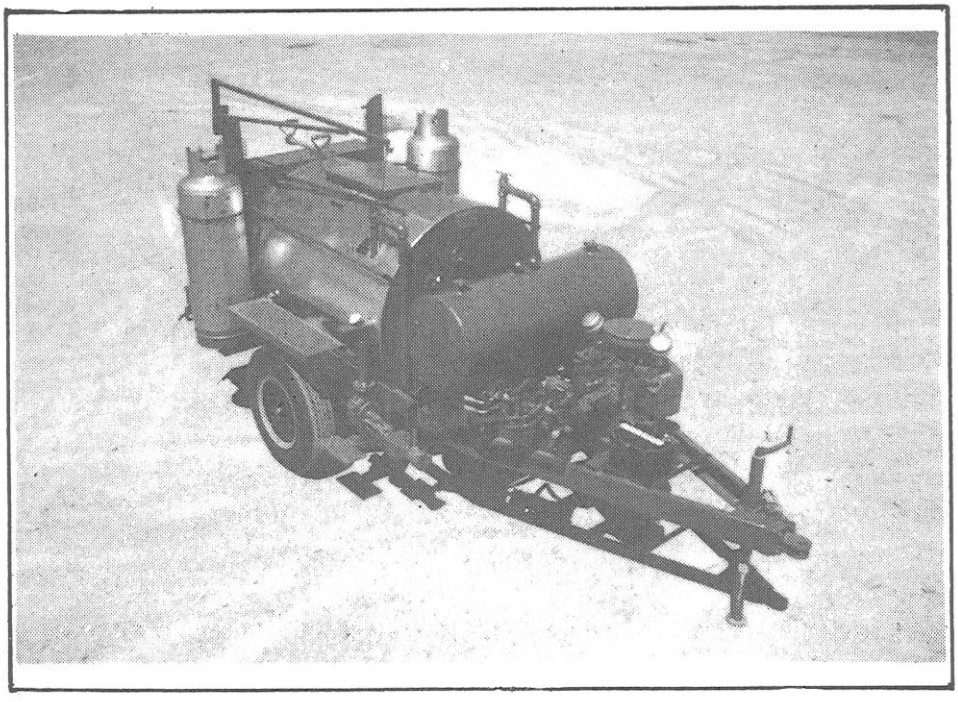
CRAFCO

BC - 220

Instruction Manual

and

Parts List



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BC - 220

This manual is furnished with each new Crafco Joint & Crack Sealer. The manual will help your machine operators learn to run the sealer properly and understand its mechanical functions for trouble-free operation.

Your Crafco BC 220 is designed to give excellent service and save maintenance expense. However, as with all specially engineered equipment you can get best results at minimum costs if:

1) You operate your machine as instructed in this manual and,

2) Maintain your machine regularly as stated in this manual.

Patent #3610588 other patents pending.

CRAFCO CRACK SEALER

MODEL BC 220

LIMITED WARRANTY

Crafco Incorporated warrants to the original purchaser only, that each new Crafco machine, excluding the hydraulic system, and heating system will be free from defects in material and workmanship for a period of one year from the date of delivery. Integral units such as gasoline engines, electric motors, transmissions, etc. are subject to the warranties issued by the manufacturers of such units.

The responsibility of Crafco under this warranty is limited to replacement or repair of defective parts at Crafco's Phoenix, Arizona factory, or at a point designated by it, of such parts as shall appear to Crafco, upon inspection at such point, to have been defective in material or workmanship, with expense for transportation to be borne by the original purchaser. The labor covered by this warranty includes only that labor which is required to repair the defective part itself, and not that labor required to gain access to the part.

Crafco Inc. shall only be liable when the equipment is used in compliance with those directions specified in the manufacturers instructions.

The warranty provided herein extends only to the repair and/or replacement of those components of the equipment covered above, and does not extend to incidental or consequential damages incurred as a consequence of any defects covered by this warranty.

This warranty shall not apply to any machine or parts altered and modified without Crafco's consent, nor shall it apply to normal wear and tear or when misuse, negligence or accident are evident, or when machines have been operated at speeds or loads beyond factory rated capacities or specifications.

Crafco Inc. specifically disavows any other representation, warranty, or liability related to the condition or use of the product.

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SAFETY PRECAUTIONS

HIGH OPERATING TEMPERATURES OF THE MACHINE AND SEALANT MATERIAL REQUIRE GLOVES AND PROTECTIVE CLOTHING TO BE WORN BY THE OPERATORS. COMPLETE EYE PROTECTION IS ALSO REQUIRED.

CAUTION: OBSERVE ALL WARNING SIGNS POSTED ON THE MACHINE.

CAUTION SHOULD BE TAKEN TO AVOID THE ENTRANCE OF WATER INTO ANY PART OF THE MACHINE. WATER WILL DISPLACE EITHER HEAT TRANSFER OIL OR SEALANT WHICH CAN BE HAZARDOUS TO PERSONNEL SURROUNDING THE MACHINE WHEN IT REACHES OPERATING TEMPERATURES. ALL BODILY CONTACT WITH HOT SEALANT MATERIALS OR HOT HEAT TRANSFER OIL SHOULD BE AVOIDED. SERIOUS BURNS MAY RESULT.

FOR SAFE AND EFFICIENT OPERATION, READ THE MANUAL THOROUGHLY BEFORE OPERATING YOUR MACHINE. CRAFCO, INC. ASSUMES NO LIABILITY FOR ACCIDENT OR INJURY OCCURRED THROUGH IMPROPER USE OF THE MACHINE.

Operating Instructions

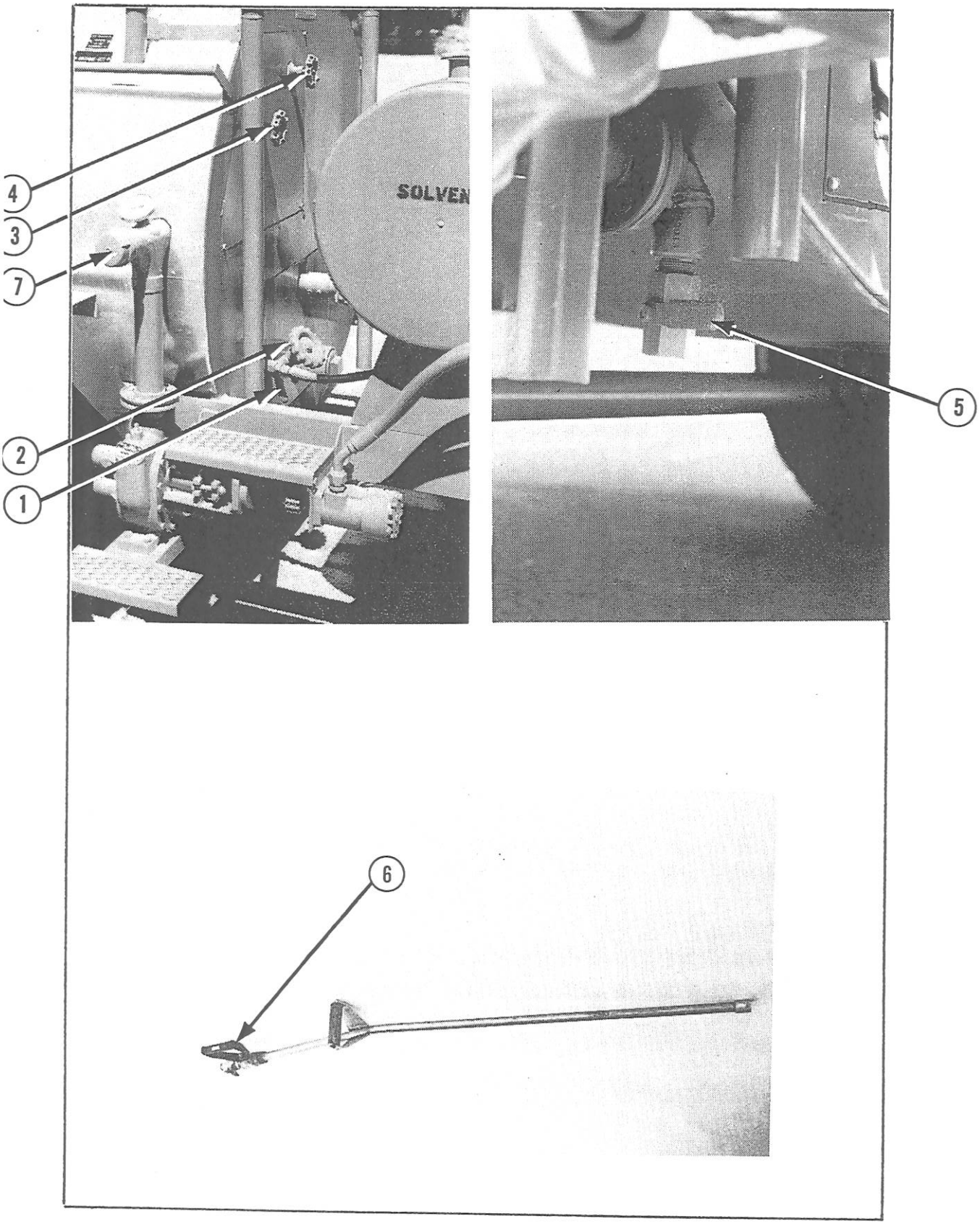


Figure 1 Valves

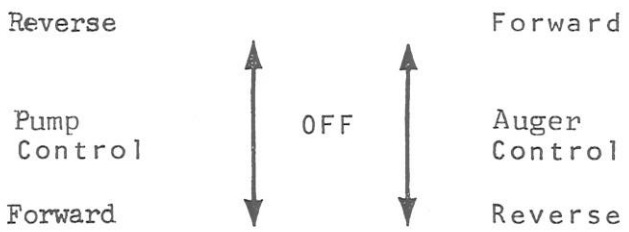
OPERATING INSTRUCTIONS

INTRODUCTION

The Crafco Joint and Crack Sealer was developed to apply Crafco's Overflex M S (Vulcanized rubberized asphalt). However, it will work equally well with all road asphalts and federal specification crack sealants.

FUNCTION OF VALVES AND CONTROLS

1. Clean Out Valve - For flushing system with solvent after use.
2. Tank Valve - Used to open material tank to pump. Refer to Figure 1.
3. Applicator Valve - For rear applicator.
4. Recirculation Valve - Controls flow of sealant returning to material tank.
5. Drain Valve - Used to drain solvent from lines after flushing system with solvent.
6. Hand Applicator Valve - For turning hand applicator off for short periods of time.
7. 2" Line - Used in loading machine with liquid sealant material.



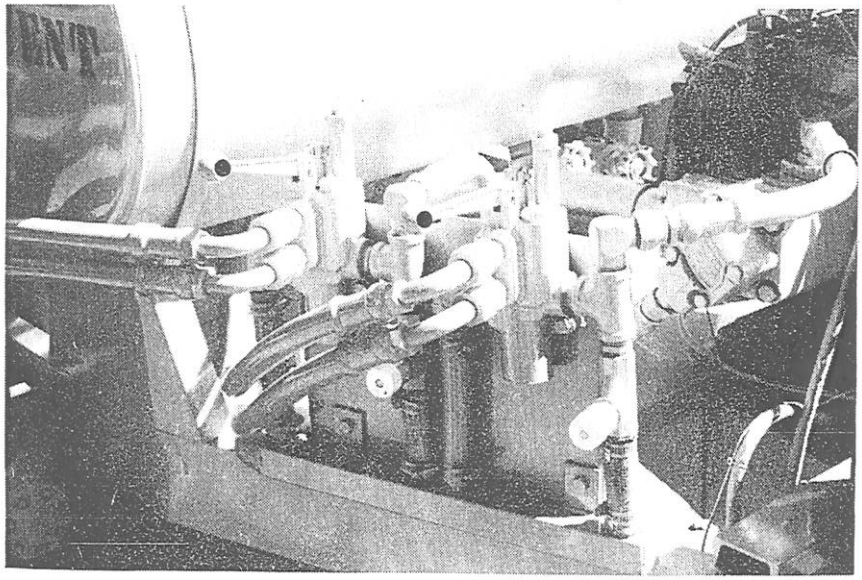


Figure 2 - Hydraulic Control Valves

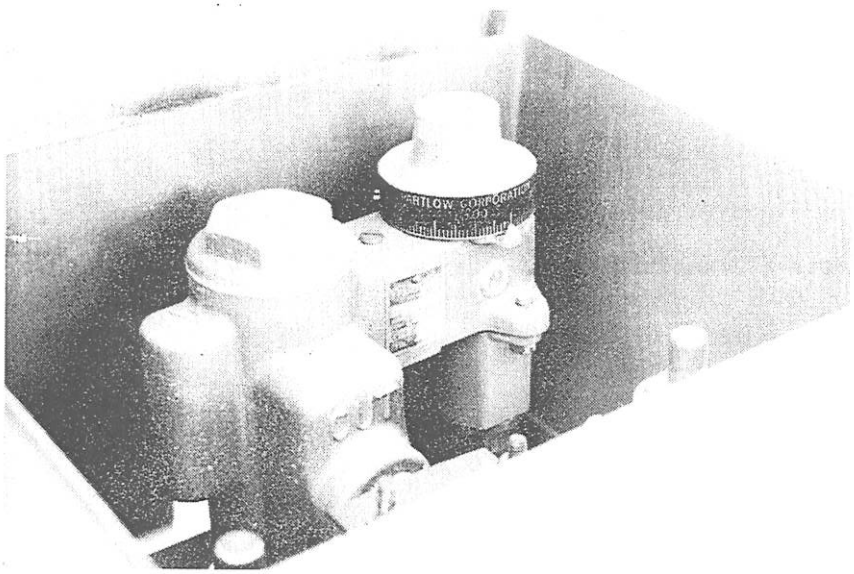


Figure 3 - Temperature Control Valve

Auger Control Valve - Controls auger rotation in either direction with off position in middle. Auger is used to agitate sealant material. See Figure 2.

