M.I. 9644 *Rev. A

Maintenance Instruction

Technical Publications

ELECTRO-MOTIVE

MODERNIZATION RECOMMENDATION

IMMERSION HEATER-LUBE OIL CIRCULATING PUMP SYSTEM FOR EMERGENCY FAST START CATEGORY III & IV INSTALLATIONS

PURPOSE: To provide an improved immersion heater lube oil circulating system (Figs. 2 & 11) that will continuously supply oil to the turbocharger and crankshaft in anticipation of an emergency start.

This revision is issued to provide part numbers for some previously unnumbered modification materials. Additionally, the parts lists give material specifications for EMD supplied piping and tubing to facilitate preparation of welding criteria.

APPLICATION: All turbocharged EMD model "S", MP45, and "999" emergency fast start installations.

DISCUSSION: Wear is minimized when lube oil is supplied to the turbocharger and engine main bearings prior to and during high speed emergency starts.

EMD's original immersion heater system provides a parallel lube oil circuit in which oil flows to the turbocharger bearings via one path and to the main lube oil filter and the oil cooler via another path. Following a load run, the oil flows only to the turbocharger because the hot oil has a low viscosity. As a result, the oil cooler and filter do not refill until the oil cools sufficiently (approximately 3 hours following shutdown). Fast engine starts during this period do not have the wear minimizing benefits of a continuously abundant oil supply. Although a few random fast starts under these adverse conditions are not expected to cause difficulty, the cumulative wear from repeated routine fast starts is likely to affect equipment reliability.

Owners of EMD nuclear standby units have been notified previously of the unnecessary wear caused by equipment exercise or test schedules that routinely call for repeat fast engine starts without first allowing for a cooling interval following a load run.

EMD continues to recommend that exercise and test schedules for engines with the *original immersion heater system* be revised to avoid repeat fast hot starts from 15 minutes to 3 hours after shutdown. Whenever possible, allow the engine to cool at least 3 hours after it has been operated in the "loaded" mode, or perform the restart within 15 minutes of shutdown.

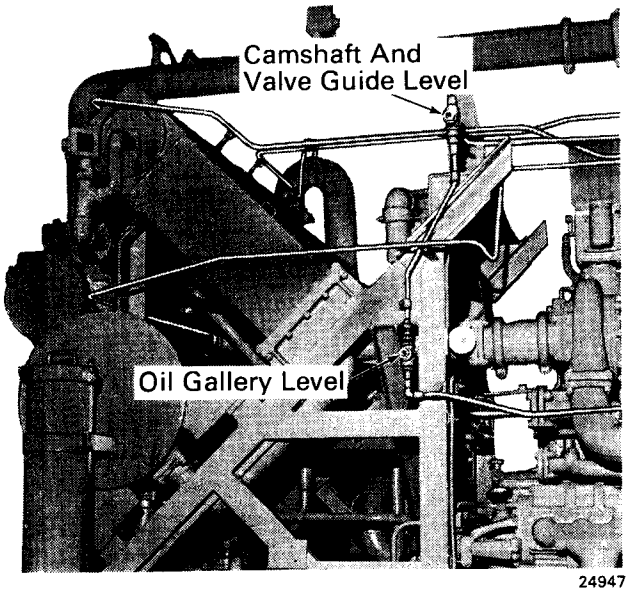
*This bulletin is revised and supersedes previous issues of this number.

The primary benefit to be gained from this modification is continuous replenishment of the oil supply in the oil cooler and main lube oil filter regardless of oil temperature and viscosity. Trapped air which may impede oil flow is vented from the system and permits the off engine lube oil system to become fully charged. The *modification* also removes the three hour restart restriction imposed on exercise or test schedules.

However, other benefits provided by this improvement make this modification attractive even when exercise or test schedules can be carefully controlled. Oil systems modified in accordance with this instruction provide continuous oil circulation through the engine crankshaft and turbocharger bearings. As a result, engines approach operating oil pressures very rapidly following start up.

Proper performance of this improved system depends on operation of AC motor driven oil pumps. If start-ups are delayed for more than 5 seconds after loss of AC power, EMD recommends that DC backup pumps be provided with suitable check valve protection against reverse flow.

Although oil flows through the crankshaft and connectinng rod bearings, the standby oil level in the engine is kept below the camshafts and valve rocker arm assemblies. (Refer to Power Pointers article 4P-83, 5-18-83). Sight glass indicators are used, as shown in Fig. 1, so that the operator can visually ascertain if the system is operating properly under standby conditions.



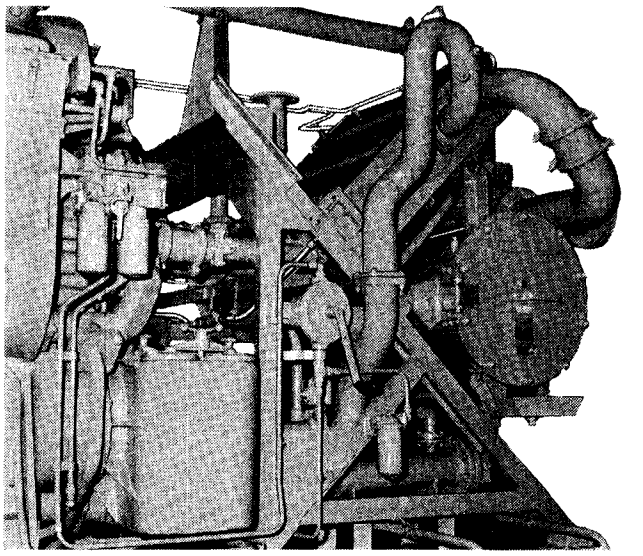


Fig.1 – Vent And Sight Glass Piping, Typical Installation

"S" UNITS

The following instructions are for the modification of "S" type emergency start units. Fig. 2 is the schematic piping diagram of this modification.

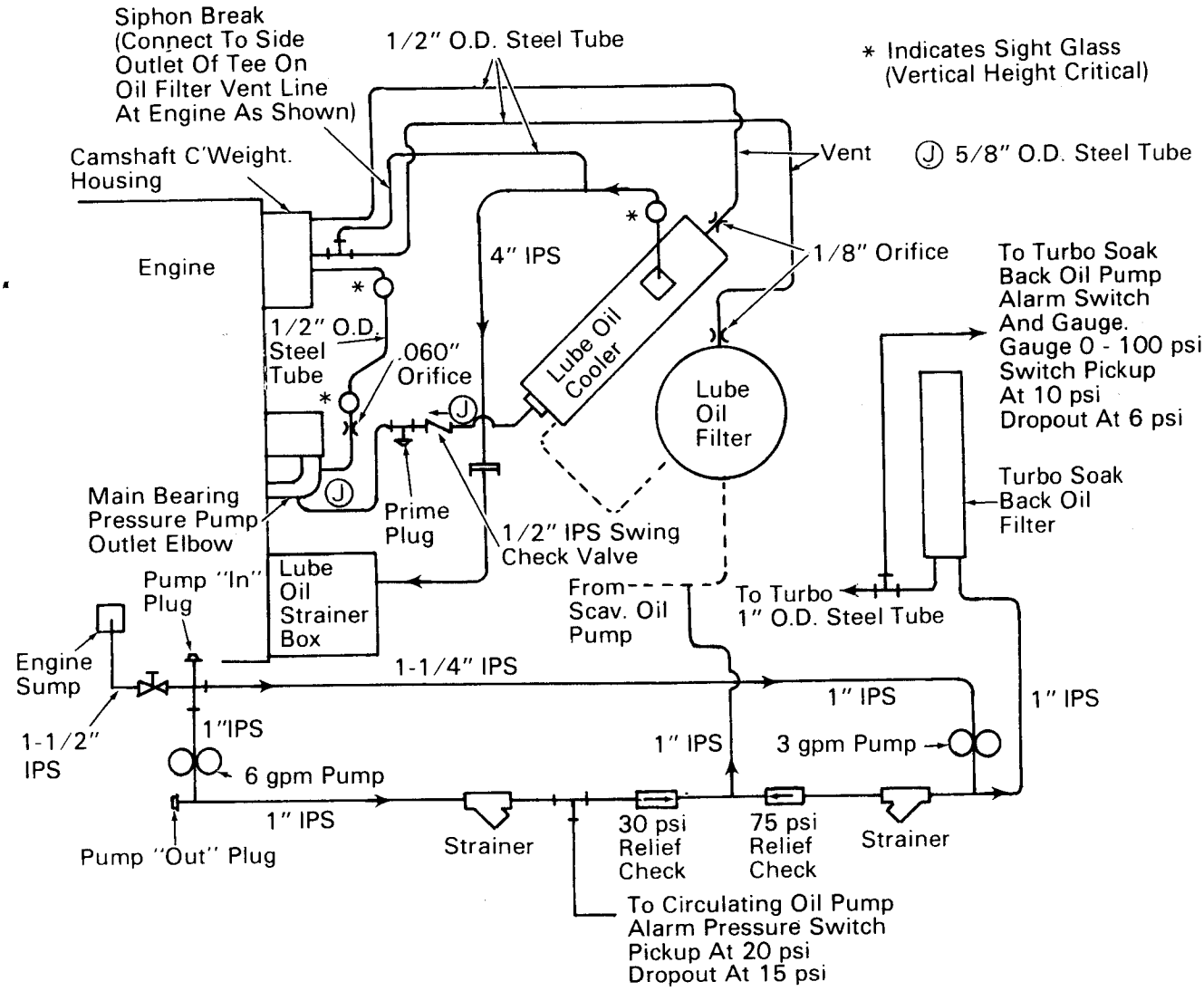


Fig.2 – System Schematic Diagram, "S" Units

MATERIAL REQUIRED

The following material is required for each engine. Items 1 through 89 are available from Electro-Motive Parts Centers. Item 90, pump and motor assembly base, should be fabricated from 1/4" steel plate according to the specifications in Fig. 10. Items 1 through 80 and item 90 can be located by reference number on the application drawings which are part of this instruction. Items 81 through 89 include tubing for pressure switch connections and tube nuts for installing the tubing.

Items marked with an "*" are not shown on the application drawings. The listed quantity for these items is the number per assembly.

Material specifications are located at the end of this M.I.

NOTE

Do not use galvanized pipe for this modification.

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
1	1	8250627	Gasket	23
2	5	9327526	Sight Glass	28
3	1	8456532	Flange	3
4	1	8430611	Gasket	22
5	1	8242814	1/16" Choke Fitting	20
6	1	8156588	1/2" PT Flange	3
7	1	8058257	Gasket	22
8	2	8059609	3/8" PT Flange	9
9	1	8086257	1/2" PT Flange	9
10	2	8290236	1/8" Choke Fitting	20
11	1	8128509	3/4" W-W-PT Tee	13
12	1	8422068	Ring Gasket	21
13	7	8108206	Clamp Assembly	—
	1	103319	1/4" Lockwasher	11
	1	179796	1/4" Hex Head Bolt	6
	1	109084	1/4" Hex Nut	12
	1	8081614	Clamp	1
	1	8081613	Clamp	1
14	1	9521740	Pipe Assembly	—
	1	8173563	1" Swivel Flange	9
	1	8173562	1" FL-1" W Insert	13
	1	8130823	1" W Elbow	13
	1	9522270	1" Pipe	14
15	2	8306502	Gasket	24
16	4	8108208	Clamp Assembly	—
	1	103319	1/4" Lockwasher	11
	1	179796	1/4" Hex Head Bolt	6
	1	109084	1/4" Hex Nut	12
	1	8081616	Clamp	1
	1	8081613	Clamp	1
17	1	9521844	1" Relief Check Valve	28
18	1	8280951	Strainer	28
19	1	9521841	Pipe Assembly	—
	1	8241948	4" W Elbow	13
	2	8266249	4" W 45° Elbow	13
	1	9522458	4" Pipe	14
	1	8463223	4" Pipe	14
	1	9522716	4" Pipe	14
	1	9521842	4" Pipe	14
	1	9332046	4" Pipe	14
	1	8246564	1" PT Outlet	13
	1	8234808	3/4" PT Outlet	13
	1	8226869	1/2" PT Outlet	13
	1	8252907	3/8" PT Outlet	13
	1	9523940	4" W Return Bend	13

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
20	1	8281365	Flange	3
21	1	8366785	Gasket	21
22	1	8447206	Flange	3
23	1	8366140	Gasket	22
24	1	9522065	Pipe Assembly	—
	1	8153158	1-1/2″ Nipple Short	14
	1	8179544	1-1/2″ W Elbow	13
	1	9522064	1-1/2″ Pipe	14
	1	8463756	1-1/2″ PT Cutoff Valve	28
	1	8153165	1-1/2″ Nipple 3-1/2″ Long	14
25	1	9521873	Pipe Assembly	—
	1	8273092	1-1/2″ - 1-1/4″ - 1-1/2″ Tee	13
	1	9089000	1-1/2″ Pipe	14
	1	9521872	1-1/2″ Pipe	14
	1	8276978	1-1/2″ PT Tee	17
	1	189071	1-1/2″ x 1″ PT Bushing	16
	1	9522822	1″ Pipe	14
	1	106643	1-1/2″ PT Plug	16
26	1	8477156	1-1/2″ Flexible Coupling	28
27	1	8347534	Flange	3
28	1	8389165	Gasket	21
29	1	8024212	1/2″ Swing Check Valve	28
30	1	8367580	Gasket	22
31	5	8108219	Clamp Assembly	—
	1	103320	5/16″ Spring Lockwasher	11
	1	179820	5/16″ Hex Head Bolt	6
	1	102634	5/16″ Hex Nut	12
	1	8109969	Clamp	1
	1	8081700	Clamp	1
32	3	8108217	Clamp Assembly	—
	1	103320	5/16″ Spring Lockwasher	11
	1	179820	5/16″ Hex Head Bolt	6
	1	102634	5/16″ Hex Nut	12
	1	8081666	Clamp	1
	1	8081663	Clamp	1
33	1	8108197	Clamp Assembly	—
	1	103320	5/16″ Spring Lockwasher	11
	1	179820	5/16″ Hex Head Bolt	6
	1	102634	5/16″ Hex Nut	12
	1	8081680	Clamp	1
	1	8081678	Clamp	1
34	1	8108211	Clamp Assembly	—
	1	103319	1/4″ Lockwasher	11
	1	179796	1/4″ Hex Head Bolt	6
	1	109084	1/4″ Hex Nut	12
	1	8081623	Clamp	1
	1	8081620	Clamp	1
35	1	8272139	Gasket - (16 and 20 Cyl. Only)	21
36	2	8417454	O-Ring Seal - (16 and 20 Cyl. Only)	23
37	2	8417453	Gasket - (16 and 20 Cyl. Only)	21
38	1	8250509	Gasket - (12 Cyl. Only)	21
39	2	8417744	O-Ring Seal - (12 Cyl. Only)	23

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
40	2	8417741	Gasket - (12 Cyl. Only)	21
41	3	9325479	Channel, Stiffener - (20 Cyl. Only)	1

For each unit, in addition to the above items, one pump and motor assembly compatible with the existing power source is to be selected from the options listed under Item 42.

