. Rotate the flywheel until the piston is at top dead center of the compression stroke and both valves are closed.
3. Inspect for clearance between the end of the valve stems and the face of the button. See specs. for proper clearance. (Check with feeler gauge.)
4. Adjust clearance by turning adjusting screws. Tighten lock nuts after adjustment.
5. Continued loss of compression through the valves will necessitate grinding or replacing of valves.

VALVE ADJUSTMENT MODELS B-12RC, E-15RC AND E-20RC

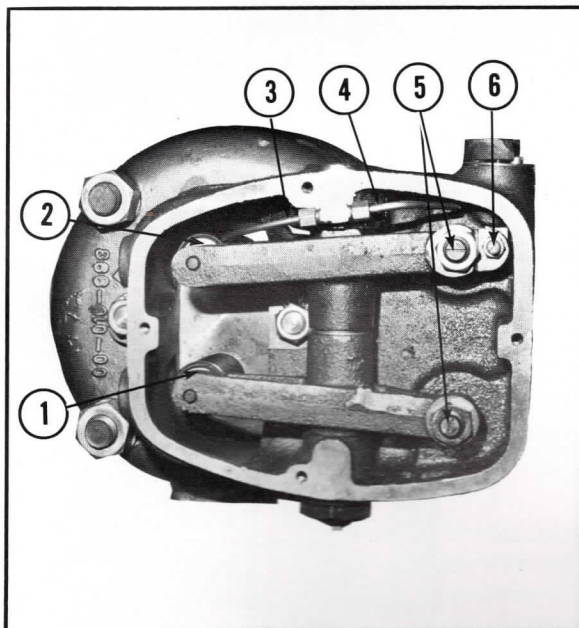


FIGURE NO. 26

1. Inlet Valve
2. Exhaust Valve
3. Valve Lube Oil Line
4. Push Rod and Tappet Lube Oil Line
5. Tappet Adjusting Screw
6. Compression Release Adjusting Screw

VALVE ADJUSTMENT MODEL F-32ARC & F-42ARC

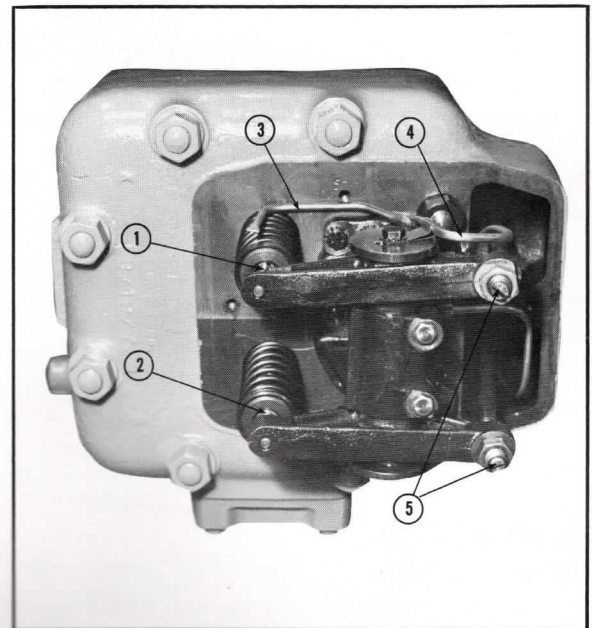


FIGURE NO. 27

1. Inlet Valve
2. Exhaust Valve
3. Valve Lube Oil Line
4. Push Rod and Tappet Lube Oil Line
5. Tappet Adjusting Screw

C. CONNECTING ROD BEARINGS Models 98RC, B-12RC and E-15RC

The connecting rod is fitted with adjustable aluminum alloy bearing inserts which are removed as follows:

MODEL 98RC

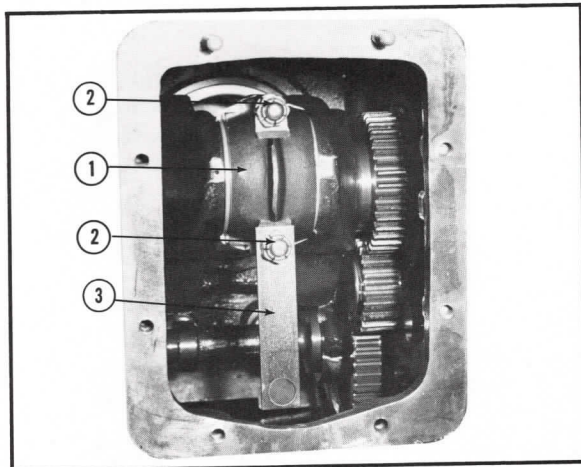


FIGURE NO. 28

- 1. Connecting Rod Bearing Cap
- 2. Connecting Rod Bolt
- 3. Lube Oil Splasher

1. Remove crankcase cover.
2. Turn crankshaft so that connecting rod assembly is easy to reach.
3. Remove cap nuts, then carefully tap the connecting rod cap with a hammer. **DO NOT** pry the cap off with a screwdriver, as this will damage the shims. Also, when removing the lower nut, be careful not to lose the oil-splasher.
4. As the cap is being removed, be sure to note the reference marks, so that the cap may be replaced in the same relation to the connecting rod.
5. Rotate the crankshaft away from the rod and examine the rod half of the bearing.
6. If it is scored, remove it by sliding it in a rotating motion out of the rod. This is also a good time to check the crankpin for undue wear. If crankpin is badly scored, you should have a qualified mechanic look at it and replace the crankshaft if necessary.
7. When installing bearing halves, be sure the inside surface of the rod and cap is free from dirt and grease. The bearing halves must

rest fully in the rod and cap, and the ends of the bearing halves must be flush with the machines surfaces of the rod.

