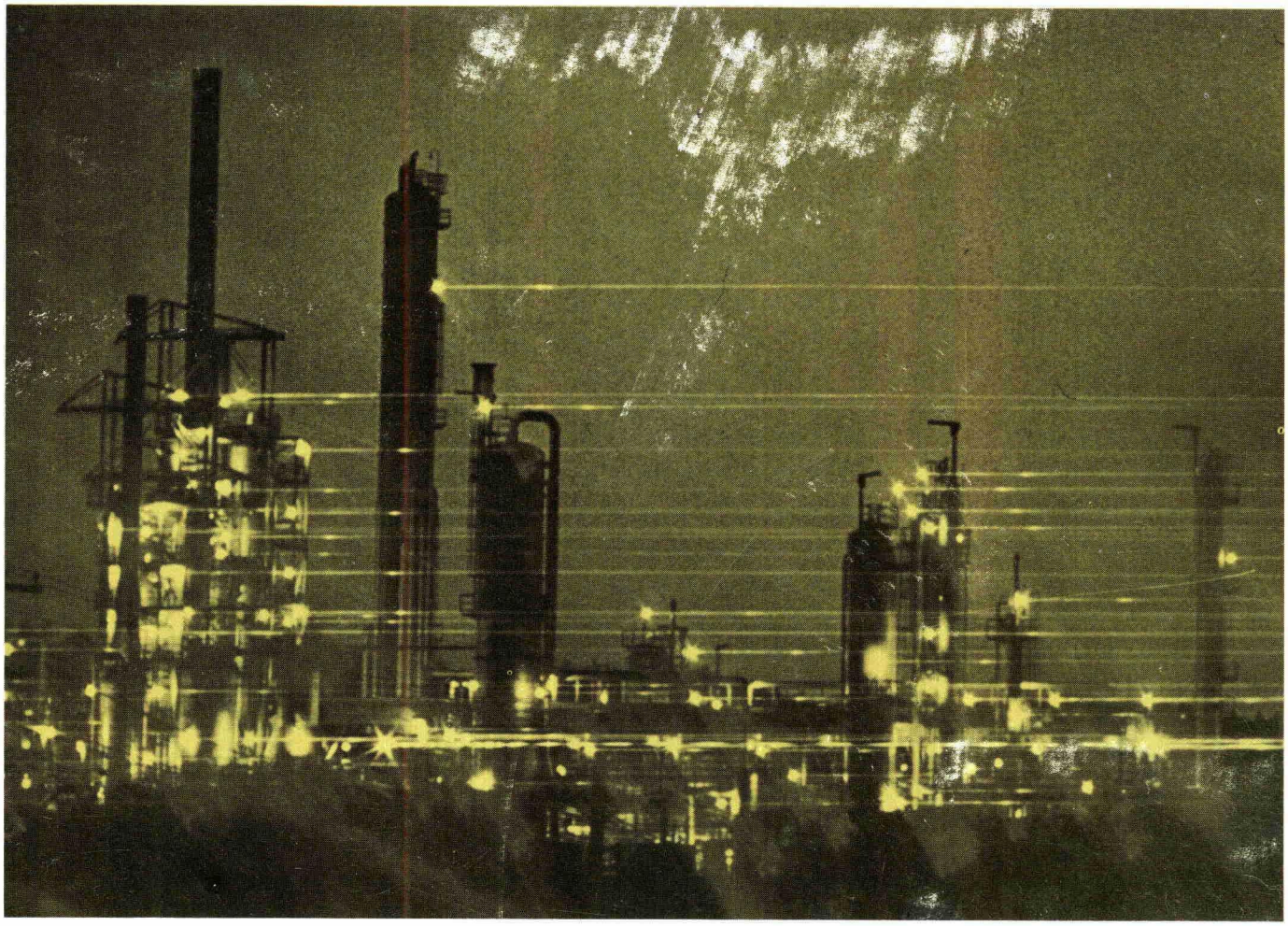
A Floco® Product



Instruments for precise measurement and control of ■ fluid flow ■ liquid level ■ static pressure ■ differential pressure ■ absolute pressure ■ temperature...and instruments for analytical analysis.

Model F-500
Positive Displacement Meter

Controls and Instruments ITT
A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
580 MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA 91754

ITEM	DESCRIPTION	PART NUMBER	PER UNIT	UNIT PRICE
* 1	Screw	1612	2	$ .15
2	Register box assembly	332	1	9.50
3	Register lid	293	1	1.50
4	Register lid pin	292	1	.10
5	Retaining ring	1216	1	.75
6	Register glass	337	1	.50
7	Gasket	1214	1	.35
8	Register assembly (specify unit of measurement when ordering)	331	1	23.50
9	Register gasket	253	1	.25
*10	Calibration gear, drive (specify diameter and number of teeth when ordering)	329	1	1.00
*11	Calibration gear, driven (specify diameter and number of teeth when ordering)	330	1	1.00
12	Worm gear assembly - 20:1	257	1	8.00
13	Worm gear assembly - 40:1	256-D-40	1	5.00
14	Worm gear assembly - 80:1	327	1	7.00
15	Screw	334	2	.15
16	Gear case adapter assembly - 20:1	1498-20	1	39.50
17	Gear case adapter assembly - 40:1	1498-40	1	39.50
18	Gear case adapter assembly - 80:1	1498-80	1	39.50
*19	Seal assembly, low pressure - 20:1	1474-20	1	19.50
*20	Seal assembly, low pressure - 40:1	1474-40	1	19.50
*21	Seal assembly, low pressure - 80:1	1474-80	1	19.50
22	Oil plug	1502	1	.10
23	Register adapter assembly	281	1	12.50
24	Seal housing	1469	1	7.50
25	Bushing	1035	1	1.00
26	"O" ring	654	1	.35
*27	"O" ring	1139	1	.50
28	Spring	1464	1	.50
29	Gear - 2 prong	914	1	.75
30	Shaft assembly - 20:1	1473-20	1	7.00
31	Shaft assembly - 40:1	1473-40	1	7.00
32	Shaft assembly - 80:1	1473-80	1	7.00
33	Spring cup	1470	1	.40
34	Floating bearing	1471	1	.75
35	"O" ring	654	1	.35
36	"O" ring	935	1	.35
37	Seal, "U" cup	315	1	1.25