42	1	Select from table	3/4 HP Pump and Motor. 3 gpm Nominal

ASSEMBLY	VAC	Hz	Ph	MATERIAL REFERENCE
9524002	230/460	60	3	28
9524003	200	60	3	28
9524004	115	60	1	28
9524005	575	60	3	28
9524006	415	50	3	28
9524007	220/380	50	3	28
9524008	115/230	50	1	28

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
43	2	118757	1/2" T x 3/8" PT Elbow	19
44	2	140807	1/2" Nipple 3" Long	5
45	2	8040352	1/2" T x 1/2" FPT Elbow	19
46	AR	8098595	1/2" O.D. Steel Tubing	15
47	1	8040343	1/2" T x 3/4" PT Elbow	19
48	3	8040319	1/2" T x 3/4" PT Conn	19
49	2	118752	1/2" T x 3/8" PT Conn	19
50	1	138105	1/2" PT Tee	18
51	1	103868	1/2" PT Plug	16
52	1	8040389	1/2" T x 1/2" PT x 1/2" T Tee	19
53	1	120142	1/2" T x 3/8" FPT Elbow	19
54	2	144147	3/4" PT Cross	18
55	1	189061	3/4" x 3/8" PT Bushing	16
56	2	8060975	1" Nipple 2" Long	14
57	1	128137	1" PT Coupling	18

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
58	1	8070292	1" MPT Union Tee	17
59	AR	8116937	1" Pipe	14
60	2	103870	1" PT Plug	16
61	1	8045220	1" PT Union Elbow	17
62	1	115237	1" PT Tee	18
63	1	189368	1" PT x 1/2" PT Elbow	18
64	1	144095	1" PT x 1/2" PT Coupling	18
65	AR	8116938	1-1/4" Pipe	14
66	1	125915	1-1/4" x 1" PT Bushing	18
67	1	8044170	1-1/4" PT Union Elbow	17
68	1	8413738	2" x 2" x 1/4" Angle	3
69	1	8060973	1/2" Nipple Short	5
70	1	145690	1" Nipple 4" Long	5
71	1	8078192	1" MPT Union Tee	17
72	1	8040345	5/8" T x 3/4" PT Elbow	19
73	4	116487	5/8" T x 1/2" PT Conn	19
74	4	179820	5/16" Hex Head Bolt	4
75	4	102634	5/16" Hex Nut	12
76	4	446362	5/16" Plain Washer	8
77	8	6101223	5/16" Aircraft Washer	7
78	AR	8098596	5/8" O.D. Steel Tubing	15
79*	1	8342487	Pressure Switch	29
80*	1	8341873	Pressure Switch	29
81*	AR	8098594	3/8" O.D. Steel Tubing	15
82*	4	121758	3/8" Flared Tube Nut	19
83*	12	120141	1/2" Flared Tube Nut	19
84*	4	144308	5/8" Flared Tube Nut	19
85*	1	189064	1" x 3/8" PT Bushing	16
86*	1	8040313	3/8" T x 3/8" PT Conn	19
87*	2	118750	3/8" T x 1/4" PT Conn	19
88*	1	144034	3/4" x 1/2" PT Bushing	18
89*	1	8037261	3/8" T x 1/2" PT Conn	19
90	1	See Fig. 10	Pump and Motor Asm. Base	3

NOTE:

*Items 81, 82, 85-89 are fittings and tubing for the pressure switch connections.

Table 1

Dimensions For Figs. 3 Through 5

	12-Cylinder	16-Cylinder	20-Cylinder
A	64-3/8"	65-1/2"	65-1/2"
B	48-7/8"	50"	50"
C	75-11/32"	75-15/16"	74-15/16"
D	19/32"	1"	1"
E	11"	11-7/8"	11-7/8"
F	5-3/8"	5-15/16"	7"
G	6-9/16"	5-1/2"	5-1/2"
H	45-13/16"	61-5/8"	77-1/2"
I	14-5/8"	14-5/8"	15-3/8"

INSTALLATION

Fig. 2 provides a schematic representation of the modified system for "S" Units. All dimensions for locating and installing components and piping are shown on the application drawings, Figs. 3 through 7, and on Table 1. Numbers in parentheses or circles provide a reference to items on the Material Required list.