Pump Control Valve - Controls pump rotation in either direction with off position in middle. Pump is used to move sealant to applicator but can also be used for loading tank.

Temperature Control Valve - Regulates the temperature of the heat transfer oil. See Figure 3. The temperature control valve may be set to any desired temperature, but not to exceed 500° F. It is necessary to calibrate the thermostat before using the machine initially, see page 8.

PREPARING MACHINE FOR OPERATION

DO NOT operate machine without following these instructions:

1. Fill engine gas tank with regular grade gasoline. For new engines, nonleaded gasoline gives the most satisfactory results. For older engines that have previously used leaded gasoline, take off heads and remove all lead deposits from engine before switching to nonleaded gasoline.
2. Fill propane storage tanks.
3. Check engine crankcase oil, refer to Onan Engine section for instructions.
4. Check hydraulic oil supply tank. Oil level should be 3 - 5" from top of tank.

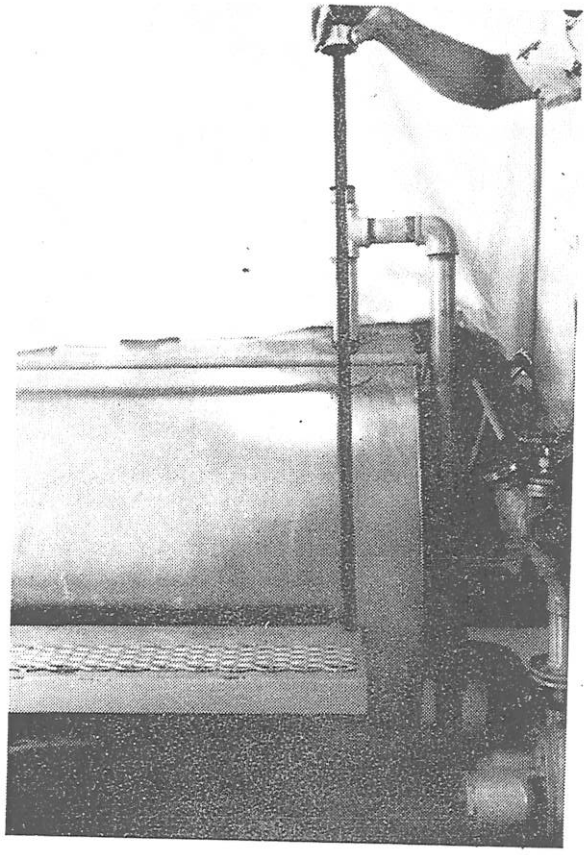


Figure 4 - Checking Heat Transfer Oil Supply

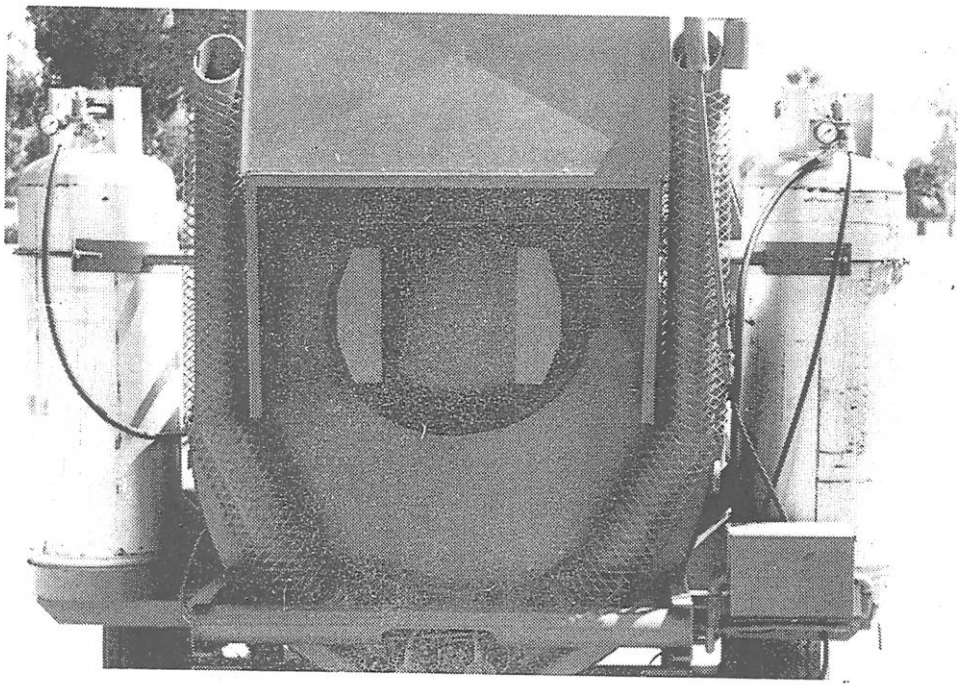


Figure 5 - Heating Chamber

5. Check heat transfer oil supply, refer to Figure 4. Check heat transfer oil level at ambient temperature with machine leveled. DO NOT OVERFILL or spillage will occur when machine reaches operating temperature.

6. Check solvent supply. Solvent must be compatible with sealant material being used. Consult manufacturer of sealant for type of solvent recommended.

7. Valves (1) thru (6) should be in closed position. See Figure 1.

8. Applicator hose can be kept warm and ready for use by storing it in heating chamber before use of machine. See Figure 5. Close heating chamber door after hose has been coiled in heating chamber.

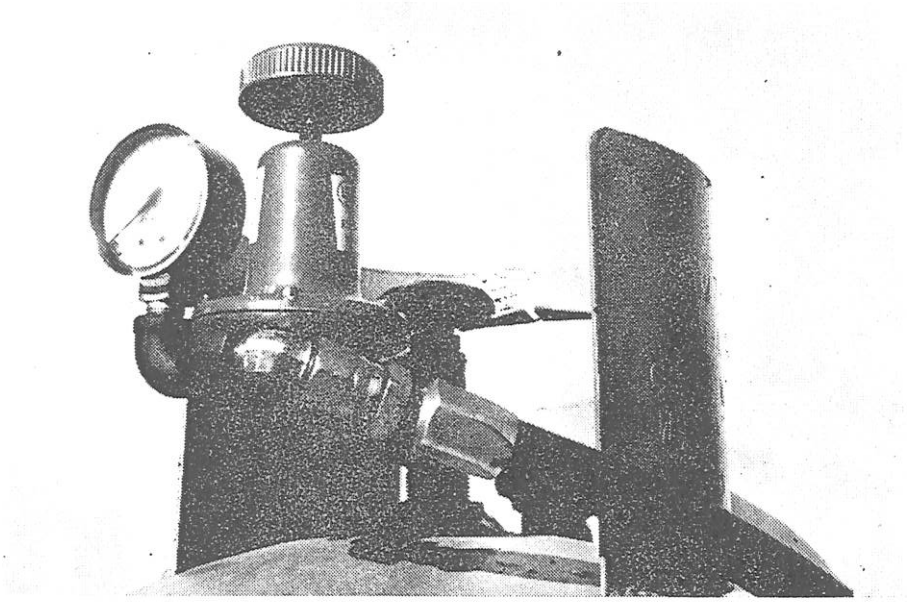


Figure 6 - Pressure Regulators

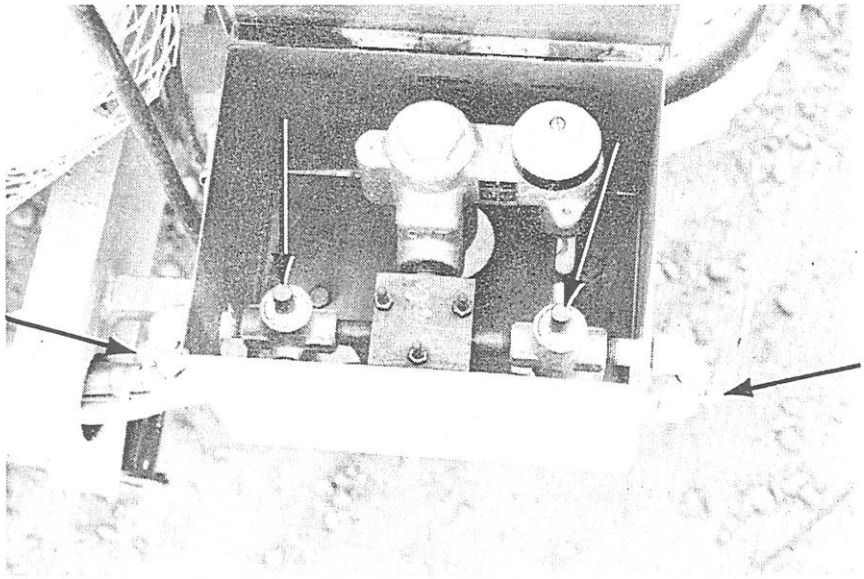


Figure 7 - Pilot Buttons and
Main Burner Valves

MACHINE START-UP

To Light Burners:

1. Open LPG Tank Valves. Valves must be opened slowly.
2. Set pressure regulators. Set pressure gauges on regulators at 10 to 15 psi by turning regulator knobs. See Figure 6.
3. Hold pilot buttons down (red buttons in control box). See Figure 7. NOTE: Use of a sharp object such as a pencil may help in holding buttons in. Light the pilots and continue to press firmly on buttons for at least 30 seconds.
4. Open each main burner valve. Refer to Figure 7.
5. Set dial to desired temperature on temperature control valve. (Figure 3) Do not exceed 500^{o} F.

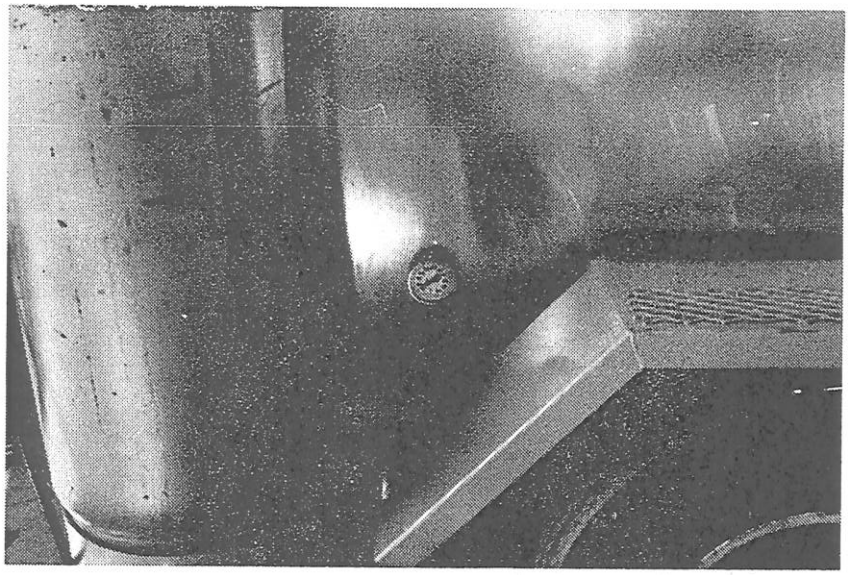


Figure 8 - Heat Transfer Oil Temperature Gauge

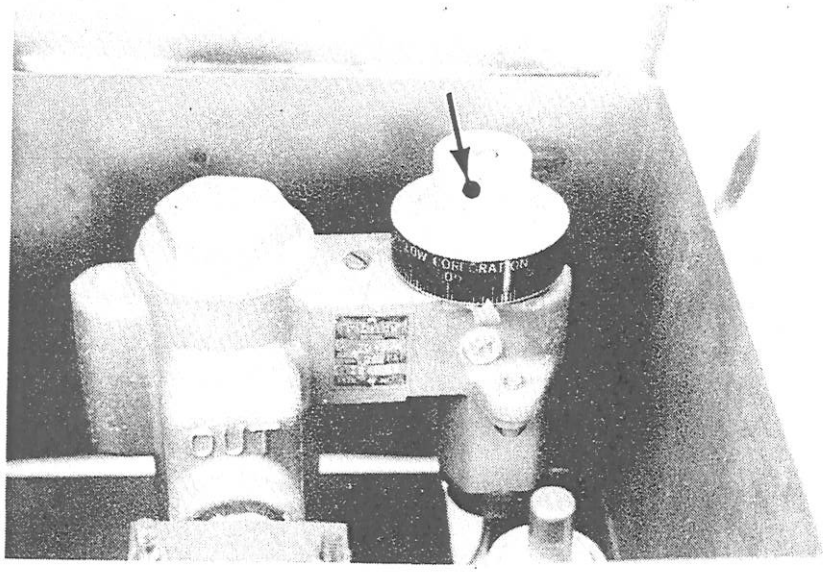


Figure 9 - Calibration of Temperature Control Valve

To Calibrate Temperature Control Valve:

CAUTION: It is necessary to calibrate the temperature control valve before using machine initially.

Proceedure: Leave burners on until heat transfer oil reaches 250° F. Gage on right side of machine registers temperature of heat transfer oil. See Figure 8. Carefully turn temperature dial down until burners shut off, leaving pilots on.

