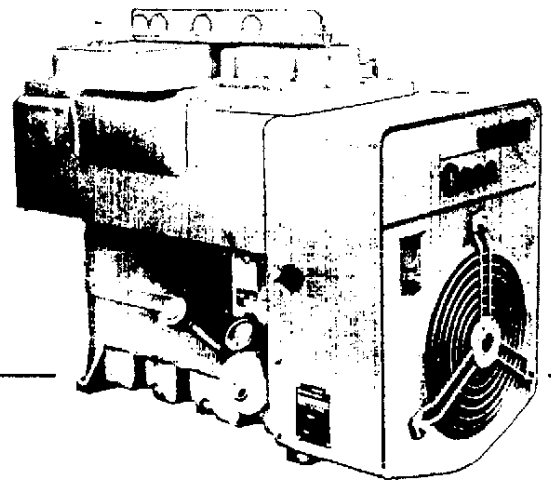


Onan

Operators and Service Manual

JB-JC Industrial Engine



967-0754
JB (SPEC A-T)
JC (SPEC A-V)
1-96
Printed in U.S.A.

Safety Precautions

It is recommended that you read your engine manual and become thoroughly acquainted with your equipment before you start the engine.

⚠ WARNING This symbol is used throughout this manual to warn of possible serious personal injury.

⚠ CAUTION This symbol refers to possible equipment damage.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

Safety Codes

- All local, state and federal codes should be consulted and complied with.
- This engine is not designed or intended for use in aircraft. Any such use is at the owner's sole risk.

General

- Provide appropriate fire extinguishers and install them in convenient locations. Use an extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the engine are secure and accurately torqued. Keep guards in position over fans, driving belts, etc.
- If it is necessary to make adjustments while the engine is running, use extreme caution when close to hot exhausts, moving parts, etc.

Protect Against Moving Parts

- Do not wear loose clothing in the vicinity of moving parts, such as PTO shafts, flywheels, blowers, couplings, fans, belts, etc.
- Keep your hands away from moving parts.

Batteries

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine.
- **DO NOT SMOKE** while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or by smoking.
- Verify battery polarity before connecting battery cables. Connect negative cable last.

Fuel System

- **DO NOT** fill fuel tanks while engine is running.

- **DO NOT** smoke or use an open flame in the vicinity of the engine or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping for flexible lines as copper will work harden and become brittle enough to break.
- Be sure all fuel supplies have a positive shutoff valve.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. All engine applications, especially those within a confined area, should be equipped with an exhaust system to discharge gases to the outside atmosphere.
- **DO NOT** use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Ensure that exhaust manifolds are secure and are not warped by bolts unevenly torqued.

Exhaust Gas Is Deadly!

Exhaust gases contain a poisonous gas that might cause unconsciousness and death. It is an odorless and colorless gas formed during combustion of hydrocarbon fuels. Symptoms of carbon monoxide poisoning are:

- Dizziness
- Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of these symptoms, get out into fresh air immediately, shut down the unit and do not use until it has been inspected.

The best protection against carbon monoxide inhalation is proper installation and regular, frequent inspections of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

Cooling System

- Coolants under pressure have a higher boiling point than water. **DO NOT** open a radiator pressure cap when coolant temperature is above 212 degrees F (100 degrees C) or while engine is running.

Keep The Unit And Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and present a potential fire hazard.

GENERAL INFORMATION

FOREWORD

This manual covers the operation, maintenance and service procedures for the two-cylinder, 60 cu. in. 21.6 horsepower JB engine and the four-cylinder 120 cu. in. 42.5 horsepower JC engine.

The two engines are very similar. Both are 4 cycle, vertical, in-line, air-cooled engines with overhead valves. Normal engine speed ranges up to 2700 rpm. An internal, constant speed, flyball-type mechanical governor, externally adjustable, is standard. Optional two-speed and variable-speed governors are available.

Each engine is test-run at the factory for several hours and adjusted for correct operation. Any damage incurred through transit must be corrected before operating the engine.