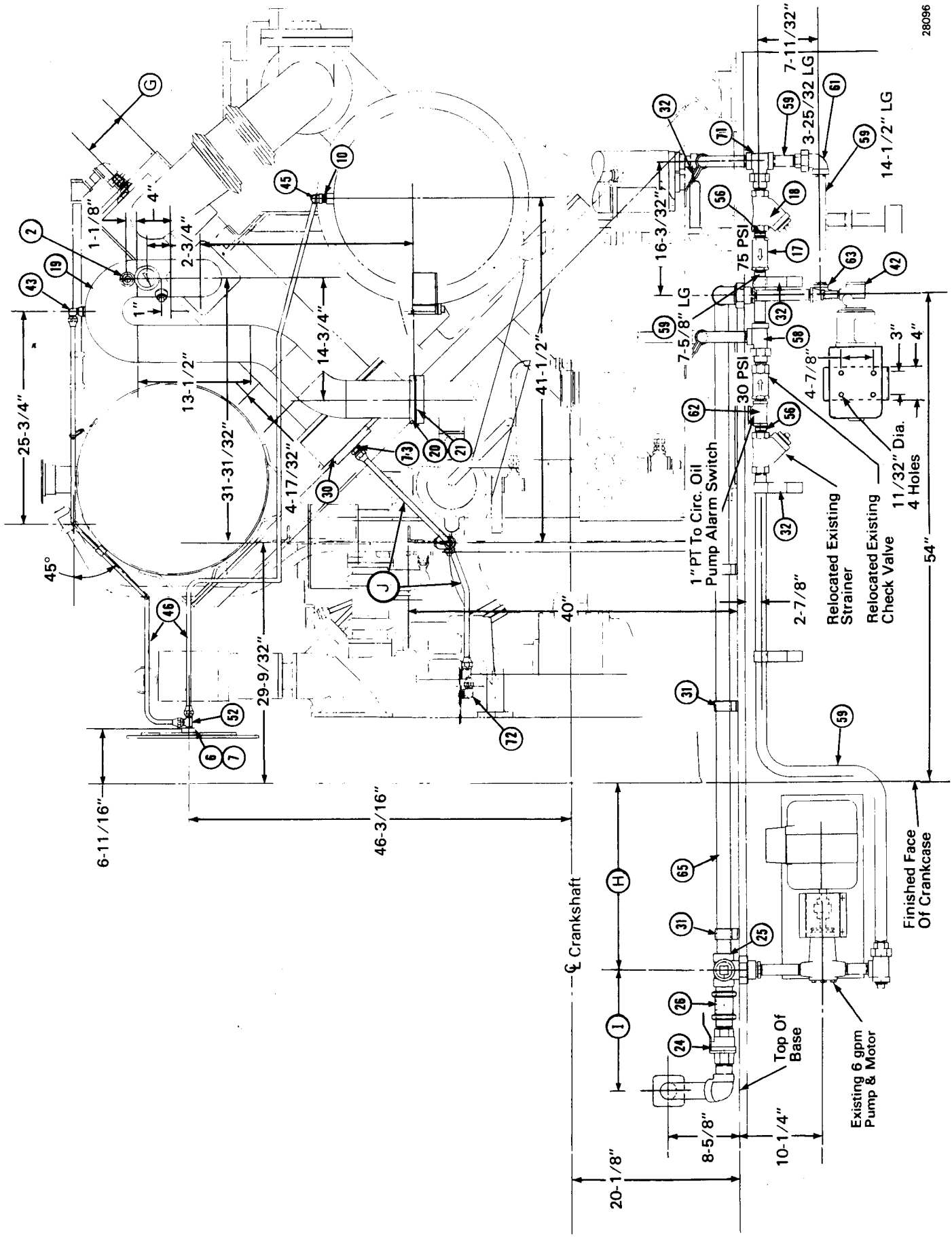


Fig.3 – "S" Unit Piping Application, Right Side View

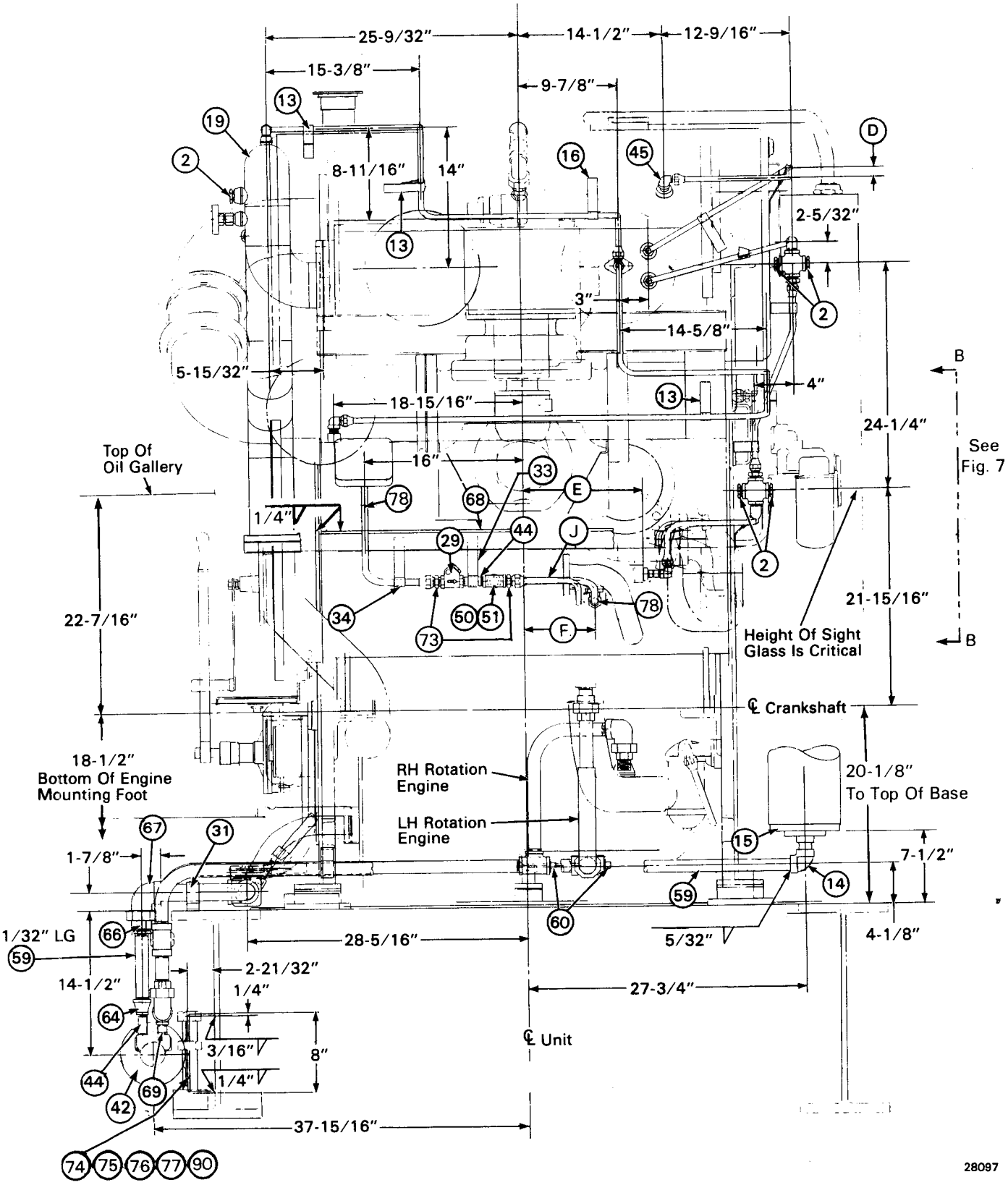


Fig.4 – "S" Unit Piping Application, Front View

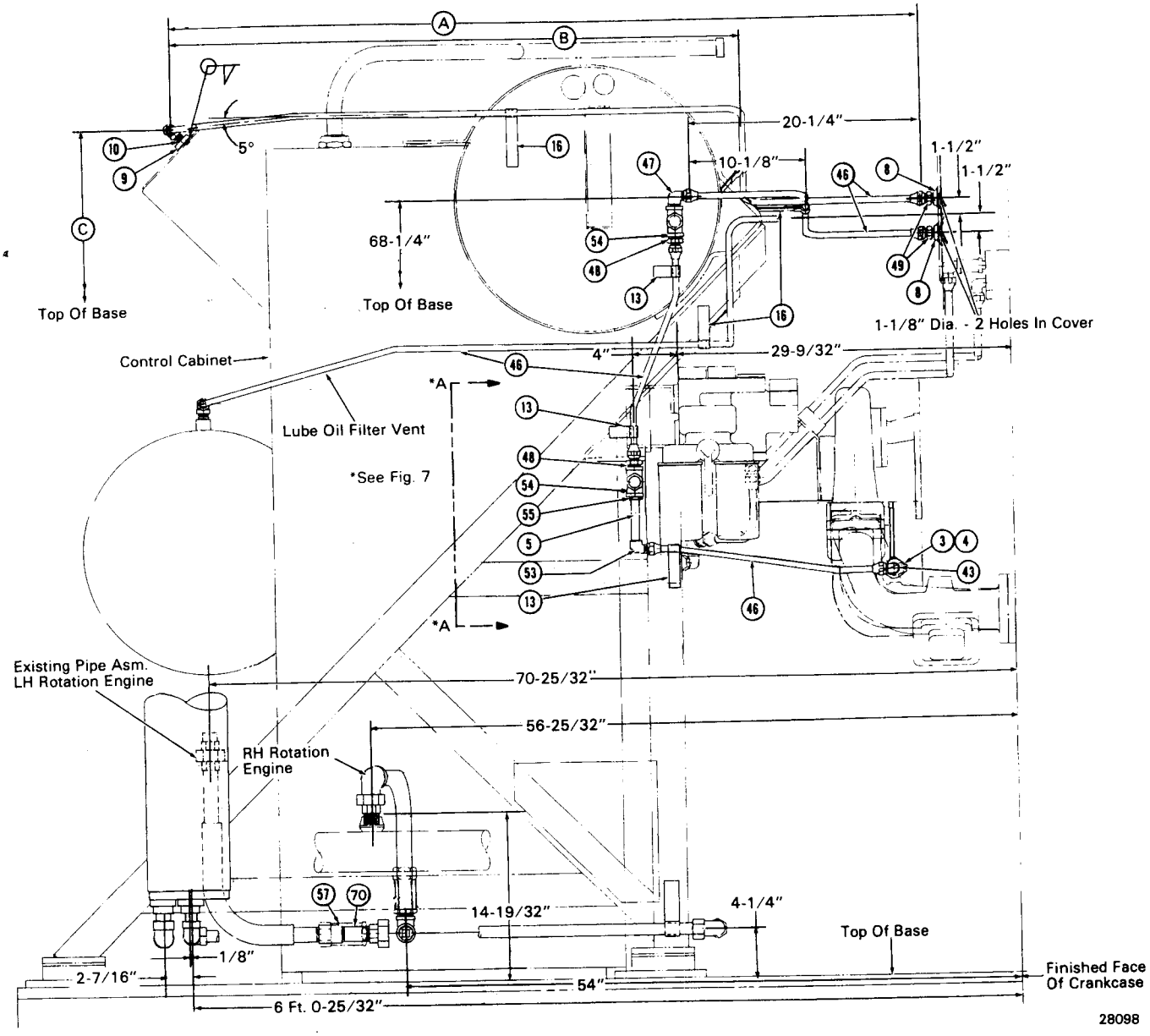


Fig.5 – "S" Unit Piping Application, Left Side View

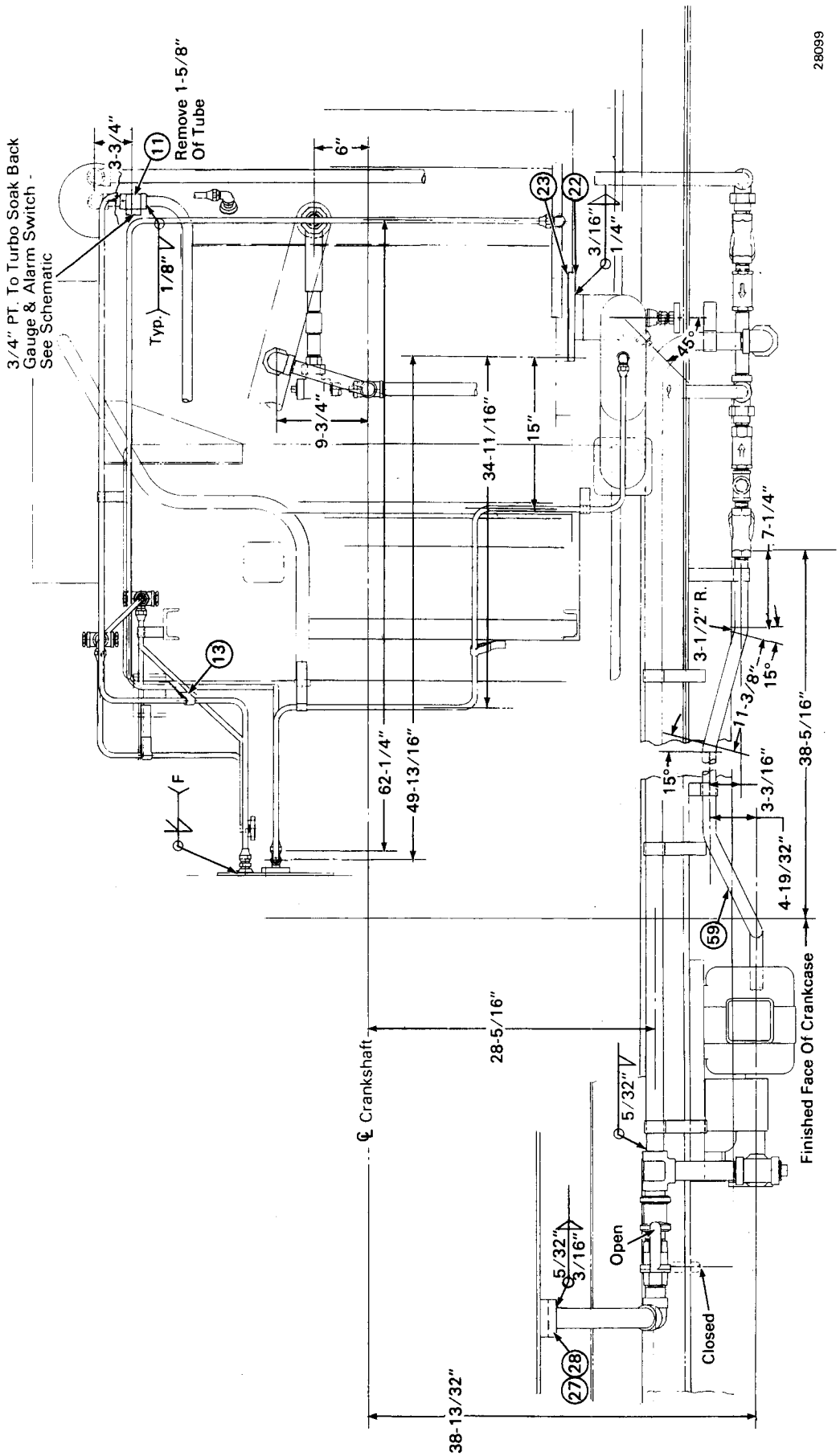


Fig.6 – "S" Unit Piping Application, Top View

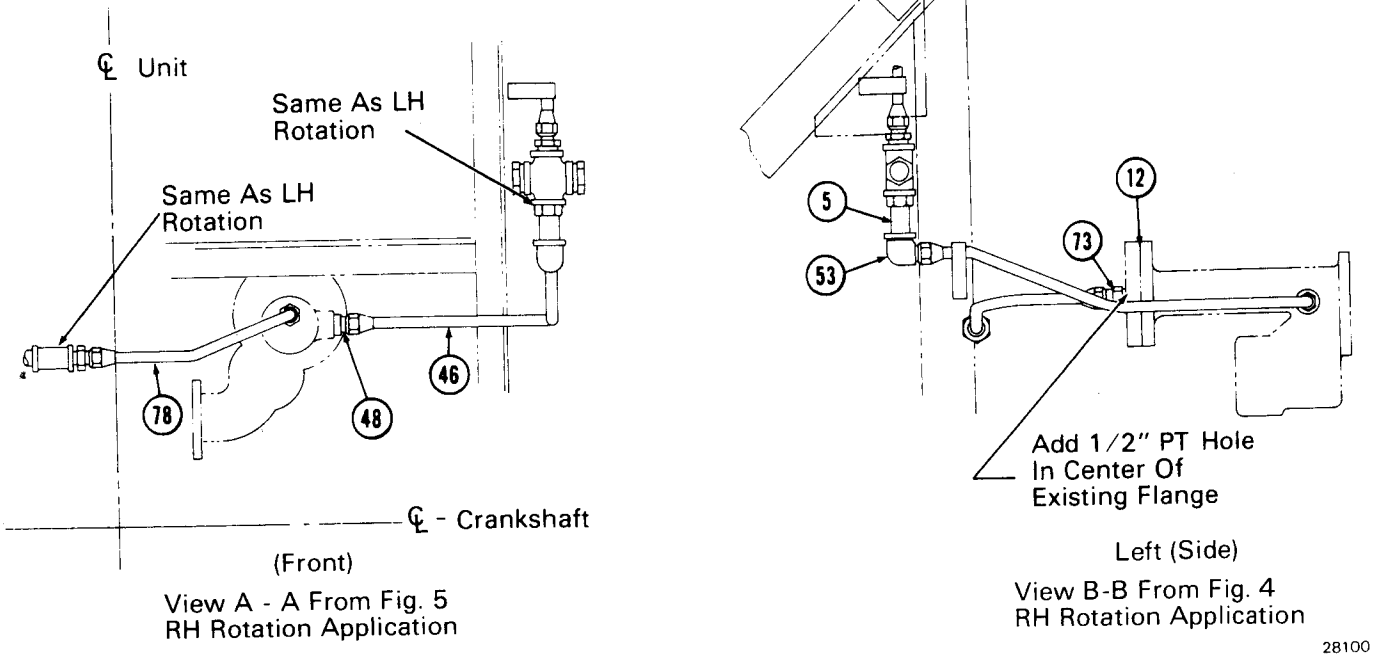


Fig.7 – Gallery Fill/Sight Glass Application, Right Hand Rotation Engine

PIPING MODIFICATION

NOTE

Do not use galvanized pipe for this modification.

CAUTION

Protect all piping and components from weld spatter, slag, drill chips, and thread shaving contamination.

1. Before proceeding with the following piping changes, drain the engine of lube oil and coolant.

CAUTION

Insure that the immersion heater system is off before draining coolant.

2. Remove the lube oil cooler tank from the cooler assembly to apply a 1/2" PT flange (9) as shown in Fig. 8.

NOTE

On twenty cylinder units only, add three stiffeners (41) to the lube oil cooler tank as shown in Fig. 9. Existing stiffeners remain in place.

3. Add a 3 gpm pump (42) as shown in Figs. 3 and 4. Mount the pump and motor assembly on the

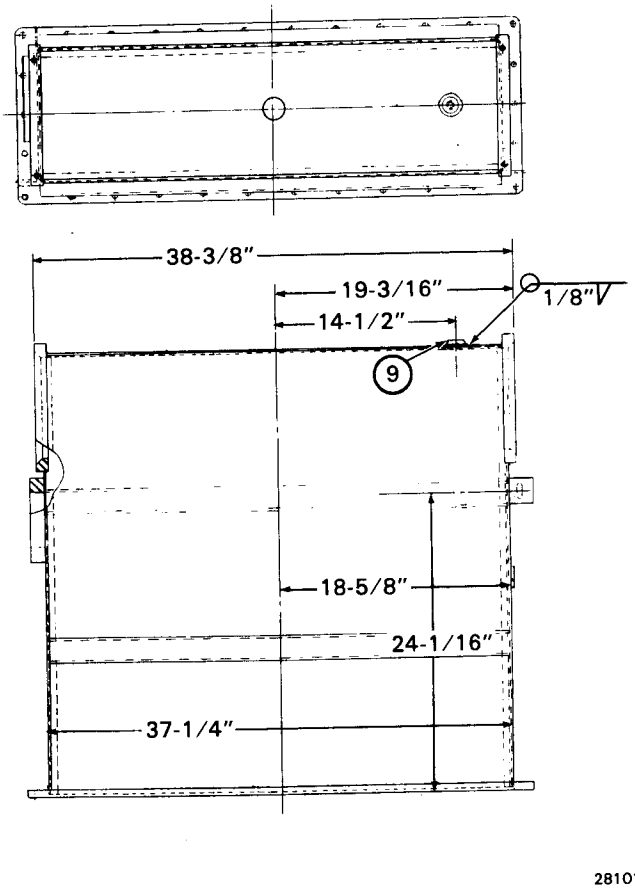


Fig.8 – "S" Unit Oil Cooler Tank Flange Application

skid no higher than the top of the skid or farther than 70" from the finished face of the crankcase, using the centerline of the pump impeller as a reference. The pump motor mounts on a steel base which appears in Fig. 10. Fabricate this base from 1/4" sheet steel according to the dimensions shown in Fig. 10. Use a steel similar to material specification 3 for the base. Weld the base to the skid as shown in Fig. 4. The skid is constructed from steel conforming to Material Specification 3. As shown in Fig. 3, the recommended location of the pump is 54" from the crankcase face and 14-1/2" below the top of the skid. Deviations from the recommended installation require slight alterations in the piping to accommodate the variance. The 6 gpm pump remains in its original location.

4. Wire both pump motors to run continuously.

5. Add alarm switches to indicate an inoperative circulating oil pump or turbo soakback pump. The switches for these pumps are (79) and (80), respectively. Install these pressure switches by tapping into the system at the tees shown in the schematic, Fig. 2. Verify that switch settings conform to pickup and dropout pressures specified in Fig. 2.

