Industrial L-Head Engines

OPERATOR'S MANUAL

Continental Motors Corporation
AUTOMOTIVE-INDUSTRIAL ENGINE DIVISION
205 MARKET STREET • MUSKEGON, MICHIGAN 49443

NUMBER X-27057

WHEN ORDERING PARTS BE SURE TO SPECIFY THE FOLLOWING INFORMATION WHICH CAN BE FOUND ON THE ENGINE NAMEPLATE ON THE SIDE OPPOSITE THE MANIFOLD:

ENGINE MODEL

ENGINE SERIAL NUMBER

SPECIFICATION NUMBER - When indicated

Your cooperation in giving the above data will be of material assistance in filling your orders promptly and correctly.

FOUR CYLINDER INDUSTRIAL L-HEAD ENGINES*

Model	Bore & Stroke	Displacement Cubic Inches	Max. Oil Press. **	Min. Oil Pressure (Idling)	Oil Capacity			Valve Clearance		Water Capacity ††		Weight (Bare Engine)
					Crkcase	Filter	Total	Intake	Exhaust	Engine	Eng. & Radiator#	
N-56	2-1/4 X 3-1/2	56	20-30	7	3-1/2	1/2	4	.015	.015	2	11	180
N-62	2-3/8 X 3-1/2	62	20-30	7	3-1/2	1/2	4	.012	.012	2	11	210
Y-69	2-1/2 X 3-1/2	69	30-40	7	3-1/2	1/2	4	.012	.012	3-3/4	14	290
Y-91	2-7/8 X 3-1/2	91	30-40	7	3-1/2	1/2	4	.012	.012	3-3/4	15	290
Y-112	3-3/16 X 3-1/2	112	30-40	7	3-1/2	1/2	4	.012	.012	3-3/4	15	290
F-124	3 X 4-3/8	124	20-30	7	4	1/2	4-1/2	.014	.016†	5	14	415
F-135***	3-1/8 X 4-3/8	135	20-30	7	4	1/2	4-1/2	.014	.016†	5	14	415
F-140	3-3/16 X 4-3/8	140	20-30	7	4	1/2	4-1/2	.014	.016†	5	14	415
F-162	3-7/16 X 4-3/8	162	20-30	7	4	1/2	4-1/2	.014	.016†	5	15	415
F-163***	3-7/16 X 4-3/8	162	20-30	7	4	1/2	4-1/2	.014	.016†	5	15	415

*DIMENSIONS AND DATA SHOWN ARE FOR STANDARD ENGINES.
** Other oil pressures are available, based on customer specifications.
† Static or cold setting .017.
†† Given in quarts - add approximately 1 quart for hoses.
# Applies to power unit radiator only. For customer supplied radiators, consult supplementary instructions.
*** IMPORTANT : Recent F135, F163, F227 and F245 engines, have a tappet setting of .012 for intake and .020 for exhaust. Please check your engine nameplate for the correct setting.

SIX CYLINDER INDUSTRIAL L-HEAD ENGINES*

Model	Bore & Stroke	Displacement Cubic Inches	Max. Oil Press. **	Min. Oil Pressure (Idling)	Oil Capacity			Valve Clearance		Water Capacity ††		Weight (Bare Engine)
					Crkcase	Filter	Total	Intake	Exhaust	Engine	Eng. & Radiator #	
F-186	3 X 4-3/8	186	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	550
F-209	3-3/16 X 4-3/8	209	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	550
F-226	3-5/16 X 4-3/8	226	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	555
F-227 ***	3-5/16 X 4-3/8	226	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	555
F-244	3-7/16 X 4-3/8	244	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	565
F-245 ***	3-7/16 X 4-3/8	244	20-30	7	5	1/2	5-1/2	.014	.016†	6-1/2	17	565
M-271	3-5/8 X 4-3/8	271	30-40	7	7	1	8	.017	.020	13-1/2	31	800
M-290	3-3/4 X 4-3/8	290	30-40	7	7	1	8	.017	.020	13-1/2	31	800
M-330	4 X 4-3/8	330	30-40	7	7	1	8	.017	.020	13-1/2	33	800
M-363	4 X 4-13/16	363	30-40	7	7	1	8	.017	.020	13-1/2	33	800
B-371	4-1/8 X 4-5/8	371	40-50	7	8	1	9	.017	.022	16	36	945
B-427	4-5/16 X 4-7/8	427	40-50	7	8	1	9	.017	.022	16	36	950

*DIMENSIONS AND DATA SHOWN ARE FOR STANDARD INDUSTRIAL ENGINES.
** Other oil pressures are available, based on customer specifications.
† Static or cold setting .017.
†† Given in quarts - add approximately 1 quart for hoses.
# Applies to power unit radiator only. For customer supplied radiators, consult supplementary instructions.
*** IMPORTANT : Recent F135, F163, F227 and F245 engines, have a tappet setting of .012 for intake and .020 for exhaust. Please check your engine nameplate for the correct setting.

FOREWORD

Gasoline engines have, over the years, maintained a position of importance in the field of power development. Because of their inherent characteristics of dependable and economical service, they have been the answer to a long standing demand for power. CONTINENTAL MOTORS CORPORATION, with its extensive research, maintains a reputation earned in over 60 years of leadership in the internal combustion engine industry.

Continental gasoline engines are designed for rugged service and are simple to service and maintain; they are capable of producing smooth dependable power, with excellent fuel economy.

Good operation and a planned maintenance program as outlined in this manual are of vital importance in obtaining maximum engine performance, and long engine life. The instructions on the following pages have been written with this in mind, to give the operator a better understanding of the various problems which may arise, and the manner in which these problems can best be solved or avoided.

Procedure in the Preventive Maintenance Section must be set up and followed by the owner and operator to obtain dependable service and long life from the engine. Owners and operators are expected to perform these maintenance procedures as outlined under the daily schedule as well as 50-hr., 250-hr. and 500-hr. periods WHILE IN THE WARRANTY PERIOD AS WELL AS DURING THE LIFE OF THE ENGINE.

Warranty service does not include tune-up of the engine such as replacing spark plugs, distributor points, tappet settings, ignition timing, ignition wiring, air cleaner service and lubrication and filter maintenance.

The operator is cautioned against the use of any parts, other than GENUINE CONTINENTAL PARTS for replacement or repair. Genuine Continental parts have been engineered and tested for their particular job, and the use of any other parts may result in unsatisfactory performance and short engine life. Likewise, Continental distributors and dealers, because of their close branch relations, can render the best and most efficient service.

THE LIFE OF YOUR ENGINE DEPENDS ON THE CARE IT RECEIVES.

PREPARATION OF NEW ENGINE FOR OPERATION

Before placing a new engine in operation, it must be thoroughly inspected for external damage and particular attention paid to the following items:

1. INSPECT ENGINE HOLD DOWN BOLTS - to make certain that they are firmly set.

2. OPEN FUEL TANK SHUT OFF VALVE - by turning handle counter-clockwise as far as it will go.

3. CLOSE WATER DRAIN COCK - in lower radiator connection, also on the side of the block. (In some cases, this may be a pipe plug.)

4. EXAMINE OIL DRAIN PLUG - to make certain that it is tightly closed.

5. FILL CRANKCASE WITH SAE 10W-30 OIL - for the first week or 50 hours operation - then follow lubrication recommendations.

6. FILL RADIATOR WITH CLEAN WATER - During freezing weather, use a sufficient amount of anti-freeze to protect the system for the lowest anticipated temperature.

7. FILL GASOLINE TANK FULL - All new engines are shipped with a treated tank which should be completely diluted with a full tank of gasoline to eliminate any tendency to clog.

Be sure that the container used for filling is clean and free from dirt. Replace cap securely.

8. ENGINE ACCESSORIES - See that all points requiring lubrication are properly supplied.

9. ELECTRICAL CONNECTIONS - Check storage battery terminals and all electrical connections. Check each spark plug wire for tightness.

10. RADIATOR COOLANT CAPSULE - The radiator coolant capsule, which comes with the engine, should not be removed: this is a water conditioner and anti rust inhibitor to protect the cooling system. Be sure to remove the cellophane wrapper, however.

STARTING THE ENGINE

1. SAFETY CONTROL SWITCH - (If Supplied) Turn manual control knob with arrow pointing toward "on" position. When oil pressure builds up to normal, control knob will automatically release and arrow will point to "run" position.

2. DISENGAGE POWER TAKE-OFF - (If equipped) Starting engine under load throws overload on starter and battery.

3. OPEN THROTTLE CONTROL ABOUT 1/3 OPEN.

4. TURN ON IGNITION SWITCH.

5. PULL OUT CHOKE - (if manually operated) but avoid flooding the engine. Operate the engine without choking as soon after starting as possible.

6. PUSH STARTER BUTTON IN - keep on until engine starts, but not longer than 15 seconds at a time.

7. WARM-UP BEFORE APPLYING LOAD - Idle the engine about 700 R. P. M. for a few minutes to circulate and warm oil - then increase the speed to approximately half throttle until the engine water reaches 100°F. This procedure will prolong the engine life.

8. CHECK OIL PRESSURE.

9. CHECK WATER TEMPERATURE.

CAUTION

After starting new engine - run it at idle for 5 minutes, then stop engine and recheck oil level in crankcase - then bring oil level to high mark on dipstick.

IMPORTANT

Breaking in a new or rebuilt engine - for peak performance and economical operation, the following adjustments should be made at end of first 50 hours operation.