Unless specified, all instructions and procedures in this manual apply to both the JB and JC. When instructions apply to a specific engine model, refer to the engine nameplate for the model and specification number.

TABLE OF CONTENTS

General Information	1
Specifications	2
Dimensions and Clearances	3
Tune-Up Specifications	4
Assembly Torques and Special Tools	5
Optional Equipment	5
Installation	6
Operation	9
Troubleshooting Guide	12
Service and Maintenance	13
Cooling System	16
Fuel System	18
Ignition System	30
Governor System	39
Oil System	41
Starting System	44
Flywheel Alternator	50
Engine Disassembly and Repair	55
Wiring Diagrams	66

WARNING

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- *Dizziness*
- *Headache*
- *Weakness and Sleepiness*
- *Vomiting*
- *Muscular Twitching*
- *Throbbing in Temples*

If you experience any of these symptoms, get out into fresh air immediately, shut down the unit and do not use until it has been inspected.

The best protection against carbon monoxide inhalation is proper installation and regular, frequent inspections of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

▲ WARNING: ▲

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

SPECIFICATIONS

SPECIFICATIONS	MANUAL STARTING		ELECTRIC STARTING	
	JB	JC	JB	JC
Dimension in Inches				
Height	26-3/8	28-5/16	26	26
Width	17-7/8	19-1/2	18	20
Length	24-5/8	37-1/2	25	37
Weight	220	375	220	375
Number of Cylinders	2	4	2	4
Displacement (cu. in.)	60	120	60	120
Bore	3-1/4	3-1/4	3-1/4	3-1/4
Stroke	3-5/8	3-5/8	3-5/8	3-5/8
H.P. @ 2700 rpm	21.6	42.5	21.6	42.5
Compression Ratio (Natural Gas Only 9:1 - Spec U & W)	6.5:1	6.5:1	6.5:1	6.5:1
Connecting Rod Bearings Tri-metal, Replaceable	STD	STD	STD	STD
Main Bearings are Steel-backed, Bronze Sleeve Type; Replaceable Precision Inserts	2	3	2	3
Battery Ignition	**			
**Breaker Points and Coil	NA	NA	STD	NA
**Distributor and Coil	NA	NA	NA	STD
Magneto				
**Flywheel Type	STD	NA	NA	NA
Gear Driven	NA	STD	NA	NA
Battery Voltage	12	12	12	12
Combustion Air (CFM) @ 2700 rpm	48	96	48	96
†Cooling Air (CFM) @ 2700 rpm	850	1250	850	1250
Inlet Vent (sq. ft.)	7	12	7	12
*Outlet Vent (sq. in.)	80	160	80	160
Air Cleaner	DRY	DRY	DRY	DRY
Choke	Manual	Manual	Manual	Manual
Fuel Pump Lift (feet)	6	6	6	6
Oil Filter (Full Flow)	STD	STD	STD	STD
***Oil Capacity, Refill (US Quarts)	3	6	3	6
Power Take-Off				
Shaft Length (inches)	4	4	4	4
Shaft Diameter (inches)	1-3/4	1-3/4	1-3/4	1-3/4
Keyway Length	3	3	3	3
Keyway Width	3/8	3/8	3/8	3/8
Keyway Depth	3/16	3/16	3/16	3/16

* - Area when duct is used; without duct, make vent as large as possible.

** - NA means not available.

*** - Plus an additional 1/2 quart when replacing oil filter.

† - For Vacu-Flo cooling: JB-610 CFM @ 1800 RPM, JC-1600 @ 1800 RPM

DIMENSIONS AND CLEARANCES

All clearances given at room temperature of 70°F.
All dimensions in inches unless otherwise specified.