6. Install the modified oil return pipe (19), which runs from the oil cooler to the engine strainer box, so that during standby the accessory rack will remain full of oil with no significant air pockets. Reuse the temperature well and gauge. Install a sight glass in the line as shown in Figs. 3 and 4.

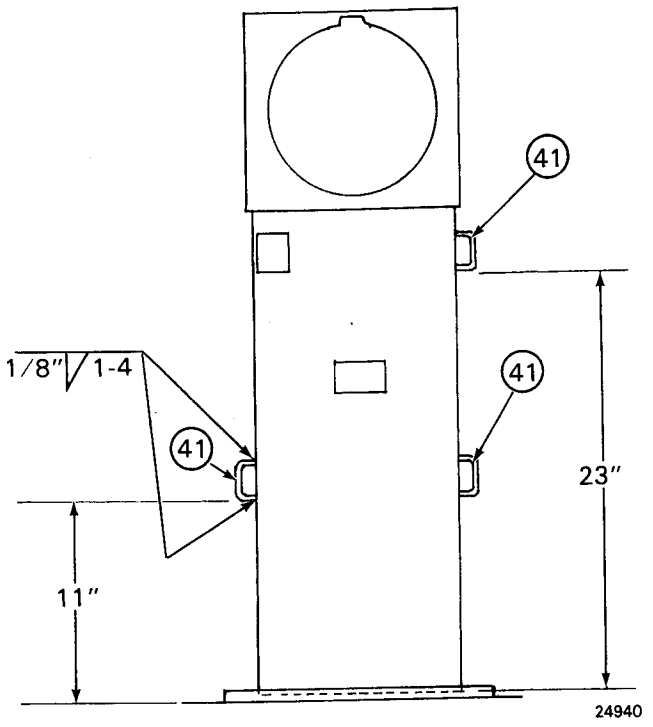
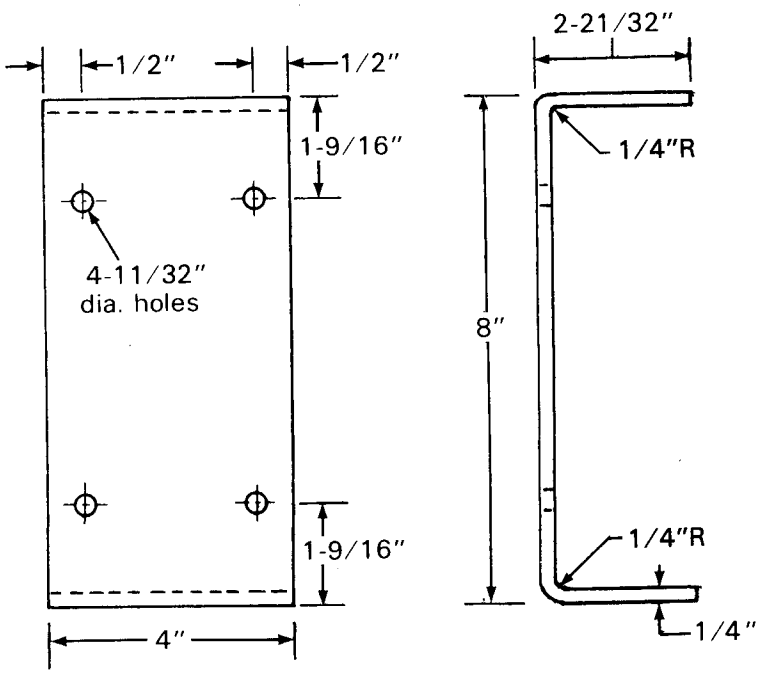


Fig.9 – "S" Unit Oil Cooler Tank Stiffener Application



Fabricate From 1/4" Sheet Steel. Refer To Material Spec. 3.

28102

Fig.10 – Motor And Pump Assembly Base

7. Run 1/2" O.D. steel tube vent line (46) as shown in Figs. 3, 4, 5, and 6. Avoid pockets or traps which will not drain to either end. Use clamps (13 or 16) to minimize vibration. Locate and connect the vents on the engine as shown in Fig. 3.

8. Relocate the existing 30 psi check valve to the side of the skid as shown in Fig. 3.

9. Run the gallery supply line (J) as shown in Figs. 3 and 4. The diameter and length of this line are critical for proper operation, therefore, adhere to the provided dimensions. In the center of the existing flange on the lube oil cooler, drill and tap for a 1/2" PT. Run the line from the tapped flange on the oil cooler to the bottom of the main bearing pressure pump discharge elbow. Fig. 7 shows the gallery fill line application for a right hand rotation engine.

10. Figs. 4, 5, and 6 provide sight glass application information. Because the heights of the sight glasses are critical, adhere to the vertical dimensions given in Fig. 4. The sight glasses are in the line between the flanged connection of the main bearing pressure pump discharge elbow and the left bank cover of the overspeed trip housing.

11. Restore engine lubricating oil and coolant to normal levels.

CAUTION

The system must contain coolant before the immersion heater is energized.

SYSTEM OPERATION AND CHECK

After reworking the lube oil system, start both pumps and energize the immersion heater. The 6 gpm pump will fill the accessories, as well as the strainer box. When the oil cooler is full, oil will begin to fill the engine oil gallery. The gallery will fill in a minimum of 15 minutes; the actual filling time depends on the oil temperature. Oil in the lower sight glass indicates that the engine oil gallery is full. Oil in the upper sight glass indicates an oil level above the camshafts. Except when the engine is running, oil should not appear in the upper sight glass when the oil temperature is between the standby and the maximum operating temperatures.

CAUTION

If the oil level is not between the upper and lower sight glasses under these conditions, the gallery supply line needs to be altered. If no oil is visible in the lower sight glass, experimentally increase the inside diameter of the supply line. If oil remains in the upper sight glass, experimentally decrease the inside diameter of the supply line.

After the system has been refilled with oil and the pumps and immersion heater switched on, the oil and engine may not reach normal standby temperature for 24 hours; under initial fill conditions, the oil may not drop below the upper sight glass for a long period of time.

To ensure that the upper sight glass is at the proper height, make the following check after the unit has reached standby temperature. Carefully wipe dry eight valve bridges (four on each side) at the rear (turbocharger) end of the engine. Wick all the oil from the cavity below the lash adjusters. Some oil may reappear due to natural drainage of oil passages; wipe dry again and repeat as necessary. Oil weeping out of the bottom of the camshaft bearings during this period is likely and should cause no concern. If oil reappears repeatedly at the valve bridges, experimentally decrease the inside diameter of the gallery supply line so that the oil level is maintained between the upper and lower sight glasses.

After the system has been modified properly, make the first start to idle speed only.

After reaching normal operating oil temperatures, shut down the engine. Oil may temporarily drain from the lower sight glass, but should return to the lower sight glass level or higher within 10 minutes.

If necessary, a fast start can be made during this period since the oil gallery would take longer than 10 minutes to drain even if no oil were being supplied to it. If oil does not return to the lower sight glass within 10 minutes, experimentally increase the inside diameter of the gallery supply line and recheck the system.

MP45 AND "999" UNITS

The following instructions are for the modification of MP45 and "999" emergency start units. Fig. 11 is the schematic piping diagram of this modification.

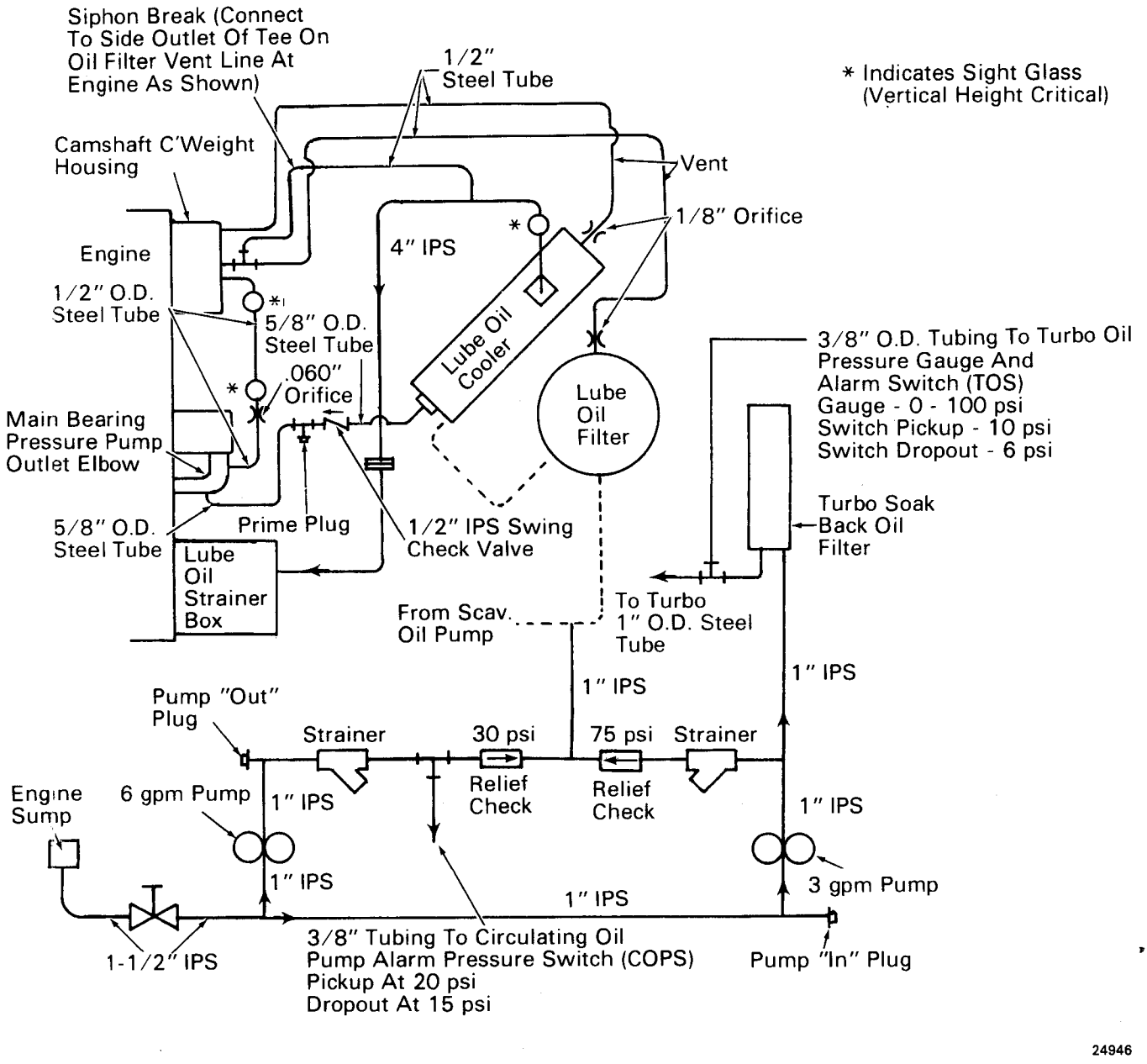


Fig.11 - System Schematic Diagram, MP45 And "999" Units

MATERIAL REQUIRED

The following material is required for each engine. The list applies to both MP45 and "999" units except as noted. The material is available from Electro-Motive Parts Centers. Items 1 through 66 and item 112 are shown on Figs. 12 through 16. Items 65 through 74 are for modifying the lube oil cooler. Items 75 through 111 are for modifying the electrical cabinets. Items 113 through 121 include tubing for pressure switch connections and fittings for installing the tubing.

Items marked with an "*" are not shown on the application drawings.

Material specifications are published at the end of this M.I.

NOTE

Do not use galvanized pipe for this modification.

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
1	1	9524002	Motor and Pump Asm. (Note §, Pg. 21)	
2	1	9339860	Plate	3
3	2	8086257	1/2" PT Flange	9
4	1	9523009	Pipe Assembly	—
	1	9523007	1" Pipe	14
	1	8060975	1" Nipple Short	14
	1	8089299	1/2" Nipple 4" Long	14
	1	8050132	1" PT Union Tee	17
	1	189065	1" x 1/2" PT Bushing	16
5	1	9523016	Pipe Assembly MP45 and Air Cooled-"999" Only	—
	1	9523015	1" Pipe	14
	1	9523010	1" Pipe	14
	2	8130823	1" W Elbow	13
	1	8173563	1" Swivel Flange	9
	1	8173562	1" FL-1" W Insert	13
6	1	9523011	Pipe Assembly-"999" With EQ Rack Soakback Filter Mounting	—
	1	8121025	1" Pipe	14
	1	9523010	1" Pipe	14
	2	8130823	1" W Elbow	13
	1	8173563	1" Swivel Flange	9
	1	8173562	1" FL-1" W Insert	13
7	1	9523013	Pipe Assembly-"999" With Heat Exchanger Rack Soakback Filter Mounting	—
	1	9523012	1" Pipe	14
	1	8130823	1" W Elbow	13
	1	8173563	1" Swivel Flange	9
	1	8173562	1" FL-1" W Insert	13
8	1	9523014	Pipe Assembly	—
	1	189591	1-1/2" - 1" - 1" Tee	18
	1	8060975	1" Nipple Short	14
	1	8153147	1" Nipple 4-1/2" Long	14
	1	8154032	1-1/2" Nipple 12" Long	14
9	1	8393914	Pipe Assembly	—
	1	8359859	1" Pipe	14
	1	8128503	1" W-PT-W Tee	13
	1	103870	1" PT Plug	16
10	3	8108208	* Clamp Assembly	—
	1	103319	1/4" Lockwasher	11
	1	179796	1/4" Hex Head Bolt	6
	1	109084	1/4" Hex Nut	12
	1	8081616	Clamp	1
	1	8081613	Clamp	1