ITEM	DESCRIPTION	PART NUMBER	PER UNIT	UNIT PRICE
38	Washer	313	2	$ .15
39	Spacer ring	1499	1	.50
40	"O" ring	652	1	.35
41	"O" ring	935	1	.35
42	Washer	1901	1	.10
43	Retaining ring	922	1	.10
44	Washer	313	1	.15
45	"O" ring	934	1	.35
*46	Body bolts	308	8	.40
47	Register sideplate assembly	2506	1	45.00
48	Sampler sideplate assembly	2507	1	47.50
*49	Body seal	304	2	1.50
50	Nut, blind	915	1	1.75
51	"O" ring	1139	1	.50
*52	Nut, bearing	1254	2	.50
*53	Rotor bearing - Aluminum Bronze	2529	2	3.50
*54	Rotor bearing - Carbon Graphite	2496	2	3.50
*55	Rotor bearing - Meehanite	2528	2	3.50
*56	Replaceable wearplate - register side	2275	1	8.50
*57	Replaceable wearplate - sampler side	2276	1	8.50
58	"O" ring	1139	1	.50
59	"O" ring	652	1	.35
60	Alignment plug	2508	1	3.00
*61	Gasket	1116	1	.10
62	Register sideplate & bushing assembly	2497	1	33.50
63	Sampler sideplate & bushing assembly	2498	1	35.00
64	Bushing	2512	2	3.00
*65	Rotor assembly, 1" or 2" meter (See Note 1)			
	(a) Buna-N (yellow dot)	AE-4R	1	37.00
	(b) Viton (red dot)	2326	1	57.00
	(c) Butyl (green dot)	2667	1	57.00
	(d) Neoprene (white dot)	2684	1	57.00
	(e) Ethylene Propylene (green white green)	2772	1	57.00
	(f) Thiokol (blue dot)	2763	1	65.00
*66	Rotor assembly 3" meter (See Note 1)			
	(a) Buna-N (yellow dot)	AE-14R	1	72.00
	(b) Viton (red dot)	2561	1	115.00
	(c) Butyl (green dot)	2668	1	115.00
	(d) Neoprene (white dot)	2685	1	115.00
	(e) Ethylene Propylene (green white green)	2777	1	115.00

ITEM	DESCRIPTION	PART NUMBER	PER UNIT	UNIT PRICE
	(f) Thiokol (blue dot)	2768	1	$125.00
67	Rotor hinge pin, 1" or 2" meter	364	3	.60
68	Rotor hinge pin, 1" or 2" meter (for Delrin rotor only, not shown in drawing)	1517	3	.60
69	Rotor hinge pin, 3" meter	2814	3	.75
*70	Rotor hinge, 1" or 2" meter (See Note 1)			
	(a) Buna-N	361	3	6.00
	(b) Viton	2334	3	9.50
	(c) Butyl	2675	3	9.50
	(d) Neoprene	2692	3	9.50
	(e) Ethylene Propylene	2775	3	9.50
	(f) Thiokol	2776	3	10.00
71	Rotor hinge, 3" meter (See Note 1)			
	(a) Buna-N	252	3	11.00
	(b) Viton	2569	3	18.50
	(c) Butyl	2676	3	18.50
	(d) Neoprene	2693	3	18.50
	(e) Ethylene Propylene	2780	3	18.50
	(f) Thiokol	2771	3	20.00
*72	Rotor hinge spring	362	3**	2.25
*73	Rotor hinge spring, epoxy coated (not shown)	362-EC	3**	3.50
*74	Rotor spring grommet			
	(a) Buna-N	363	6	.25
	(b) Viton	2338	6	.35
	(c) Butyl	2681	6	.35
	(d) Neoprene	2698	6	.35
	(e) Ethylene Propylene	2724	6	.35
	(f) Thiokol	2723	6	.50
75	Rotor hub, 1" or 2" meter (See Note 1)			
	(a) Buna-N	1528	1	25.00
	(b) Viton	2327	1	35.00
	(c) Butyl	2669	1	35.00
	(d) Neoprene	2686	1	35.00
	(e) Ethylene Propylene	2773	1	35.00
	(f) Thiokol	2764	1	37.50
76	Rotor hub, 3" meter (See Note 1)			
	(a) Buna-N	1530	1	46.00
	(b) Viton	2562	1	66.00
	(c) Butyl	2670	1	66.00
	(d) Neoprene	2687	1	66.00

ITEM	DESCRIPTION	PART NUMBER	PER UNIT	UNIT PRICE
	(e) Ethylene Propylene	2778	1	$ 66.00
	(f) Thiokol	2769	1	72.00
77	Screw, bridge	309-S	2**	.75
78	Washer	310	2**	.10
79	Bridge assembly, 1" or 2" meter, Delrin (standard)	AE-3D	1	17.50
80	Bridge assembly, 1" or 2" meter, steel	AE-3	1	23.50
81	Bridge assembly, 1" or 2" meter, 316 SS	2406	1	65.00
82	Bridge assembly, 3" meter, Delrin (standard)	2790	1	35.00
83	Bridge assembly, 3" meter, steel	2819	1	47.00
84	Bridge assembly, 3" meter, 316 SS	2820	1	130.00
85	Bridge seal, set of 2			
	(a) Buna-N	2791	1	3.50
	(b) Viton	347	1	3.50
	(c) Butyl	2726	1	3.50
	(d) Neoprene	2727	1	3.50
	(e) Ethylene Propylene	2729	1	3.50
	(f) Thiokol	2728	1	3.50
86	Bridge seal, set of 4			
	Viton only	258	1	7.00
	(For other construction materials, order two sets of above)			
87	Wedge	302	1**	.15
88	Liner, 316 stainless steel, 1" or 2" meter	301	1	15.00
89	Liner, 316 stainless steel, 3" meter	2656	1	20.00
90	Dowel pin	303	4	.15
91	Body assembly, 1" meter	1135	1	65.00
92	Body assembly, 2" meter	1132	1	65.00
93	Body assembly, 3" meter	2848	1	102.50

NOTES: * Indicates recommended spare parts.
** Double these quantities for 3" meters.

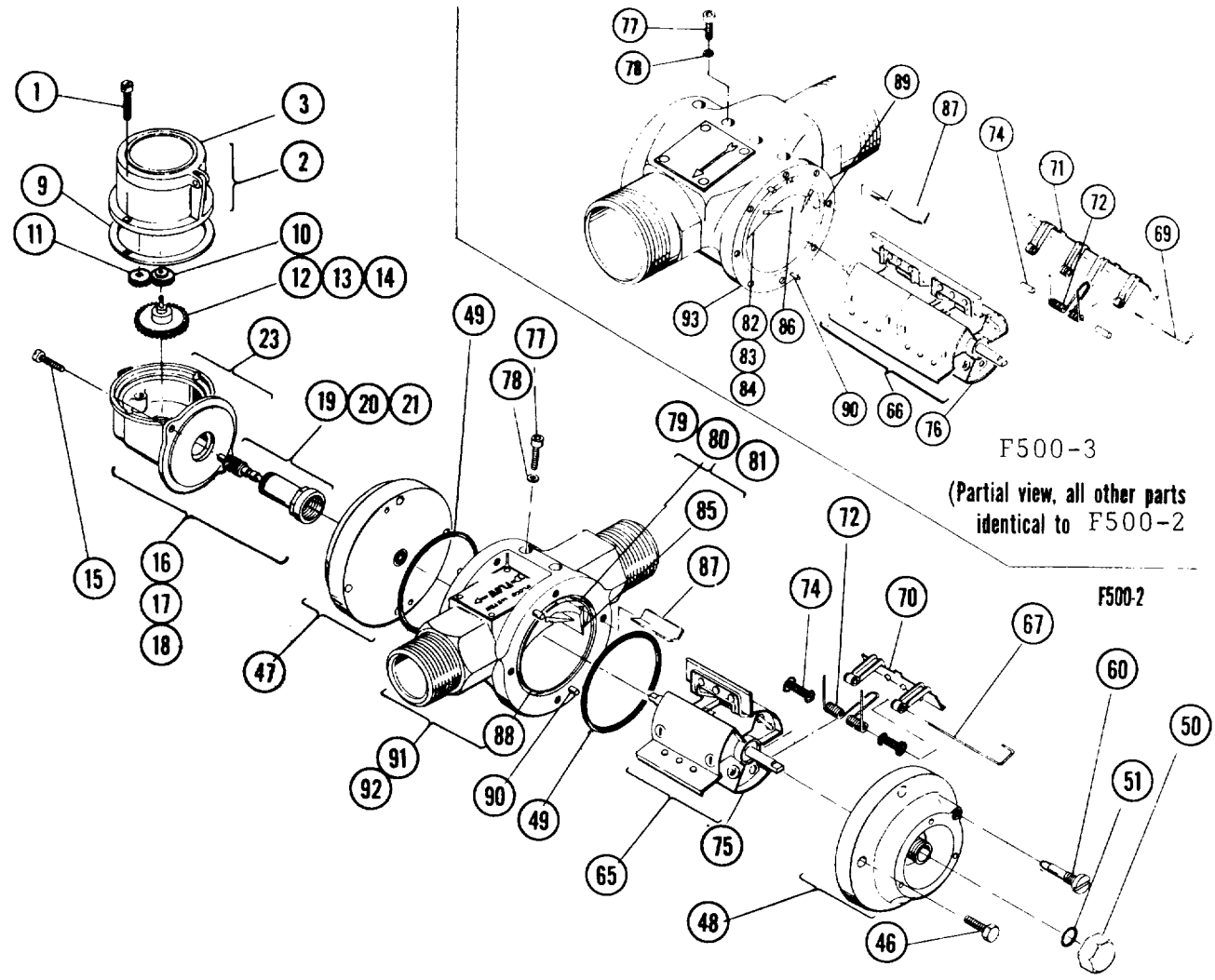
1. Standard Floco meters are furnished with Buna-N elastomers. Most special elastomers are stock items, but may require additional time if stock is depleted.