	Minimum	Maximum
CAMSHAFT		
Bearing Journal Diameter, Front	2.500	2.505
Bearing Journal Diameter, Rear	1.1875	1.1880
Bearing Journal Diameter, Center (JC)	1.2580	1.2582
Bearing Clearance Limit .....	.0012	.0037
End Play, Camshaft .....	.007	.039
Cam Tappet Hole Diameter (Prior to Spec P) .....	.7505	.7515
Cam Tappet Hole Diameter (Begin Spec P) .....	.8755	.8765
Cam Tappet Diameter (Prior to Spec P) .....	.7475	.7480
Cam Tappet Diameter (Begin Spec P) .....	.8725	.8730
CONNECTING RODS		
Large Bearing Bore Diameter	2.1871	2.1876
Small Bushing Bore Diameter	1.044	1.045
Distance, Center Large Bearing Bore to Small Bushing Bore	5.998	6.002
Clearance, Large Bearing to Crankshaft .....	.001	.003
Piston Pin Bushing Inside Diameter (bushing reamed) .....	.9903	.9906
CYLINDER		
Cylinder Bore Honed Diameter	3.2495	3.2505
Maximum Allowable Taper		0.005
Maximum Allowable Out-of-Round		0.002
CRANKSHAFT		
Main Bearing Journal Diameter (JB)	2.2437	2.2445
Main Bearing Journal Diameter (JC)	2.2427	2.2435
Crankshaft Main Bearing Clearance (JB) .....	.0014	.0052
Crankshaft Main Bearing Clearance (JC) .....	.0024	.0062
Connecting Rod Journal Diameter	2.0600	2.0605
Connecting Rod Bearing Clearance .....	.0010	.0033
End Play, Crankshaft .....	.010	.015
PISTON		
Piston Clearance to Cylinder Wall .....	.0012	.0032
PISTON PIN		
Length	2.753	2.738
Diameter .....	.9899	.9901
Piston Pin in Piston		Thumb Push Fit
Connecting Rod Bushing Clearance .....	.0002	.0007
PISTON RINGS		
Ring Type		
Top		Compression
2nd		Compression
3rd		Oil Control
Ring End Gap .....	.010	.020
VALVE INTAKE		
Stem Diameter .....	.3405	.3415
Clearance in Guide .....	.001	.003
Seat Angle		42°
VALVE, EXHAUST (Stellite Faced)		
Stem Diameter .....	.3405	.3415
Clearance in Guide .....	.0030	.0050
Seat Angle		45°

VALVE GUIDE

Length		1-25/32
Outside Diameter .....	.4690	.4695
Cylinder Block Bore Diameter .....	.467	.468
Inside Diameter (after Reaming)		
Exhaust .....	.344	.345
Intake .....	.342	.343

VALVE SEATS (Stellite)

Valve Seat Bore (diameter)		
Intake	1.547	1.548
Exhaust	1.361	1.362
Depth (from Cylinder Head Face) .....	.433	.439
Seat Outside Diameter		
Exhaust	1.364	1.365
Intake	1.550	1.551
Seat Width	3/64	1/16
Seat Angle		45°
Available Oversizes .....	.002, .005, .010, .025	

VALVE SPRINGS

Free Length		1-7/8
Length, Valve Closed		1.528
Load, Valve Closed		45-49 lbs.
Length, Valve Open		1.214
Load, Valve Open		83-93 lbs.
Valve Stem to Guide (intake) .....	.0005	.0025
Valve Stem to Guide (exhaust) .....	.0025	.0045
Valve Face and Seat Angle		45°
Valve Spring Tension		
Valve open — Prior to Spec P	83 lbs.	93 lbs.
Spec P and later	87.2 lbs.	97.2 lbs.
Valve closed — Prior to Spec P	45 lbs.	49 lbs.
Spec P and later	45 lbs.	49 lbs.
Distributor Stem Diameter (JC)	1.061	1.062
Distributor Hole Diameter (JC)	1.063	1.064

Tune-Up Specifications

Valve Clearance — Intake (cold - 10° to 45° ATC on power stroke)	
Prior to Spec C .....	.010
Begin Spec C	*.012
Valve Clearance — Exhaust (cold - 10° to 45° ATC on power stroke)	
Prior to Spec C .....	.013
Begin Spec C	** .015
ONAN Ignition Breaker Point Gap .....	.020
WICO Magneto Breaker Point Gap .....	.015
Distributor Breaker Point Gap (JC) .....	.018-.022
Spark Plug Gap:	
JB .....	.025
JC .....	.035
Start-Disconnect Switch Point Gap .....	.020
Ignition Timing Spark Advance - 25° BTC for gasoline, 35° BTC for natural gas, LPG, or combination gas/gasoline	
Firing Order (JC)	1-2-4-3

* - Exception: with natural gas fuel, intake is .013.