8. Install the inner bearing half in the connecting rod and lightly coat it with oil. Rotate the crankshaft until the connecting rod is in place.
9. Oil cap bearing half; place the cap and bearing half over the crankpin, making sure that the reference marks correspond. This will place the cap in the same position as when it was removed.
10. Replace the connecting rod nuts. Be sure to put the oil splasher on the bottom connecting rod bolt before the nut is replaced.
11. In the event adjustment is necessary, remove one shim from connecting rod and tighten connecting rod nuts uniformly. Repeat this procedure removing shims from alternate sides until the bearing drags heavily on crankpin.
12. Now loosen the nuts and insert one shim in each side. This will provide the approximate desired running clearance. (See specifications.)
13. The connecting rod bearing side clearances should be checked (See specifications.)
14. After the correct clearances are obtained, replace the crankcase cover.

MODELS B-12RC & E-15RC

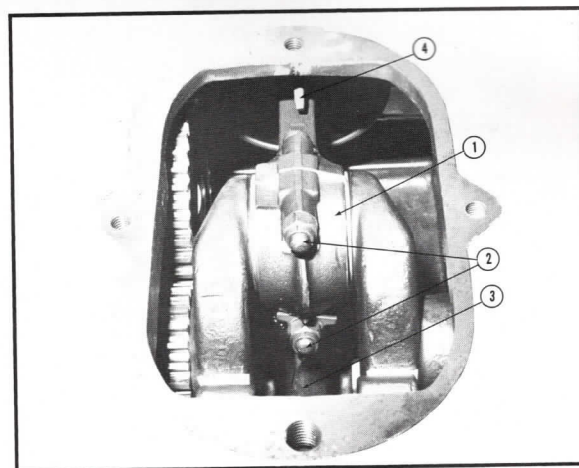


FIGURE NO. 29

- 1. Connecting Rod Bearing Cap
- 2. Connecting Rod Bolt
- 3. Lube Oil Splasher
- 4. Connecting Rod Bearing Oiler

Models E-20RC, F-32ARC & F-42ARC

The connecting rod is fitted with a removable precision insert type bearing, which can be installed without removing the connecting rod from the engine. To do this:

MODEL E-20RC

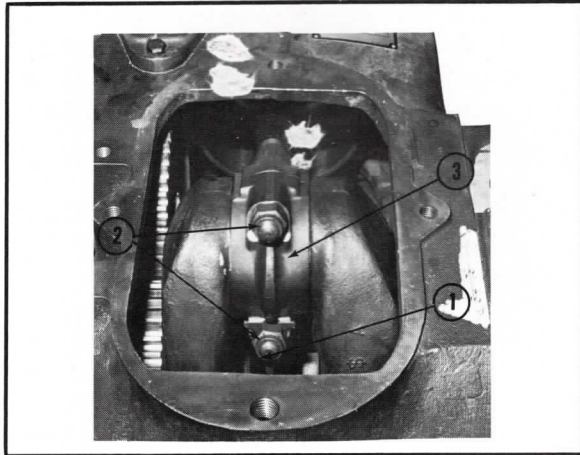


FIGURE NO. 30

1. Oil Splasher
2. Connecting Rod Bolts
3. Connecting Rod Bearing Cap

1. Remove crankcase cover.
2. Turn crankshaft so that the connecting rod assembly is easily reached.
3. Remove nuts holding connecting rod cap.
4. The connecting rod cap and its bearing half may now be removed by gently tapping cap with hammer. Do not use screw driver or in any way attempt to pry cap loose, as this may damage the mating surfaces. Be sure to notice reference marks on the connecting rod cap, so it can be replaced in the same relation as when removed.
5. Turn crankshaft to inspect or remove other bearing half.
6. If bearing halves show considerable wear (flaking or bad scoring) replace with new parts. Also inspect crankpin to see that it is not scored or damaged before replacing bearing halves.
7. When installing new bearing halves, be certain that both the rod halves and the cap surfaces are smooth and free from dirt or grease. The bearing halves must rest fully in the rod and cap with the edges of the bearing

halves positioned evenly with the mating surfaces of the rod and cap.

8. When replacing the connecting rod cap, put oil on the bearing and be sure to replace the cap in the same relation as when removed, so that reference marks correspond. Be sure to tighten the connecting rod cap nuts uniformly.