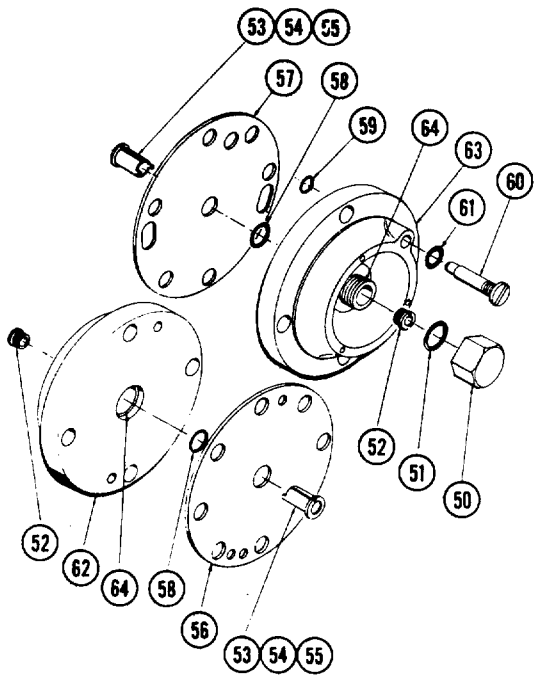
2. When ordering parts, please specify serial number and meter model number of instrument with which they are to be used.

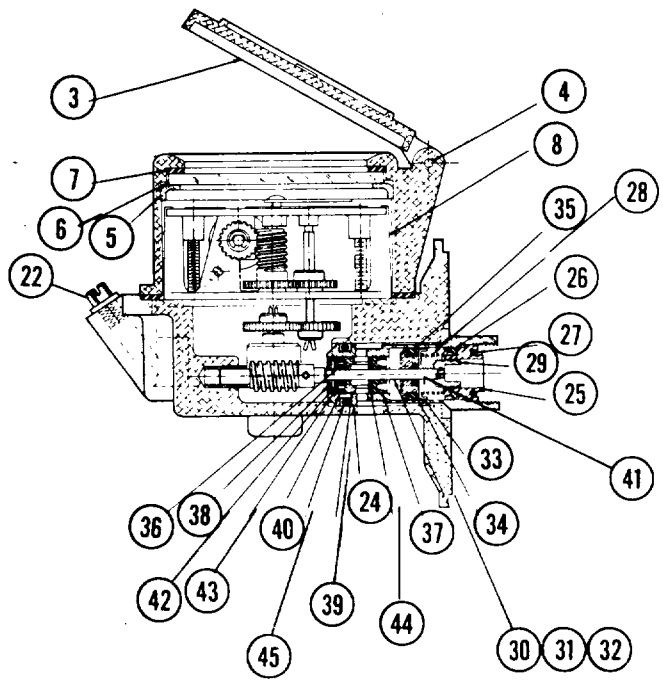
3. Minimum parts order is $5.00. Identification drawing is on Page 5.

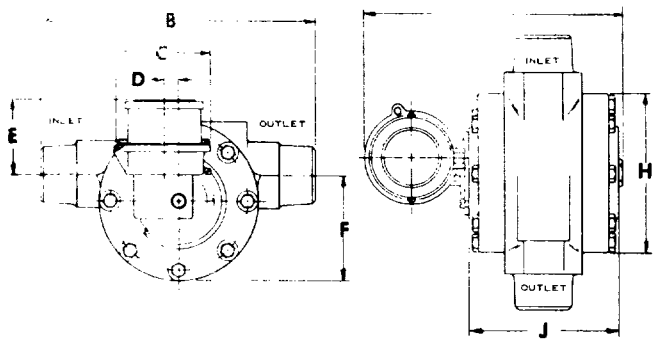
4. Parts are listed in order of disassembly.

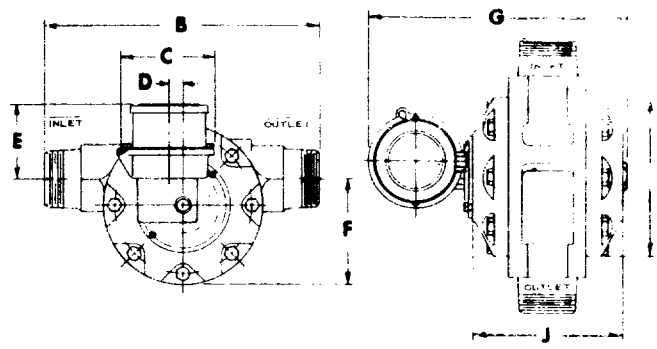
Prices are f.o.b. shipping point, and are subject to change without notice. (3D)