1) Torque down cylinder head studs to specifications.
2) Adjust valve tappets to specified clearances.
3) Adjust idle mixture and idle speed to 400-600 R. P. M.

PREVENTIVE MAINTENANCE

In order to obtain maximum efficiency from your gasoline engine, a definite maintenance program should be set-up and followed. Haphazard maintenance will only lead to faulty engine performance and shorten engine life.

All moving parts in the engine are subject to wear; however, wear can be retarded by careful operation and a planned maintenance program.

In general, gasoline engine operation demands careful attention to cleanliness of air, fuel and oil and maintaining operating temperatures of 180°-200° F.

The following pages, covering DAILY, 50-250 and 500 hour maintenance, have been worked out with our field service division as "Minimum Requirements" to keep your engine in dependable operating condition.

DAILY

PREVENTIVE MAINTENANCE SCHEDULE

1. OVERALL VISUAL INSPECTION OF ENGINE. Look for evidence of fluid leaks on floor, cylinder head and block, indicating loose fuel, oil or water connections - tighten if found.

2. CHECK OIL LEVEL OF ENGINE. The dipstick indicates the high and low oil level in the crankcase - make allowance for additional oil drainage back into oil pan if engine has not been stopped 15 minutes. The most efficient oil level is between the two dipstick levels.

NOTE

Do not add oil until oil level approaches the low mark - then add only enough to bring it to high level - NEVER ABOVE.

Do not operate the engine with oil below low level mark.

3. CHECK RADIATOR. Fill radiator with clean water or anti-freeze to normal level maintained due to expansion when heated. Visually inspect fan and belt for condition and adjustment.

4. FILL FUEL TANK. Should be done at end of day's operation to prevent condensation forming in tank. Clean filler cap and area around spout before filling to prevent entrance of dust into fuel system.

5. CHECK AIR CLEANER.

a. OIL BATH AIR CLEANER. Inspect daily or more often in extremely dusty conditions. Change oil and clean cup when oil becomes thick or 1/2 inch of dirt collects in bottom of cup. Always refill cup to exact oil level as indicated on the cup. Use SAE 20 oil in summer and SAE 10 oil or lighter in winter. Inspect all hoses, clamps and connections between air cleaner and engine. Tighten loose clamps and replace damaged hoses promptly.

b. DRY-TYPE AIR CLEANER. Under normal conditions, dry-type filters should be serviced every 50 hours of operation. Extreme conditions will require daily cleaning. Cartridge can be cleaned best by blowing compressed air from inside out. Do not apply air closer than 2 inches and don't use more than 90 pounds pressure. Do not damage gasket surface or bend outer screen. Cleaning can only be done a few times as the element will finally clog and restrict air flow. The cartridge must then be replaced.

CAUTION

Never wash a dry element in a liquid tank.

6. CHECK OIL PRESSURE*. Note oil pressure gauge which should indicate the following pressure range at full throttle and a minimum of 7 pounds pressure at idling speed (400-600 R. P. M.):

20-30# Pressure --------- Model N-F Engines
40-50# Pressure --------- Model B Engines
30-40# Pressure --------- Y-M Series

* Standard Engines: on some special customer specifications, this may change.

7. NOTE ANY UNUSUAL NOISE. Operators familiar with daily engine operation soon become alert to any noise not normally present. This is very valuable in correcting defects in the early stages and preventing expensive repairs or delays.

EVERY 50 HOURS

1. REPEAT DAILY OPERATIONS OUTLINED. Follow previous instructions.

2. CHANGE CRANKCASE OIL. Engine life is dependent upon clean oil being circulated to all moving parts; therefore, the frequency of oil changes and oil filter replacement is very important and should be made at regular, scheduled periods.

The crankcase oil should be changed after 50 hours service and when the oil is at operating temperatures so that complete drainage will result.

Replace the oil filter element every 150 hours unless extremely unfavorable operating conditions indicate that filter replacements should be made at every oil change period.

Thoroughly clean the filter, cover and sealing surfaces before replacing new element and gasket.

3. SERVICE AIR CLEANER. If oil-bath air cleaner is used, remove bottom half of air cleaner - clean thoroughly and fill with engine oil to oil level mark on cup, avoid overfilling. Replace cup and check all connections to manifold. Be sure that no unfiltered air can enter the engine intake manifold.

If a dry type air cleaner is used, clean element with compressed air. (See Daily Instructions.)

4. CHECK FAN BELT TENSION. Inspect wear condition of fan belt; note alignment and check belt tension which should allow 3/4" to 1" deflection on long span.

5. CHECK BATTERY. Check specific gravity of each cell - which should be at least 1.250. Add distilled water, if required, to raise level 3/8" above the separators.

Particular attention should be given battery during cold weather. The cranking power of a fully charged battery @ 80° F. is reduced 60% @ 0° F. - yet the power required to crank the engine is 2-1/2 times greater @ 0° F. than @ 80° F.

6. LUBRICATE GENERATOR AND STARTER. Apply 3-5 drops of engine oil to each cup on the generator and if required on the starter. (Many starters have sealed bearings.)

7. LUBRICATE POWER TAKE OFF. Using grease gun, lubricate the clutch throw out bearing and output shaft bearing with approved ball bearing grease.

Operations requiring frequent de-clutching should be lubricated daily.

EVERY 250 HOURS

1. REPEAT DAILY AND 50-HOUR SCHEDULES. Follow previous instructions.

2. CLEAN EXTERIOR OF ENGINE. Use steam if available, otherwise any good commercial engine cleaner to wash down the engine.

3. CHECK GOVERNOR CONTROL. Clean and lubricate all governor linkage to insure free operation of governor. Free-up any joints that may be binding or rods or levers that may be twisted. Check for full throttle opening.

4. CLEAN SPARK PLUGS. Clean depressions around plugs before removing them - then clean and re-set point gap to .025 on standard plugs and .035 on resistor plugs.

Install spark plugs (18 mm) and tighten to 35 ft. lbs. torque.

5. CHECK DISTRIBUTOR. Clean distributor cap inside and outside with solvent without removing wires and blow off with compressed air - inspect cap and rotor for cracks.

Examine contact surfaces of points - replace if burned or pitted and adjust to .020 gap.

Lubricate distributor cam sparingly with a lubricant such as Mobilgrease Special (with Moly).

Check distributor clamp bolts and if found loose - retiming the engine is necessary.

6. INSPECT IGNITION WIRES AND CONNECTIONS. Examine ignition wires for breaks in insulation, chafing and loose connections. Replace if defective.

7. IF DRY REPLACEMENT ELEMENT AIR CLEANER IS USED, REPLACE ELEMENT.

EVERY 500 HOURS

1. REPEAT DAILY - 50 HOUR AND 250 HOUR SCHEDULES.

2. COOLING SYSTEM. Clean radiator core by blowing out with compressed air.

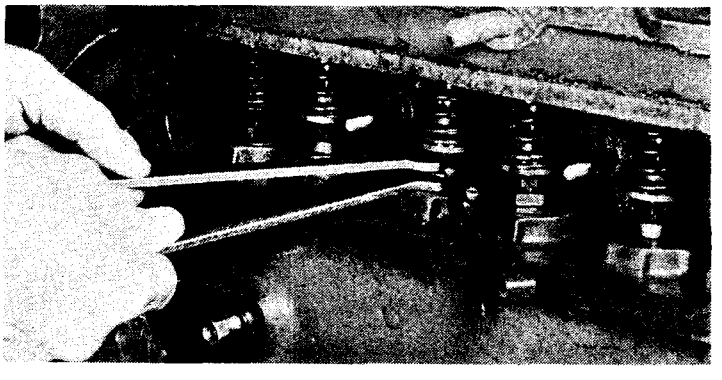
Inspect radiator mounting.
Inspect water pump and connections for leaks.
Check fan and accessory drive belts.

3. ADJUST VALVE TAPPET CLEARANCE. Check and adjust intake and exhaust valve tappets to following clearances at idling speed and running temperatures.

The correct clearance between the tappet and the valve stem is very important. This should be set according to the chart on this page. Two wrenches and a feeler gauge will be required to make the necessary adjustment.

When the adjustment has been correctly made the feeler gauge will pass between the tappet and valve freely.

It is recommended that the tappets be adjusted with the machine running at idle speed whenever possible. If it is not possible to make the adjustment with the engine running, it will be necessary to crank the engine until both valves are closed and the piston is on Top Dead Center on the compression stroke. As a final check start the engine and be sure the correct feeler gauge will pass between the tappets and valves.



	INTAKE	EXHAUST		INTAKE	EXHAUST
N-56	.015	.015	** F Series	.014	.016*
N-62	.012	.012	M Series	.017	.020
Y Series	.012	.012	B Series	.017	.022

* Static or cold setting .017

** IMPORTANT: Recent F135, F163, F227 qnd F245 engines, have a tappet setting of .012 for intake and .020 for exhaust. Please check your engine nameplate for the correct setting.

4. CARBURETOR. Clean exterior and check mounting to manifold.

Adjust carburetor air adjustment for even running and adjust idle speed to 400-600 R. P. M. minimum.

Inspect throttle and choke linkage for free operation.

5. FUEL PUMP.
   Clean filter bowl and screen.
   Inspect mounting and gasket.
   Check all connections for leaks.

6. MAGNETO (WHEN EQUIPPED). Spark test with engine operating by checking firing with each high tension cable held about 1/16" away from spark plug terminal.

Remove end cap and examine carbon brushes for free movement and inspect breaker points for wear and gap. Gap should be .015.