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
11	1	9523028	Pipe Assembly	—
	1	8130823	1″ W Elbow	13
	1	8078051	1″ Nipple 4″ Long	14
	1	8045220	1″ PT Union Elbow	17
	1	119100	1″ PT Elbow	18
	4	8060975	1″ Nipple Short	14
	1	8044180	1″ PT Union Tee	17
	1	8280951	Strainer	28
	1	9521844	1″ Relief Check Valve	28
12	1	9523027	Pipe Assembly	—
	1	8391956	1″ Pipe	14
	1	8128503	1″ W-PT-W Tee	13
	1	8044162	1″ MPT Union	17
	1	103870	1″ PT Plug	16
13	1	8128509	3/4″ W-W-PT Tee	13
14	1	9521841	Pipe Assembly-Water Cooled "999" Only	—
	1	8241948	4″ W Elbow	13
	2	8266249	4″ W 45° Elbow	13
	1	9522458	4″ Pipe	14
	1	8463223	4″ Pipe	14
	1	9522716	4″ Pipe	14
	1	9521842	4″ Pipe	14
	1	9322046	4″ Pipe	14
	1	8246564	1″ PT Outlet	13
	1	8234808	3/4″ PT Outlet	13
	1	8226869	1/2″ PT Outlet	13
	1	8252907	3/8″ PT Outlet	13
	1	9523940	4″ W Return Bend	13
15	1	9523377	Pipe Assembly-MP45 and Air Cooled "999" Only	—
	1	8241948	4″ W Elbow	13
	2	8266249	4″ W 45° Elbow	13
	1	9522458	4″ Pipe	14
	1	8494632	4″ Pipe	14
	1	9523376	4″ Pipe	14
	1	9523383	4″ Pipe	14
	1	8393750	4″ Pipe	14
	1	8246564	1″ PT Outlet	13
	1	8234808	3/4″ PT Outlet	13
	1	8226869	1/2″ PT Outlet	13
	1	8252907	3/8″ PT Outlet	13
	1	9523940	4″ W Return Bend	13
16	1	8447206	Flange	3
17	2	8366140	Gasket	22
18	1	8441882	Flange	3
19	1	8366785	Gasket	21
20	1	8281365	Flange	3
21	1	8367580	Gasket	22
22	1	8470340	1″ Flexible Coupling	28
23	5	9327526	Sight Glass	28
24	1	8456532	Flange	3
25	1	8430611	Gasket	22
26	1	8242814	1/16″ Choke Fitting	20
27	1	8290236	1/8″ Choke Fitting	20

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
28	1	8158308	1/8" Choke Fitting	20
29	1	9086873	Thermometer Well	2
30	1	9086874	Temperature Gauge	28
31	1	8024212	1/2" Swing Check Valve	28
32	1	8318966	Clamp Assembly	—
	1	103321	3/8" Lockwasher	11
	1	179845	3/8" Hex Head Bolt	6
	1	102635	3/8" Hex Nut	12
	1	8318968	Clamp	1
	1	8318967	Clamp	1
33	1	8108222	Clamp Assembly	—
	1	103321	3/8" Lockwasher	11
	1	179841	3/8" Hex Head Bolt	6
	1	102635	3/8" Hex Nut	12
	1	8081641	Clamp	1
	1	8081639	Clamp	1
34	1	8108197	Clamp Assembly	—
	1	103320	5/16" Spring Lockwasher	11
	1	179820	5/16" Hex Head Bolt	6
	1	102634	5/16" Hex Nut	12
	1	8081680	Clamp	1
	1	8081678	Clamp	1
35	1	8108209	Clamp Assembly	—
	1	103319	1/4" Lockwasher	11
	1	179796	1/4" Hex Head Bolt	6
	1	109084	1/4" Hex Nut	12
	1	8081621	Clamp	1
	1	8081620	Clamp	1
36	10	8108206	Clamp Assembly	—
	1	103319	1/4" Lockwasher	11
	1	179796	1/4" Hex Head Bolt	6
	1	109084	1/4" Hex Head Bolt	12
	1	8081614	Clamp	1
	1	8081613	Clamp	1
37	1	8042834	1/2" PT Tee	17
38	1	8060973	1/2" Nipple Short	5
39	1	219199	1/2" PT Plug	18
40	AR	8098595	1/2" OD Steel Tubing	15
41	1	118752	1/2" T x 3/8" PT Conn	19
42	1	8027428	1/2" T x 1/2" PT Conn	19
43	2	8040319	1/2" T x 3/4" PT Conn	19
44	1	8040389	1/2" T x 1/2" PT x 1/2" T Tee	19
45	1	120142	1/2" T x 3/8" FPT Elbow	19
46	1	8040352	1/2" T x 1/2" FPT Elbow	19
47	1	118757	1/2" T x 3/8" PT Elbow	19
48	2	8027437	1/2" T x 1/2" PT Elbow	19
49	2	8040343	1/2" T x 3/4" PT Elbow	19
50	2	116487	5/8" T x 1/2" PT Conn	19
51	1	8040345	5/8" T x 3/4" PT Elbow	19
52	AR	8098596	5/8" O.D. Steel Tubing	15
53	2	144147	3/4" PT Cross	18
54	AR	8116937	1" Pine	14
55	2	8060975	1" Nipple Short	14
56	1	218201	1" PT x 3/8" PT Reduction Elbow	18
57	1	8044162	1" MPT Union	17

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
58	1	119100	1" PT Elbow	18
59	1	189368	1" PT x 1/2" PT Elbow	18
60	1	8042836	1" PT Tee	17
61	4	100121	5/16"-18 x 3/4" Bolt	4
62	4	103340	5/16" Plain Washer	8
63	4	103320	5/16" Lockwasher	11
64	1	8413738	2" x 2" x 1/4" Angle	3
65	8	100160	1/2"-13 x 1-1/2" Bolt	4
66	8	103343	1/2" Plain Washer	8
67*	2	8272143	O-Ring	23
68*	2	8272142	Gasket	21
69*	2	8363882	Gasket (L.O. Cooler to Water Piping)	21
70*	1	8272139	Gasket	21
71*	1	8250627	Gasket	23
72	1	8366139	Flange	3
73*	4	9325479	Channel (stiffener)-"999" Water Cooled Units Only	1
74*	4	8130457	Channel (stiffener)-MP45 and "999" Air-Cooled Units Only	1
75	4	8035144	1/4"-20 Self-locking Nut	29
76*	10	8210498	Terminal Lug #10	29
77*	10	8291466	Terminal Lug #6	29
78*	15	8402844	Terminal Lug #10	29
79*	30	8380934	Terminal Receptacle	29
80*	20 Ft.	8475694†	2 Cond. Cable, AWG 16 (16T2)	25
81*	100 Ft.	8468611†	Wire, AWG 14 (XE)	26
82*	125 Ft.	8475587†	Wire, AWG 16 (16E)	27
83	3	8035120	#8-32 Self-locking Nut	29
84	3	9417755	#8-32 PSL Screw	29
85	6	145368	#2 Drive Screw	29
86	1	9098921	Nameplate	29
87	1	8425270	Nameplate	29
88	1	9522572	Nameplate, Turbo Oil Pressure	29
89	2	8038584	1/2" Locknut	29
90	16	9419644	#10-24 HWTT Screw	29
91	2	9424783	#10-24 HWTT Screw	29
92	2	9419641	#8-32 PCRTT Screw	29
93	4	133789	1/4"-20 FLS Screw	29
94	3	9522571	Heater Coil	29
95	1	8390271	Grommet	29
96	1	119291	1/4" Nipple 6" Long	17
97	1	187395	1/4" PT Coupling	17
98	2	8038643	1/2" M Insulated Bushing	29
99	2	8038594	1/2" F Insulated Bushing	29
100	2	8250161	1/2" M STR RL Bushing	29
101	1	8342487	Pressure Switch (COPS)	29
102	1	8341873	Pressure Switch (TOS)	29
103	1	8382961	Relay (OLSPM) "999" Only	29
104	1	8474707	Relay (SPMC) "999" Only	29
105	2	8446084	Relay (TO, CO)	29
106	6	8421017	Rectifier Assembly	29

ITEM	QTY.	PART NO.	DESCRIPTION	MATERIAL REFERENCE
107	2	(See Pg. 22)	Light and Resistor Assembly	29
			(Order Component Parts)	29
108	1	8329996	Pressure Gauge	29
109*	1	9322038	Circuit Breaker	29
110*	1	8230431	Switch	29
111*	6	8271289	Adapter	29
112	1	140807	1/2" Nipple 3" Long	17
113*	AR	8098594	3/8" O.D. Steel Tubing	15
114*	4	121758	3/8" Flared Tube Nut	19
115*	12	120141	1/2" Flared Tube Nut	19
116*	4	144308	5/8" Flared Tube Nut	19
117*	1	189064	1" x 3/8" PT Bushing	16
118*	1	8040313	3/8" T x 3/8" PT Conn	19
119*	2	118750	3/8" T x 1/4" PT Conn	19
120*	1	144034	3/4" x 1/2" PT Bushing	18
121*	1	8037261	3/8" T x 1/2" PT Conn	19

†Part Number for Minimum Order.

8475694	50 Ft.
8468611	500 Ft.
8475587	500 Ft.

NOTE§

The pump and motor assembly (Item 1, page 17) for the MP45 and "999" units should be 9524002 to match the original lube oil circulating pump voltages. The original lube oil circulating pump on the "999" unit was 460 VAC. A 240 VAC pump was used on the MP45. However, if another power source is desired, pump and motor assemblies from the following list are available.

3/4 HP Pump And Motor

3 gpm Nominal

ASSEMBLY	VAC	Hz	Ph	MATERIAL REFERENCE
9524002	230/460	60	3	28
9524003	200	60	3	28
9524004	115	60	1	28
9524005	575	60	3	28

LIGHT AND RESISTOR ASSEMBLY SOLD AS COMPONENT PARTS

QTY.	PART NO.	DESCRIPTION
1	8408163	Light Assembly
1	8491084	Resistor Assembly
1	8189218	Lug
1	8490814	Terminal
1	437155	Screw
2	138526	Washer
2	8412097	Nut

INSTALLATION

Fig. 11 provides a schematic representation of the modified system for MP45 and "999" Units. All dimensions for locating and installing components and piping are shown on the application drawings, Figs. 12 through 16. Numbers in parentheses or circles provide a reference to items on the Material Required list.

PIPING MODIFICATION

NOTE

Do not use galvanized pipe for this modification.

CAUTION

Protect all piping and components from weld spatter, slag, drill chips, and thread shaving contamination.

1. Before proceeding with the following piping changes, drain the engine of lube oil and coolant.

CAUTION

Ensure that the immersion heater system is off before draining coolant.

2. Remove the lube oil cooler tank from the cooler assembly.

   a. Cut a 4" diameter hole in the side of the tank for application of a flange, (72) Fig. 12; locate and weld per Figs. 12 and 14. Install a blank plate (18) using referenced bolts and washers to cover the original lube oil outlet.

   b. Apply additional stiffeners to the oil cooler tank. On water cooled "999" units apply four additional stiffeners (73). Apply two on each side approximately equally spaced between existing spacer and the top and bottom of the tank. On the original rear outlet side, locate the upper stiffener just above the outlet flange.

      On MP45 and "999" air cooled units apply four additional stiffeners (74), located as described above. These stiffeners must be used on air cooled units to ensure clearance between the stiffeners and the water tank.

      Weld the channels in a manner similar to that shown in Fig. 9.

3. Add a 3 gpm pump (1) to the system. Mount the pump as shown in Figs. 12, 14, and 16. The 6 gpm pump remains in its original location. Both pumps run continuously.

4. Fabricate the oil return pipe, which runs from the newly installed outlet on the side of the oil cooler to the strainer box, as shown in Figs. 12 and 14. This configuration ensures that the accessory rack remains full of oil with no significant air pockets when the unit is on standby and the circulating pumps are running. Install the sight glass (23) and temperature gauge (30) as shown. Locate and connect the vent lines as shown.

5. Locate and connect the vent lines as shown in Figs. 12, 14, 15 and 16. Avoid pockets or traps, which will not drain to either end. Use clamps to minimize vibration.

6. Pipe the gallery fill line as shown in Figs. 12 and 13. The diameter and length of this line are critical; therefore, adhere to the specified dimensions. In the center of the existing flange on the lube oil cooler, drill and tap for 1/2" PT. The line should run from the flange to the bottom of the main bearing pressure pump discharge elbow.

7. Apply sight glasses as shown in Figs. 12, 14, and 15. Because the heights of the glasses are critical, locate the sight glasses according to the vertical

dimensions given in Fig. 14. The sight glasses are in the line between the flanged connection of the main bearing pressure pump discharge elbow and the left bank cover of the overspeed trip housing.

8. Gauge connection:

   a. Install Item 13, Fig. 12, by removing 1-5/8" of tubing. This provides a 3/4" PT for connection to the turbo oil pressure gauge and alarm switch (TOS).

   b. Item 60, Fig. 14, provides a connection to the circulating oil pump alarm switch (COPS).

   c. See schematic, Fig. 11, for pressure settings.

9. Restore engine lubricating oil and coolant to normal levels.

CAUTION

The system must contain coolant before the immersion heater is energized.