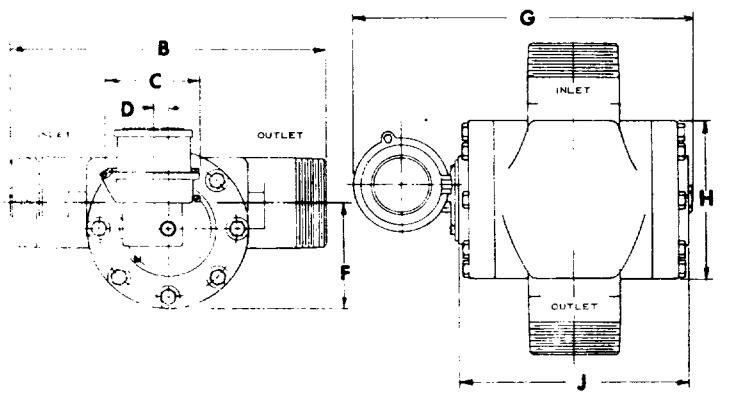

F500-3
(Partial view, all other parts identical to F500-2
F500-2

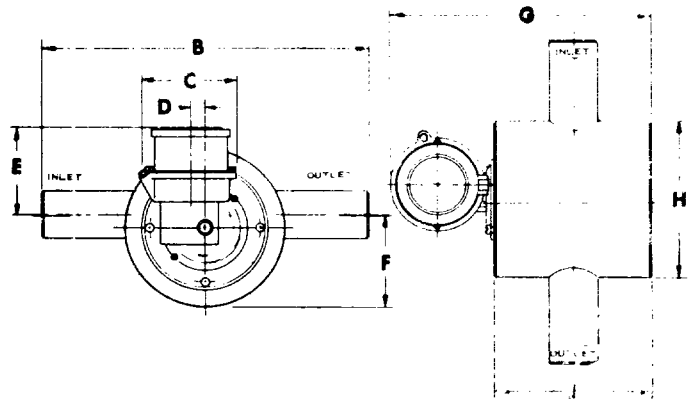












DIMENSIONS

MODEL	A	B	C	D	E	F	G	H	J
F500-1	See Below	10	3-1/2	1	1-7/8	4	9-13/16	6	5-3/4
F500-2	" "	10-1/2	3-1/2	1	1-7/8	4	9-13/16	6	5-3/4
F500-3	" "	12	3-1/2	1	1-7/8	4	12-13/16	6	8-3/4
F2500-1	" "	10	3-1/2	19/32	2-15/16	4	9-13/16	6	5-3/4
F2500-2	" "	10-1/2	3-1/2	19/32	2-15/16	4	9-13/16	6	5-3/4
F2500-3	" "	12	3-1/2	19/32	2-15/16	4	12-13/16	6	8-3/4
F3500-1	" "	10	3-1/2	19/32	2-15/16	4	9-13/16	6	5-3/4
F3500-2	" "	10-1/2	3-1/2	19/32	2-15/16	4	9-13/16	6	5-3/4
F3500-3	" "	12	3-1/2	19/32	2-15/16	4	12-13/16	6	8-3/4
F5000-1	" "	12-1/2	3-1/2	19/32	3-7/16	3-1/2	9-15/16	6	6

NOTE: ALL DIMENSIONS MAY VARY ± 1/16 IN.

FLANGE DIMENSION "A" (FACE TO FACE)

	150 OR 300 RF OR RTJ			400 OR 600 RF OR RTJ			900 OR 1500 RF OR RTJ		
	1"	2"	3"	1"	2"	3"	1"	2"	3"
F500-1 *	12								
F500-2		12							
F500-3			12						
F2500-1				$12\frac{5}{8}$			$13\frac{3}{4}$		
F2500-2					13			$13\frac{1}{2}$	
F2500-3						13			$13\frac{1}{2}$
F3500-1							$13\frac{3}{4}$		
F3500-2								$13\frac{1}{2}$	
F3500-3									$13\frac{1}{2}$
F5000-1									

* [illegible] LB FLANGES ONLY

SPECIFICATIONS

MODEL	N. P. T. PIPE SIZE	CAPACITY G. P. M. * MIN.	CAPACITY G. P. M. * MAX.	MAX. TEMP FAHR.	MAX. W.P.	APPROX. SHIPPING WEIGHT
F500-1	1" FEMALE	1	60	180	500	31
F500-2	2" MALE	1	60	180	500	31
F500-3	3" MALE	3	90	180	500	47
F2500-1	1" FEMALE	1	60	180	2500	37
F2500-2	2" MALE	1	60	180	2500	37
F2500-3	3" MALE	3	90	180	2500	52
F3500-1	1" FEMALE	1	60	180	3500	43
F3500-2	2" MALE	1	60	180	3500	41
F3500-3	3" MALE	3	90	180	3500	59
F5000-1	1" FEMALE	1	60	180	5000	44

* BASED ON PALE HYDRAULIC OIL
.935 S. G., 210 API 110SSU AT 100 [illegible]

INSTALLATION AND OPERATION MANUAL FLOCO POSITIVE DISPLACEMENT METERS

TABLE OF CONTENTS

TABLES

ILLUSTRATIONS

INTRODUCTION

THIS MANUAL IS PROVIDED TO ASSIST FIELD PERSONNEL IN THE INSTALLATION, OPERATION, TROUBLE SHOOTING AND REPAIR OF ANY FLOCO POSITIVE DISPLACEMENT METER. THE MANUAL SHOULD BE RETAINED IN A LOCATION AVAILABLE TO OPERATING PERSONNEL FOR DATA ON CALIBRATION, SERVICE, MAINTENANCE, AND PARTS.

THE PARTS LIST AT THE BACK OF THIS MANUAL CONTAINS THE EXPLODED VIEW OF ALL THE PARTS, THE PART AND ASSEMBLY NUMBERS, AND THE PARTS PRICE LIST FOR THE SPECIFIC METER ORDERED. RECOMMENDED SPARE PARTS ARE INDICATED BY ASTERISKS ON THE PARTS PRICE LIST.

THE FULL LINE OF FLOCO METERS ARE AS FOLLOWS WITH COMMENTS ON INTERCHANGEABILITY:

INTERNAL PARTS - ROTOR, BRIDGE, LINER, BRIDGE SEALS, O-RINGS, AND WEARPLATES ARE IDENTICAL FOR ALL 1" AND 2" METERS, EXCEPT THE F 5000-1 WHICH HAS SPECIFIC WEARPLATES AND O-RINGS. REGISTERS ARE THE SAME ON ALL METERS.

1. F 500-1 AND F 500-2

   ALL PARTS ARE IDENTICAL EXCEPT HOUSING THREADED CONNECTIONS. A MODEL 1474 SEAL ASSEMBLY IS USED ON THE REGISTER SIDE OF THE METER. A MODEL 1483 IS USED ON THE SAMPLER SIDE WHEN A SAMPLER IS USED.

2. F 500-3

   ALL PARTS ARE IDENTICAL WITH THE F 500-1 AND F 500-2, EXCEPT THE HOUSING AND ROTOR ASSEMBLIES.

3. F 2500-1

   ALL PARTS ARE IDENTICAL WITH THE F 500-1 AND F 500-2, EXCEPT THE HOUSINGS, SIDEPLATE ASSEMBLIES, AND GEAR CASE ASSEMBLIES.

4. F 2500-2

   THE F 2500-1 AND F 2500-2 ARE IDENTICAL, EXCEPT THE HOUSING THREADED CONNECTIONS.

5. F 2500-3

   ALL PARTS ARE IDENTICAL IN F 2500-1, F 2500-2 AND F 2500-3, EXCEPT THE HOUSING AND ROTOR ASSEMBLIES.

6. F 3500-1

   ALL PARTS ARE IDENTICAL WITH THE F 2500-1 AND F 2500-2 EXCEPT THE HOUSING AND SIDEPLATE ASSEMBLIES.

7. F 3500-2

   ALL PARTS ARE IDENTICAL IN THE F 3500-1 AND F 3500-2 EXCEPT THE HOUSING THREADED CONNECTIONS.