7. SAFETY AND THERMAL CONTROLS. Inspect wires and connections.

Examine armored capillary tubing on water temperature element for visual damage that may cause faulty operation.

LUBRICATION RECOMMENDATIONS

Motor oils used for internal combustion engine lubrication perform many useful functions including: dissipating heat, sealing piston rings, preventing metal to metal contact wear and reducing power loss through friction.

The lubricating oil recommendation is based upon engine design, type of service and the atmospheric temperature prevailing. High quality oils are required to assure maximum performance, long engine life and minimum cost of operation.

L-Head gasoline engines operate in a wide range of service conditions and seasonal temperatures, so our recommendations are given for various types of service and ambient temperatures.

The American Petroleum Institute (API) has established new service classifications so that the engine operator can properly select the best type of oil.

They have the following three classifications of engine oils relating to the different operating conditions for gasoline or other spark-ignition engines:

1. SERVICE ML - (Former API Designation: Regular).

a. Light or Easy Service Conditions - such as moderate operating speed at normal engine temperatures - especially where the engine is relatively insensitive to promote deposit formation and bearing corrosion.

2. SERVICE MM - (Former API Designation: Premium).

a. Moderate Severe Service Conditions - involving higher speeds and operating temperatures; particularly when the higher temperatures tend to promote deposit formation and bearing corrosion.

3. SERVICE MS - (Former API Designation: Heavy-Duty Type).

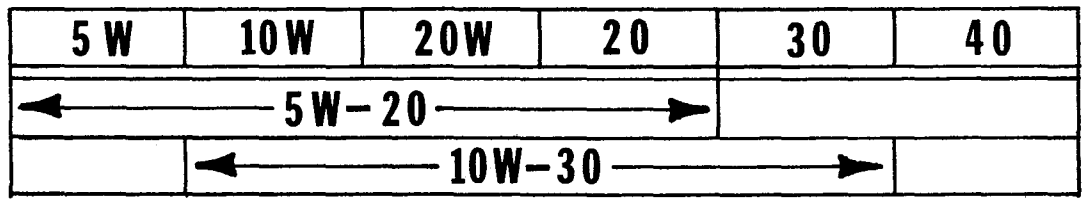
a. Serverest Service Conditions - include:

(1) Start-Stop Operation - which leads to emulsion sludge and corrosive wear; involves essentially a low-temperature condition, and one which gets worse in colder weather.

(2) Severe High Temperature Operation - resulting from high loads or overloads or high operating speed which tends to result in carbon, lacquer and sludge deposits.

S.A.E. OIL BODY GRADES

The oil body grades available from the lightest (SAE 5W) to the heaviest (SAE 40) are:



1. MULTI-GRADE OILS - such as SAE 5W-20 and SAE 10W-30 have the starting grade characteristics of the lighter oil and after it warms up it has the running characteristics of the heavier grade.

The following SAE grades are general recommendations for Continental L-Head engines during changing seasonal atmospheric temperatures:

ENGINE SERIES	SEVERE WINTER BELOW 0° F.	NORMAL WINTER 0°-32°F.	SPRING—FALL 32° — 75° F.	SUMMER ABOVE 75° F.
N	5W—20	10W	SAE 20W	SAE 30
Y	5W—20	10W	SAE 20W	SAE 30
F	5W—20	10W	SAE 20W	SAE 30
M	5W—20	20W	SAE 30	SAE 40
B	5W—20	20W	SAE 30	SAE 40

The Multi-Grade oil used should cover the single grade recommendation for the atmospheric temperature involved, e.g. SAE 10W-30 covers SAE 10W, SAE 20W, SAE 20 and SAE 30.

Use High Grade MS Oils such as Socony Mobil Oil Company Mobiloil or Delvac 1100-Series. Favorable conditions may warrant oils listed under ML and MM service; however, our above general recommendations are listed under SERVICE MS Oils such as:

Mobiloil AF (SAE 40)
Mobiloil A (SAE 30)
Mobiloil Artic (SAE 20-20W)
Mobiloil 10W (SAE 10W)
Mobiloil 5W (SAE 5W-20)
Mobiloil Special (SAE 10W-30)

Delvac 1140 (SAE 40)
Delvac 1130 (SAE 30)
Delvac 1120 (SAE 20W)
Delvac 1110 (SAE 10W)
Delvac Special (SAE 10W-30)

2. GENERATORS, STARTERS, DISTRIBUTORS - Add 3-5 drops of engine oil to the generator and starter oil cups every 50 hours and to the distributor every 250 hours.

3. AIR COMPRESSORS (ENGINE MOUNTED) - normally are engine lubricated; however, if lubricated separately from the engine, use the same type and grade as used in the engine.

4. CLUTCHES - use a high temperature bearing grease such as Mobilgrease No. 5 or Mobilgrease MP. Do not over-lubricate.

5. CONVENTIONAL TRANSMISSIONS - For the greatest efficiency over the life of the transmission, use a high quality straight mineral oil such as the "Mobilube C" line. The oil should be changed seasonally.

Use the following proper grades:

	SUMMER	WINTER
Clark	SAE 30	SAE 90
Fuller	SAE 140	SAE 90
Twin Disc	SAE 40	SAE 40
Warner	SAE 140	SAE 90

6. TORQUE CONVERTERS AND HYDRAULIC OR AUTOMATIC TRANSMISSIONS - These units employ a fluid medium to transmit power which must be very stable to resist formation of harmful deposits or change in body in use. The correct fluid must be selected to obtain maximum efficiency of the transmission. All fluids should be changed seasonally.

Type "A" Automatic Transmission fluid is most widely used. There are many widely distributed brands of this type, such as Socony Mobil Oil Company's Mobilfluid 200.

7. DO NOT FLUSH CRANKCASE WITH KEROSENE. Some operators unwisely put kerosene in the crankcase after draining the engine oil, then turn the engine over with the starter - in the belief they are doing a better job of crankcase cleaning.

In doing this, kerosene is circulated through the oil pump, the main oil header and the branches leading into the engine bearings - thereby washing away the protective oil film. In addition, some of the kerosene will be trapped and remain to thin out the new oil, reducing its lubricating qualities.

Do not put kerosene into the crankcase. The best method is to drain the oil when the engine is thoroughly heated - which will carry off most of the sediment.

TRANSMISSION AND CONVERTER LUBRICATION RECOMMENDATIONS

The following grades are generally recommended for hydraulic torque converters and transmissions for Summer and Winter operation:

MANUFACTURER	SUMMER	WINTER
CONTINENTAL MOTORS CORP. Co-Matic Drive Fluid Coupling HC15	 Type A Type A	 Type A Type A
CLARK EQUIPMENT CO. Torcon (converter only) Torcon Converter and Transmission	 SAE 10W Type A	 Type A (below 10° F.) Type A
FULLER MFG. CO. Torque Converter	 SAE 10W	 Type A (below 0° F.)
BORG-WARNER Borg & Beck & Long Mfg. Co. All converters and hydraulic transmissions	 Type A	 Type A
ALLISON DIVISION Torque Converters and Torqmatic Transmissions	 Type C	 Type C
TWIN DISC CLUTCH CO. Hydraulic Reverse Gears Coupling or Power Take-off	 SAE 10W	 SAE 10W
Hydraulic Converter Transmissions Input shaft & impeller bearings (C, FC)	 Same as Engine	
Fluid Medium except Two speed transmission and converter transmission combinations (Models T-DRR-FT-IT)	 Special Twin-Disc Fluid Type A	 Type A
Reverse Transmissions Models RR-CRR-ICRR	 SAE 40	 SAE 20
NOTE: For all grease applications on the above units a good high temperature grease, such as, Socony Mobil Oil Company's Mobilgrease No. 5 or MP should be used.		

8. AIR CLEANER. All engines, when operating, consume several thousand cubic feet of air per hour. Since dusty air is full of abrasive matter, the engine will soon wear excessively if the air cleaner does not remove the dust before entering the cylinders.

Two basic types of air cleaners are normally used - the oil bath type and the dry replaceable element type.

Operating conditions determine the air cleaner service periods. In extremely dusty operations, this may be once or twice daily. In dust protected areas, the air cleaner should be serviced when changing oil.

As the dirt is strained from the air flowing through the cleaner it thickens the oil in the cup and raises the level. If the level is too high, agitation of the oil on the screen is effected and gritty oil is carried over into the air stream, through the carburetor and into the engine cylinders. This would actually introduce a grinding compound with resulting very rapid wear.

9. OIL PUMP. On all engines except the N-series, a large capacity, submerged, gear type oil pump is driven off the camshaft and protected by a large screen inlet; on the N-series the oil pump is mounted on the rear end plate.

An adjustable by-pass valve maintains suitable oil pressure from idle to maximum speed automatically. The normal oil pressure at full throttle is 20-30 pounds for the N-F type engines and 40-50 pounds for the B engines and should not fall below 7 pounds pressure at 400-600 RPM idling speed. * (M and Y engines are 30-40 pounds.)

CAUTION

If the oil pressure is erratic or falls below these limits, stop the engine IMMEDIATELY and find the cause of the trouble. Refer to trouble shooting section for this information.

A by-pass type oil filter is normally provided to remove dirt and foreign elements from the oil, a percentage of which is passed through the filter during the operating period. The removal of grit, sludge and foreign particles causes filter elements to clog and become ineffective unless they are normally replaced every 150 hours.

* Other pressures are available, based on customer specifications.

10. OIL CHANGE FREQUENCY. Engine oil does not "wear out". However, the lubricating oil in internal-combustion engines becomes contaminated from the by-products of combustion: dirt, water, unburned fuel entering the crankcase and the detergents holding the carbon particles in suspension in the crankcase.