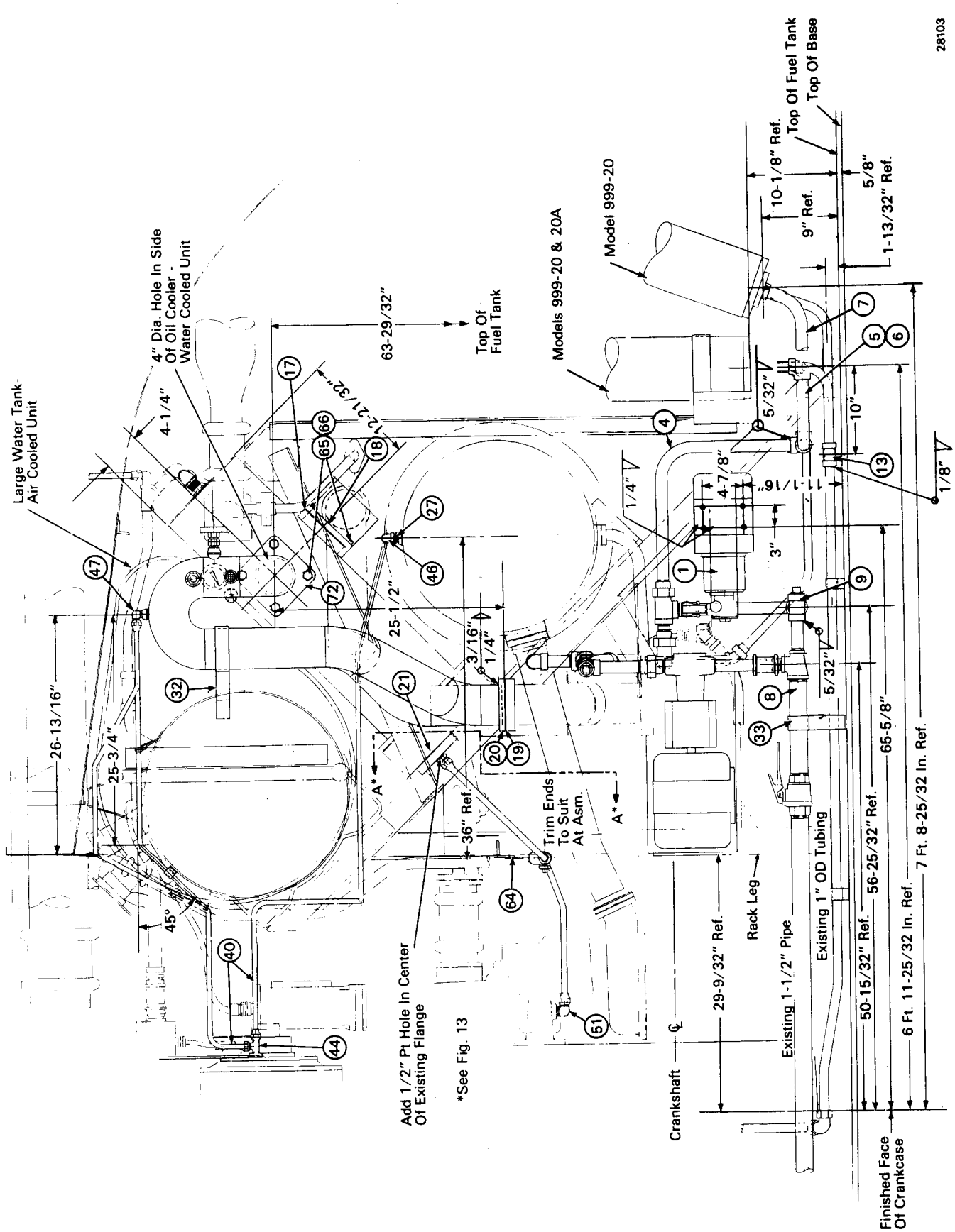
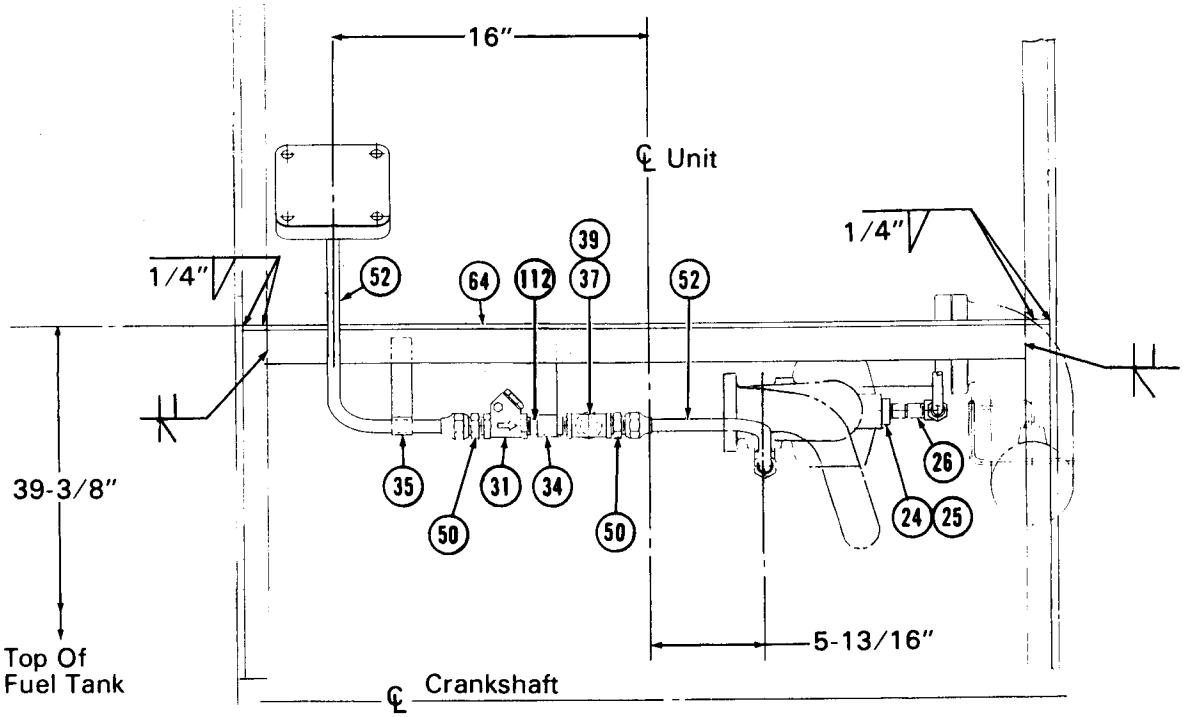