8. F 3500-3

   ALL PARTS ARE IDENTICAL WITH THE F 3500-1 AND F 3500-2 EXCEPT THE HOUSING AND ROTOR ASSEMBLIES.

9. F 5000-1

   ALL PARTS ARE IDENTICAL WITH 1" 2500 LB. AND 3500 LB. METERS EXCEPT HOUSING, SIDEPLATES, WEARPLATES, HOUSING O-RINGS, AND REAR CASE FASTENERS.

UNPACKING

1. Contents List:

   A. Floco Positive Displacement Meter.

   B. Installation and Operation Manual

   C. Other accessories, per customer's order.

2. Precautions:

   A. The Floco meter and accessories should be checked for damage or breakage in shipment.

   B. The flow lines up-stream of the Floco meter installation should be purged to remove scale, rocks, welding slag or other debris prior to installing the Floco meter, if no bypass manifold is used.

   C. Control valves should be opened slowly to permit charging the Floco meter with liquid before normal operation begins. Sudden surges of pressures or gas can severely damage the Floco rotor assembly, if these valves are not opened slowly.

   D. If the liquid to be measured contains gas or vapor, a separator or air eliminator must be used ahead of the Floco meter to prevent rotor damage.

INSTRUMENT PRE-CHECK

The Floco meter was calibrated at the factory on hydraulic oil to an accuracy of plus or minus 1 percent. Do not change any calibration gears without proving the meter in normal operating conditions. Contact the nearest Floco representative for information regarding meter calibration. Check for damage or breakage that may have occurred during shipment.

INSTALLATION

1. Operating Limitations:

   The warranty on Floco meters and accessories will not apply if the following limitations are exceeded:

   A. Temperature: Do not subject the meter body to temperatures in excess of 180°F, or below the freezing point of the metered liquid. High temperature components may be requested for temperatures up to 300°F or higher, depending on the metered liquid.

   B. Pressure: Do not subject the Floco meter to pressures higher than the pressure rating specified on the nameplate model number.

      1. F500, 500 psi SWP.
      2. F2500, 2500 psi SWP.
      3. F3500, 3500 psi SWP.
      4. F5000, 5000 psi SWP.

   C. Corrosion: The Floco meter body is cast carbon steel. The interior of the standard meter is constructed of 316 stainless steel, 304 stainless steel, delrin, inconel and Buna-N. If liquids not compatible with these construction materials are to be metered, special construction materials must be requested. (Optional elastomers of Viton, butyl, neoprene, ethylene propylene, or thiokol are available for special applications.)

D. Pulsation, vibration, and shock. Pulsation and vibration will cause excessive wear on the Floco meter and require more frequent repairs. Severe shock or water hammer may cause instantaneous damage to the rotor assembly. Therefore, it will be necessary to open all control valves slowly to prevent gas or air turning the rotor too fast, and to prevent high pressure liquid subjecting the rotor to an initial shock.

2. Mounting:

The Floco meter may be mounted either vertically or horizontally. When mounted horizontally the nameplate should face upward. When mounted vertically, the liquid flow should be downward.

A. Separators: (See Figs. 4 and 5)

1. The Floco meter may be mounted on any liquid/gas separator which has, or may be adapted to liquid level controllers.
2. Liquid level height should be maintained at least 18" above liquid outlet.
3. The liquid level control valve should always be downstream from the Floco meter.
4. Isolation valves and a bypass manifold should be included in the mounting assembly to permit normal operation if meter repairs are necessary.

B. Oil Treaters: (See Fig. 6)

1. The Floco meter may be mounted on both oil and water outlets. The downcomer in either case should be at least two times flow line pipe diameter, and never less than 4" O.D.
2. The liquid level in each downcomer should be adjusted so that minimum liquid height after dump is six (6) feet.
3. Liquid level control valves should always be downstream from meter.
4. The Floco Model 700 Control Kit should be used to provide snap-acting controls for a constant flow rate and positive shut off. Throttling controls should not be used.
5. The meter manifold should include a bypass with isolation valves to permit normal operation if meter repairs are necessary.

C. Flow Line: (See Figs. 7 and 8)

1. The Floco meter may be mounted in a flow line, but should have a control valve or back pressure valve downstream from the meter.
2. The meter manifold should include a bypass manifold with isolation valves, to permit normal operation if meter repairs are necessary.
3. Where gas or air is present in the flow line, a gas eliminator should be installed ahead of the meter.

D. Waterflood Injection: (See Fig. 9)

1. The Floco meter may be mounted either near the injection well or in a meter manifold near the injection pump.
2. The meter manifold should include a bypass with isolation valves to permit normal operation if meter repairs are required.
3. The flow rate control valve should always be installed downstream from the meter.
4. If pulsation or vibration is possible, a pulsation dampener should be installed ahead of the meter. Severe pulsation may cause rotor damage.

OPERATION

APPLICATION DRAWINGS SHEETS, FIGS. 4 THROUGH 9, ILLUSTRATE RECOMMENDED INSTALLATION PIPING FOR MOST FLOCO INSTALLATIONS.

1. THE FOLLOWING PRACTICES SHOULD BE OBSERVED WHEN STARTING UP A FLOCO METER.

   A. ALWAYS START WITH ISOLATION VALVES SHUT.

   B. FLOW THROUGH THE BYPASS FOR SUFFICIENT TIME TO PURGE THE FLOW LINES OF GAS AND DEBRIS. DURING THIS START-UP PHASE, ADJUST LIQUID LEVEL CONTROLS WHERE APPLICABLE.

   C. OPEN THE ISOLATION VALVE AHEAD OF THE METER SLOWLY TO EQUALIZE PRESSURE ACROSS THE METER.

   D. OPEN THE DOWNSTREAM ISOLATION OR CONTROL VALVE SLOWLY TO ALLOW METER TO BEGIN OPERATING.

   E. CLOSE BYPASS VALVE.

   F. ADJUST THE DOWNSTREAM CONTROL VALVE TO PERMIT PROPER FLOW RATE THROUGH THE METER.

2. STRAINER:

   THE FLOCO METER DOES NOT NORMALLY REQUIRE AN UPSTREAM STRAINER. HOWEVER, IN APPLICATIONS WHERE LARGE SOLID FRAGMENTS MAY ENTER THE FLOW LINES, A FILTER MAY BE USED WITHOUT MODIFYING THE METER.

3. GAS ELIMINATOR:

   IF THE LIQUID STREAM CONTAINS DISSOLVED GAS OR VAPORS, A GAS ELIMINATOR SHOULD BE INSTALLED AHEAD OF THE METER.

CALIBRATION

THE FLOCO METER MAY BE CALIBRATED BY ONE OF THREE PROVING METHODS: GRAVIMETRIC PROVING, VOLUMETRIC PROVING, OR MASTER METER PROVING. METER PROVING, BY ANY METHOD, IS BASICALLY A LABORATORY TEST, AND SHOULD BE PERFORMED CAREFULLY, SO THAT CORRECT DATA ARE OBTAINED AND MATHEMATICAL CALCULATIONS ARE EXACT. FOR COMPLETE PROCEDURES REGARDING METER PROVING, REFER TO AMERICAN PETROLEUM INSTITUTE API STANDARD 1101, AUGUST 1960.

1. GRAVIMETRIC METHOD:

   A. THE GRAVIMETRIC METHOD OF CALIBRATION REQUIRES THE CAREFUL WEIGHING OF THE QUANTITY OF LIQUID PASSED THROUGH THE METER.