The frequency with which engine oil should be changed depends upon (1) the quality of the oil, (2) type of operation, (3) mechanical condition of the engine and (4) the type of contaminants from the engine operation and the surrounding atmosphere.

In normal industrial operation, the Continental L-Head engines should have the oil changed after every 50 hours of operation. The oil filter should be changed every 150 hours. The oil should be drained when the engine is at normal operating temperature.

11. BREAKING IN NEW OR RECONDITIONED ENGINES. New or reconditioned engines have very small clearances. To assure adequate oil distribution to these closely fitted surfaces during the first week or 50 hours of engine operation, the use of a lighter bodied oil is desirable.

When the engine break-in is performed during the warmer months of the year, an SAE 10W-30 oil should be used. Be sure to allow a several-minutes warm-up period before applying the load.

12. COLD WEATHER OPERATION. The oil used during cold weather should have a cold test below the lowest anticipated temperatures that will be encountered during its use. The new multigrade lubricating oils 5W-20 and 10W-30 are ideal for cold starting with its reduced initial drag until warmed up, when it assumes the characteristics of the heavier oil.

Sludge formation at low temperatures is a close second to dirt in causing engine damage and wear. This is formed by the piston combustion gases mixing with the fine oil mist in the crankcase and condensing on a cold surface. This condensation forms both a sulphuric and sulphurous acid which combines with the oil to become a highly injurious sludge. This dew point is about 135° F. - when crankcase temperatures are higher, the contaminated gases remain in gaseous form and the engine operates clean as long as breather system is kept clean - however, temperatures below this will result in injurious sludge formation. It is vitally important therefore to maintain oil and crankcase temperatures above 135° F.

In sub-zero temperatures, to prevent damage to oil pump gears (when engine is started) use a 5W-20 oil, or use a plug-in type water heater to keep warm water circulating in the engine.

COOLING SYSTEM

The function of the cooling system is to prevent the high temperature in the combustion chamber from damaging the engine and at the same time keep the operating temperatures within safe limits.

Maintaining the cooling system efficiency is important, as engine temperatures must be brought up to and maintained within satisfactory range for efficient operation; however, engines must be kept from overheating, in order to prevent damage to valves, pistons and bearings.

TYPES OF ANTI-FREEZE	OPERATING TEMPERATURE RANGE		
	32° to 10° F.	+10° to -10° F.	-10° to -30° F.
PLAIN ALCOHOL - (evaporates easily)	Not Recommended w/180° Thermostat		
METHYL ALCOHOL COMPOUNDS	Not Recommended w/180° Thermostat		
ETHYLENE GLYCOL - such as Mobil Permazone, (permanent type) - When there are no leaks add water only to make up for evaporation	1 to 4	2 to 5	1 to 1

NOTE

While the above list includes three types of generally used Anti-Freeze, the Ethylene Glycol or Permanent Type will be found to be the most desirable and likewise the most economical because of the temperatures necessary to maintain efficient operation.

1. CORROSION INHIBITORS. Water forms rust due to its natural tendency to combine chemically with iron and air in the system. Rust inhibitors for water are inexpensive, simple to use and make cleaning and flushing necessary only after long periods of operation.

The most commonly used are either a 3% addition of soluble oil or commercial corrosion inhibitors such as Mobil Hydrotone that are readily available at low cost. The addition of corrosion inhibitors is not necessary if an anti-freeze containing a rust inhibitor is used.

2. RADIATOR. The radiator or heat exchanger consists of a series of copper tubes through which the cooling water is circulated. In standard radiator design fins are connected to the copper tubes to give an extended surface through which heat can be dissipated. It is important that these tubes be kept clean on the inside and the fins free of dirt on the outside so that maximum heat transfer can take place in the radiator.

Blowing out between the fins of the radiator, using compressed air, in a direction opposite to that of the fan circulated air, will serve to keep the cooling surfaces of the core free of dirt and other particles.

Every 500 hours of operation the radiator and cooling system should be well cleaned and flushed with clean water.

Whenever possible, only soft clean water should be used in the cooling system. Hard water will cause scale to form in the radiator and the engine water jackets and cause poor heat transfer. Where the use of hard water cannot be avoided an approved water sofener can be used.

3. CLEANING COOLING SYSTEM. Deposits of sludge, scale and rust on the cooling surfaces prevent normal heat transfer from the metal surfaces to the water and in time render the cooling system ineffective to properly maintain normal operating temperatures. The appearance of rust in the radiator or coolant is a warning that the corrosion inhibitor has lost its effectiveness and should be cleaned before adding fresh coolant.

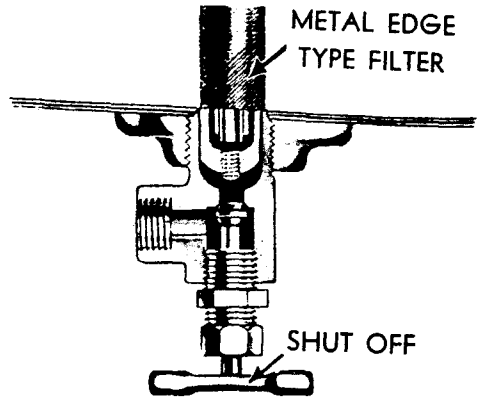
Dependable cleaning compounds should be used. Follow the procedure recommended by the supplier. This is of prime importance because different cleaners vary in concentration and chemical compositions. After cleaning and flushing, the system should be filled with an approved anti-freeze compound containing a rust and corrosion inhibitor or water with a corrosion inhibitor.

FUEL SYSTEM

The basic purpose of the fuel system is to store, convey, mix fuel with air, then vaporize and introduce the mixture into the engine.

Fuel is stored in the gasoline tank; it is filtered and flows through the fuel supply line to the carburetor - either by gravity or under pressure of a fuel pump. The carburetor mixes the fuel with proper proportions of air and at the same time breaks it into very fine spray particles. This atomized spray changes to vapor, by absorbing heat as it travels through the intake manifold to the combustion chamber. Fuel must be vaporized since it will not burn well as a liquid.

1. GRAVITY FUEL SYSTEM. This is the most simple fuel system and is generally used on power units as it eliminates the need of a fuel pump - it only requires the fuel tank located higher than the carburetor.



All power units with fuel tank have a combination shut-off valve and an efficient metal edge type filter. This filter prevents all foreign particles and water from entering the carburetor.

With reasonable care in filling the tank with clean fuel, this filter will require only seasonal cleaning of both the filter and tank.

CAUTION

IT IS RECOMMENDED THAT THIS VALVE BE KEPT IN THE CLOSED POSITION EXCEPT WHEN UNIT IS IN OPERATION.

2. CARBURETOR. Continental L-Head gasoline engines normally use various models of Zenith and Marvel-Schebler carburetors - of both the updraft and downdraft types.

The carburetor mixes fuel with air and meters the mixture into the engine as the power is demanded. Most carburetors incorporate the following systems to provide the flexibility and sensitive requirements of varying loads and conditions:

a. Float System - controls the level and supply of fuel.

b. Idle or Low Speed - furnishes the proper mixture for the engine idle, light load and slow speeds, until the main metering system functions.

c. Main Metering System - controls the fuel mixture from part throttle operation to wide open throttle.

d. Power or Economizer System - provides a richer mixture for maximum power and high speed operation. This system ceases to function when the manifold vacuum is above 6" Hg.

e. Compensating System - provides a mixture which decreases in richness as the air speed increases.

f. Choke System - delivers additional fuel to the manifold for cold engine starting.

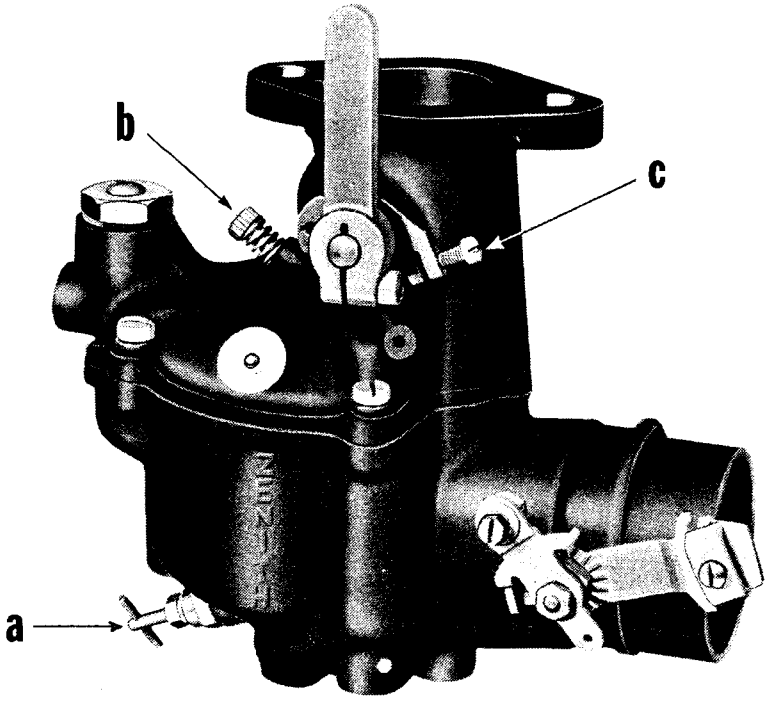
3. ZENITH CARBURETOR. The Zenith 62 Series carburetor shown page 17 has the following three adjustments:

a. Main Adjustment Screw - determines the amount of fuel which may be obtained for high speed operations.