MODELS F-32ARC & F-42ARC

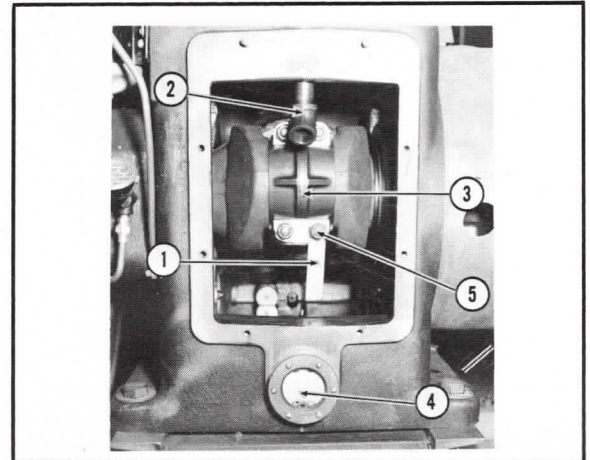


FIGURE NO. 31

1. Oil Splasher
2. Crankcase Breather
3. Connecting Rod Bearing Cap
4. Oil Level Sight Gauge
5. Connecting Rod Bolt Nut

D. HIGH PRESSURE LUBRICATING OIL RELIEF VALVE ALL MODELS EXCEPT 98RC

The high pressure lube oil relief valve is located in the pump and set at the factory at 50 psi (345 kPa) No adjustment is necessary.

E. OIL FILTER ASSEMBLY: ALL MODELS EXCEPT 98RC

1. Remove filter cover screw, filter cover and gasket. Remove filter cartridge.
2. Wash out filter assembly with solvent and wipe dry.
3. Install new filter cartridge.
4. Replace cover and gasket. If gasket is damaged, replace with new gasket. Whenever the filter cartridge is replaced, the lubricating oil should be drained from the engine and replaced with new clean oil.

F. MAGNETO — LOW TENSION ALL MODELS

All OILWELL engines are standard equipped with a heavy duty low tension magneto employing an impulse coupling, which assures a good hot spark even at low cranking speeds.

The low tension ignition systems are equipped with transformers, located near the spark plugs, to provide the necessary ignition voltage. With normal service these transformers should last for years. If difficulty is suspected replace the questionable unit and have same checked at your local ignition service center. Observe positive (+) and negative (-) markings wire color coding of wire harness when replacing transformers. This will insure maximum spark plug life.

MAGNETO TIMING REFERENCE MARK MODEL 98RC

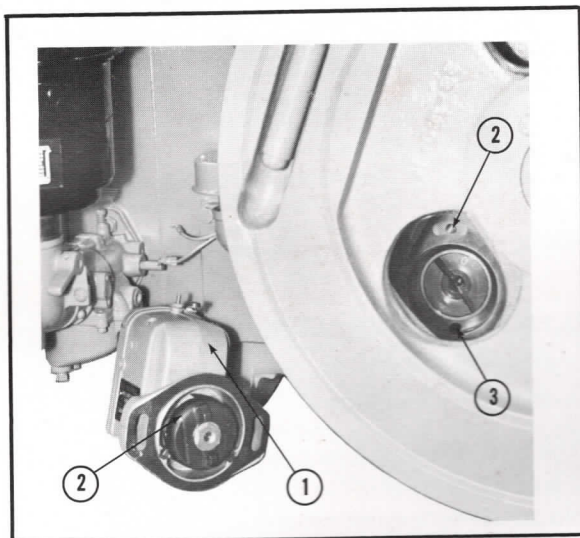


FIGURE NO. 32

1. Magneto
2. Timing Reference Marks
3. Oil Return Hole

Different grades of fuel will require a change in running spark timing for best performance. Spark timing may be changed by use of the magneto flange mounting slots. We caution for safety reasons, that when hand cranking the engines the impulse starting spark should be no more than 2 degrees (0.035 rad.) before T.D.C.

If, under full load conditions, an excessive combustion knock is audible, the spark should be retarded until the knock is reduced to a slight ping.

If your engine runs sluggishly or heats excessively, the spark should be advanced.

Timing the Magneto:

1. Release compression.
2. Loosen the capscrews that secures the magneto.
3. Magneto flange is slotted so that the magneto can be rotated.
4. Models B-12RC, E-15RC and E-20RC — rotate the magneto clockwise to advance the timing, counterclockwise to retard.
5. Models 98RC, F-32ARC, & F-42ARC — rotate the magneto counterclockwise to advance the timing, clockwise to retard.