   B. THE NET WEIGHT OF THE METERED LIQUID IS CONVERTED INTO VOLUME, CORRECTED FOR TEMPERATURE AND PRESSURE WHERE NECESSARY.

   C. IT IS ALSO POSSIBLE TO CONVERT THE METERED VOLUME INTO NET WEIGHT AND OBTAIN THE CORRECT METER FACTOR.

   D. THE GRAVIMETRIC METHOD IS PARTICULARLY ADVANTAGEOUS WHEN THE METERED LIQUID CONTAINS ENTRAINED GAS OR VAPOR, PARAFFIN, WAX, SAND OR OTHER SOLIDS, OR IS HEAVY OR VISCOUS. WEIGHT WILL NOT CHANGE, REGARDLESS OF TEMPERATURE OR PRESSURE.

2. VOLUMETRIC METHOD:

   A. THE VOLUMETRIC METHOD OF METER CALIBRATION REQUIRES THE USE OF A VESSEL, CALIBRATED FOR A KNOWN VOLUME.

B. The metered volume through the Floco meter is compared to the true volume of the calibrated vessel to obtain the correct meter factor.

C. The volumetric method of meter proving eliminates some mathematical calculations, and, therefore, is quicker. However, if the liquid contains entrained gas or vapor, solids, paraffin, or other impurities which may adhere to the side of the calibrating vessel, or if the liquid is viscous, serious errors may result in this method.

D. The calibration vessel should be cleaned thoroughly before being used, and after each use.

3. Master Meter Method:

A. The master meter method of proving requires a prover loop, into which is placed a meter of known accuracy.

B. The meter readings of the production meter are compared after the test with the reading of the master meter.

C. Extreme care should be exercised when using the master meter method since tests of this type may only increase meter inaccuracy if the master meter is damaged.

D. After each series of tests, the master meter should be proved to verify that its accuracy has not changed since the last proving.

4. Meter Calibration:

A. After the meter is proved, and the true volume and meter volume are obtained, the meter may be calibrated by changing two non-slip, positive-drive change gears, located between the register assembly and the gear case assembly. Refer to the exploded view and parts shown in the parts list at the back of the manual. These gears may be changed even while the meter is in operation.

B. Selection of correct change gears may be accomplished in two ways, both of which require dividing the true volume into the metered volume:

True Volume: 100 barrels (gallons, liters, etc.)

Metered Volume: 103 barrels (gallons, liters, etc.)

$$\frac{103}{100} \times 100 = 103 \text{ Percent (now being registered)}$$

1. Chart Method. Tables I and II, indicate gear changes required to calibrate meters to approximately 100 percent accuracy when percent registered is known.

Example: The Floco meter registers 104 barrels. True volume is 100 barrels. Using the formula in paragraph B, the percent registered is calculated to be 104 percent. For a 1" or 2" Floco meter, the .670 - 30 driven gear and the .670 - 26 drive gear will return the meter to approximately 100 percent accuracy. For a 3" Floco meter, gears would change to .460 - 22 and .860 - 38. These charts are correct only if percent registered is calculated from meters with standard gears, as underlined in the two charts.

2. Slide Rule. The Floco Calibration Slide Rule may be obtained from the Floco representative or the Floco factory. This circular slide rule matches drive gears and driven gears with percentage of meter accuracy. Directions for use are printed on the slide rule.

A. Move top and bottom gear discs so that present gear teeth numbers are opposite each other.

B. Move hairline to percent now being registered. Refer to paragraph 4B above for method of calculating percent.

C. Keep hairline in place, and rotate "top gear" disc so that desired percent comes under hairline, normally 100 percent.

D. Select new gears where lines match for drive and driven gears. Check back of slide rule for available gears.

3. Accuracy. It must be noted that all positive displacement meters require a meter factor number for extreme accuracy. The meter factor number may be determined by dividing the true (calculated) volume by the metered volume:

$$\frac{\text{True Volume}}{\text{Metered Volume}} = \text{Meter Factor}$$

The metered volume for future accounting is then multiplied by the meter factor to obtain the true volume:

Meter Volume x Meter Factor = True Volume

TABLE I
CALIBRATION CHART 42 GALLON U.S. BARRELS

Percent Registered	1" or 2" Meters				3" Meters			
	Driven		Drive		Driven		Drive	
	teeth	dia.	teeth	dia.	teeth	dia.	teeth	dia.
105	28	.670	24	.670	21	.460	36	.860
104	30	.670	26	.670	22	.460	38	.860
103	32	.670	28	.670	20	.460	35	.860
102	34	.670	30	.670	31	.460	37	.860
101	28	.670	25	.670	23	.460	41	.860
100	30	.670	27	.670	20	.460	36	.860
99	33	.670	30	.670	22	.460	40	.860
98	35	.670	32	.670	19	.460	35	.860
97	28	.670	26	.670	20	.460	37	.860

TABLE II
CALIBRATION CHART U.S. GALLONS

Percent Registered	1" or 2" Meters				3" Meters			
	Driven		Drive		Driven		Drive	
	teeth	dia.	teeth	dia.	teeth	dia.	teeth	dia.
105	20	.460	36	.860	35	.770	25	.570
104	21	.460	38	.860	29	.770	21	.570
103	19	.460	35	.860	30	.770	22	.570
102	21	.460	39	.860	27	.770	20	.570
101	18	.460	34	.860	28	.770	21	.570
100	20	.460	38	.860	33	.770	25	.570
99	17	.460	33	.860	34	.770	26	.570
98	18	.460	35	.860	31	.770	24	.570
97	19	.460	38	.860	32	.770	25	.570

SERVICING

1. Trouble Shooting Suggestions:

If trouble develops, the procedure listed in tabular form in Fig. 10 will usually locate the problem and provide the solution. Normally, problems will be found in the gear case assembly, rotor assembly, or bearings.

2. Tools Required:

Description	Purpose
1/2", 9/16" and 5/8" sockets or box wrenches	To remove sideplate bolts on the 500, 2500, and 3500 psi meters.
7/8" open end wrench	To remove the AE 9 gear case assembly.
3/8" box end wrench	To remove the AE 9 gear case assembly from the F 5000-1 meter.
7/32" hex key	To remove bridge screws.
Long nose pliers	To remove rotor hinge pin.
File	To dress replaced liner.
Wide blade screw driver	To replace bearings.
Standard screw driver	----
Oil can	----
*Sideplate tool no. 260	To remove sideplate of F 5000-1.
*Rotor spring tool no. 2209	To replace rotor springs.
*Sideplate bushing tool no. 1434	To remove and replace bushings.
*AE 9 repair kit	To repair AE 9 gear case assembly.
*LPS tools nos. 2170, 1509-9, and 1509-10	To repair low pressure seals.
*Truarc pliers no. 1 and no. 2	To remove snap rings.

*Optional. Normally used only in meter repair shop.

3. Maintenance:

A. Inspection. Regular inspection and preventive maintenance on Floco meters will insure many months of trouble-free service. The following procedure is suggested for a maintenance program. However, this program should be adapted to the type of liquid metered, based on corrosive and abrasive qualities.