To set this adjustment, open the throttle to about 1/4 open. Turn the adjustment clockwise, shutting off the fuel until the engine speed decreases or begins to miss due to lean mixture. Now open the adjustment until the engine reaches its maximum speed and runs smoothly without missing.

b. Idle Mixture Adjustment Needle - controls the amount of air admitted to the idling system, which functions only at low speeds.

Turning the screw clockwise cuts off the air, making the mixture richer - while unscrewing it admits more air making the mixture leaner. The idling adjustment needle should be set for the smoothest running of the engine; or, if a vacuum gauge can be attached to the manifold, set the adjustment for highest manifold vacuum.



ZENITH 62 SERIES CARBURETOR

c. Idle Speed Adjustment Screw - controls the idling speed - which should be 400-600 R. P. M. for most industrial applications.

4. MARVEL-SCHEBLER CARBURETOR (Model TSX). The Model TSX carburetor without power adjustment has the following two adjustments:

a. Preliminary Adjustments

(1) Set throttle stop screw "A" so that throttle disc is open slightly.

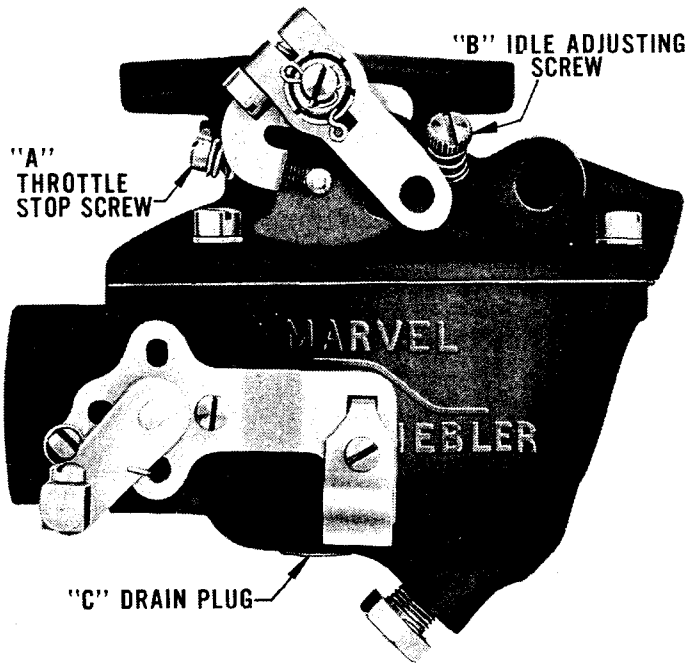
(2) Make certain that gasoline supply to carburetor is open.

(3) Set throttle control lever to 1/3 open position.

(4) Close choke valve by means of choke control button.

(5) Start engine and partially release choke.

(6) After engine is up to operating temperature throughout, see that choke is returned to wide open position.



MARVEL-SCHEBLER TSX CARBURETOR

b. Low Speed or Idle Adjustment

(1) Set throttle or governor control lever in slow idle position.

(2) Adjust throttle stop screw "A" for correct engine idle speed (normally 400-600 RPM).

(3) Turn idle adjusting screw "B" in, or clockwise, until engine begins to falter or roll from richness, then turn screw "B" out, or counterclockwise, until the engine runs smoothly.

NOTE

IT IS BETTER TO HAVE THIS ADJUSTMENT SLIGHTLY TOO RICH THAN TOO LEAN.

NOTE

It is very important not to paint over the powdered bronze overflow drain plug shown in illustration. This has to remain porous to drain off excess gasoline from over choking. If this plug is sealed, gas can back up into the air cleaner hose and create a fire hazard.

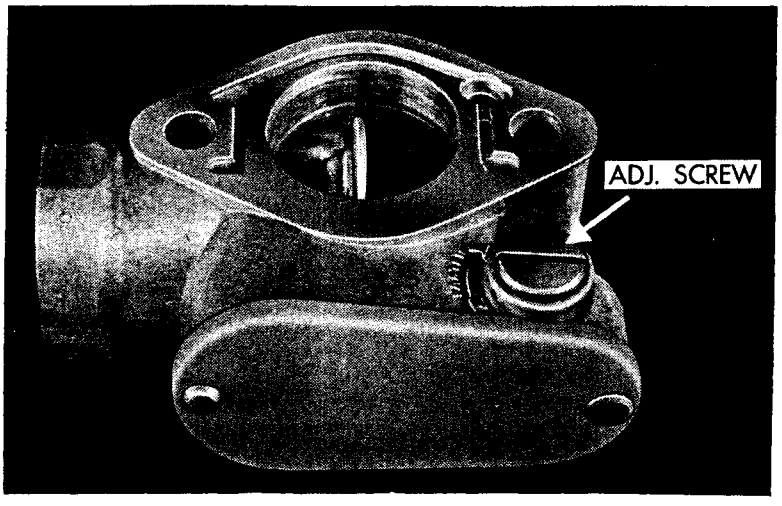
5. GOVERNORS. The governor is a device which controls engine speed - either keeping it operating at a constant speed or preventing it from exceeding a predetermined speed. It promotes engine operation economy and eliminates needless engine failures.

Continental L-Head engines use many types of velocity and centrifugal governors - however, the majority use centrifugal (Mechanical) governors.

6. VELOCITY GOVERNORS.

a. Velocity Governors - are generally used to prevent engine speed from exceeding a predetermined maximum. The governor is mounted between the carburetor and manifold flanges. In its most simple form, it consists of a main body, which contains a throttle shaft, a throttle valve and a main governor spring. The main governor spring is attached by linkage to the governor shaft and the spring force holds the throttle valve open.

When the engine is started, air flows through the carburetor throat and the governor throat. The velocity of the air creates a pressure above the throttle valve. When this pressure exceeds the force exerted by the spring, the throttle will move toward a closed position. The adjusting screw varies the spring tension.



HOOF VELOCITY GOVERNOR

When this closing action of the valve exactly balances the spring, governing action takes place and maximum speed is fixed at this point.

When load is applied - the engine speed tends to drop - the velocity of the gas through the manifold and the pressure against the governing valve is reduced and the spring opens the valve to feed more gasoline to the engine to handle the increased load demand. Thus an almost constant speed is maintained whether the engine is running with or without load.

b. Checking and Adjusting Governor Linkage. The following is a step by step procedure to follow in checking and adjusting the governor linkage:

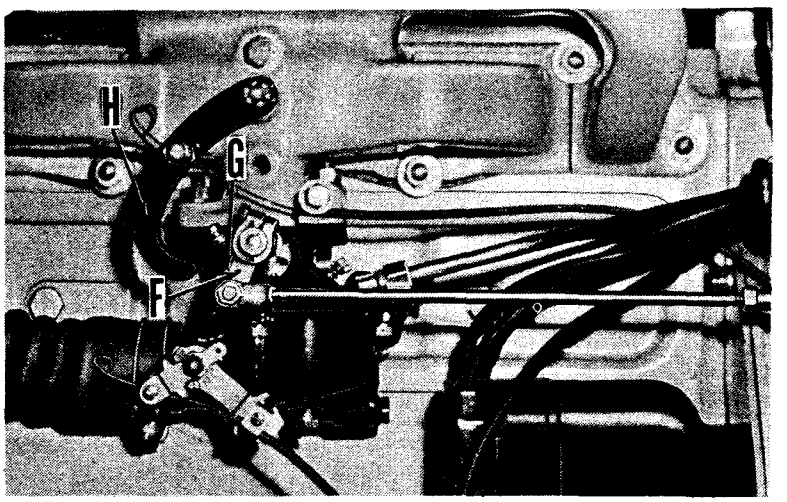
(1) With the engine stopped and spring tension about normal, the governor should hold the throttle in the open position. The governor to carburetor control rod should be adjusted in length so the throttle stop lever is 1/64 to 1/32 off the stop pin.

(2) Make certain that all linkage is free with spring at operating tension disconnect the governor spring and check movement of levers and rods.

(3) The carburetor lever "F" is attached to the throttle shaft by a coil spring, which must be under sufficient tension to move the throttle as a unit with the lever, without any fluctuation due to the velocity of air striking the throttle butterfly.

This tension is adjustable by winding or unwinding spring.

(4) Lever "G", which is firmly attached to throttle shaft, serves to slow the engine down, overriding the governor, through the spring loaded lever "F". A throttle control cable attached to lever "H" provides this idle control, since as this lever "H" is pulled toward the front of the engine, it moves lever "G" to close the carburetor throttle.



GOVERNOR LINKAGE

NOTE

Lever "G" must be located so as to clear lever "F". This may be checked by moving lever "G" forward with the finger and noting if it returns to position freely and quickly.

7. NOVI GOVERNOR.

a. The Novi Governor - is used on most industrial units requiring normal industrial speed regulation. Novi governors differ from conventional centrifugal governors mainly in that round steel balls are used as the motivating force producer instead of masses of weight.

When the governor is driven at increasing speeds by the engine through the governor gear, the hardened steel balls, move outward, forcing the conical upper race, fork base, fork and lever assembly toward a closed throttle position.

An externally mounted spring imposes tension on the lever assembly toward the open throttle position. As the engine speed increases, the centrifugal force created by the balls will increase until a balanced condition between the governor force and the spring force exists and the governing lever remains stationary - holding a constant engine R. P. M.

b. Adjustment - The desired engine speed is obtained by increasing or decreasing the governor spring tension.

c. Novi Constant Speed Governor

(1) Start the engine. While it is warming up, back out surge adjusting screw "C" (See illustration) so it will have no effect.