Using allen wrench loosen set screws in temperature dial, being careful not to turn knob while loosening set screws. After loosening screws rotate temperature dial until pointer is aimed directly at 250° F. Retighten set screws. Calibration is now complete. See Figure 9. Note: Calibration should be checked periodically, using this proceedure.

6. When sealant begins to liquify start agitation action.

Refer to the next sections for the correct proceedure.

To Start Engine:

Note: It is recommended that you read the Onan Engine Manual before you start the engine.

For starting LPG engines, refer directly to engine manual.

1. Return hydraulic pump controls to "off" position. See figure 2.
2. Turn gasoline valve on (if so equipped).
3. Move ignation switch to "on" position. Engage starter and choke as required.

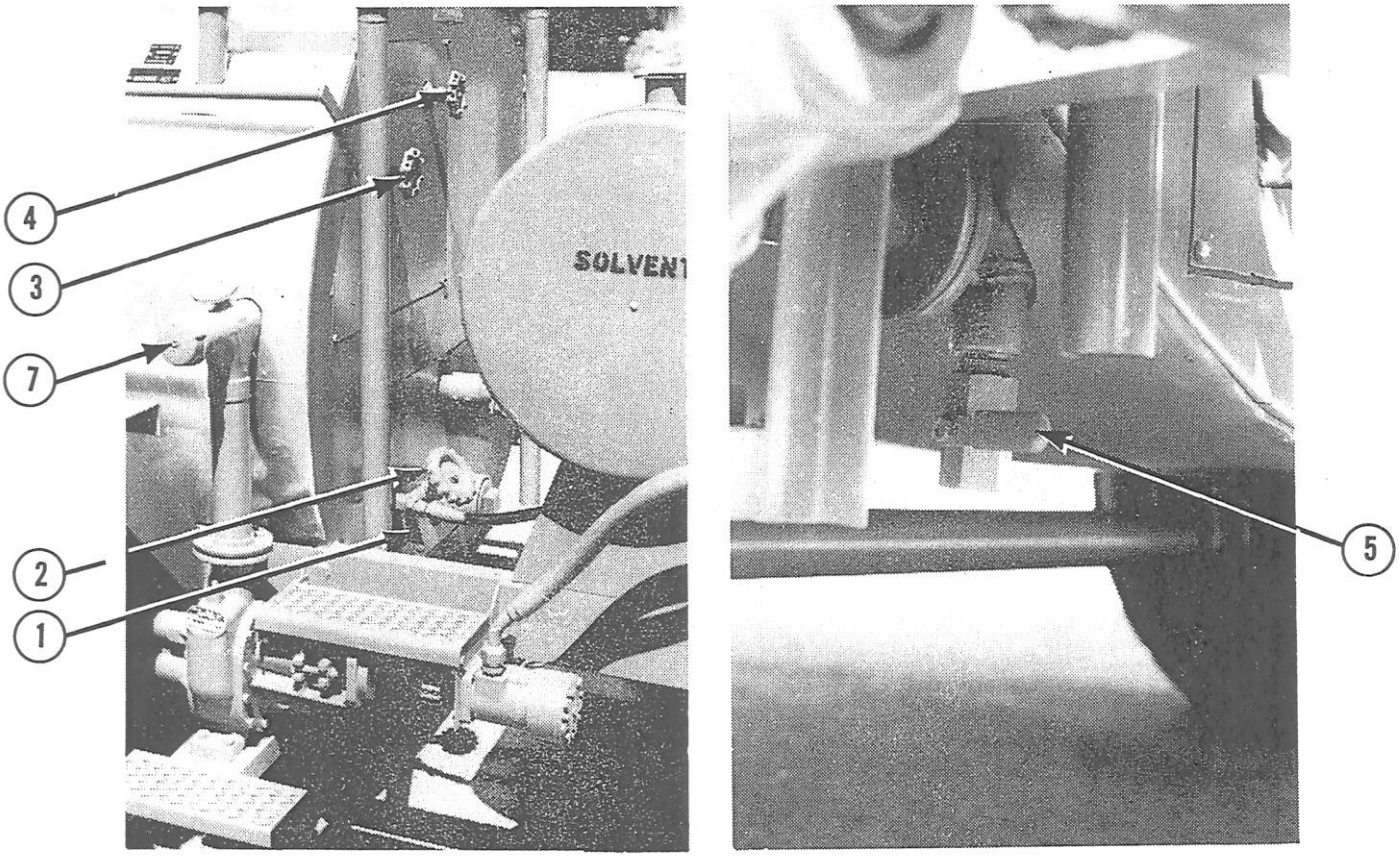


Figure 10 - Valves

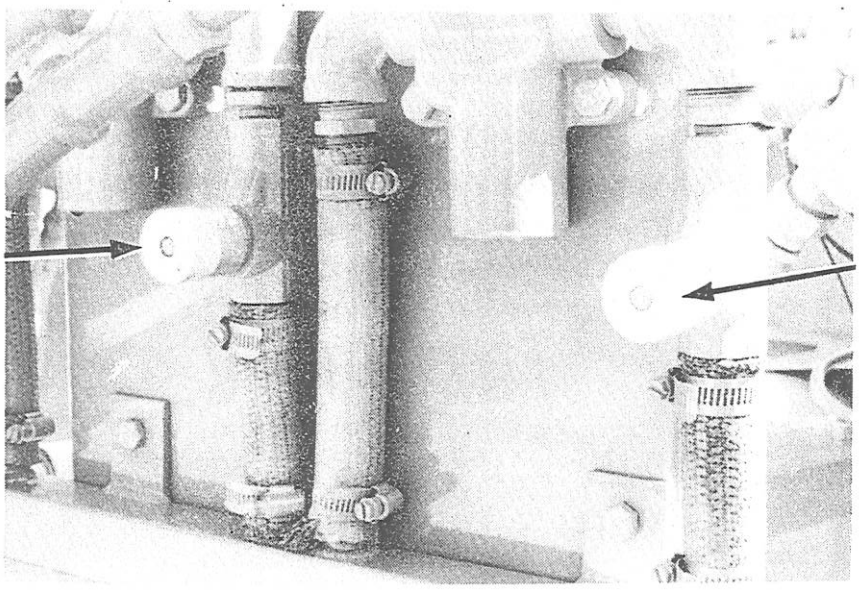


Figure 11 - Flow Control Valves

AGITATION AND PUMPING

1. With engine running, start agitation by moving hydraulic control for forward auger rotation (Figure 2). If auger jams control may be moved for reverse rotation.
2. When sealant become liquid throughout, pumping action may begin.
   a. Move hydraulic control for forward pump rotation (Figure 2).
   b. Open recirculation valve (4) to allow sealant to recirculate.
   c. Open tank valve (2) to allow sealant to enter pump. Refer to Figure 10.
   d. Hydraulic flow control valves have been added to increase the flexibility of the BC-220. See Figure 11. Counter clockwise rotation of the valves decreases hydraulic pressure. Consequently the speeds of the material pump and auger may be varied. For best results keep both flow control valves turned in clockwise, unless it is necessary to independently slow pump or auger speed. To slow both pump and auger speed reduce the speed of the engine.

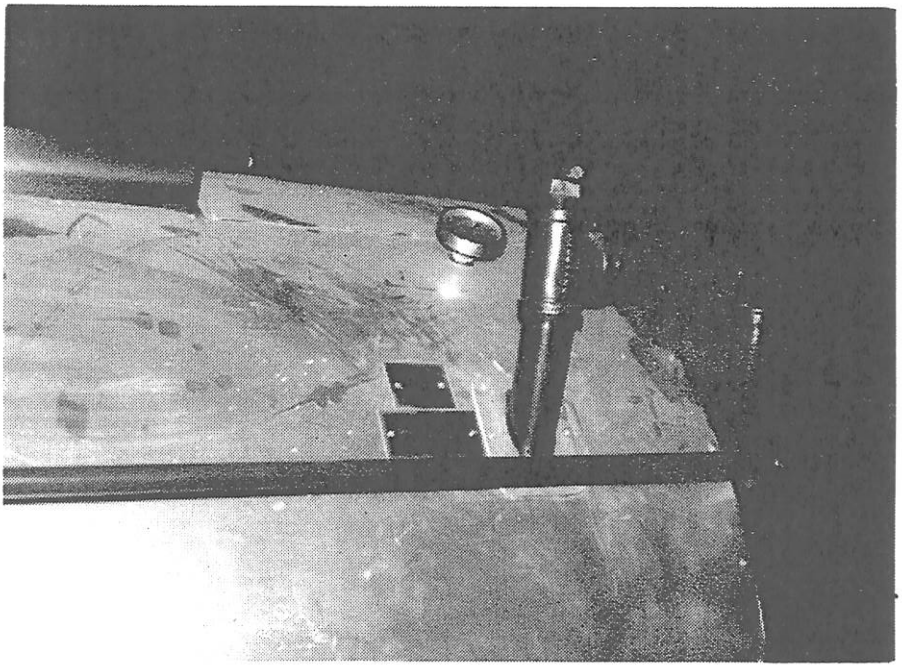


Figure 12 - Sealant Temperature Guage

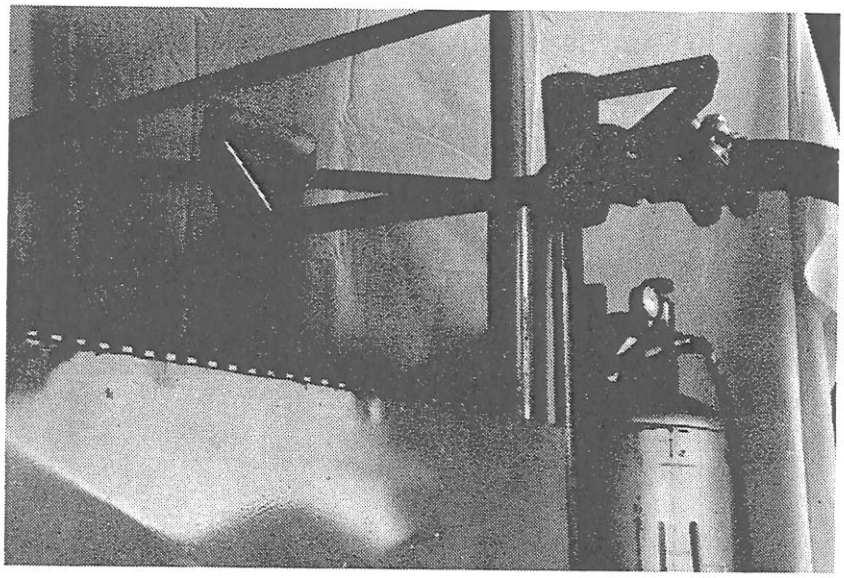


Figure 13

e. When sealant reaches application temperature (refer to sealant manufacturer's recommendation) pumping through applicator nozzle may begin. Thermometer located on top of material tank indicates material temperature. See Figure 12. Thermometer located in 2" line also indicates material temperature, but only when material is flowing thru lines. See Figure 1. Remove hose from heating chamber and place hand applicator in tank opening with hand applicator valve in "on" position. See Figure 13.

f. Open applicator valve (3) to allow sealant to flow thru hand applicator, see Figure 10.

g. Adjust recirculation valve (4) to allow desired flow thru applicator wand.

h. Sealant may now be applied as desired. Turn hand applicator valve off before removing hand applicator from tank.

IMPORTANT:

When hand applicator is not in use, place it into tank opening. Open hand applicator valve to keep hose warm and unobstructed.