1. Inspect gear case assembly quarterly.

a. The 281 gear case adapter on F 500 series Floco meters contains a vent hole on the bottom. Any leakage through this hole indicates immediate repairs required. Refer to paragraph 4D of Repair Procedure.

b. The AE 9 high pressure gear case must be removed from the meter for a thorough inspection.

(1) Close isolation valves upstream and downstream from the Floco meter.
(2) Loosen sideplate bolts to relieve pressure on the meter.
(3) Remove the AE 9 gear case assembly.
(4) Use a Floco tool no. 1509-10 or a narrow blade screw driver to rotate the 2-prong gear.
(5) If the 2-prong gear does not turn freely, repair of the AE 9 assembly is required. Refer to paragraph 4E of Repair Procedure.

2. Inspect register assembly semi-annually.

a. All gears should turn freely.

b. Assembly must be free from scale and corrosion.

c. Clean by soaking in a pale hydraulic oil or commercial grade brake fluid. A stiff bristle brush may be used to remove scale or dirt.

3. Inspect rotor assembly if accuracy changes. Inspect particularly the edges of hinges and rotor hub, where positive seal is required, for separation or splitting of elastomer. Replace hinges or rotor hub if splitting or separation occurs.

4. Inspect bearings every 25,000 barrels for excessive wear. Tests on brine indicate satisfactory service above 100,000 barrels generally. Replace bearings if rotor shafts become scored, if bearing surface shows excessive wear, or if bearing becomes out of round.

5. Inspect bridge and bridge seals semi-annually or whenever sideplate is removed. Bridges seldom need replacing except where high temperature or alkalis attack the delrin. Bridge seals should not be split, chipped, or elongated.

6. Liners should be inspected annually for excessive wear or scoring. If liner is excessively worn replace with new liner. Refer to paragraph 4A of Repair Procedure. If slightly scored, the liner may be polished with a fine emery cloth.

7. Wear plates should be inspected annually or when accuracy varies. If wear plates show excessive wear, they should be reversed or replaced. Do not confuse normal wear pattern with excessive wear, since the rotor will normally wear a pattern on the wearplate.

4. Repair Procedure:

A. Floco body disassembly and assembly procedure.

1. Remove bridge screws, part 309, and washers, part 310, with 7/32" hex key.

2. Remove bridge, part AE 3 or AE 3D (delrin).

3. Remove liner wedge, part 302, by prying out with screw driver or other sharp tool.

4. Remove liner, part 301 or 316. Liner should slide out of body freely.

5. Remove scale deposits or rust from meter body with wire brush and emery cloth.

6. To replace liner, insert liner so that edges of liner are equally spaced from bridge screws, and nearly flush with body facings on both sides.

7. Insert wedge between bridge screws so that apex is against bridge, and edges are against body at liner edges.

8. Insert steel bridge, with screws very loose.

9. Tighten bridge screws so that bridge flattens wedge against body, and wedges liner in place.

10. With the liner wedged in place, remove bridge, and dress edges of liner until smooth and flush with body facings on both sides.

11. Replace bridge with screws loose.

12. Do not tighten bridge screws until sideplate assemblies are attached and snug. The sideplates will align bridge in correct position when bridge screws are tightened.

13. Replace bridge seals, part 347, and body seal o-rings, part 304.

14. Floco meter body is now ready for further assembly.

B. Rotor disassembly and assembly procedure.

1. Inspect edges of rotor hub covered with rubber material. Inspect hinge edges. If rubber material is split or separated, replace. If rotor shaft is rough, replace hub. Inspect hinge pin holes. If elongated so that firm position cannot be maintained with hinge pin, replace hub. Replace springs, grommets, or pin if worn.

2. Crimp the spread ends of rotor hinge pins, part 364, with long nose pliers.

3. Remove hinge pins with pliers, allowing hinges, springs, and grommets to be removed.

4. To assemble rotor, insert hinge pin in appropriate hole in web so that hinge arm will slip on.

5. Insert spring with grommets in place so that holes are aligned with pin.

6. Insert hinge pin through all grommet holes and through pin hole in opposite web.

7. Hold hinge pin firmly in place, and spread split end with screw driver.

   Caution : Hinge pin should be firmly in place without wobble or lateral movement.

8. Repeat procedure for each hub section.

C. Sideplate disassembly and assembly.

Caution : Sideplate bushings on all Floco meters are designed with left hand threads.

1. Remove gear case assembly, sampler or 915 blind nut from sideplate.

2. Unscrew bearing nut, part 1254, with a wide blade screw driver.

3. Slide out bearing assembly, part 2496 (old style bearing 1631).

4. Wearplate, part 2275 or 2276, will now detach easily.

5. Remove o-ring, part 1139.

6. To remove bushing, part 1480, place sideplate face down on flat surface, such as 2" x 8" wood block with a 1-1/2" O.D. hole bored in wood.

7. Using bushing insertion tool 1434, or a similar flat tool, place tool against bushing and tap sharply with a small hammer. The bushing is pressed in place and will fall out easily when the pressure is released.

8. To replace bushing, turn sideplate face up and place bushing in place, using tool 1434, tap with small hammer until bushing is flush with sideplate face. Do not dent or scar bushing or sideplate.

9. Bushing must be flush with sideplate or within 0.003".

10. Replace 1139 o-ring and wearplate.

11. Insert 2496 bearing assembly, taking care that bearing sleeve lugs fit into lug slots in bushing.

12. Insert and tighten bearing nut 1254.

D. Low pressure seal (1474 register side and 1483 sampler side) disassembly and assembly procedure.

Disassembly.

1. Remove low pressure seal from sideplate bushing (left hand threads).
2. Remove 1035 bushing and 1464 spring.
3. Hold worm and shaft firmly while removing 2-prong gear with tool 1509-10 or screw driver. Two-prong gears are right hand thread for the register side and left hand thread for the sampler side.
4. Pull worm and shaft assembly from the 1469 seal housing.
5. Remove 313 washer from back of seal housing.
6. Push against 1901 washer with 1/4" rod to force internal parts from the seal housing. Removal of the 922 retaining ring is not required unless its replacement is necessary.
7. Clean all metal parts with a petroleum cleaning solvent. Use a small bottle brush to remove scale or rust from seal housing.
8. Refer to Fig. 11 for inspection procedures to determine if parts replacements are necessary. Caution : Always use new o-rings and u-cups in repairing the low pressure seal.

Assembly

9. Oil all o-rings and u-cup seals before installing. Caution : If air is trapped in the oil seal during assembly, serious damage will result.
10. Install 922 retaining ring in 1469 seal housing.
11. Hold worm and shaft assembly in a vertical position, preferably in a vise, using wood blocks for clamping to prevent damage to shaft.
12. Drop one 313 brass washer over shaft, and position against worm.
13. On sampler low pressure seal install 1519 spacer on shaft before 313 brass washer.
14. Set 1469 housing over shaft.
15. Place 1901 washer over shaft and position against 922 retaining ring.
16. Place 652 o-ring over shaft and position at bottom of housing.
17. Insert one 935 o-ring into 1499 seal spacer ring.
18. Rock o-rings over threads of shaft and use tool 1509-9 tc push 1499 spacer ring to bottom of housing. Do not damage o-rings. Be sure spacer ring is seated against 1901 washer.
19. Place second 313 brass washer over shaft and bottom on top of spacer ring.
20. Rock 315 u-cup over shaft threads, open side up, and use tool 1505-9 to seat u-cup against 313 washer.
21. Use a medium weight machine or motor oil (SAE 10 to SAE 30) to fill seal housing to threaded part of shaft. Caution : Allow oil filled housings to set for several minutes to eliminate air bubbles.
22. Install one 654 o-ring on 1471 floating bearing and install gently on the worm shaft.
23. Using tool 2170, push the floating bearing until the tool bottoms on the face of the housing. The positioning of the bearing is very important to the proper functioning of the low pressure seal.