Fig.12 - MP45 And "999" Unit Piping Application, Right Side View



View A-A From Fig. 12 And 14 28104

Fig.13 – Gallery Fill Line, Front View

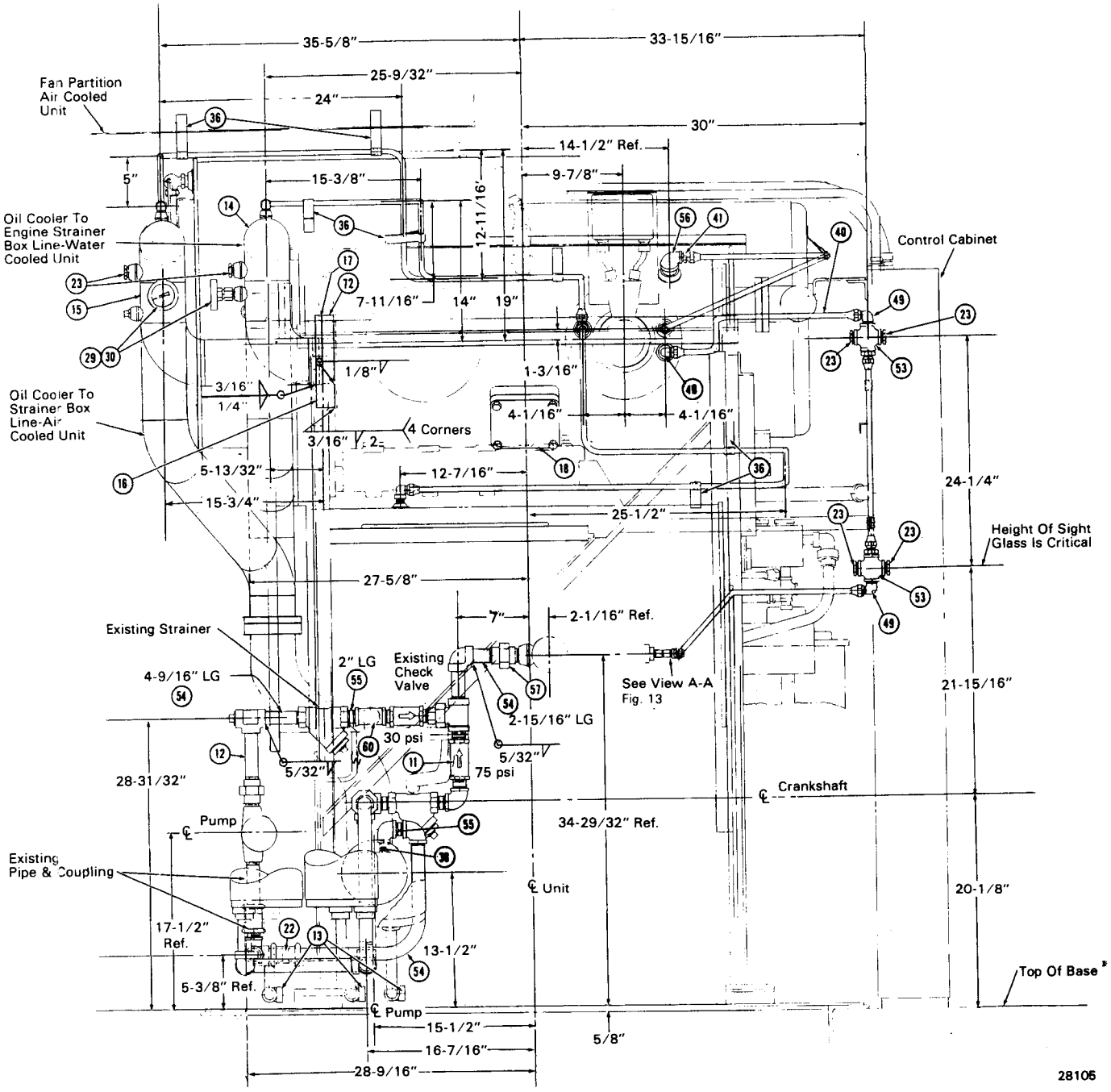


Fig.14 - MP45 And "999" Unit Piping Application, Front View

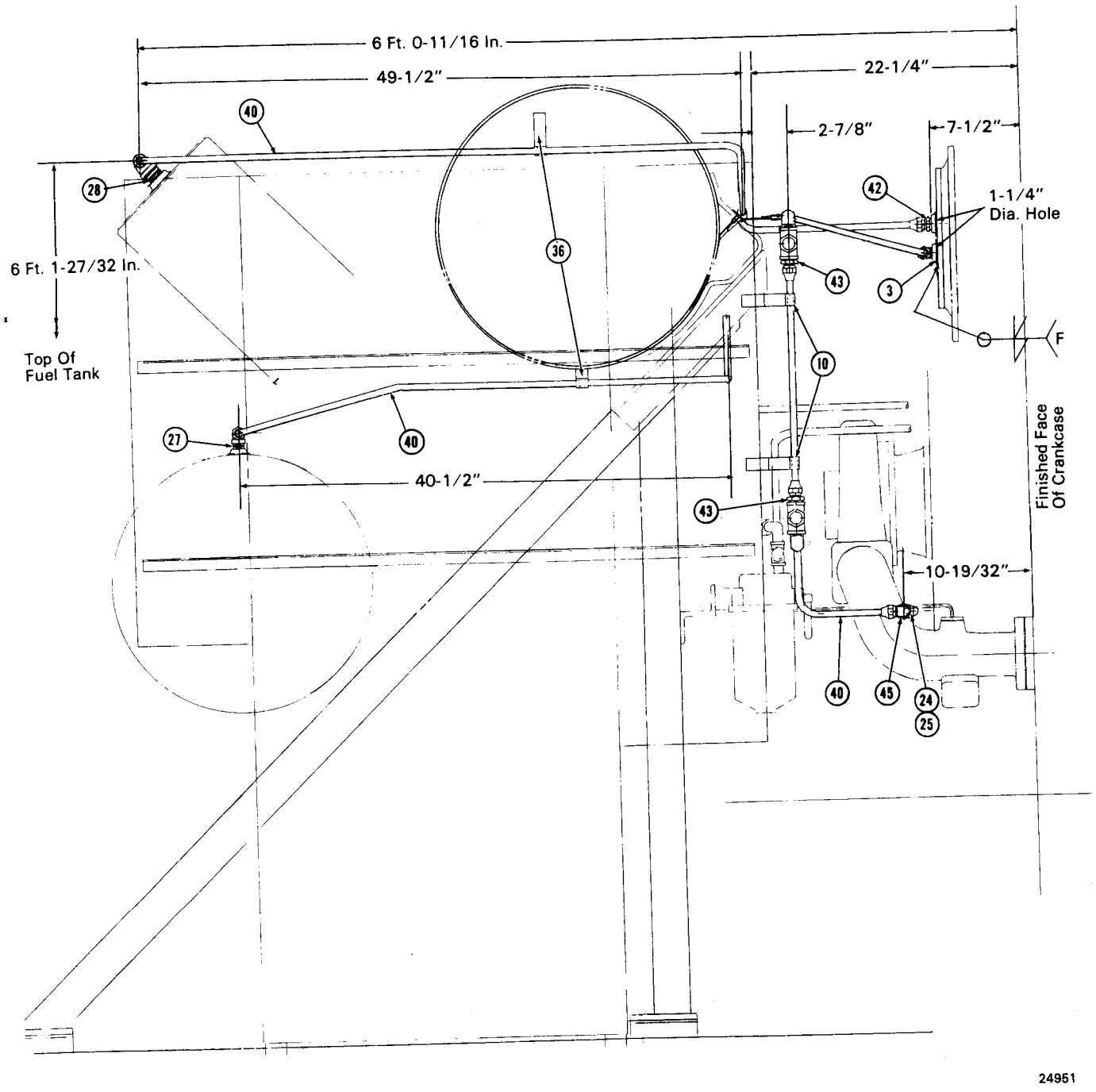


Fig.15 – MP45 And "999" Unit Piping Application, Left Side View

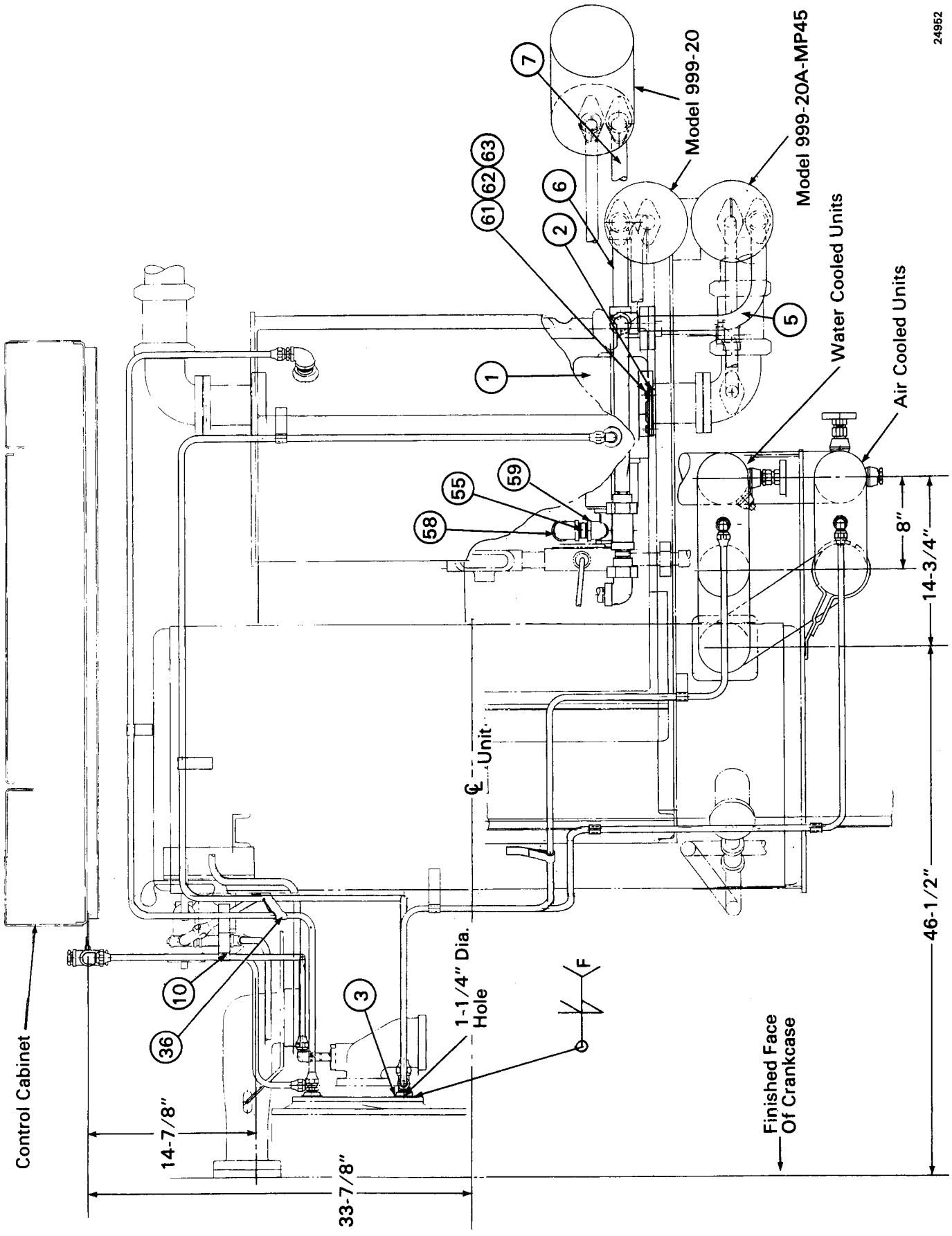


Fig.16 – MP45 And "999" Unit Piping Application, Top View

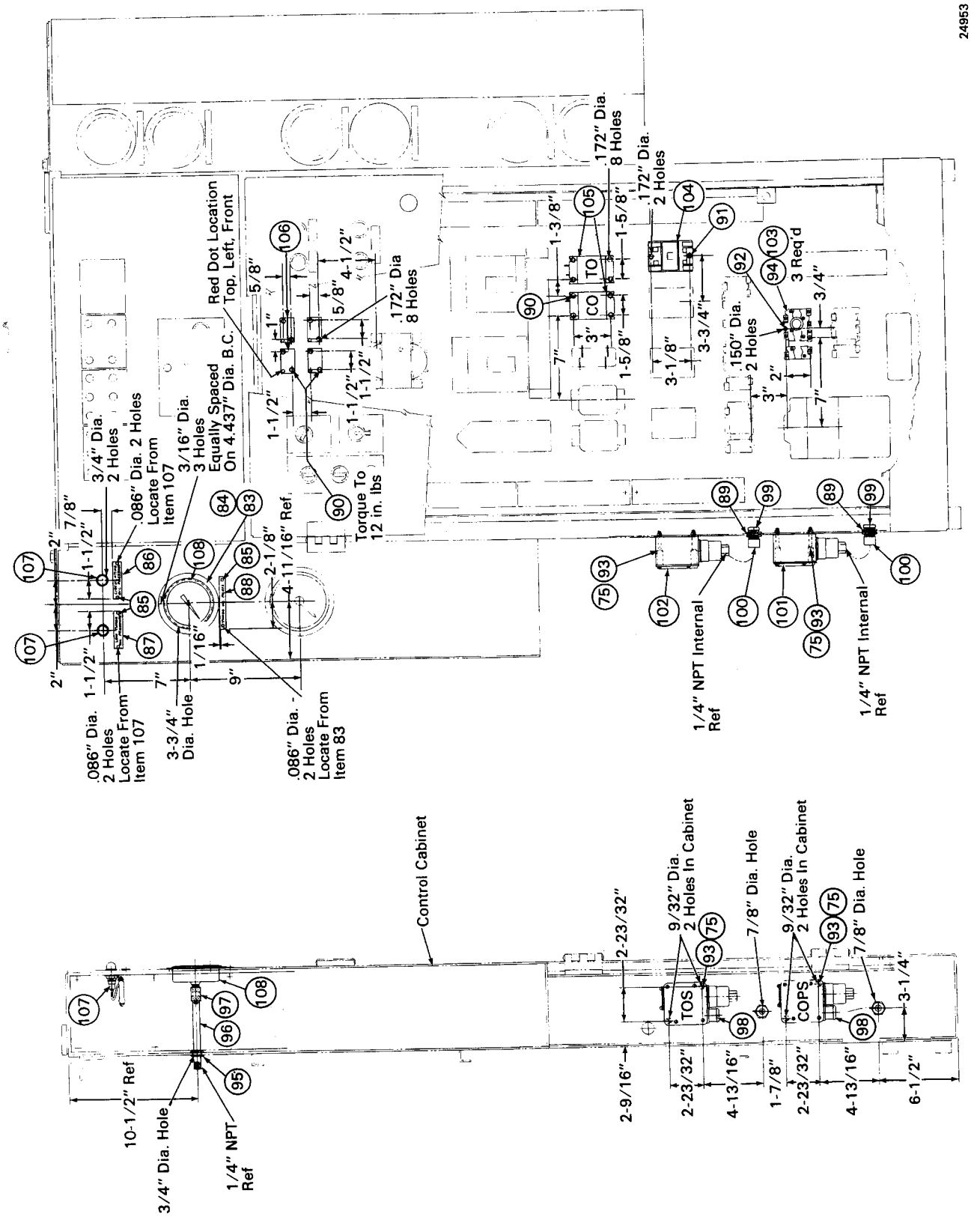


Fig.17 – "999" Electrical Control Cabinet, Component Location Diagram

MP45 ELECTRICAL CONNECTIONS

1. The following list identifies and cross references the new electrical devices specified in the Material Required list.

2. Fig. 18 is a typical electrical schematic for the MP45 modification. Use this schematic with the wire running list and Figs. 19 and 20 to wire the system, but note that actual terminal board connections are application dependent and may vary. For this reason, verify voltages and functions before wiring the system. Most electrical components for this modification may be located in or near the engine or generator control cabinets, in the switchgear room, or in the control room; however, both COPS and TOS must be installed at the engine control cabinet, zone 25.

ADD NEW EQUIPMENT

NAME	DESCRIPTION	PART NO.
COPS	Pressure Switch	8342487
TOS	Pressure Switch	8341873
CB SPM	Circuit Breaker	9322038
SW LAMP TEST	Switch 1NO-1NC	8230431
CO	Relay	8446084
TO	Relay	8446084
CR51, 52, 53, 54	Rectifier Assembly	8421017
LT LOW TURBO OIL	Light and Resistor Assembly	Order Component Parts
LT CIRC OIL PRESS	Light and Resistor Assembly	(See page 22)

ADD NEW WIRES

FROM	TAG	TO	SIZE
SW COPS-1B/R	UP50	Positive String	16T2
SW TOS-B/TOP	UP51	Positive String	16T2
SW LAMP TEST-TOP/R	UP52	Positive String	16E
CO-E	UP53	SW LAMP TEST-TOP/R	16E
CO-E	UP54	TO-E	16E
CO-N	N50	Negative String	16E
CO-N	N51	TO-N	16E
LT CIRC OIL-RES/FR	N52	TO-N	16E
LT CIRC OIL-RES/FR	N53	LT TURBO OIL-RES/FR	16E
CO-R	AA50	Alarm Reset	16E
CO-R	AA51	TO-R	16E
CO-O	ASA	SW COPS-1B/L	16T2
TO-O	ASB	SW TOS-B/BOT	16T2
CR52-BLK	ARB1	SW LAMP TEST-TOP/L	16E
CR52-RED	ARA1	LT CIRC OIL-LT	16E
CO-D	ARA	LT CIRC OIL-LT	16E
CR52-BLK	ARB	CR53-BLK	16E
CR53-RED	ARC1	LT TURBO OIL-LT	16E
TO-D	ARC	LT TURBO OIL-LT	16E
CO-C	ARF	CR51-BLK	16E
CR51-RED	ARD	CR54-RED	16E
CR54-BLK	ARE	TO-C	16E
CR54-RED	ARD1	Alarm Relay	16E
CB SPM-TOP/L	LXA11	3 Ø Power, Phase A	XE
CB SPM-TOP/MID	LYA11	3 Ø Power, Phase B	XE
CB SPM-TOP/R	LZA11	3 Ø Power, Phase C	XE
CB SPM-BOT/L	LXB	MTR SPM-1	XE
CB SPM-BOT/M1B	LYB	MTR SPM-2	XE
CB SPM-BOT/R	LZB	MTR SPM-3	XE

NOTE

Fig. 19 shows a 240 VAC pump motor. Use of another voltage motor is optional, but the motor should be wired independently to run continuously.