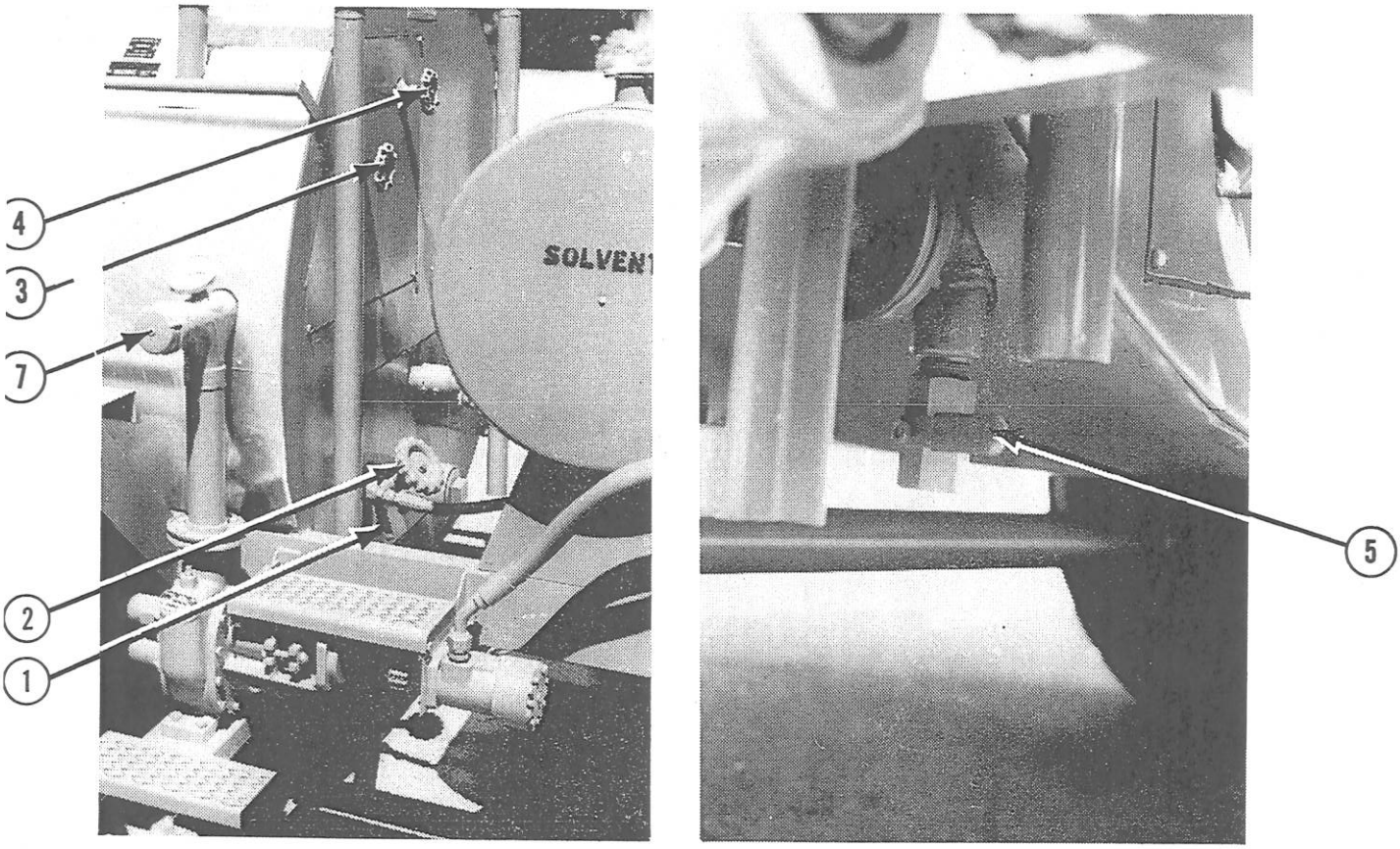


Figure 14 - Valves

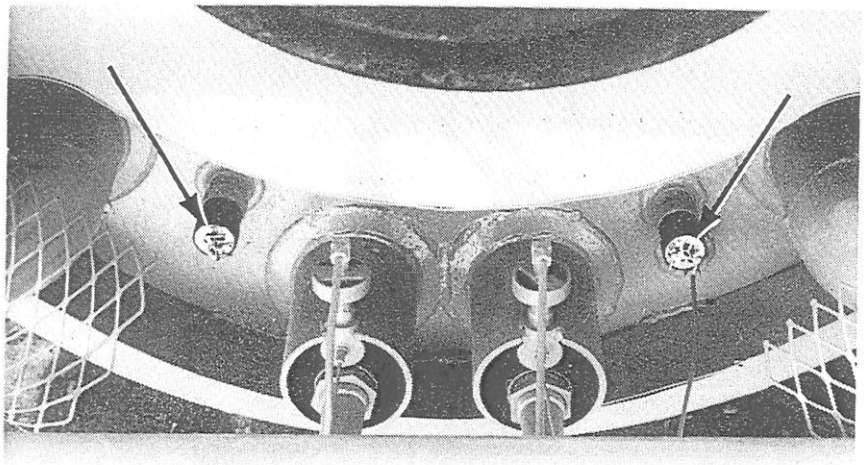


Figure 15 - Heating Elements

CLEANOUT AND SHUTDOWN PROCEDURE

1. Close main burner valves (Figure 7).
2. With hand applicator valve open, reverse material pump for approximately one minute.
3. Stop material pump. Close tank valve ② (Figure 14).
4. Remove hand applicator from tank, leaving hand applicator valve open.
5. Close recirculation valve ④ completely and open cleanout valve ①.
6. Engage pump in forward direction.
7. When solvent flows freely through hand applicator, close cleanout valve ① and disengage pump.
8. Open drain valve ⑤ and reverse pump until all fluid is purged from lines.
9. Stop pump and close drain valve ⑤.
10. Shut down engine. Close propane tank valves.
11. Coil hose in heating chamber for next use (Figure 5). Hang hand applicator on hooks. Cleanout of all lines and pump is complete.

Use of Heating Elements

To keep material warm overnight simply plug heating elements into 110 volt supply line. Disconnect before using machine. See Figure 15.

LOADING MACHINE

Loading the machine can be accomplished in two different ways: 1) Loading machine with solid material. 2) Loading machine with liquid single component material.

Solid Material Method

Lower solid material into the machine thru the door. Auger should be disengaged temporarily while door is open. Caution: Do not let material splash hot sealant on personnel surrounding machine. Solid material must be put in at intervals which will allow the auger continuous rotation.

Caution: Too many blocks at any one time will stop the auger and slow the melting process.

Note: Solid material may be added while machine is in operation. However, it is recommended that material level is maintained above the auger.

Liquid Material Method

1. Connect hose from the 2 inch line (7) to the sealant supply. All valves should be closed. (Figure 14).
2. Open tank valve (2).
3. Start engine (for instructions refer to page 8.)
4. Actuate pump in reverse direction (Figure 2).
5. When desired amount of material has been pumped into the tank, shut off the supply line valve at the supply source.

6. Remove hose from supply source and elevate hose above the level of the melting tank. Hold in this position until all material is displaced from hose.

7. Disengage pump, disconnect supply hose and close tank valve (2).

STORING MACHINE

The BC 220 should be stored with the trailer tongue in an elevated position. This will allow the moisture condensation to settle to the bottom rear of the heat transfer oil tank, above the drain plug. After extended periods of time the water can be drained by removing the plug and replacing it when all water is displaced. See Figure 16.

CAUTION: If there is any suspicion that moisture is still present, after draining, warm heat transfer oil to 300° for 2 to 3 hours to evaporate any moisture.

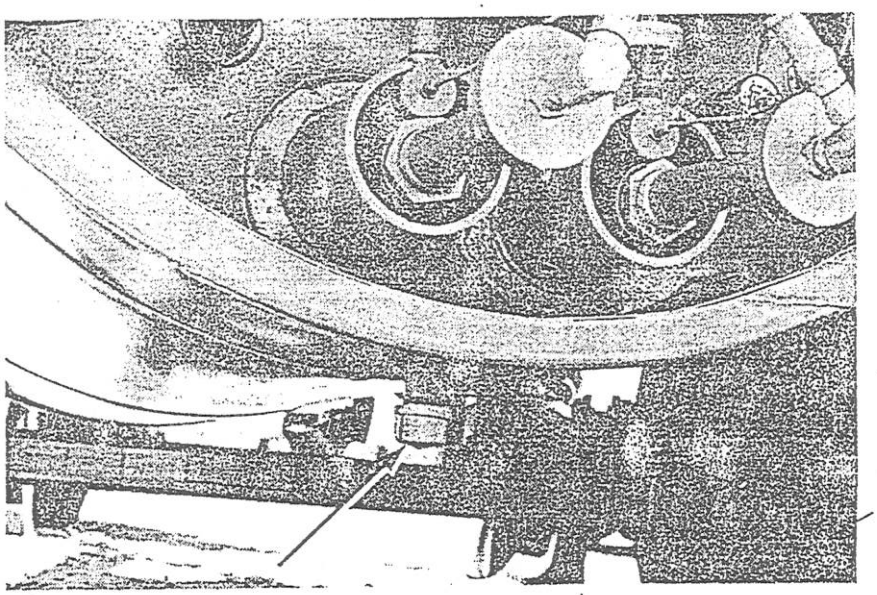


Figure 16 - Drain Plug

TROUBLE SHOOTING CHART

PROBLEM	CAUSE	REMEDY
Auger will not rotate	Sealant not to high enough temperature	Heat sealant to higher temp before starting auger rotation
	Too many blocks placed in machine at one time	Continue heating and reverse auger direction
	Inadequate hydraulic pressure	Increase pressure by turning Hyd. Flow . Control valve. See p. 14
Pump will not rotate	Machine improperly cleaned, after previous use	Heat inlet line to pump and other lines to liquify sealant
	Material in tank NOT to operating temperature	Continue heating with Auger in rotation
	Inadequate Hyd. pressure	Increase pressure by turning Hyd. flow control valve. See p. 14.
	Pump damaged	Refer to Roper Pump Book
	Foreign object lodged in pump	Remove foreign object
Burners will not light.	Regulator not adjusted properly	Adjust regulator. See p. 10
	LPG tank empty	Fill tank
	Thermocouples damaged	Replace Thermocouples
	Red buttons not pushed in to full in position	Push in to full depression
	Refer to page 10	

Trouble shooting chart - Cont'd

PROBLEM	CAUSE	REMEDY
Sealant material will not flow thru recirculation valve with pump rotating in correct direction	Sealant not to high enough temperature Old material remains in lines	Heat sealant to operating temp. before pumping Heat lines and recirculation valve to liquify old mat'l
Sealant material flows thru recirculation valve, but will not flow thru hand applicator when recirculation valve is closed	Applicator valve (3) in closed position. See Fig. 14 Machine improperly cleaned out in previous use	Open hand applicator valve Place hose in heating chamber to liquify old sealant and heat lines coming from pump with hand torch
When applying sealant it stops flowing from applicator tube	Hand applicator valve (6) was left in off position too long Too many blocks of material added to tank. Cold material entered pump and and stopped flow Solid material entered supply line to pump	Heat hose by placing in heating chamber to liquify sealant. Heat lines with hand torch Heat material hose by placing in heating chamber. Heat inlet line to pump and lines coming out of pump Reverse pump rotation momentarily

Trouble shooting chart - Cont'd.

PROBLEM	CAUSE	REMEDY
Pump rotates but will not pump sealant material	Pump worn or damaged	Replace sealant pump
	Pump rotating in wrong direction	Move control lever for forward rotation
	Foreign object lodged in inlet line to pump	Dislodge foreign object from inlet line by reversing pump direction or dissambling inlet line.
	Machine improperly cleaned out	Heat lines to liquify old sealant material
Slow heat up of sealant	Build up of coked or crystallized material on inside of material tank	Allow machine to cool. Remove deposits and flush with solvent

Service and Maintenance Instructions

SERVICE AND MAINTENANCE INSTRUCTIONS

PREVENTIVE MAINTENANCE INSTRUCTIONS

1. Conduct a general inspection of your machine at least once a week. Replace all worn or damaged parts, make any necessary adjustments and tighten all loose nuts or screws.
2. Keep regular replacement items in stock for emergency repairs, to avoid costly "down" time. Refer to general maintenance items, page 33.
3. Watch for leaks - tighten packing on pump and auger as necessary.
4. Clean machine externally periodically, using solvent compatible with sealant being used.
5. Follow recommended maintenance proceedures on maintenance chart.

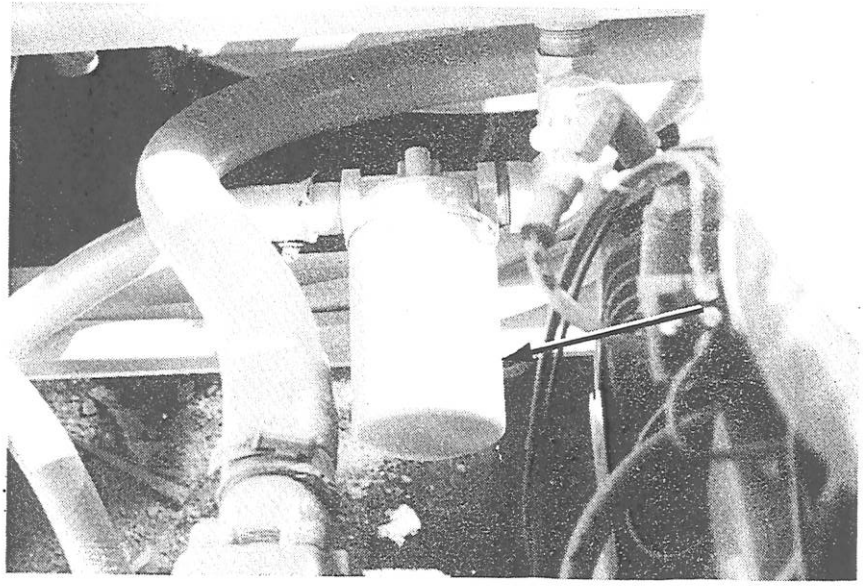


Figure 17 - Return Filter

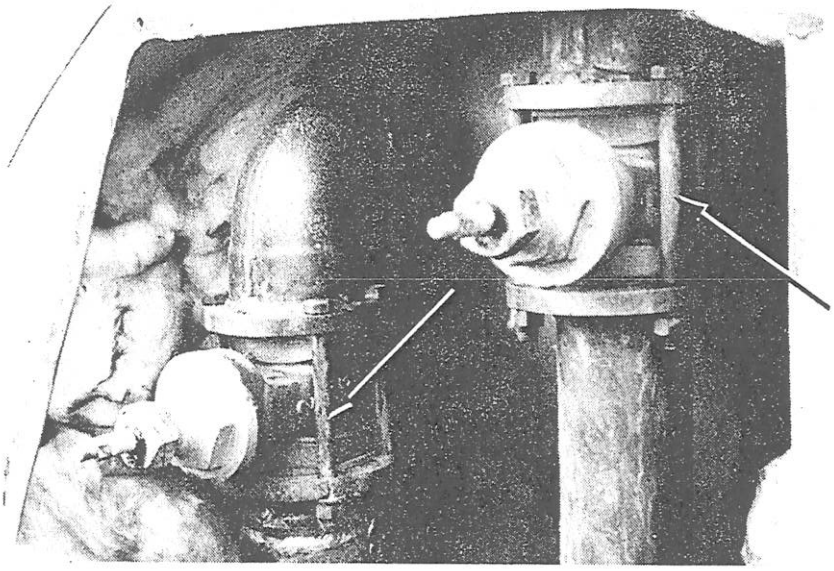


Figure 18 - Checking Valve Bolts

MAINTENANCE INSTRUCTIONS

ENGINE:

Check oil every 8 hours of operation. Change after the first 25 hours of operation and change every 100 hours thereafter.