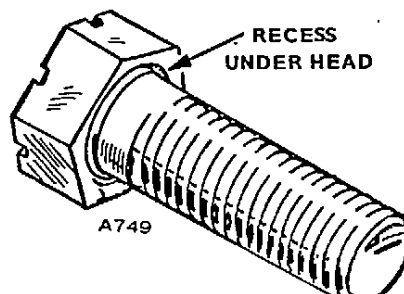
** - Exception: with natural gas fuel, exhaust is .020.

ASSEMBLY TORQUES AND SPECIAL TOOLS

ASSEMBLY TORQUES

The assembly torques given here will assure proper tightness without danger of stripping threads. If a torque wrench is not available, be careful not to strip threads. Use reasonable force only and a wrench of normal length.

Specially designed place bolts do not require a lockwasher or gasket. Check all studs, nuts and screws often and tighten as needed to keep them from working loose.



PLACE BOLTS

TORQUE SPECIFICATIONS	(Ft. Lbs.)
Center Main Bolt (4 cylinder).....	97-102
Connecting Rod Bolt	27-29
Cover-Rocker Box	8-10
Cylinder Head Bolt	28-30
Exhaust Manifold Nuts	13-15**
Flywheel Mounting Screw	65-70
Hub-to-Flywheel Screws (4 cylinder)	17-21
Fuel Pump Mounting Screws	15-20
Gear Case Cover	18-20
Intake Manifold	13-15
Oil Base Mounting Screws	45-50
Oil Filter	Hand Tight + 1/2 Turn
Oil Pump Mounting Screws	15-20
Rear Bearing Plate.....	40-45
Rocker Arm Nut	4-10*
Rocker Arm Stud	35-40
Spark Plug	25-30

* - This torque is from friction between the threads only and locks the nuts in place. The rocker arm nuts are for adjusting valve lash.

** - Tighten nuts evenly to avoid manifold damage.

SPECIAL TOOLS

These tools are available from ONAN to aid service and repair work.

Driver, Valve Seat	420-0270
Oil Seal Guide and Driver	420-0456
Valve Seat Remover	420-0311
Replacement Blades for 420-0272	420-0274
Crankshaft Gear Pulling Ring	420-0248
Driver, Center Camshaft Bearing (JC only) ..	420-0254
Driver, Combination Main and Cam	420-0326
Reamer, Ridge.....	420-0260
Valve Guide Remover and Driver	420-0300

OPTIONAL EQUIPMENT

- Solenoid Shift Starting Motor** — 12 volt or 24-32 volt; less solenoid switch.
- Auto-Cycle Starting Motor** — 12 volt DC or 120 volt AC; 18 to 1 gear reduction; gear train lubricated by crankcase oil; one-way, sprag-type engaging clutch.
- Flywheel Alternator** — For battery charging; integral; no brushes or commutator; two step regulator; maximum charge rate at 2400 rpm; 14.5 amperes into 70 AH discharged battery.
- Low Oil Pressure Cut-Off** — Shuts down plant if oil pressure fails. Crankcase oil level must be checked regularly.
- Two-Speed Governor** — Two springs for low- and high-speed control of engine.
- Gas-Gasoline Carburetor** — One carburetor with gasoline and gaseous fuel provisions. Available as a factory modification or as a field conversion kit.