MAGNETO TIMING MODEL B-12RC, E-15RC & E-20RC

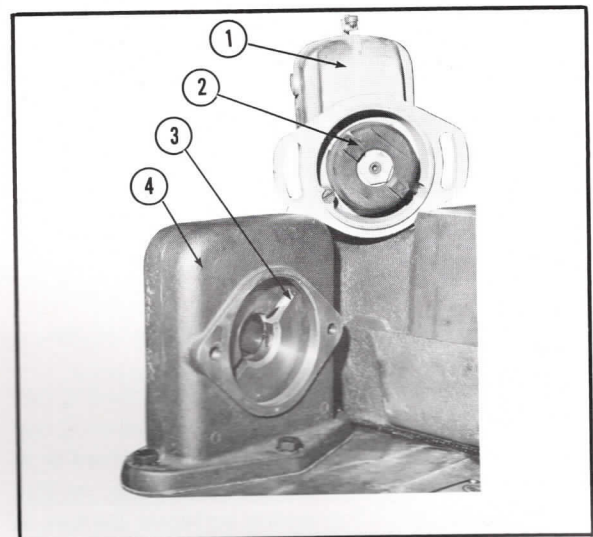


FIGURE NO. 33

1. Magneto
2. Magneto Drive Coupling
3. Magneto Drive Gear
4. Magneto Drive Gear Housing

To install Magneto — If the magneto has been removed from the engine, observe the following for timing the magneto to the proper cycle of the engine:

1. Rotate flywheel in the direction which the engine runs until the resistance of the compression stroke is felt.
2. Open the compression release and continue rotation until the piston arrives at the top dead center position. This can be determined as follows:
 - a. Model 98RC the flywheel hub key is directly opposite the head end of the engine.

MAGNETO TIMING MODEL F-32ARC AND F-42ARC

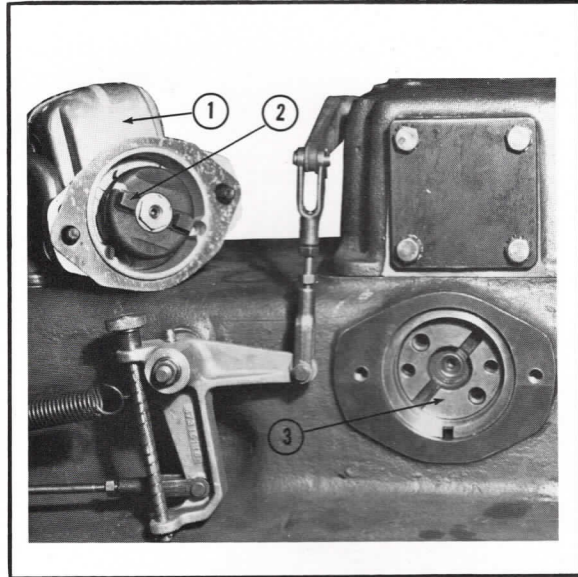


FIGURE NO. 34

1. Magneto
2. Magneto drive coupling
3. Magneto drive

- b. Models B-12RC, E-15RC and E-20RC — the starting crank is parallel to the cylinder and pointing towards the cylinder head.
- c. Models F-32ARC and F-42ARC — the flywheel key is on the horizontal centerline of the crankshaft towards the head end of the engine.

Rotate impulse coupling until mark on coupling closely approaches the mark on magneto flange.

3. Rotate magneto impulse coupling drive dogs until the timing mark on the drive coupling lines up with the timing mark on the top of the magneto mounting flange.
4. Engage the impulse drive dogs into the corresponding drive slot.
5. Secure the magneto in the approximate vertical position (horizontal on model 98RC engines) and carefully rotate the flywheel thru top dead center. Adjust the magneto in its mounting slots so that the "Impulse Spark" occurs at T.D.C. or 1 or 2 degrees (0.018 or 0.035 rad.) after T.D.C. This will give you the correct starting spark timing and a running spark of approximately 30° (0.524 rad.) B.T.D.C.
6. Tighten the magneto mounting nuts.

MAGNETO-CAPACITOR DISCHARGE, BREAKERLESS ALL MODELS EXCEPT 98RC

The Capacitor Discharge (C-D) system consists of a single unit which is mounted on the conventional magneto drive housing. It is completely interchangeable with the standard low-tension system and may be obtained as a factory installed option or installed on any of the subject engines now in the field.

The "C-D" type magneto is very similar in appearance to our standard low-tension magnetos. The principal difference in outward appearance is that the removable plastic cover has a small rectangular extension approximately one inch (25 mm) high just below the spark plug cable connection.

Major advantages of the "C-D" type system are:

1. High K.V. output for easier starting and firing "dirty" plugs.
2. Longer spark plug life due to reduced electrode erosion.
3. No breaker points or breaker point condenser.
4. Requires no lubrication or routine maintenance.

The magneto drive incorporates an impulse coupling that provides a "Hot" spark at hand cranking speed and automatically advances the spark timing 30° (.0524 rad.) after the engine is started.

The CD Breakerless magneto has a sealed body and the electronic components, including the high tension coil, are encapsulated into the replaceable rear cover.

Installation and timing of the C-D type magneto is the same as the low-tension type — see page 36.

G. SPARK PLUG AND CABLE: ALL MODELS

The spark plugs should be removed, cleaned, and regapped at regular intervals, and replaced when necessary. Checking intervals should never exceed 750 hours of operation. For the correct gap of the spark plugs, see specifications.

Also, the spark plug cables should be periodically checked for breaks in the insulation, which might result in ignition failure.