Change oil filter after every 100 hours. See engine maintenance manual for other maintenance.

HYDRAULIC SYSTEM:

Change oil after every 500 hours of operation. Change return filter after every 500 hours. See Figure 17. Check oil level weekly. Oil level should be kept 3-5 inches from top of tank.

WHEEL BEARINGS:

Repack wheel bearings every 24,000 miles or every two years, using a good grade of bearing grease.

TONGUE JACK:

Lubricate tongue jack, using a good grade of bearing grease.

SEALANT PUMP:

Lubricate outboard bearings using a good grade of bearing grease. Adjust pump packing periodically. A slight drippage (several drops per minute) should be allowed. Refer to Pump Section for details. See page 49.

INTERNAL VALVES:

Check bolts which clamp recirculation valve and sealant valves in place. Proper torque is 20-25 ft-lbs. Check after the first 8 hours of operation and again after every 500 hours of use. Watch for leaks. Replace gaskets if tightening does not stop leaks. See Figure 18.

AUGER:

Adjust auger packing periodically. Make sure gland is pulled up evenly. If pulled too tight, packing will over heat and score shaft. If too loose packing will leak excessively. Adjust packing when auger is at operating temperature and wait 15 minutes between adjustments. A slight drippage (several drops per minute) should be allowed. See Figure 19. To replace packing refer to Pump Section, page 49. Procedure for repacking auger is similar to procedure for repacking sealant pump.

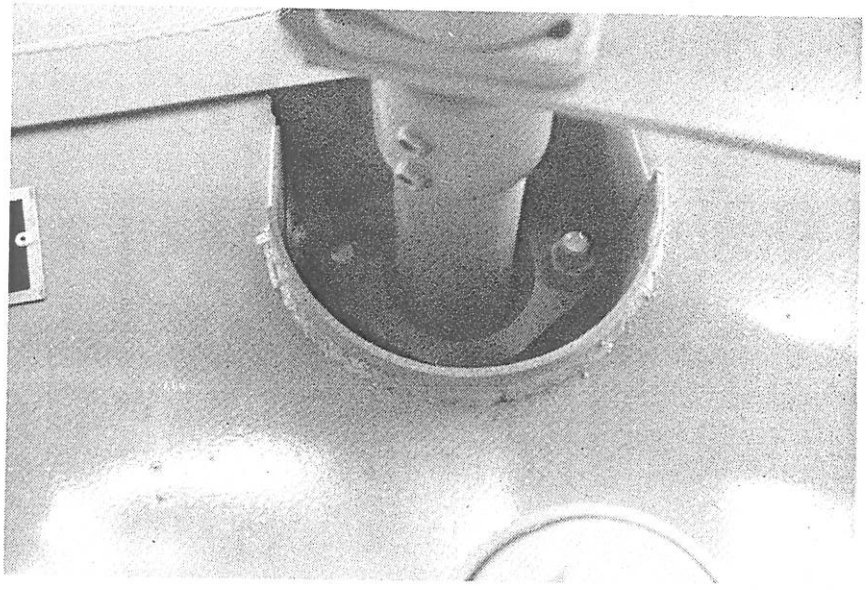


Figure 19 - Auger Packing

MAINTENANCE CHART

LOCATION	PROCEEDURE	HOURS 8	50	100	500
Engine Check Oil Level	See Onan Engine instruction manual	*			
Change Oil				*	
Battery	Check Battery water, refill if necessary		*		
Roper Pump Packing	Tighten as required Seepage should be several drops /minute		*		
Heat Transfer Oil	Check Change		*		*
Roper Pump Outboard bearing	Lubricate, using a good grade of bearing grease.		*		
Other Engine Maintenance	See Onan operating and maintenance instructions.				
Engine Oil Filter	See Onan Oper & Main't instructions.			*	
Hydraulic Oil return line filter	Refer to Figure No. 17				*
Hydraulic Oil	Check Oil Change Oil For proper oil see recommended fluids and lubricants, Page 31 .	*			*

Wheel Bearings	Clean and repack - using good grade of bearing Grs.	Every 24,000 miles or every two Yrs.
Tongue Jack	Grease, using good Grade of bearing grease.	Once a Year

Auger	Adjust packing periodically to allow slight drippage, several drops per minute.	*		

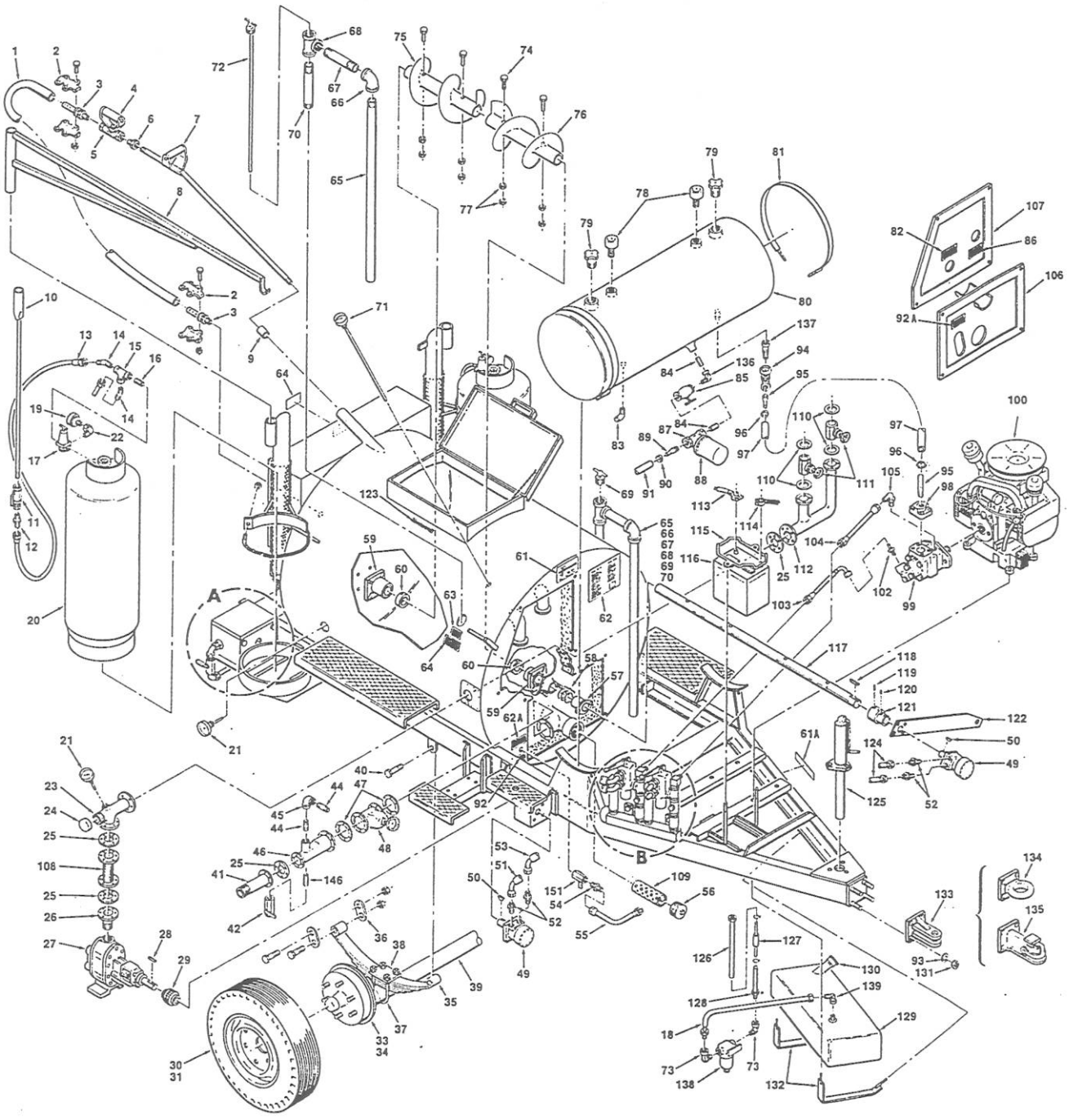
RECOMMENDED FLUIDS & LUBRICANTS

Application	Recommended	Capacity
Engine Oil	Refer to Onan Engine Operating Manual.	
Heat Transfer Oil	Use heat transfer oil with these minimum specifications: Flash Point 502° Fire Point 520°	65 Gal.
L P G	Propane	200 Lbs.
Hydraulic Oil	Use Type F automatic transmission fluid (Ford Motor Co.)	30 Gal
Machine cleanout (Solvent)	Use kerosene, diesel or recommended solvent for sealant material being used.	30 Gal.

GENERAL MAINTENANCE ITEMS

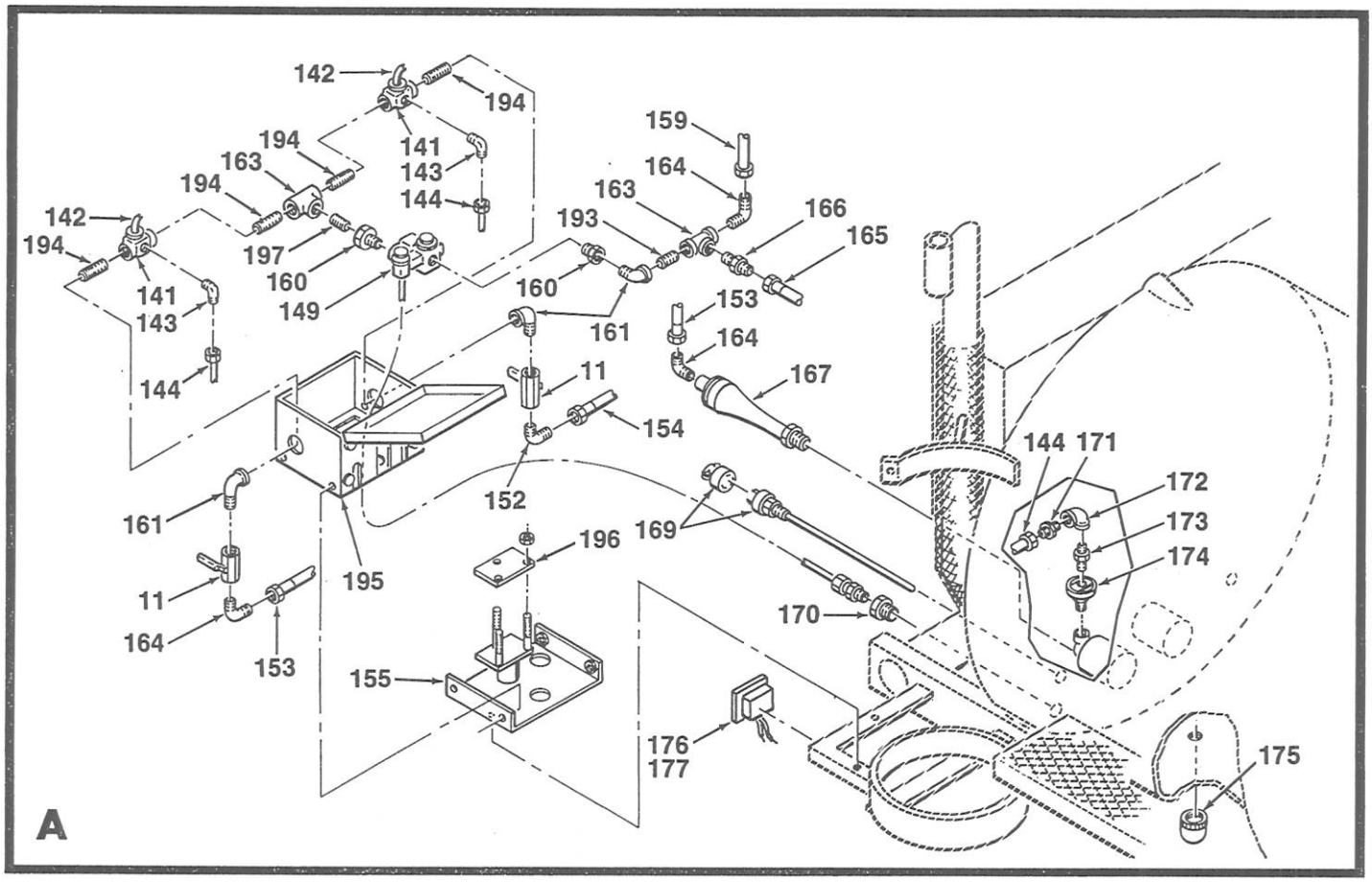
RECOMMENDED QUANTITY	DESCRIPTION	PART NO.
1 Set	Packing, Sealant Pump	29990
1 Set	Packing, Auger	21009
1	Applicator Valve	29240
1	Sealant Hose	27010
1	Engine Oil Filter	32122