INSTALLATION

GENERAL

The initial installation is very important. Plan it carefully to ensure maximum operating efficiency. Use this manual as a general guide. Recommendations are based on extensive tests under favorable operating conditions. Conform to local, state or federal codes regulating the installation and operation of internal combustion engines.

LOCATION

Engine location is determined chiefly by the intended application. Provide adequate access for service and repair. Protect the engine from adverse weather. Consider location of related systems, such as fuel, exhaust and ventilation.

MOUNTING

Secure the engine to a rigid, level foundation. See Figures 1 and 2 for typical installations. Foundations must be sturdy enough to withstand distortion and to retain alignment with related equipment.

If necessary to exceed 23 degree tilt angle, consult factory for maximum allowable angle. Compensate for any tilt when checking crankcase oil.

VENTILATION

Provide sufficient fresh air intake and exhaust ventilation to support combustion and cool the engine and generator. Avoid recirculation of ventilating air to prevent engine overheating. See *Specifications* for air flow requirements and vent sizes.

Locate vents so the flow of air from the inlet to the outlet passes over the engine. The outlet should be slightly higher than the inlet. Allow for heat produced by related equipment. See Figures 1 and 2.

An optional air shutter may be used at the outlet vent to control engine temperature by regulating air flow. Air shutters also prevent the backflow of cold air during engine shut-down.

When air ducts are used between the engine and outlet vent, use a section of canvas to restrict vibration, as shown in Figure 2.

EXHAUST

WARNING Exhaust gas is poisonous. Pipe exhaust gases outside. Exhaust pipes must not terminate near ventilation system inlet vents.

1. Avoid sharp bends.
2. Use sweeping, long-radius elbows.

3. Use a section of seamless, flexible tubing between the engine and any rigid piping to isolate vibration.
4. Increase pipes one size for each additional 10-foot span.
5. Protect walls and partitions through which exhaust pipes pass with a metal thimble, Figure 2.

Install a suitable muffler, preferably as close to the engine as possible. Pitch exhaust pipes downward, or provide a condensation trap at the point where a rise in the exhaust system begins.

CAUTION Some installations may require unusually long exhaust pipes and/or numerous elbows. A poor exhaust system will increase back pressure at the engine, and can cause low engine power with reduced efficiency, overheating and eventual damage.

To check exhaust back pressure, install a tee or adapter in exhaust line next to the manifold. Connect a manometer or pressure gauge to the adapter. If there is a condensation trap next to the manifold, this fitting can be used for connecting the manometer. Permissible maximum back pressure is 27" water column (2" mercury) at full load for all models. At no-load, maximum limit is 5.1" water column (3/8" mercury) for the two-cylinder and 4.7" water column (1/3" mercury) for the four-cylinder engine. Check at full load for the best measurement. If the reading is higher than maximum limit, the exhaust system should be disassembled and cleaned or altered to reduce back pressure.

GASOLINE FUEL

Locate separate fuel tanks no lower than six feet below the engine fuel pump. Auxiliary fuel pumps are available to provide an additional six-foot lift.

WARNING To prevent fuel loss and fire hazards due to leaks from line breaks, avoid gravity feed of fuel to the engine from tanks not mounted on the engine.

CAUTION When sharing a fuel tank, do not connect lines at a point above the fuel supply level to prevent starving the engine.

Install the fuel supply line from the tank to the 1/8" pipe inlet in the fuel pump. Use an approved flexible fuel line at the fuel pump to absorb vibration.

Fuel supply line must be leaktight. Install a shut-off valve at the fuel tank for service convenience. Run a vent pipe from the fuel tank to the outside of the compartment to remove gasoline fumes to the outside atmosphere.