H. GOVERNOR ALL MODELS

The purpose of the governor is to maintain a pre-determined constant engine speed. All governors used on OILWELL engines are gear drive and of the centrifugal, flyball type. On models F-32ARC and F-42ARC the governor is located within the governor housing on the top of the cylinder block. All other models have the governor mounted within the cylinder block itself, in the camcase area.

Adjust engine speed as follows:

Models F-32ARC and F-42ARC — To decrease the governed speed, turn speeder knob counter-clockwise. If additional speed reduction is desired, adjust screw at end of spring.

Models B-12RC, E-15RC and E-20RC — Make fine adjustment by use of the speeder stem. Additional range may be obtained by moving the spring anchor clip along the push rod cover pipe.

Model 98RC — Adjust speed by turning speeder knob. If additional adjustment is required, move lever end of the spring to another hole provided in the governor lever.

If engine "hunts" (speed alternately increases and decreases) after making operating speed adjustment, adjust carburetor until engine speed levels off.

If the above adjustments fail to give satisfactory speed control, the trouble probably lies in the governor or the governor linkage. In this event, remove the governor from the engine and disassemble. Inspect all components for wear. Also, inspect governor linkage for wear or binding.

I. CRANKCASE BREATHER VALVE ALL MODELS EXCEPT 98RC

To properly adjust the breather valve, remove the crankcase breather and crankcase cover. Tighten the breather valve screw until the valve is retained lightly on the seat. Then back off the breather valve screw between $\frac{1}{2}$ and $\frac{3}{4}$ of a turn. Tighten locknut to secure adjustment. This adjustment provides sufficient breathing action. Oil spray, leaking past the valve, drains back to the crankcase through a hole which must be cleaned when clogged.

J. VALVE LUBRICATION ALL MODELS EXCEPT 98RC

1. The valve lever case cover or cylinder head cover should be removed every 90 days and the valve and tappet lubrication checked.
2. Check the position of the oiler tubes to determine that the valves, valve guides, push rods and valve levers are receiving adequate lubrication. The oiler tubes must be positioned to direct the oil onto the exhaust valve and the ends of the push rods.
3. Remove oiler tubes and clean if oil flow appears to be inadequate:
4. Oil is returned to the engine crankcase by means of an oil drain hose on the model E-15RC and E-20RC engines and through the lower push rod housing on model B-12RC. The model B-12RC valve lever case incorporates Synthane-flutter-check valves concentric with the push rods, to maintain constant oil level. The check valves are secured by retainer rings which seat them against the valve-lever case. It is to be noted that the retainer ring for the exhaust (upper) valve has notches around the circumference, and the retainer for the inlet (lower) valve is solid around the circumference.
5. Keep the valve lever case mechanism clean of all sludge. Sludge can seriously reduce oil flow and valve lubrication.

K. CLUTCH ADJUSTMENT: ALL MODELS

1. Disengage the clutch.
2. Remove cover plate.
3. Turn clutch until the adjusting lockpin is in reach. Push pin in to clear adjusting yoke.
4. While holding the lockpin in, turn the adjusting yoke clockwise, until the shifting lever requires a distinct pressure to engage the clutch.
5. Release the lockpin and move the adjusting yoke slightly until the pin fits all the way into a notch in the pressure plate.
6. Replace Cover.
7. A new clutch or one with new discs may require several adjustments before the discs are worn in.

CLUTCH ADJUSTMENT ALL MODELS

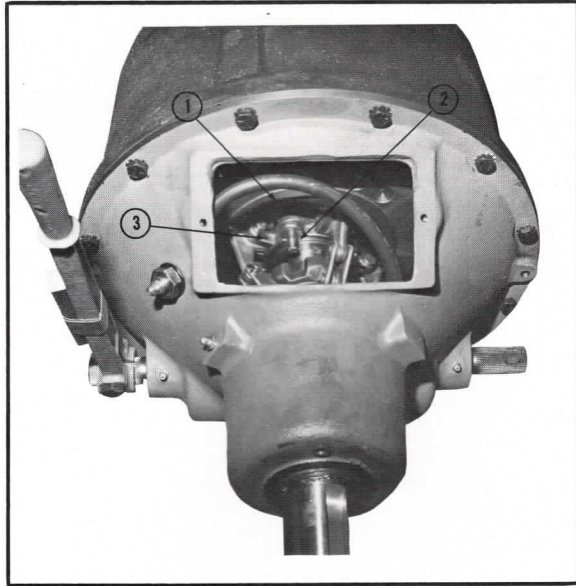


FIGURE NO. 35

1. Clutch Drive Plate
2. Clutch Adjustment Lock
3. Clutch Adjustment Yoke

8. When the adjusting yoke cannot be tightened any further, the driving discs are worn out and must be replaced.

L. SECONDARY FUEL GAS REGULATOR ALL MODELS

All present production engines are equipped with secondary fuel gas regulators produced by Beam Products Manufacturing Company. The Beam regulator will also be supplied as service replacements for the previous regulators that were here-to-fore standard. This change does not alter the principle of pressure/volume gas regulation or operating instructions given elsewhere in this publication.