(2) With engine warmed up, adjust idle speed approximately 150 R. P. M. higher than the required speed under load, by turning screw "B" in or out, thus either increasing or decreasing pull on the spring.

Lock screw "A" should be backed out so as not to interfere with the adjustment.

(3) Apply the desired load, and readjust screw "B" in order to obtain the required speed under load.

Release load and note R. P. M. at which engine settles out.

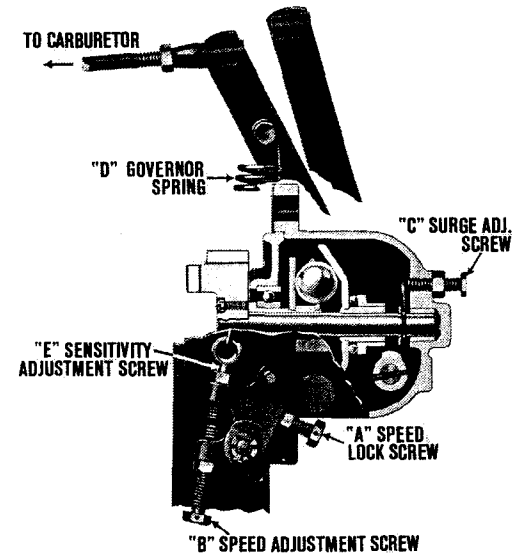
Again apply load, and observe the drop in R. P. M. before governor opens throttle to compensate.

(4) The range of a governor's action is indicated by the differential between R. P. M. under load and that under no load.

This can be varied and the sensitivity of governor changed by changing the length of screw "E".

(5) To broaden the range of the governor and produce a more stable action, lengthen screw "E" and compensate for this change by turning in screw "B" to restore speed.

Lengthening screw "E" changes pull on spring to more nearly the arc of the lever action, thus having the effect of increasing the spring rate.



NOVI GOVERNOR

(6) To narrow the range and increase the sensitivity of the governor, reverse procedure outlined in 5. (Changing the length of screw "E" has the same effect as using a stronger or weaker spring.)

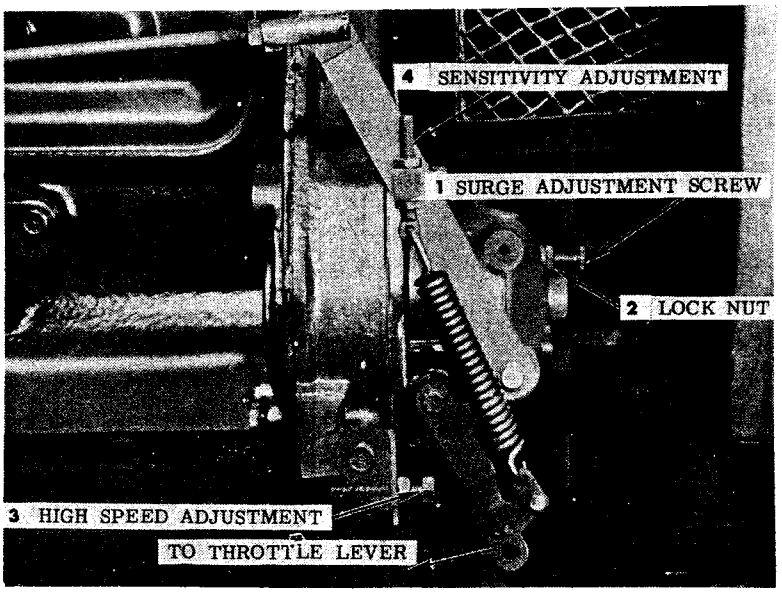
(7) With the governor adjusted for desired performance, release the load and allow engine to run at governed speed, no load. If a surge is noted, turn surge adjusting screw "C" in or clockwise until surge is eliminated. Do not turn in further than necessary as it may make it difficult to get a low enough slow idle.

Alternate method if a tachometer is used: have engine running at high idle (governed speed) no load. Turn surge adjusting screw in until RPM increases 10-20 RPM and lock. If linkage and carburetor are all properly adjusted, surge will be gone.

(8) When governor adjustment is completed, tighten locking screw "A", which locks the cam in position. Then make sure that all lock nuts are tight, in order to maintain the adjustment.

d. Novi Variable Speed Governor

(1) Back Out Surge Screw "1" - until only 3-4 threads hold - then lock with lock nut "2".



NOVI VARIABLE - SPEED GOVERNOR

(2) Start Engine and Idle - until warmed to operating temperature.

(3) Set Specified High Idle No-Load Speed - by moving throttle to required position and adjusting high speed screw "3".

(4) Check Regulation - by applying and removing engine load.

(a) If regulation is too broad - increase spring tension with sensitivity screw "4" and readjust high speed screw "3" throttle stop to obtain high idle speed.

(b) If regulation is too narrow - decrease spring tension with sensitivity screw "4" and readjust high speed screw "3" throttle stop to obtain desired high idle speed.

(c) If governor surges under load - decrease spring tension with sensitivity screw "4" and readjust throttle lever position to desired high idle speed.

(d) Repeat above steps as required - until desired performance is obtained. When adjustment is complete, lock all lock nuts to maintain settings.

NOTE

Surge Screw "1" - is used to remove a no-load surge only.

If governor surges at no-load, turn surge screw in a turn at a time until the surge is removed. Do not turn in far enough to increase the no-load speed more than a few RPM, if at all.

e. Maintenance. The slotted driver, in which the balls move, is pinned to the governor shaft; the two races are free floating on the shaft. When the engine is running at a fixed speed all parts go around with the governor shaft and the thrust is taken on the thrust bearing between conical shaped race and fork base. When a change in speed, due to change in load, takes place, the relative speed between the balls and races is changed. Consequently, wear is distributed over the entire operating surface of the races and balls. Since the surfaces are hardened, little or no wear other than a polish should ever take place on these parts.

The driver must always be tight to the shaft. The races must be free on the shaft.

In assembly of the governor a space of .004 to .006 is provided between the driver and the flat race. This is to assure freedom for movement of the flat race. When servicing the governor, make sure that both races revolve freely on the shaft.

When the balls are "in", that is in the bottom of the driver slots, the space between the top of the conical shaped race bushing and hairpin clip should be .230-.240. Use .010 spacer washers to obtain required space.

The governor shaft is pressed into gear and secured with screw that is partially in the shaft and partially in gear.

Lubrication is supplied the governor by splash from the front end gear train through holes provided in the governor base. Like all mechanical governors, the Novi must have ample lubrication for its functioning. Make sure the governor parts are being well supplied with oil.

f. Novi Hinged Lever Governor. The Novi hinged lever governors are basically the same as other Novi Governors, except the governor arm is in two parts. Pivoted on a pivot bolt, it is spring loaded to hold the arm in a straight position except when low idle is desired. (Figure A)

When carburetor lever is forced to idle position by speed control lever, this in turn pivots top half of governor arm forward.

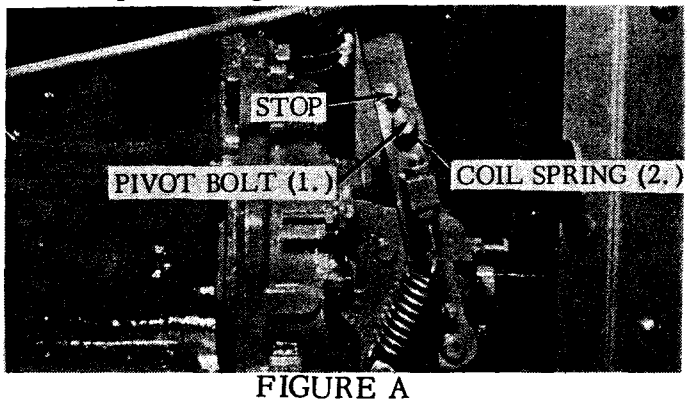


FIGURE A

On older models, a small coil spring loaded throttle lever and shaft on carburetor was used to get idle position. (Figure B).

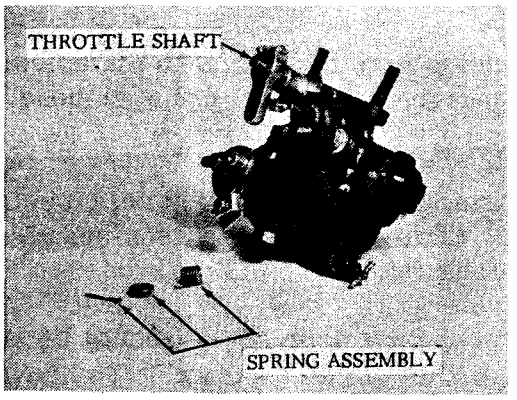


FIGURE B

Should a hinged lever governor be used with a spring loaded throttle lever, the cotter key (Figure C) should be removed and coil spring would up as tight as possible, counterclockwise, by turning serated nut (Figure C) until it lines up with nearest hole in nut and carburetor shaft and then reinstall cotter key. This governor can be supplied as constant speed or variable speed.

Governor adjustments are the same as previously explained under Novi Governor adjustments.