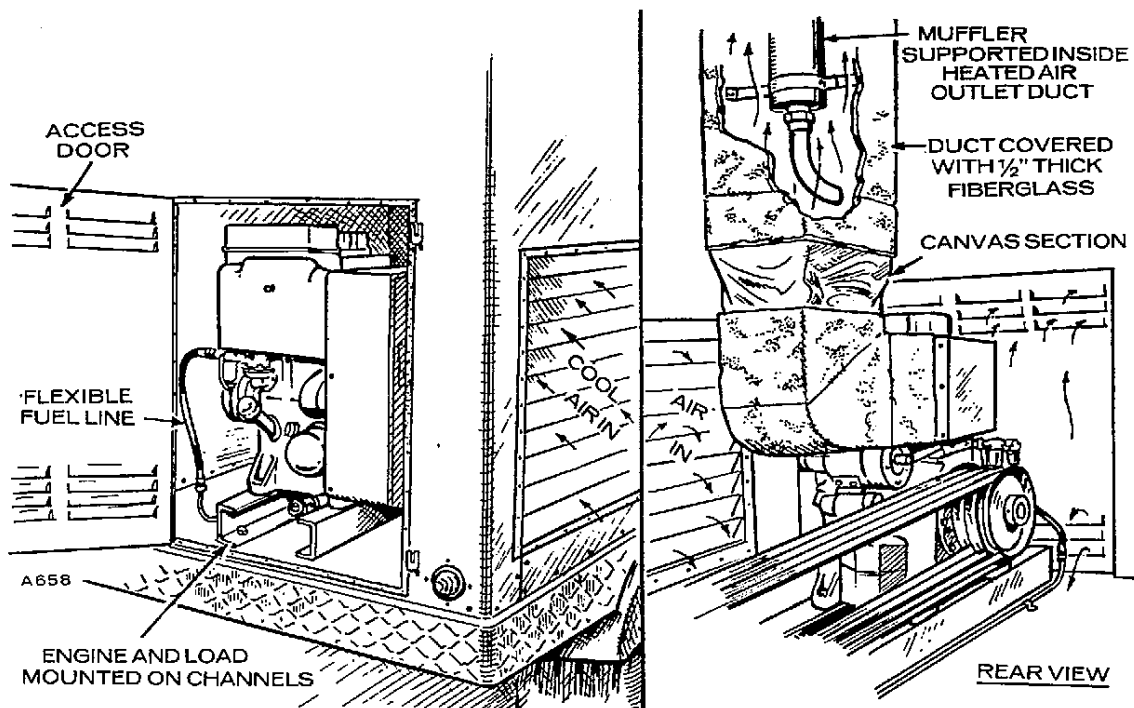


FIGURE 1. MOBILE INSTALLATION

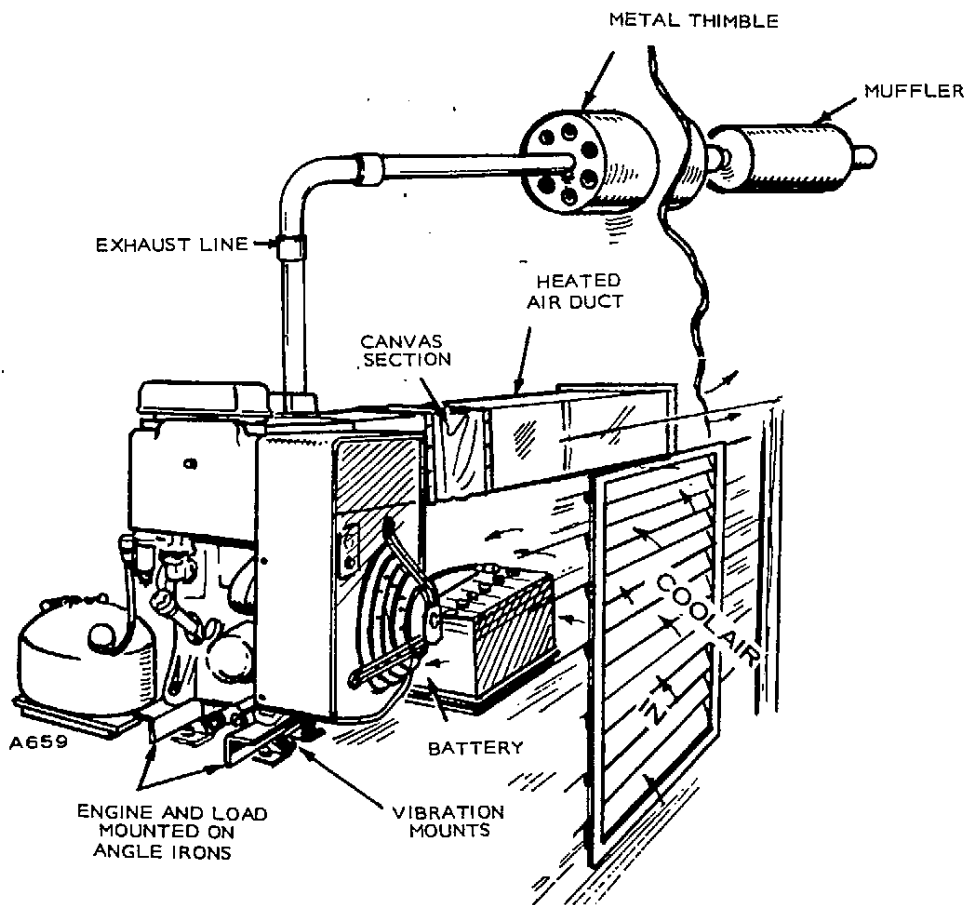


FIGURE 2. STATIONARY INSTALLATION

GASEOUS FUEL

Check with your supplier for local regulations covering the use and handling of gaseous fuel supplies and equipment. Seal gas line connections with shellac or some other compound approved for use in gaseous fuel systems. Thread-sealing compounds with a lead base are not satisfactory. Engines with electric controls may require a solenoid primer and a shut-off valve.

Install a manual shut-off valve as the first component in the supply line. Install a "dry gas" filter and fuel solenoid valve if recommended by your gas supplier or local code. Install the demand-type regulator according to the instructions supplied. Use shortest possible hose between the regulator and carburetor for best starting. See Figure 3.

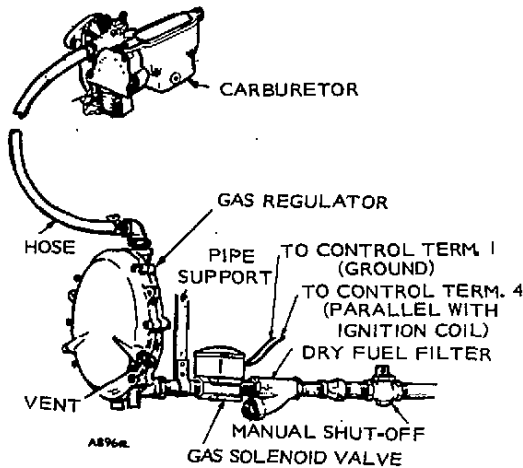


FIGURE 3. GASEOUS FUEL SYSTEM

OIL DRAIN EXTENSION

For service convenience, install an oil drain extension in the 1/2 inch pipe-tapped oil drain hole in the oil base. Use standard 1/2 inch pipe and fittings.

BATTERY

Mount the battery on a wooden or metal rack near the engine. Air circulation around the battery is essential. Use battery cables of proper length to limit voltage drop. Coat connections on the battery with vaseline or grease to prevent corrosion.

BATTERY CONNECTIONS

On engine with flywheel alternator, ground the negative terminal of the batteries to the engine.

CAUTION

Failure to ground the battery negative terminal will result in destruction of the selenium rectifiers.

Connection of battery positive terminals depends on the type of starting motor used for cranking, as follows:

1. **Bendix (standard on cranking models):** Connect positive from a suitable source of DC to start switch. Connect negative to a good ground on engine.
2. **Solenoid Shift (optional on cranking models):** Connect positive from a suitable DC source to B+ terminal on start solenoid. Connect negative to a good ground on engine.
3. **Auto-cycle (optional on cranking models):** 12 volt DC and 120 volt AC starters have 2 wire connections through a sensing device for automatic starting.

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