The adaptation of the Beam regulator to an engine originally equipped with another make will require modification of the existing regulator to carburetor piping. See Figure No. 38, 39, or 40 for the correct piping arrangement for the respective engine model being modified.

M. ANTI-FREEZE RECOMMENDATIONS ALL MODELS

1. Prior to filling the engine with an anti-freeze solution it is imperative that the cooling system be free of rust and contamination. Drain and, if necessary, thoroughly flush the system. If a cleaning solution is used all traces of the cleaner must be removed.

2. Because of the temperatures involved in the cooling system, never use methyl or ethyl alcohol and water solution for anti-freeze protection. The alcohol boils at a much lower temperature than water and offers uncertain protection to the engine. Only "permanent" type anti-freeze should be used.
3. Most types of "permanent" anti-freeze use ethylene glycol as a base material with a rust inhibitor additive. As the rust inhibitors used in different brands of anti-freeze vary, and may not be compatible with others, anti-freeze of different brands should not be mixed.
4. The anti-freeze solution should be prepared in a clean container prior to filling the cooling system. Water used should be clean and free from acid, alkalines or high mineral content.

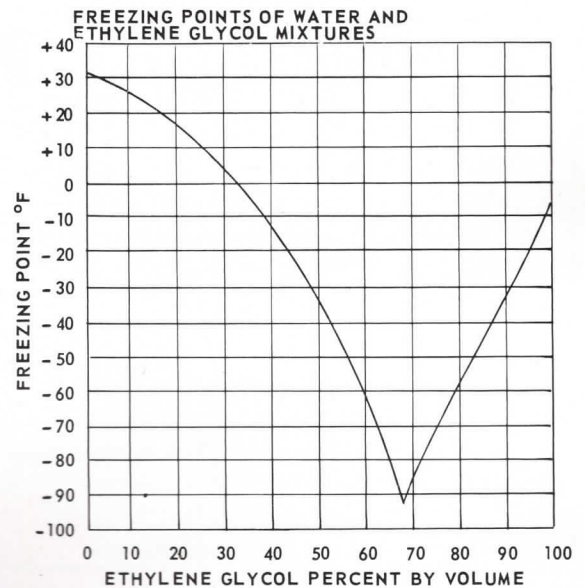


FIGURE NO. 36

5. The anti-freeze solution should be mixed in the proportions recommended by the manufacturer for the proper protection for your weather conditions. Under no circumstances use more than 60% ethylene glycol anti-freeze. Increasing the percentage beyond 60% will reduce the freezing protection. Pure ethylene glycol will freeze at approximately (-) 10°F. ((-)23°C). Also, the high boiling point (330°F) (166°C) of 100% ethylene glycol will cause overheating and severe engine damage. See figures 36 and 37.
6. When it becomes necessary to add liquid to the cooling system during the winter season, always use the same brand of anti-freeze previously used and mixed in the same proportions as the original solution.

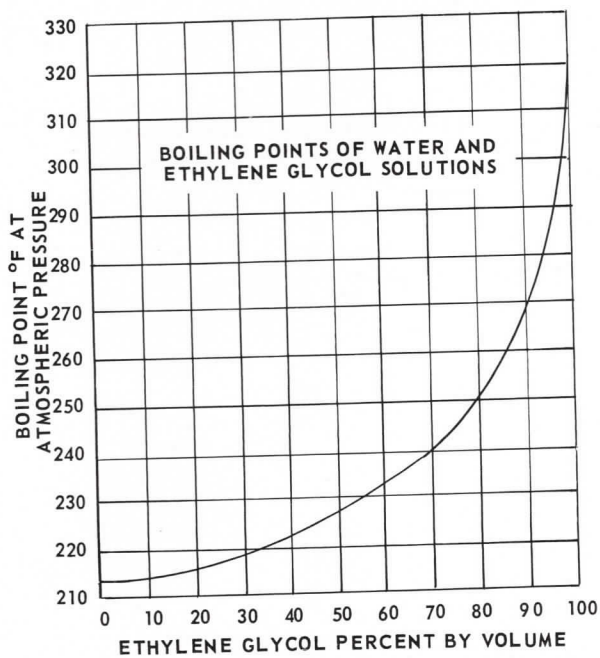


FIGURE NO. 37

7. If the anti-freeze solution is left in the engine during the summer season the coolant level and the anti-freeze to water ratio must be closely monitored and correctly maintained. The higher boiling point and lower heat rejection of the anti-freeze solution retards cooling and at high ambient temperature may cause venting of water vapor from the cooling system. This loss of water from the anti-freeze solution increases the ratio of anti-freeze to water and if not corrected continues to increase, resulting in greater overheating and possible engine damage.