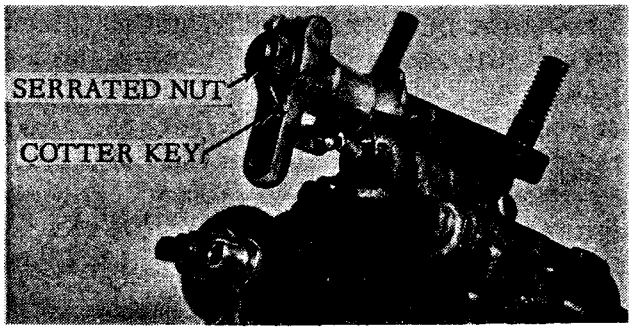


FIGURE C

8. LOCATING IGNITION TROUBLE - If you suspect ignition trouble when engine does not start (provided the battery is well charged and starting motor is functioning), or if the engine is running irregularly, the following routine is a good short method of locating the trouble:

a. Disconnect the high-tension wires to spark plugs, one cylinder at a time, and hold the end of the wire about 1/4" from the cylinder head, then trip the starter relay switch (use the emergency switch under screw cap at end of solenoid) and observe if you get a good spark. This may also be done by shorting across with a screw-driver, without disconnecting wire to the plug.

b. If spark is good then the trouble is in the spark plug, which may be cracked or fouled. Remedy: install new plug. Gap should be .025.

c. If spark is weak, or missing altogether, check the coil.

d. Pull the high tension wire that leads to the coil out of the distributor cap and hold end of wire 1/4" from cylinder head, then test again for spark.

e. If you get a weak spark or no spark here, trouble is indicated in the coil or distributor. Examine the high tension wire, also the primary wire leading from distributor to coil.

f. The distributor compartment cover should be removed, care being taken not to damage the gasket attached to the cover side of the joint. The interior should be thoroughly cleaned and the air inlet and outlet passages opened. Examine the high tension lead brush; replace if noticeably worn or damaged. This brush should move freely in its holder and should have a slight spring pressure.

g. Remove the distributor cap and check the breaker points; these should be examined for evidences of pitting or pyramiding. A small tungsten file or fine stone may be used to resurface the points. If points are worn or badly pitted, they should be replaced. Points are to be adjusted to have a .020 inch gap at full separation. Adjustment is made by loosening the round head locking screw at the upper end of the stationary point bracket, then turning the eccentric head adjusting screw until the gap is obtained, and locking the assembly by tightening the round head screw.

h. If you do not get a satisfactory spark from the coil after distributor has been checked, trouble is indicated in the coil.

i. Check the high tension wires from distributor to spark plugs. These wires must be dry as surface moisture will cause a short.

9. DISTRIBUTOR MAINTENANCE.

a. Check Breaker Arm Hinge: Make sure the breaker arm moves freely on its hinge, and apply a drop of light oil as covered under "Lubrication". Moisture or oil under certain conditions may cause swelling of the fiber bushing in breaker arm hinge, producing irregular running at high speeds. Remedy is to ream the bushing very slightly.

b. Adjust Breaker Points: If the points are burned or pitted they should either be replaced or dressed down with a fine-cut stone or point file. File must be clean and sharp. Never use emery cloth to clean contact points. After filing, check the breaker point gap and reset to .020. The breaker arm must be resting on the high point of the cam during this operation.

When replacing contacts be sure they are aligned and that they make contact near the center. Bend the stationary arm to secure proper alignment. Do not bend the breaker arm.

TROUBLE SHOOTING

A preventive maintenance system including inspection, lubrication and adjustment as recommended in our Maintenance Section will prevent the greater portion of gasoline engine troubles.

Failure of a gasoline engine to start is mainly due to two things; ignition trouble or failure in the fuel system.

Operators handling the same engine every day, soon develop a sense of impending trouble when abnormal operation occurs. Immediate attention to these danger signals can prevent major failures, insure dependable operation and increase the life of the engine.

A good rule to follow in locating trouble is to never make more than one adjustment at a time - then locate the trouble by a process of elimination. Remember the cause is usually SIMPLE - rather than mysterious and complicated.

Following are listed some of the normal complaints encountered in routine operation of all gasoline engines and the probable causes.

A. STARTING MOTOR - WILL NOT CRANK ENGINE:

1. Weak or dead battery.
2. Poor ground connection.
3. Faulty starting switch or relay.
4. Defective starting motor.
5. Internal engine seizure - turn engine manually to determine cause.

B. ENGINE CRANKS - BUT DOES NOT START:

Disconnect one spark plug wire, turn ignition on with starter cranking engine and free end of wire 1/8" from cylinder head - note spark.

1. <u>No Spark:</u>

   a. If Ammeter Shows No Discharge - it indicates an open primary circuit due to:

      (1) Points not closing.
      (2) Open primary wires.
      (3) Defective ignition switch.
      (4) Faulty coil.

b. Normal Ammeter Reading (2-5 Amps) - this indicates that primary circuit is OK - trouble may be in secondary circuit due to:

(1) Broken or grounded high tension wire from coil to distributor.
(2) Wet high tension wires.
(3) Faulty distributor cap or rotor.
(4) Broken secondary winding of coil.

c. Excessive Ammeter Reading (over 5 Amps) - indicates a "short" in the primary winding which may be due to:

(1) Shorted or grounded primary winding.
(2) Distributor or magneto points not opening.
(3) Grounded breaker point arm.
(4) Defective condenser.

2. Weak Spark - may be caused by:

a. Loose ignition wiring connections.
b. Burned or pitted distributor points.
c. Wet spark plug wires.
d. Defective condenser.
e. Cracked distributor cap.
f. Weak ignition coil.

3. Good Spark at Each Plug - indicates that ignition system is OK and trouble is in fuel system - which may be due to:

a. No Gas in Carburetor - which may be due to:

(1) No gas in tank.
(2) Clogged filter or lines.
(3) Faulty fuel pump.
(4) Leaky fuel line from tank.
(5) Plugged vent in fuel tank neck.

b. Gas in Carburetor - which may be flooded due to:

(1) Too much choking - plugs are wet.
(2) Wrong float level.
(3) Choke not operating correctly.
(4) Water in gas.

C. ENGINE RUNS WITH CONTINUOUS MISFIRING DUE TO:

1. Uneven compression.
2. Wet or deteriorated high tension wires.
3. Cracked distributor cap.
4. Faulty spark plugs - if spark plug porcelain is white when removed, use COLDER plug - if light brown OK - if black or oily use HOTTER plug.

D. ENGINE RUNS UNEVENLY

1. At Idling Speed - which may be due to:

   a. Too wide spark plug gaps.
   b. Poor carburetor idle adjustment.
   c. Wrong float level.
   d. Carburetor or intake manifold air leaks.
   e. Leaky cylinder head gasket.

2. At High Speed - which may be due to:

   a. Wide breaker points.
   b. Weak distributor breaker arm spring.
   c. Weak valve springs.
   d. Spark plug of wrong type or incorrect gap.

E. ENGINE RUNS IMPROPERLY

1. Back-Firing Into Manifold - indicates Too Rich a fuel mixture; into carburetor indicates Too Lean a mixture - may be due to:

   a. Late ignition timing.
   b. Clogged air cleaner.
   c. Fuel line restrictions.
   d. Clogged carburetor jets.
   e. Sticking valves.
   f. Weak or broken valve springs.

2. Excessive Ping (Detonation) - results in damaged pistons and bearings and is caused by pre-ignition or using inferior grade of gas.

3. Engine Idles Too Fast - indicates improper throttle adjustment or weak throttle return springs.

4. Engine Dies When Idling - which indicates incorrect speed or mixture adjustment; clogged idling circuit in carburetor or wrong choke adjustment, or air leaks in intake manifold.

5. Engine "Stumbles" on Acceleration - which may be due to defective accelerator pump or air in fuel lines.

6. Defective Spark Plugs.

F. LACK OF POWER - which may be due to:

1. Poor compression.
2. Wrong timing.
3. Throttle control not opening fully.
4. Air leak in fuel system.
5. Restriction in air cleaner - should have vacuum less than 10" water.
6. Exhaust line obstructed - should have back pressure of not more than 20" water.
7. Poor fuel.
8. Piston rings sticking or worn.

G. POOR COMPRESSION - check with compression gauge - if irregular, seal the piston with a teaspoonful of engine oil poured through the spark plug hole, and take a second reading; if pressure does not increase this will indicate that poor seating of valves are at fault.

Poor compression may be due to:

1. Valves holding open - no tappet clearance.
2. Leaky cylinder head gasket.
3. Broken or weak valve springs.
4. Burned or sticking valves.
5. Badly worn, broken or stuck piston rings.
6. Wrong valve timing.

H. OVERHEATING

1. Lack of water in radiator.
2. Fan belts slipping.
3. Thermostat sticking or inoperative.
4. Radiator clogged or leaky.
5. Late ignition timing.
6. Back pressure in exhaust line.
7. Defective water pump.
8. Overloading of engine.

I. LOW OIL PRESSURE

1. Low oil level.
2. Oil pressure gauge or line faulty.
3. Oil too light - diluted.
4. Suction screen plugged.
5. Dirt in relief valve or broken spring.
6. Worn bearings.
7. Worn or damaged oil pump gears.
8. Worn cam bushings.

J. HIGH OIL PRESSURE - should not exceed recommended pressures except when engine is starting up cold. Abnormally high oil pressure is not desirable because it increases oil consumption - possible causes of high oil pressures are:

1. Engine oil too heavy.
2. Stuck relief valve.
3. Obstruction in distributing line.
4. Faulty oil pressure gauge.

K. HIGH OIL CONSUMPTION

1. Oil leaks.
2. Too high oil level.
3. Incorrect grade of oil used.
4. Clogged crankcase breather.
5. Oil pressure too high - stuck relief valve.
6. Piston rings not run-in, due to too smooth cylinder bore finish or glazed condition.
7. Worn, broken or stuck piston rings and clogged oil control rings.
8. Worn pistons and sleeves.
9. Worn bearings.
10. Worn valve guides.