Parts List



ITEM NO.	DESCRIPTION	QTY. PER UNIT	PART NO.
1	Sealant Hose	1	27010
2	Dixon "Boss" Hose Clamp (1")	2	27045
3	Dixon Hose and Pipe Fitting	2	27040
4	Hand Applicator Valve Handle	1	27080
5	Modified 1" Bronze Ball Valve	1	29240
6	1" x 3/4 Hex Pipe Bushing	1	28351
7	Hand Applicator Body	1	27075
8	Hose Support JIB	1	27020
9	3/4" Pipe Coupler	1	28179
10	Hand Torch	1	25015
11	3/8" Bronze Ball Valve	3	29202
12	Straight Male Adapter 4MJ-6MP	1	29840
13	LPG Handtorch Hose	1	25135
14	4MJ-4MP	2	29837
15	1/4" Pipe Tee	1	28251
16	1/4" Close Nipple	1	28001
17	LPG Pressure Regulator	2	25060
18	Hose, Gas Tank to Fuel Pump	1	22113
19	LPG Pressure Gage	2	25066
20	LPG Storage Tank	2	25118
21	Temperature Gauge	2	25050
22	1/4" Street Elbow	2	28236
23	Intermediate Piping Assembly	1	27003
24	2" Pipe Cap	1	28273
25	2" x 6 Hole Gasket	4	29050
26	Pump Outlet Nipple Assembly	1	27051
27	Sealant Pump	1	27030
28	Sealant Pump Shaft Key	1	27017
29	Sealant Pump Chain Coupling	1	22050
30	Tire 7.50-16	2	23055
31	Wheel and Rim 7.50-16	2	23040
	Axle Assembly (Items 33-40)	1	23005
33	Brake Shoes	2 sets	23023
34	Brake Drum and Hub Assembly	2	23025
35	Leaf Spring	2	23060
36	Rear Spring-Shackles, Bolts and Nuts	2 sets	23107
37	U-Bolt, Washers and Nuts	4 sets	23110
38	Spring Tie-Down Plate	2	23070
39	Axle and Brake Flange Assembly	1	23015
40	Shackle Bolt and Nut (Front)	2	23100
41	Pump Intake Nipple	1	27050
42	3/4" Bronze Ball Valve	1	29227
44	1/2" Pipe Nipple 4" Long	2	28037
45	1/2" Pipe Elbow	1	28208
46	Lower Piping Assembly	1	27002
47	3" x 8 Hole Gasket	2	29060
48	3" Allegheny Gate Valve	1	29292
49	Hyd. Motor	2	22020
50	Hyd. Motor Shaft Key (1/4" x 1")	2	22021
51	Hyd. Hose Cont. Valve to Pump Motor	1	22103
52	Jic Adapter 12MJ-8MP	4	29846
53	Hyd. Hose Pump Motor to Control Valve	1	22109
54	Jic Adapter 8MJ-8MP	1	29845
55	Solvent Hose, Tank to Valve	1	22108
56	3-1/2" Pipe Plug	1	28291
57	Packing Gland	1	21008
58	Packing	1	21009
59	Auger Shaft Bearing	2	21004
60	2" Auger Shaft Collar	2	21011
61	Crafco Nameplate	1	26179
61a	Read Instruction Manual Plate	1	26176
62	Instruction Plate	1	26185
62a	Cleanout Valve Plate	1	26182
63	Heat Transfer Oil Plate	2	26178
64	Warning - Hot, Plate	3	26175
65	Breather Pipe (or Vent)	2	21052
66	1-1/2" Pipe Elbow	2	28212
67	1-1/2" Nipple x 9" Long	2	28120
68	1-1/2" Pipe Tee	2	28257
69	Breather Pipe Cap	1	21018
70	1-1/2" Pipe Nipple	2	28134

ITEM NO.	DESCRIPTION	QTY. PER UNIT	PART NO.
71	Temperature Gage Long Stem	1	25052
72	Dip Stick	1	21017
73	1/8" Street Elbow	2	28235
	Auger Assembly (Items 60, 74-77, 117)	1	21023
74	Auger Bolt 1/2"-13 x 3" Long	4	28766
75	Right Spiral Auger	1	21006
76	Left Spiral Auger	1	21007
77	Auger Nuts	8	28504
78	Tank Filter and Breather	2	26025
79	Tank Filler Pipe Cap	2	26035
80	Hyd. Oil and Solvent Tank	1	22040
81	Restraining Strap	2	22165
82	Applicator Valve Plate	1	26183
83	8MJ-8MP 45° Adapter	1	29860
84	1" Close Nipple	2	28005
85	1" Bronze Gate Valve	1	29242
86	Recirculation Valve Plate	1	26180
87	Oil Filter Body and Element	1	22070
88	Oil Filter Element Only	1	22071
89	1" Combination Nipple	2	28662
90	1" Hose Clamp	2	26084
91	Manifold Hose	1	22106
92	Drain Valve Plate	1	26184
92a	Tank Valve Plate	1	26181
93	5/8" Spring Washer	4	28650
94	1-1/2" Gate Valve	1	29260
95	1-1/2" Combination Nipple	2	28664
96	1-1/2" Hose Clamp	2	26083
97	1-1/2" Hose to Hyd. Pump	1	22107
98	Coupling Flange	1	22015
99	Hyd. Pump	1	22010
100	2 Cyl. Gasoline Engine	1	22000
101	2 Cyl LPG Engine	1	22001
102	Jic Adapter 12MJ-12MP	1	29847
103	Hyd. Hose - Pump to #2 Cont. Valve	1	22101
104	Hyd. Hose - Pump to #1 Cont. Valve	1	22100
105	90° Jic Fitting 12MJ-12MP	3	29883
106	Bottom Cover-Plate	1	21075
107	Top Cover-Plate	1	21074
108	Flex Hose Assembly	1	27095
109	Outlet Strainer Assembly	1	21055
110	2" Gaskets	4	29054
111	2" Gate Valve	2	29270
112	Upper Piping Assembly	1	27001
113	Battery Cable - Hot	1	24015
114	Battery Cable - Ground	1	24010
115	Battery Hold-Down Frame	1	24005
116	12V Battery	1	24000
117	Auger Shaft	1	21005
118	Auger Shaft Key	1	21022
119	Set Screw, 1/2"-20 Auger Shaft Coupling	4	28977
120	Set Screw, 3/8"-24 Auger Shaft Coupling	4	28976
121	Auger Shaft Coupling	1	26055
122	Motor Bracket and Torque Arm	1	20084
123	Do Not Open Plate	1	26177
124	Hyd. Hose - Auger Motor to Cont. Valve	2	22102
125	Tongue Jack	1	23095
126	Upper Gasoline Hose	1	22111
127	Gasoline Filter	1	22073
128	Lower Gasoline Hose	1	22112
129	Gasoline Tank	1	22153
130	Gas, Tank Filler Cap	1	26020
131	5/8"-11 Hex Nut	4	28505
132	Retaining Strap - Gas Tank	2	22166
133	Pin Hitch	1	20015
134	Pintel Hitch	1	20016
135	Atwood 2" Ball Hitch	1	20017
136	1" Street 90° Elbow	1	28240
137	1-1/2" Street 90° Elbow	1	28242
138	Fuel Pump	1	26050
139	4MJ-4FP 90°	1	29891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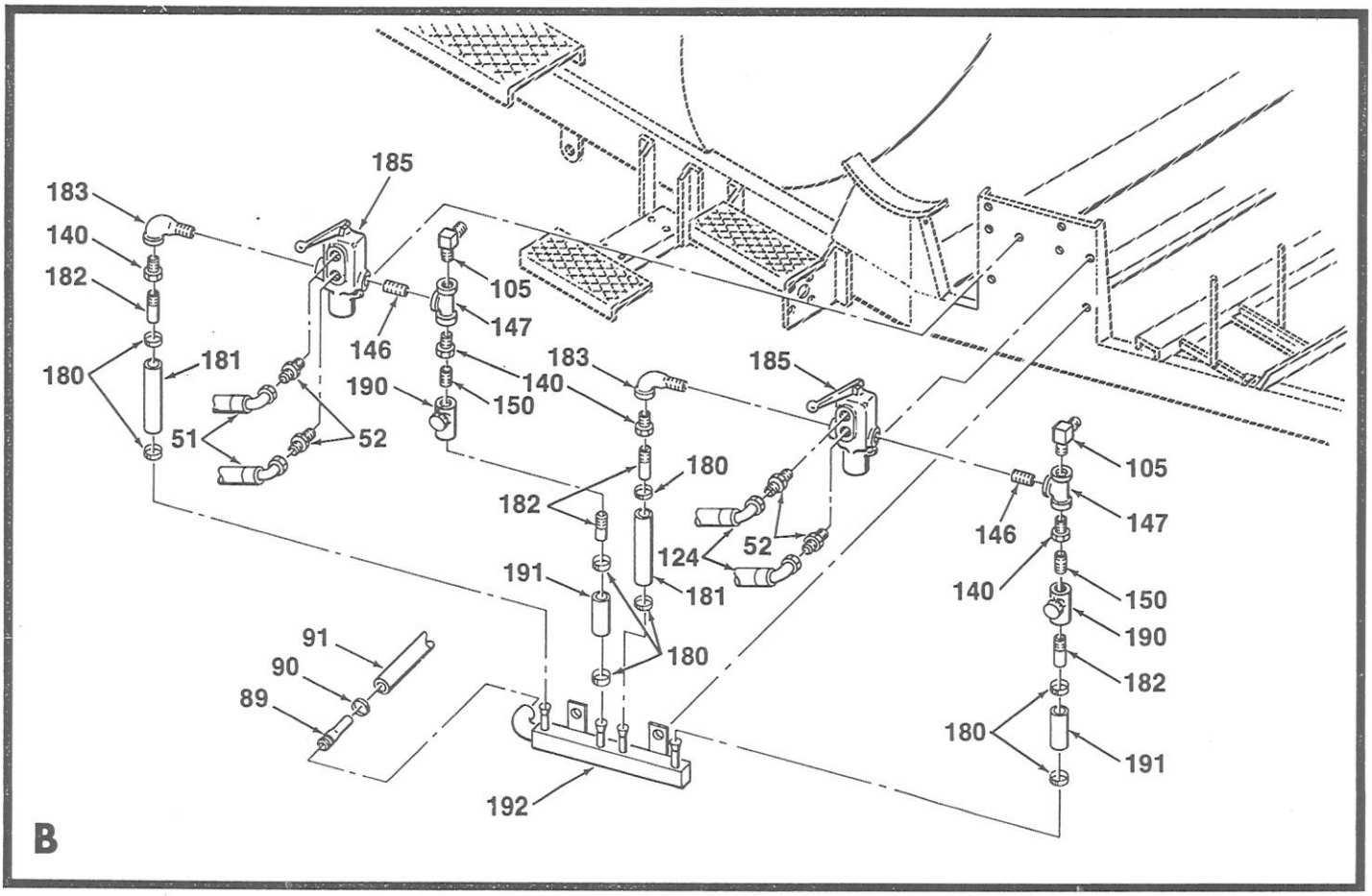
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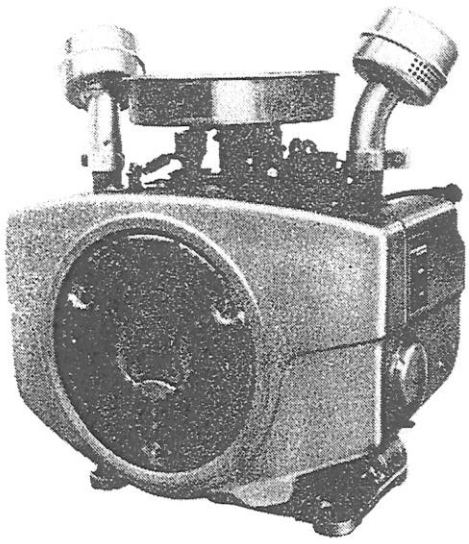
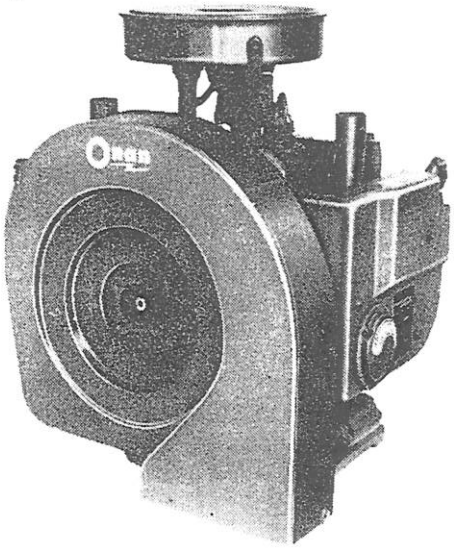
ITEM NO.	DESCRIPTION	QTY. PER UNIT	PART NO.
140	Hex Pipe Bushing 3/4" to 1/2"	4	28348
141	Pilot Control Valve	2	25020
142	Pilot Sensing Tube	2	25035
143	90° 1/8" Pipe to 1/4" Tube Fitting	2	29915
144	1/4" Copper Tube to Pilot	2	25037
146	3/4" Close Nipple	3	28004
147	3/4" Pipe Tee	2	28254
149	Temperature Control Valve	1	25025
150	1/2" Close Nipple	2	28003
151	1/2" Brass Ball Valve	1	29214
153	LPG Hose to Right Burner	1	25143
154	LPG Hose to Left Burner	1	25142
155	Base Plate	1	25011
159	LPG Hose Left LPG Tank to Control	1	25140
160	3/4"-3/8" Hex Pipe Bushing	2	28347
161	3/8" Street Elbow	3	28237
163	3/8" Pipe Tee	2	28252
164	Jic Fitting 6MJ-6MP 90°	4	29877
165	LPG Hose to Right LPG Tank	1	25141
166	Jic Fitting 6MJ-6MP Adapter	1	29842
167	LPG Burner	2	25000
169	Electric Heating Element	2	24040
170	3/4" to 1/4" Hex Pipe Bushing	1	28346
171	1/8" Pipe to 1/4" Copper Tube	2	29910
172	1/8" Pipe Elbow	2	28205
173	Pilot Orifice	2	25007
174	Pilot for Burner	2	25005
175	1" Pipe Cap	1	28270
176	Right Tail Light	1	24022
177	Left Tail Light	1	24023
180	Gear Hose Clamp	8	26082
181	Manifold Hose (Long)	2	22105
182	1/2" Stub Nipple	4	28019
183	3/4" Street Elbow	2	28239
185	Control Valve	2	22080
190	Flow Control Valve	2	22081
191	Manifold Hose (Short)	2	22104
192	Manifold	1	22060
193	3/8" Nipple 3" Long	1	28025
194	3/8" Nipple 2" Long	4	28017
195	Temp Control Housing and Lid	1	28010
196	Hold Down Plate	1	25165
197	3/8" Close Nipple	1	28002

Engine Section

OPERATING AND MAINTENANCE INSTRUCTIONS





NHA-NHAV AND NHB-NHBV INDUSTRIAL ENGINES

ONAN

1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432

A DIVISION OF ONAN CORPORATION

FORM NUMBER
940-0153

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ENGINE 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.