8. A rust inhibitor should always be added when water only is used as a coolant.

**N. STORAGE
ALL MODELS**

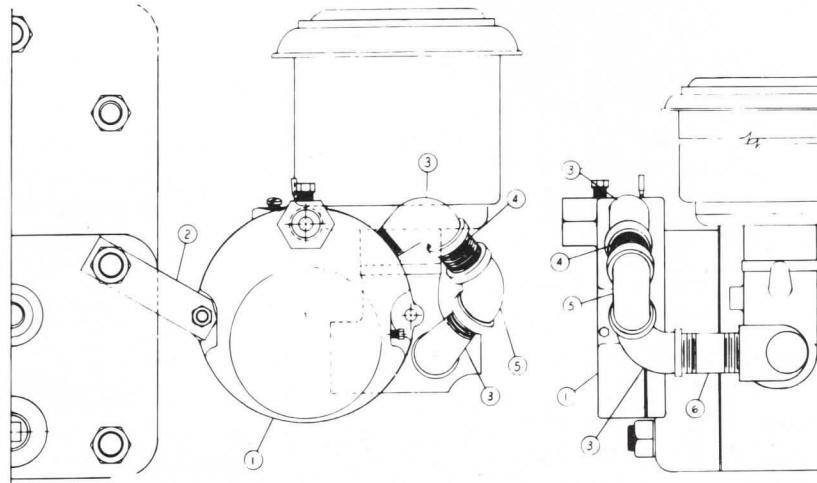
When an engine is to be stored, considerable damage may result unless the following precautions are taken:

1. Remove air cleaner from carburetor and start engine. With engine running at moderate speed, rapidly squirt a 50-50 mixture of gasoline and heavy lube oil into the carburetor air intake until engine stops. Reinstall air cleaner.
2. Rotate flywheel until engine is on compression stroke.
3. Cover all exposed machined surfaces with rust preventive compound or heavy lubricating oil.
4. Cover all openings, exhaust ports, air intake and crankcase breather with water-proof material to keep out moisture and foreign objects.
5. Drain cooling system and fuel system.

Gas Regulator Assembly

BILL OF MATERIAL

ITEM	REQ'D.	COMM. NO.	DESCRIPTION
1	1	64-597-202	Regulator-Gas Beam #202NL-C
2	1	47-318-086	Bracket-Regulator Mounting
3	2	86-342-106	$\frac{3}{4} \times 90^\circ$ 150# MI Street Elbow
4	1	86-425-005	$\frac{3}{4} \times 2$ Sch. 40 BW Stl. Pipe Nipple
5	1	86-336-106	$\frac{3}{4} \times 90^\circ$ 150# Blk. MI Elbow
6	1	86-425-007	$\frac{3}{4} \times 2\frac{1}{2}$ Sch 40 BW Stl Pipe Nipple

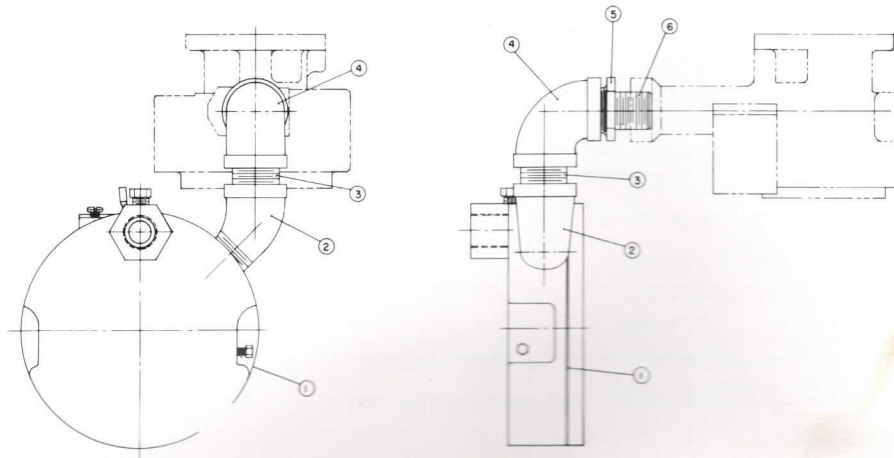


Model 98RC

FIGURE NO. 38

BILL OF MATERIAL

ITEM	REQ'D.	COMM. NO.	DESCRIPTION
1	1	64-597-202	Regulator-Gas
2	1	86-341-005	Elbow-Street $\frac{3}{4} \times 45^\circ$
3	1	86-425-001	Nipple $\frac{3}{4}$ Sch. 40 Close
4	1	86-336-106	Elbow $\frac{3}{4} \times 90^\circ$
5	1	86-061-010	Bushing $\frac{3}{4} \times \frac{1}{2}$
6	1	86-424-001	Nipple $\frac{1}{2}$ Sch. 40 Close