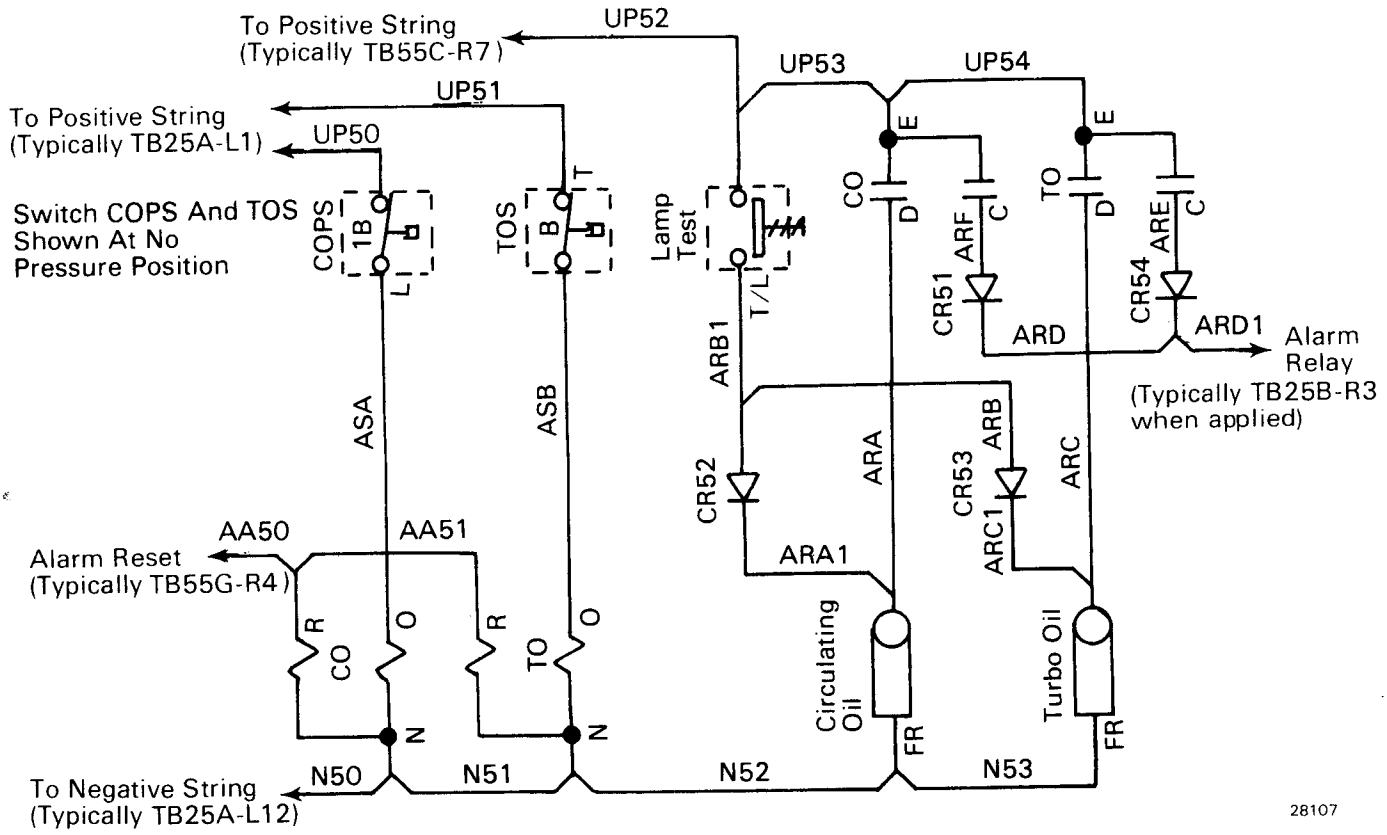


Fig.18 – Electrical Schematic, MP45 Unit Pressure Switch Circuits

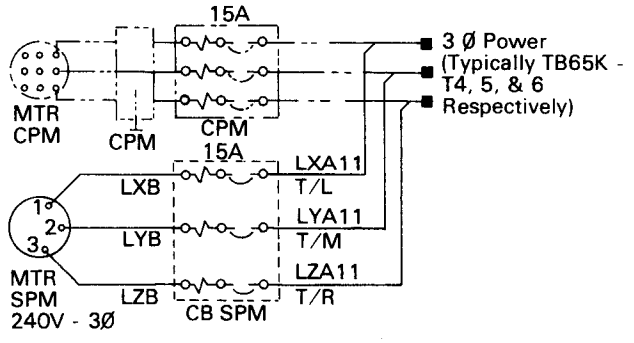


Fig.19 – Soakback Pump Motor Circuit, MP45 Units

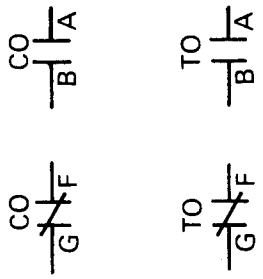


Fig.20 – Annunciator Contacts Available For Use

"999" ELECTRICAL CONNECTIONS

1. The following list identifies and cross references the new electrical devices specified in the Material Required list.

2. Fig. 17 provides information for mounting the following new equipment in or near the electrical cabinet.

ADD NEW EQUIPMENT

NAME	DESCRIPTION	PART NO.
COPS	Pressure Switch	8342487
TOS	Pressure Switch	8341873
OLSPM	Relay	8382961
SPMC	Relay	8474707
CO	Relay	8446084
TO	Relay	8446084
CR51, 52, 53, 54	Rectifier Assembly	8421017
LOW TURBO OIL	Light and Resistor Assembly	Order Component Parts
CIRC. OIL PRESS	Light and Resistor Assembly	(See Page 22)

3. Install new wiring using the following typical wire running list as a guide. Refer to Figs. 21, 22, and 23 for interconnections.

ADD NEW WIRES

FROM	TAG	TO	SIZE
SW COPS-1B/R	AP50	Positive String	16T2
SW TOS-B/TOP	AP51	Positive String	16T2
CO-E	AP52	Positive String	16E
CO-E	AP53	TO-E	16E
CO-N/COIL	AN4	Negative String	16E
CO-N/COIL	AN6	TO-N/COIL	16E
LT CIRC OIL-RES/FR	AN7	TO-N/COIL	16E
LT CIRC OIL-RES/FR	AN8	LT TURBO OIL-RES/FR	16E
CO-R/COIL	ASC1	Alarm Reset	16E
CO-O/COIL	ASA	SW COPS-1B/L	16T2
CO-R/COIL	ASC	TO-R/COIL	16E
TO-O/COIL	ASB	SW TOS-B/BOT	16T2
CR52-BLK	ARB1	Alarm Test	16E
CR52-RED	ARA1	LT CIRC OIL-LT	16E
CO-D	ARA	LT CIRC OIL-LT	16E
CO-C	ARF	CR51-BLK	16E
CR51-RED	ARD	CR54-RED	16E
CR54-BLK	ARE	TO-C	16E
CR51-RED	ARD1	Alarm Test	16E
CR52-BLK	ARB	CR53-BLK	16E
CR53-RED	ARC1	LT TURBO OIL-LT	16E
TO-D	ARC	LT TURBO OIL-LT	16E
OLSPM-RESET/BOT	HA2	OLSPM-RESET/BOT	XE
OLSPM-RESET/TOP	HW	SPMC-COIL/L	XE
SPMC-COIL/R	HC2	SPMC-COIL/R	XE
SPMC-TOP/L	L12D	TB25H-R1	XE
SPMC-TOP/MID	L22D	TB25H-R2	XE
SPMC-TOP/R	L32D	TB25H-R3	XE
OLSPM-TOP/L	L12W	SPMC-BOT/L	XE
OLSPM-TOP/MID	L22W	SPMC-BOT/MID	XE
OLSPM-TOP/R	L32W	SPMC-BOT/R	XE

NOTE

Fig. 23 shows a 460 VAC pump motor. Use of another voltage motor is optional, but the motor should be wired independently to run continuously.

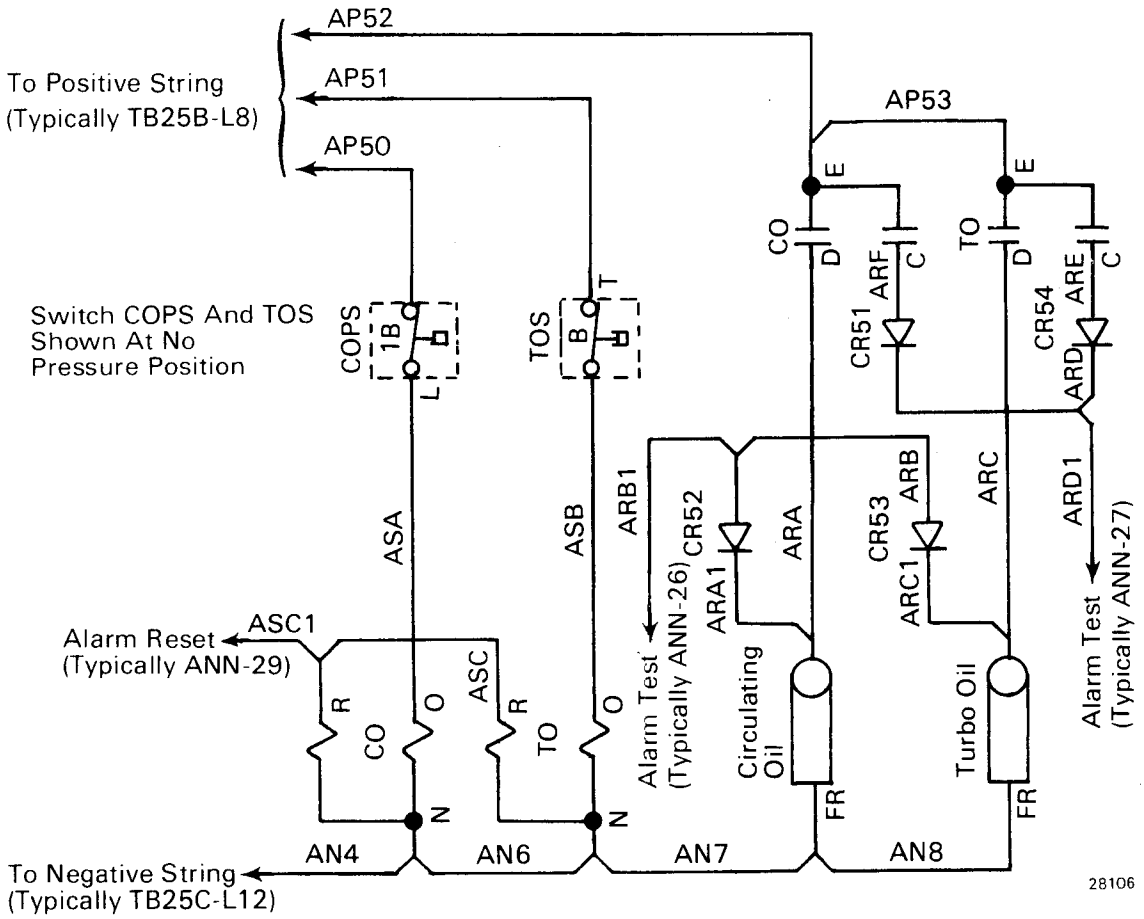


Fig.21 – Electrical Schematic, "999" Unit Pressure Switch Circuits

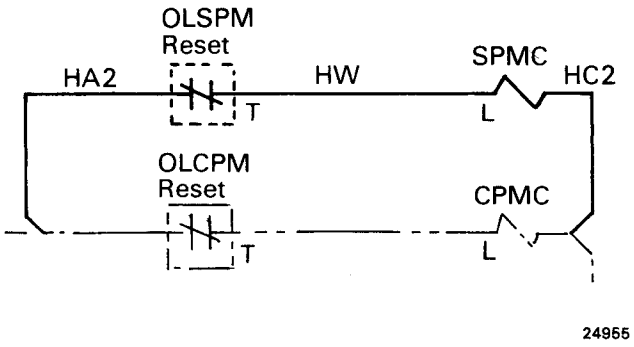


Fig.22 – Electrical Schematic, Oil Pump Motor Overload Reset Circuit, "999" Units

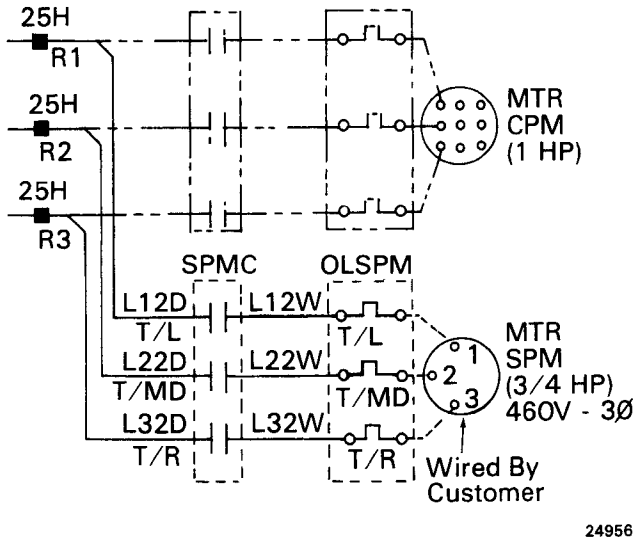


Fig.23 – Soakback Pump Motor Circuit, "999" Units

SYSTEM OPERATION AND CHECK

The system operation and check procedures for "S" Units also apply to MP45 and "999" Units.

CAUTION

System must contain coolant before the immersion heater is energized.

MATERIAL SPECIFICATIONS

1. Hot Rolled Commerical Quality Sheet Steel
   Carbon 0.15% Max.
   Manganese 0.30-0.50%

2. Carbon Steel
   Carbon 0.15-0.20%
   Manganese 0.30-0.60%
   Phosphorus 0.040% Max.
   Sulfur 0.050% Max.

3. Steel
   Carbon 0.13-0.22%
   Manganese 0.30-0.60%
   Phosphorus 0.040% Max.
   Sulfur 0.050% Max.

4. Low or Medium Carbon Steel
   Carbon 0.28% Max.
   Phosphorus 0.048% Max.
   Sulfur 0.058% Max.

5. Wrought Steel
   Carbon 0.30% Max.
   Manganese 0.29-1.06% Max.
   Phosphorus 0.048% Max.
   Sulfur 0.058% Max.
   Silicon 0.10% Max.

6. Medium Carbon Steel
   Carbon 0.28-0.55%
   Phosphorus 0.048% Max.
   Sulfur 0.058% Max.

7. Cold Rolled Steel
   Half to Fully Hardened

8. Steel ASTM 325

9. SAE 1020 Steel

10. SAE 1035 Steel

11. SAE 1060 Steel

12. SAE 1108, 1109, 1110, 1113, or 1115 Steel.

13. Carbon Steel Pipe
    ASTM A234

14. Steel Pipe
    ASTM A120, Welded and Seamless

15. Steel Tubing ASTM A254

16. Gray Cast Iron

17. Malleable Iron
    Carbon 2.20-2.90%
    Manganese 0.15-1.25%
    Phosphorus 0.02-0.15%
    Sulfur 0.02-0.20%
    Silicon 0.90-1.90%

18. Malleable Iron
    Same as 17 with maximum 5% Pearlite and maximum 3% Carbide

19. Brass
    SAE CA 345, 350, 360, or 377

20. Brass
    ASTM B16 or B124

21. Rubber Gasket
    ASTM D1170

22. Nitrile Butadiene Rubber Gasket
    Fiber or Fiber and Cork Reinforced
    ASTM D1170

23. Synthetic Rubber - Buna N
    Heat and Oil Resistant
    AMS 3327C

24. Synthetic Rubber - Neoprene Type
    ASTM D735

25. Two Conductor Cable
    Flexible, silicone rubber insulated
    Teflon coated
    600 V Rating

26. Wire, 37/30 Strand
    Polyolefin (Exane) insulated
    1000 V Rating

27. Wire, 19/29 Strand
    Polyolefin (Exane) insulated
    600 V Rating

28. The motor frames and bases are fabricated from Hard Hot Rolled Sheet Steel conforming to AISI 1008.

29. Items with this category are multi-material items which are not given specifications in this publication. Additionally, sources for these items may change from time to time. Where a need may arise for specifications on this equipment, the information may be obtained from Electro-Motive Power Products Offices.