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. Tighten supports and clamps, 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, unless tanks are outside engine compartment.
- 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 on 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 installations, especially those within a confine, should be equipped with an exhaust system to discharge gases to the 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.

Engine Exhaust Gas (Carbon Monoxide) is Deadly!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

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

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection 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 while the engine is running. Bleed the system pressure first.

Keep the Unit and Surrounding Area Clean

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

PRE-START INSTRUCTIONS

BEFORE STARTING

Inspection: Inspect the engine visually before starting. Check for loose or missing parts or any damage occurring from shipment.

Crankcase Oil: Be sure to fill the crankcase with oil to the "FULL" mark on the oil level indicator. Use oil with the API (American Petroleum Institute) designation SE or SE/CC. Do not use an oil with the designation CD unless it also has designation SE and the oil manufacturer certifies it performs satisfactorily in gasoline engines.

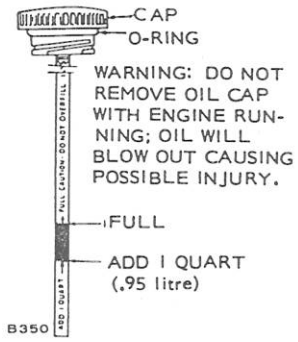
Oil consumption may be higher with a multigrade oil than with a single grade oil if both oils have comparable viscosities at 210 F (99 C). Therefore, single grade oils are generally more desirable, unless anticipating a wide range of temperatures. Use the proper grade oil for the expected conditions.

Recommended Fuel: Use clean, regular grade, automotive gasoline. Do not use highly leaded premium types.

For new engines, nonleaded gasoline gives the most satisfactory results. For older engines that have previously used leaded gasoline, take off heads and remove all lead deposits from engine before switching to nonleaded gasoline.

CAUTION **Failure to remove lead deposits from engine before switching from leaded to nonleaded gasoline could result in preignition causing severe damage to the engine.**

WARNING **Never fill the tank when the engine is running. Gasoline fumes can ignite causing fire or explosion. Leave some space in the tank for fuel expansion.**



OIL LEVEL INDICATOR

STARTING

STARTING (Electric Start)

1. Move ignition switch to its "ON" position.
2. Push "START" button to crank engine.

If the engine does not start at first, inhibitor oil used at factory might have fouled the spark plugs. Remove the plugs, clean, dry thoroughly, and install. Inhibitor oil might cause heavy exhaust smoke when the engine is first started and is normal.

STARTING (Manual Start)

1. Hold choke about three quarters closed or as necessary according to temperature conditions.
2. Pull start rope with a fast, steady pull to crank engine.
3. Open choke as engine warms up.

APPLYING LOAD

When applying the load to a new or reconditioned engine, do it gradually in about four steps, each not less than 30 minutes running time. Start with 1/4 load, then 1/2, 3/4, and full load.

STOPPING THE ENGINE

Disconnect all load before stopping the engine. Stop engines equipped with battery ignition by positioning the ignition switch to the "OFF" position.

HIGH ALTITUDE

For operation at altitudes of 2500 feet (760 m) or more, close the carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio. Each 1000 feet (305 m) increase in altitude will reduce maximum power about four percent.

OPERATION

BREAK-IN PROCEDURE

Controlled break-in with proper oil and a conscientiously applied maintenance program will help assure satisfactory service for many hours from your Onan engine. Break-in or ideal fitting of all internal moving metal parts can best be achieved by maintaining proper cooling and correct lubrication during the running-in period. Using the wrong grade and weight of oil and high engine operating temperature conditions during break-in can result in engine damage. Run the engine at about half load for the first three hours with intermittent periods of full load to control engine break-in.

Check the oil level at least every five operating hours. Add oil to maintain proper level, but never overfill as oil will foam and enter the breather system.

HOT WEATHER OPERATION

When operating the engine in temperatures above 75 F (24 C), pay particular attention to the following items to prevent damage.

1. Keep the engine cooling fins clean and free of obstruction to maintain maximum airflow to and from the engine.
2. Use the proper grade and weight of engine oil for the operating temperature conditions. Check the oil level each time you fill the fuel tank.
3. Check the battery water level more frequently than normal. High temperatures cause faster evaporation.

COLD WEATHER OPERATION

For operating temperatures below 32 F (0 C), check the following items closely.

1. Use correct SAE oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel and protect against moisture condensation. Keep fuel system clean.
3. Keep batteries in a well-charged condition.
4. Partially restrict cool airflow to maintain proper engine temperature, but use care to avoid overheating.

DUST AND DIRT

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as required.
3. Change crankcase oil and filter more often than recommended under normal conditions.

MAINTENANCE

CRANKCASE OIL

The oil capacity is 3-1/2 U.S. quarts (3.3 litre) or 4 quarts (3.8 litre) with filter. Fill to the "FULL" mark on the oil level indicator. Use the following recommended oil numbers for expected ambient temperatures.

Above 40 F (5 C) ..... SAE 30
10 to 40 F (-12 to 5 C) ..... SAE 10W-40
Below 10 F (-12 C) ..... SAE 5W-30

OIL LEVEL

Check oil level at least every eight hours of operation. Check more frequently on a new or overhauled engine as oil consumption is higher until piston rings seat properly.

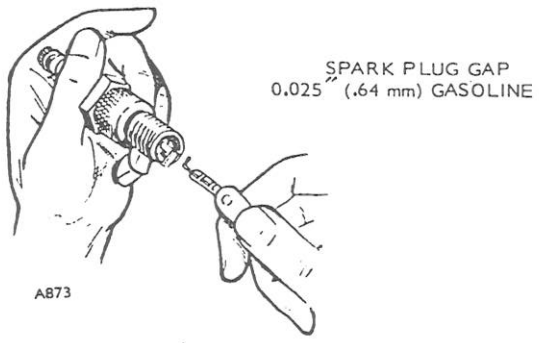
OIL CHANGE

Change crankcase oil after the first 25 hours of operation and after every 100 hours after that. If operating in extremely dusty conditions, change oil more frequently.

COOLING SYSTEM

Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

CAUTION **Plugged or clogged cooling fins can cause overheating and engine damage.**



CHECKING SPARK PLUG GAP

SPARK PLUGS

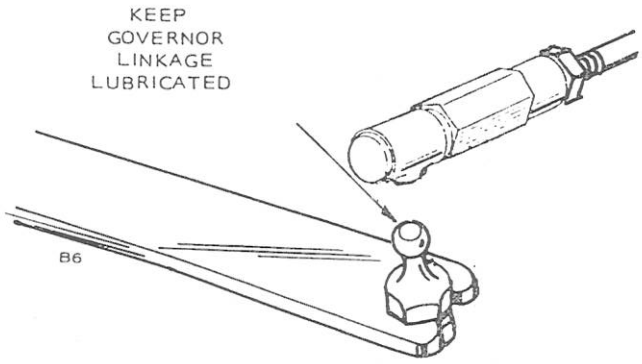
Check, clean and reset spark plugs every 100 operating hours. Replace spark plugs that show signs of fouling or electrode erosion. Replace with new spark plugs every 200 operating hours.

MAINTENANCE

GOVERNOR LINKAGE

The governor linkage must move freely through its entire travel. Every 50 hours of operation, clean the metal joints shown in Figure. Also inspect the linkage for binding, excessive slack and wear.

Clean and lubricate metal ball joints. Don't lubricate plastic joints.

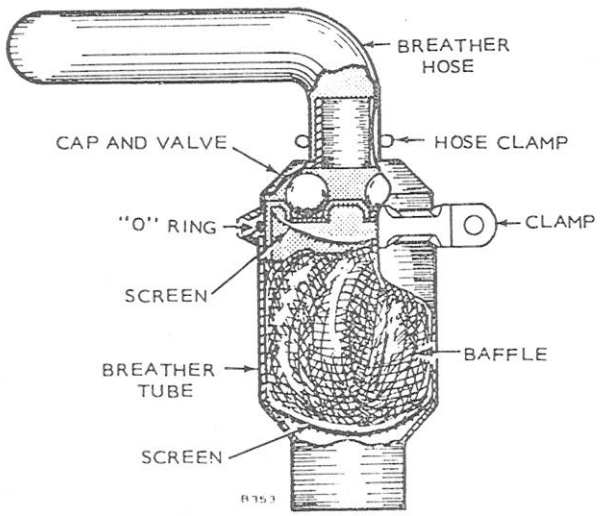


GOVERNOR LINKAGE BALL JOINT

CRANKCASE BREATHER

The crankcase breather maintains a partial vacuum in the crankcase during operation to control oil loss and ventilate the crankcase. To disassemble, remove the rubber cap from the crankcase tube and pry the valve out of the cap. Wash the valve in a petroleum-base solvent at regular intervals and, if defective, replace it. Also, pull the baffle out of the breather tube and clean it. Install the valve with the perforated disk toward the engine.

WARNING **Use extreme care when cleaning with a petroleum-base cleaner due to fire hazard.**



CRANKCASE BREATHER

AIR CLEANER

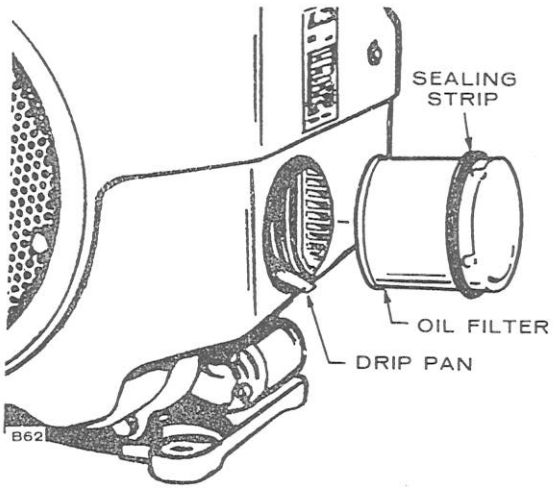
Check air cleaner paper element every 50 hours. Clean element by tapping to shake off dirt. Depending on operating conditions for the engine, replace the paper element every 200 hours or whenever it becomes dirty.

CAUTION **Do not run engine with air cleaner removed. Intake of dirty air or solid materials could cause severe damage to engine parts.**

REDUCTION GEAR DRIVE (OPTIONAL)

Drain the gear box after the first 100 hours of operation and refill with fresh lubricant of the recommended grade. Remove the filler plug on top of the case and the oil level plug from the face of the gear case. Fill the case until the oil just begins to flow from the oil level plug hole (replace both plugs). Gear box holds 1/2 U.S. pint (0.24 litre). Repeat this procedure every six months thereafter, or every 100 hours.

Use only SAE 50 (winter) motor oil or SAE 90 (summer) gear oil. Do not use lubricants commonly known as extreme pressure lubricants, hypoid lubricants, etc.



CRANKCASE OIL FILTER

OIL FILTER

Change the crankcase oil filter every 200 hours. Remove the filter (see Figure) by turning counterclockwise, using a filter wrench. Add the strip provided with the filter to prevent air loss in the area indicated. It is advisable to wipe dry the drip pan located below the filter. Coat rubber gasket on filter with a film of oil before installing. Install the filter finger-tight plus 1/4 to 1/2 turn. Do not overtighten. If oil becomes so dirty that you cannot see the markings on the oil level indicator, change the filter and shorten the filter service period.

PERIODIC SERVICE GUIDE

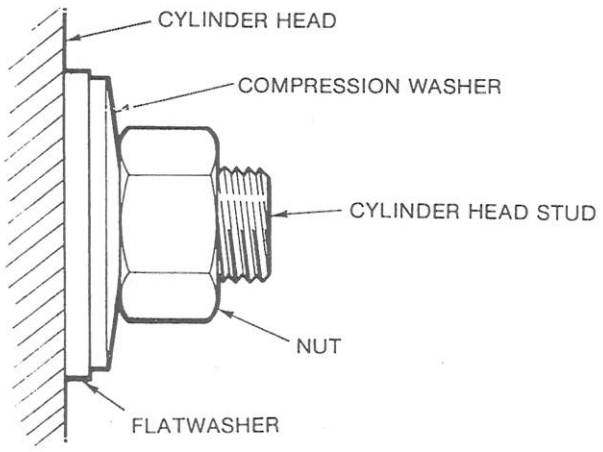
SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	50	100	200	500	1000
Inspect Engine Generally*	x					
Check Fuel Supply	x					
Check Oil Level	x					
Clean Governor Linkage		x*				
Change Crankcase Oil			x*			
Check Breaker Points & Ignition Timing			x			
Check Spark Plugs			x			
Check Battery Electrolyte Level			x			
Clean Fuel Filter			x			
Adjust Valve Lash				x[1]		
Replace Spark Plugs				x		
Replace Oil Filter				x*		
Replace Air Cleaner				x*		
Inspect Valves, Grind if Necessary						x[1]

* - Check for exhaust leaks, fuel leaks, proper mounting, etc.
x* - Perform more often under dusty or extreme cold weather conditions.
x[1] - For detailed maintenance—contact your Onan service center.