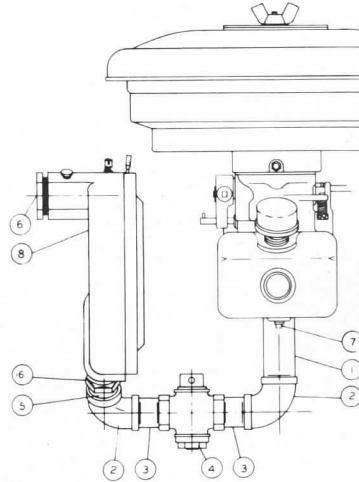
Model B-12RC E-15RC E-20RC

FIGURE NO. 39

Gas Regulator Assembly

BILL OF MATERIAL

ITEM	REQ'D.	COMM. NO.	DESCRIPTION
1	1	86-426-013	Nipple 1" - Sch. 40 x 4 Lg.
2	2	86-336-108	Elbow 1" x 90°
3	2	86-426-005	Nipple 1" - Sch. 40 x 2 Lg.
4	1	83-591-008	Gas Cock 1" - Bronze
5	1	86-426-001	Nipple 1" - Sch. 40 Close
6	2	86-061-021	Bushing - 1 1/4 x 1
7	1	86-486-101	Pipe Plug 1/8
8	1	64-597-208	Regulator - Gas 1 1/4-Beam #802 N-C



Model F-32ARC & F-42ARC

FIGURE NO. 40

TROUBLE SHOOTING
ALL MODELS

TROUBLE	POSSIBLE CAUSE	CORRECTION
1. Engine fails to start or stops in operation	Fuel Supply shut off, out of fuel, or crude oil entering carburetor	Check for obstructed fuel line. Drain oil sediment from gas volume tank.
	Governor to carburetor linkage stuck.	Clean and use thin oil to lubricate linkage.
	No spark at spark plug.	Replace spark plug and/or clean and set magneto breaker points.
	Water in fuel. (Gasoline)	Drain float bowl and tank and refill.
	Sticking valve.	Have valves ground, clean valve stem and guide surface.
2. Missing and Uneven operation	Lack of compression.	Check compression. Adjust valve clearance or have valves and seats ground. Have new piston rings installed if necessary.
	Dirty fuel or water in fuel. (Gasoline)	Replace with clean fuel.
	Sticking valve	Have valves ground, clean valve stem and guide surface.
	Incorrect Timing of Magneto	Adjust timing.
	Incorrect spark plug gap, or magneto breaker gap.	Adjust gap. Clean and replace as required.
	Exhaust restricted.	Remove restrictions and sharp bends.
	Spark plug cracked or dirty	Clean if dirty, replace if cracked.
	Faulty insulation on spark plug cable.	Replace if necessary.
Water or crude oil collected in gas fuel volume tank.	Drain liquids from tank.	
3. Engine speed trouble, alternately increases and decreases	Improper carburetor adjustment.	Adjust carburetor.
	Governor action and lubrication obstructed by sludge deposits.	Clean sludge from crankcase and governor parts. Eliminate friction from linkage.
	Worn bearings or bushings in the governor.	Replace worn parts.
	Worn, damaged or dirty governor linkage.	Clean, repair or replace as required. Eliminate friction from linkages.
	Rich carburetor adjustment on light loads.	Adjust properly.
4. Engine smokes after reaching normal operating temperature	Fuel adjustment too rich.	Adjust carburetor to suit load condition.
	Engine overloaded (black smoke)	Reduce load to be within engine rating.
	Incorrect timing.	Adjust magneto timing.
	White smoke indicates engine is using excessive lube oil.	Check for high oil level and drain to proper level. Have engine checked for possible piston ring replacement.
	Incorrect valve clearances.	Adjust valve clearances.
	Air filter dirty.	Service air cleaner.
5. Lack of power	Air intake restricted. Valve seat leaking.	Clean or replace air cleaner element. Have valves ground or adjust to proper clearance.
	Low gas pressure or restricted gas supply.	Adjust supply pressure — Remove restriction.

TROUBLE	POSSIBLE CAUSE	CORRECTION
6. Engine overheats	Low water level or scale in cooling system.	Correct as needed.
	Incorrect magneto timing.	Correct as needed.
	Loose fan drive belt	Adjust or replace as required
	Ratio of Anti-freeze to water too high.	Use correct ratio
7. Engine vibrates	Base bolts loose.	Tighten bolts securely.
	Incorrect foundation.	Revise foundation as required.
8. Engine uses excessive lubricating oil.	Poor quality lube oil and incorrect viscosity lube oil.	Use better grade and refill with correct viscosity.
	Oil leaks.	Tighten connection and replace gaskets.
	Worn or sticking piston rings.	Have piston and/or rings replaced.
	Dirty crankcase breather.	Remove crankcase breather and clean.
	High oil level in crank case.	Maintain at proper oil level.
	Crankcase vacuum flapper valve not operating.	Clean and adjust — replace if worn.
9. High fuel consumption.	Obstructed air cleaner.	Clean and/or replace
	Low quality fuel.	Drain and refill with better fuel.
10. Excessive knocking.	Ignition too early.	Adjust magneto timing.
	Improper fuel.	Change to better grade of fuel.

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Installation, maintenance and servicing of this equipment is the responsibility of the purchaser. The manufacturer will upon request and contract provide trained experienced personnel to assist the purchaser in every phase of this responsibility. This assistance can be obtained by contacting any of the following:



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