(Manifold may be removed for visual inspection.)

L. ENGINE KNOCKS AND OTHER NOISES

1. Operating Knocks - which may be due to:

   a. Pre-Ignition - most common cause is due to wrong type plugs which are too hot.
   b. Carbon - noticeable when engine is accelerated while hot - clean head and pistons.
   c. Timing - early timing causes knocks similar to carbon - but may tend to kick back when starting.
   d. Fuel - detonation knock caused by poor gas.
   e. Overloads - particularly at lower operating speeds.

2. Mechanical Knocks - result from wear, abuse or improper adjustments - which may be due to:

a. Crankshaft and Main Bearings:

(1) Worn or Burned-out Main Bearings - a heavy, dull knock when accelerating under load. Locate by shorting out plugs on both sides of the bad bearing.

(2) Crankshaft End Play - excessive end play is indicated by an intermittent knock which will come and go when the load is released and engaged.

b. Connecting Rod Bearings:

(1) Worn or Burned-out Bearings - the worst condition, a light pound or metallic knock, is noted at idling and to about 2/3 maximum speed. Bad bearings can be determined by shorting out plugs.

c. Pistons and Wrist Pins:

(1) Loose Wrist Pins - noise doubles when the correct plug is shorted out - most noticeable at idling speed.

(2) Piston Loose in Cylinder - "Piston-Slap" is noted by metallic knocking at low speed under load; but disappears at high speed - also most noticeable when starting cold - test by shorting out plugs.

d. Broken Piston Ring or Pin - sharp clicking noise that won't short out.

e. Valves

(1) Burned Valves and Seats - engine misses, especially at low speeds, or acceleration under load.

(2) Weak or Broken Valve Springs - missing at low or high speeds when under load.

(3) Sticking Valves - loss of power and popping sound when bad.

(4) Tappet noise - excessive clearances cause noise when cold - which diminishes at normal operating temperature.

f. Camshaft - noise due to loose bearings or end play - usually occurs at half engine speed.

g. Timing Gear Noise - loose or worn gears rattle or knock - tight gears hum.

3. Vibration Originating at Engine - the most common sources of vibration originating in or on the engine, as distinguished from causes created outside the engine are as follows:

a. Misfiring.
b. Misalignment of engine.
c. Bent or off-center coupling.
d. Engine loose on bed and type of mountings.
e. Out of balance condition of flywheel and clutch assembly.

TORQUE SPECIFICATIONS

Continental L-Head engines have many studs, bolts and cap screws of special material and sizes and it is very important that special care be exercised to replace all studs and bolts in their respective locations during assembly of engine.

The torque specifications, foot pounds, listed below, MUST be followed in order to have the assembled engine conform to the original specifications:

SIZE-DIAMETER	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"
Cylinder Heads		35-40	70-75	100-110	130-140	145-155
Main Bearing Caps		35-40	70-75	85-95	110-120	140-150
Connecting Rods	20-25	40-45	55-60	90-100	110-120	
Flywheels	20-25	35-40	70-75	85-95	100-110	145-155
Manifolds	15-20	25-30	40-50	50-60	50-60	60-70
Gear Covers, Water Pumps, Front and Rear End Plates	15-20	25-30	50-55	80-90		
Oil Pans	12-16	12-16				
Flywheel Housings	15-20	25-30	50-55	80-90	115-125	

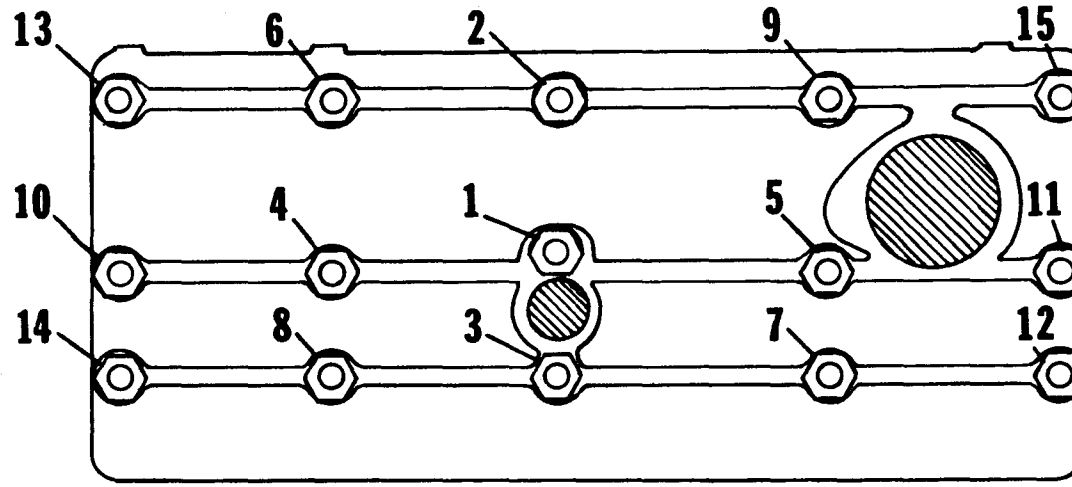
CAMSHAFT NUT

THREAD SIZE	3/4"	7/8"	1"	1-1/8"	1-1/4"	
C. I. Shafts	65-70#	70-80#	95-100#	125-130#	145-150#	
Forged Steel Shafts		*120-125#	*175-180#			
Elastic Stop Nut w/C. I. or Forged Steel Shaft		65-70#				

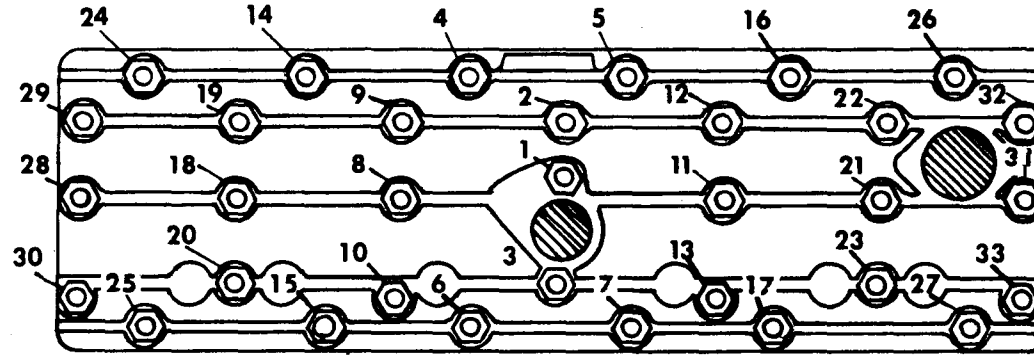
* When Cam Gear Governor is used with a steel camshaft, torque cam nut to 85-90#.

TORQUE SPECIFICATIONS FOR CYLINDER HEAD TIGHTENING SEQUENCE IN FOOT POUNDS

Size - Diameter				
3/8"	7/16"	1/2"	9/16"	5/8"
Cylinder Heads				
35-40	70-75	100-110	130-140	145-155



Cylinder Head Tightening Sequence – Four Cylinder



Cylinder Head Tightening Sequence – Six Cylinder

PREPARATION OF ENGINE FOR SEASONAL STORAGE

CAUTION

Before starting the processing, engine must be cooled down to the surrounding temperature, since oil will adhere much better to cold metal surfaces.

1. DRAIN OIL FROM OIL PAN - and replace drain plug.
2. REFILL OIL PAN - with high grade SAE 50 engine oil to 1/2 its normal capacity.
3. START UP ENGINE - and run at above 600 RPM for 2 minutes to complete oil distribution on all surfaces - DO NOT RUN LONGER THAN 2 MINUTES.
4. STOP ENGINE - Remove all spark plugs.
5. POUR 3 OUNCES OF SAE 50 ENGINE OIL - into each spark plug hole.
6. IGNITION CUT OFF - CRANK ENGINE WITH STARTER - for at least a dozen revolutions to distribute this oil over the cylinder walls and valve mechanism.
7. DRAIN OIL FROM PAN AND REASSEMBLE PLUG.
8. DRAIN COOLING SYSTEM AND CLOSE DRAIN COCKS.
9. DRAIN ALL GASOLINE - from tank, lines and carburetor bowl.
10. REPLACE ALL SPARK PLUGS.
11. SEAL AIR CLEANER INLET - EXHAUST OUTLET - CRANKCASE BREATHER TUBE - with weather proof masking tape.
12. CHECK OIL FILLER CAP - GAS TANK CAP AND RADIATOR CAP to make certain they are securely in place.

SHORT TERM STORAGE

(Instructions below should be adhered to every 90 days on outside storage and every 6 months on inside storage.)

If the shut down period is to be over 30 days duration, the following instructions should be adhered to:

1. Stop engine, remove spark plugs.
2. Pour 3 ounces clean engine oil in each spark plug hole.
3. With ignition cut off, crank engine with starter at least a dozen revolutions to distribute this oil over the cylinder walls and valve mechanism.
4. Replace all spark plugs.
5. Remove drain plug from carburetor bowl and drain gasoline.
6. Replace drain plugs.

CAUTION

Gasoline evaporates if left in carburetor for long periods. This evaporation of gasoline will leave a gum and varnish coating over jets and moving parts; when engine is started up again, you may have flooding or poor operation from carburetor.