CYLINDER HEAD TORQUE

Cylinder head nut compression washers are specified on some engine models only. When these washers are used, torque the head nuts in three 5 lb ft (7 N•m) steps to 14 to 16 lb ft (19 to 22 N•m).

CAUTION **Too much torque will flatten the compression washers and destroy their purpose. See Figure.**



CYLINDER HEAD COMPRESSION WASHER (NOT ON ALL MODELS)

Head nuts which do not use the compression type washers should have a torque of 16 to 18 lb ft (22 to 24 N•m).

EXHAUST SYSTEM

Make regular inspections of the exhaust system throughout the entire life of the engine. Locate leaks in muffler and piping while the engine is operating. Repair all leaks immediately after they are detected for personnel safety.

WARNING **Leaky exhaust systems emit noxious carbon monoxide fumes which are a potential safety hazard.**

BATTERY

Check charge condition. Check electrolyte level. Add distilled water to keep electrolyte at its proper level. In freezing weather, run engine immediately after adding water. A specific gravity reading should be approximately 1.260 at 77 F (25 C). Keep battery connections tight and clean.

Onan recommends that qualified service personnel perform all major service. An engine service manual and complete parts catalog are available at additional cost. Contact your nearest authorized dealer or Onan parts and service center.

ADJUSTMENTS

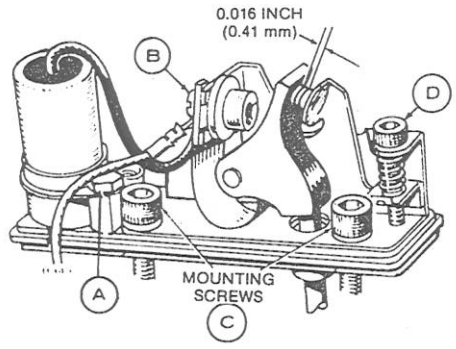
BREAKER POINTS—TIMING

To maintain maximum engine efficiency, change the breaker points every 200 hours of operation using the following procedure.

1. Remove spark plugs and rotate flywheel TC mark to 20 degrees BTC (points open); then rotate another 90 degrees clockwise to ensure points open fully.
2. Remove breaker box cover and unplug coil wire at coil (+) terminal.
3. Remove condenser (screw A) and detach condenser lead and coil lead (screw B).
4. Remove two Allen screws (C) and lift breaker assembly from engine.
5. Replace condenser and point assembly with new parts and reinstall using above procedure in reverse order of removal.
6. Using Allen wrench at screw (D), adjust point gap 0.016 inch (0.4 mm) using a clean, flat thickness gauge.

Setting point gap accurately adjusts engine timing.

7. Replace breaker box cover and spark plugs.

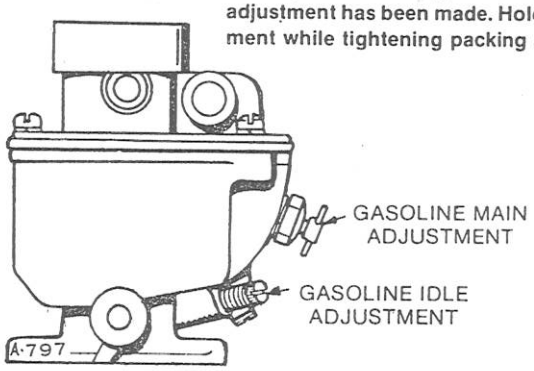


BREAKER POINT ADJUSTMENT

CARBURETOR ADJUSTMENT

1. Start engine and allow it to warm up.
2. Check to see that ignition and governor operation are normal.
3. With no load on engine, turn carburetor idle adjustment slowly in then out until best normal idle speed (2400 rpm) is achieved (1 to 1-1/2 turns open is normal).
4. Pull outward on governor linkage to slow engine to 800 to 900 rpm and set idle adjustment for smooth operation.
5. Release governor linkage to allow engine to accelerate. The main adjustment is correct if engine accelerates without a lag. If not, turn main adjustment out about 1/2 turn and repeat check until engine accelerates evenly without a lag.
6. Set throttle stop at desired speed.
7. With load applied, turn main adjustment slowly in then out until best normal speed is achieved.

CAUTION **Loosen packing nut before turning main fuel adjustment and tighten to a snug fit after adjustment has been made. Hold the adjustment while tightening packing nut.**



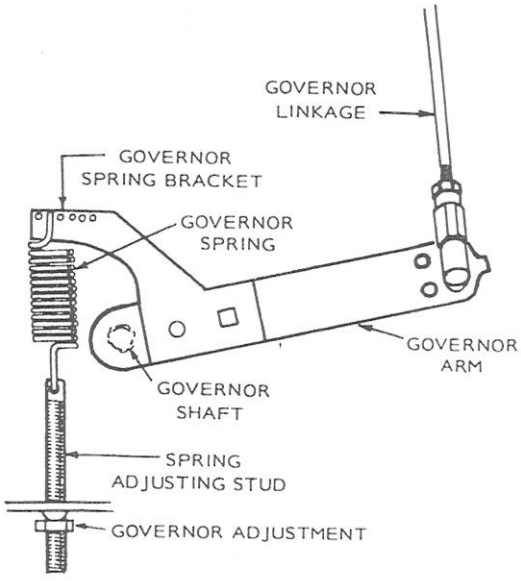
CARBURETOR ADJUSTMENTS

GOVERNOR ADJUSTMENT

The governor should allow a nominal engine speed of 2400 rpm at no load. The no load speed should be slightly higher (90 rpm) than the speed requirements of the connected load. Using a tachometer, check engine speed and adjust the governor as follows.

Speed: Turn speed adjusting nut in to increase speed or out to decrease speed, see Figure.

Sensitivity: Referring to Figure, move spring toward governor shaft to increase sensitivity and away from governor shaft to decrease sensitivity. The engine speed drop from no load to full load should not be less than 100 rpm.



GOVERNOR ADJUSTMENTS

GENERAL INFORMATION

ENGINE MODEL REFERENCE

Identify your model by referring to the MODEL and SPECIFICATION NUMBER as shown on the unit nameplate. Always use this number and the engine serial number when making reference to your engine.

How to interpret MODEL NUMBER.

NHA - MS / 123 C
1 2 3 4

1. Factory code for general identification purposes.
2. Specific type: MS—electric starting.
3. Factory code for optional equipment supplied.
4. Specification (Spec Letter) advances with factory production modification.

If your engine needs service or repair, contact an Onan service center. Trained mechanics will assure expert repair service on your Onan engine.

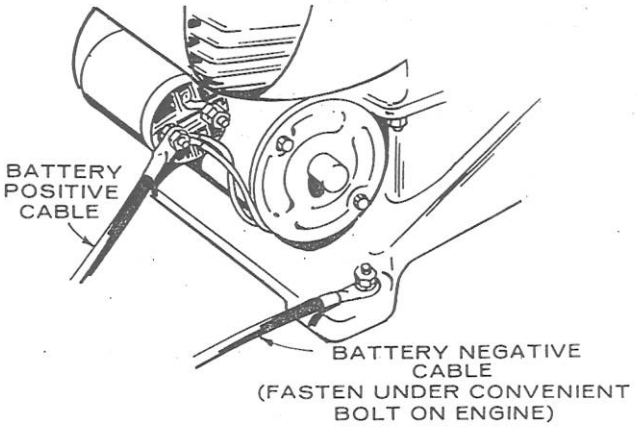
OUT-OF-SERVICE PROTECTION

Protect an engine that will be out-of-service for more than 30 days as follows:

1. Run engine until thoroughly warm (5 to 10 minutes).
2. Turn off fuel supply and run until engine stops.
3. If battery is used, disconnect and follow standard battery storage procedure.
4. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
5. Remove spark plugs. Pour one ounce (two tablespoons) of rust inhibitor (or SAE 50 oil) into the cylinders. Crank engine over a few times. Install spark plugs.
6. Service air cleaner per maintenance schedule.
7. Clean governor linkage and protect by wrapping with a clean cloth.
8. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
9. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
10. Provide a suitable cover for entire unit.

BATTERY CONNECTIONS (Engines with Automotive Type Separate Starter)

Connect the 12-volt battery positive cable to the engine start switch terminal. Connect the battery negative cable to the ground point on the engine oil base (see Figure).



BATTERY CONNECTIONS

RUNNING REPLACEMENT PARTS

Oil Filter	122-0323
Oil Filter Air Seal	122-0347
Air Filter	140-1228
Breather Tube Baffle	123-0865
Spark Plugs	167-0240
Ignition Tune-Up Kit (points & condenser)	160-1161
Carburetor Repair Kit	141-0371
Fuel Pump Repair Kit	149-0526
Carbon Removal Gasket Kit	168-0121

A complete Onan parts catalog is available—contact your Onan parts and service center or authorized dealer.

SPECIFICATIONS

Displacement	60 cu in. (983 cm³)
Cylinder Bore	3.563 inch (90.5 mm)
Piston Stroke	3 inch (76 mm)
Horsepower	
NHA @ 3000 rpm	18 BHP (13.4 kW)
NHAV @ 3300 rpm	20 BHP (14.9 kW)
NHB @ 3000 rpm	17.5 BHP (13.1 kW)
NHBV @ 3200 rpm	19.5 BHP (14.5 kW)
Compression Ratio	
NHA, NHAV	6.5 to 1
NHB, NHBV	7.0 to 1
Ventilation Required @ 3600 rpm	
NHA, NHB	1100 cfm (31.14 m³/min)
NHAV, NHBV	1200 cfm (33.97 m³/min)
Oil Capacity	3.5 quart (3.3 litre)
Oil Capacity with Filter Change	4 quart (3.8 litre)
Combustion Air (3600 rpm)	80 cfm (2.3 m³)
Fuel	Nonleaded or Regular Grade Gasoline
Battery	12 Volt

TUNE-UP SPECIFICATIONS

Cylinder Head Torque (Models with special compression washers)	15 lb ft (20.4 N•m)
Cylinder Head Torque (std)	18 lb ft (24 N•m)
Spark Plug Gap	0.025 inch (0.64 mm)
Breaker Point Gap	0.016 inch (0.41 mm)
Ignition Timing (Fixed), Electric Start Units	20° BTC
Tappets (Cold) Intake	0.003 inch (0.08 mm)
Exhaust	0.012 inch (0.30 mm)

Pump Section

Operate the pump under normal conditions and, after a short run-in period, examine packing for leakage. If leakage is excessive tighten locknuts evenly until there is only slight leakage from the packing rings. This slight leakage is a necessary and normal condition for packing and allows for expansion and proper seating.

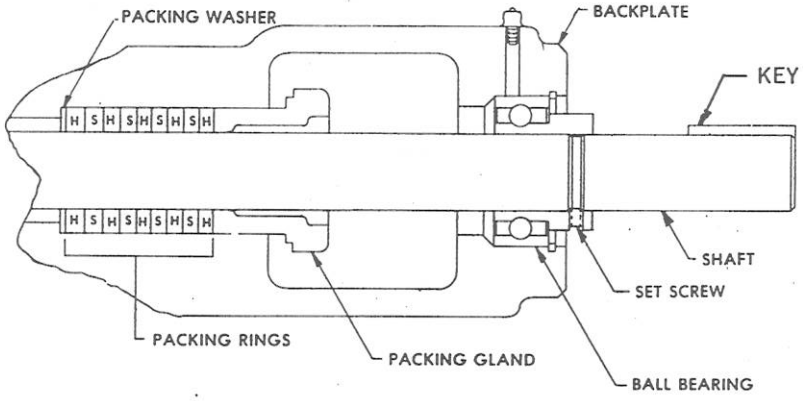
NOTE: WHERE LIQUID BEING HANDLED IS HAZARDOUS OR VOLATILE, FULL PRECAUTIONS SHOULD BE TAKEN DURING THE RUN-IN PERIOD.

To replace packing on "H" pump remove key, two nuts and clips, packing gland and packing rings. On "HB" and "GHB" pumps, remove two nuts, clips, spring clip, packing gland and packing rings. (Packing hooks are commercially available to assist in removing the packing rings). Clean the shaft and adjacent parts. Examine the shaft, if it is excessively worn or scored, replace the shaft.

Insert packing rings alternating hard (H) and soft (S) rings as shown, making sure the joints are staggered 180 degrees. Use split ring bushings or a flexible packing tamper to seat each ring before adding the next ring. The rings must not be tamped or seated in place too tightly. Check shaft for free movement after each ring is installed. When the packing box is sufficiently full to allow entry of the packing gland about ¼" reassemble the packing gland, clips and nuts. Draw up evenly on the packing gland to assure proper seating of the packing, and then loosen nuts about ½ turn. Do not cock the packing gland. (This could cause binding or heating of the shaft). Before operating the pumps see run-in instructions above.

3600, 4600 PACKED BOX

"HB"



"H"