24. Use tool 1509-9 to pick up and place a new 935 o-ring over worm shaft into groove on the 1471 floating bearing.

25. Clean out excess oil and inspect the assembly to be sure o-ring is in place. Firm pressure on the 935 o-ring with tool 1509-9 should not depress the floating bearing past the third ring. If the tool goes past the third ring, there is too much air in the unit, and it should be reassembled.

26. Install 1470 spring cup open end up on worm shaft and seat on top of 1471 floating bearing.

27. Install 654 o-ring and 1139 o-ring on 1035 bushing.

28. Use tool 1509-10 to attach 2-prong gear (914 on register low pressure seal, 687 on sampler low pressure seal).

29. Set spring 1464 and bushing 1035 into housing around 2-prong gear.

30. Install low pressure seal on meter. Be sure that the 2-prong gear engages shaft before tightening.

E. High pressure gear case assembly, AE 9 repair and servicing. Caution : Read assembly instructions thoroughly before attempting assembly or repair. Serious damage to parts will result if improper techniques are used.

Caution : Any attempt to remove the 917 tube prior to removal of the 919 worm gear will result in ruining the worm gear.

Disassembly.

1. Remove 1612 screws and lift off 331 register.

2. Remove 947 screws and 941 register flange.

3. Remove 329 calibration gear.

4. Use No. 2 Truarc pliers and remove 945 snap ring, 943 washer and 944 gasket. Remove 942 register adapter, being careful not to lose the 954 friction springs on underside of part 942.

5. Use No. 1 Truarc pliers and remove 936 and 922 snap rings.

6. Use tool 14 and 945 snap ring to remove 951 housing assembly. Remove 938 o-ring and 928 felt washer (allow felt washer to soak in oil until replaced).

7. Use long nose pliers and remove 919 worm gear.

8. Remove 1809 screw.

9. Pull out 952 tube assembly. Remove 1139 o-ring and slide off 916 nut.

10. Use a piece of 5/16" dia. rod to push into flanged end of tube against 914 2-prong gear and press out all enclosed components. Do not scratch tube bore. Unscrew 2-prong gear and remove both 921 tube bearings and 924 floating bearing from 918 worm shaft. Use tool no. 1 (see fig. 3) to remove 935 and 651 o-rings from floating bearing and 652 o-ring from tube plug. It is not necessary to remove 939 worm from shaft unless either the 939 worm or the 918 shaft is damaged and must be replaced.

11. Carefully remove the two 934 o-rings.

Assembly. Clean all parts with petroleum cleaning (Stoddard) solvent.

12. Use small bottle brush on 917 tube. Occasionally a soft wire tube brush may be necessary. Use care not to scratch the bore of floating seal.

13. Clean all rust or foreign matter from o-ring and snap ring grooves.

14. Inspect and replace all worn or damaged parts. Since the inspection of parts of the AE 9 will call for judgement of the repairman, see Fig. 12 which gives a brief description of cause for replacement.

    Caution : If air is trapped within the AE 9 unit during assembly, serious damage will result.

15. Reassembling 952 tube assembly.

    A. If 939 worm is to be replaced, put worm on 918 shaft, aligning holes. Start 324 pin in holes and squeeze into place with pliers, being careful not to nick shaft or worm.

    B. Slide two 921 tube bearings on shaft at each end of worm.

    C. Slip worm shaft, worm, and bearings into 917 tube, threaded end first. Be sure that first bearing is seated against shoulder in tube.

    D. Hold tube with bearing end up. Drop 652 o-ring into tube and lay it flat on bearing.

    E. Push 923 tube plug past snap ring groove. (Tap into place, if necessary.)

    F. Use No. 1 Truarc pliers to replace 922 snap ring in groove. Check to see that shaft has small amount of axial movement and is free to rotate.

    G. Place 1139 o-ring into groove on opposite end of tube.

16. Replacing 952 tube assembly in 925 gear case block.

    A. Using assembly tools No. 2 and 3 (see fig. 3) and working from both ends of gear case block, replace two oiled 934 o-rings (one in each end of tube hole).

    B. Place 916 nut on tube, threaded end first.

    C. Replace tube in block, lining tube slot with 937 alignment pin or hole in end of tube with 1809 screw. Do not cut o-rings by forcing.

    D. Install 1809 retaining screw (earlier models have the 937 pin only).

17. Preparing 925 gear case assembly for 951 housing assembly.

    A. Place gear case assembly with tube extending to right. Block up rear of case and end of tube about 1" to tilt case forward and tube up. Screw assembly tool no. 4 (see fig. 3) on shaft in tube. Now add Floco light AE 9 gear case oil to cover worm about 1/8". Turn assembly tool to rotate worm and work shaft back and forth to expel air between bearings. Do not hurry any procedures for expelling air ; wait for all bubbles to appear.

    B. Drop 919 worm gear into hole, pressing into oil with pliers over stub shaft, and engage with worm by pressing down on gear while turning worm with assembly tool no. 4. Unscrew and remove assembly tool no. 4.

    C. Place vent plug, tool no. 12 (see fig. 3), in 917 tube with groove on small end of tool up and partially exposed. Now set gear case almost flat, keeping end of tube slightly higher than level, to bleed air out of tube. A container may be placed under end of tube to save excess oil which will flow from tube. Fill gear case hole half full of oil and work the vent plug back and forth until all air is out. Push vent plug in to seal, and refill gear case to top of block.

18. PREPARING 951 HOUSING ASSEMBLY FOR REPLACEMENT IN 925 GEAR CASE BLOCK.

A. PLACE 938 O-RING AGAINST WIDE LAND AND FILL REST OF GROOVE NEXT TO NARROW LAND WITH GREASE TO ELIMINATE THIS AIR POCKET.

B. REPLACE 920 SHAFT IN 951 HOUSING USING THE FOLLOWING PROCEDURE TO REPLACE ALL AIR WITHIN THE HOUSING WITH FLOCO AE 9 LIGHT GEAR CASE OIL. HOLD HOUSING WITH SMALL DIAMETER DOWN WITH THE FINGER OVER THE END. INSERT SPOUTED OIL CAN, CONTAINING LIGHT OIL, INTO BEARING HOLE APPROXIMATELY 1/2". FILL CAVITY WITH OIL UNTIL IT ACTUALLY COMES THROUGH THE BEARING; WORK THE 920 SHAFT IN AND OUT A LITTLE UNTIL ALL BUBBLES DISAPPEAR, THEN INSERT 920 SHAFT ALL THE WAY.

CAUTION : DO NOT LAY THIS UNIT DOWN AFTER FILLING BUT PROCEED TO THE NEXT STEP, WITH THE HEAVY OIL.

19. REPLACING 951 HOUSING ASSEMBLY IN 925 GEAR CASE BLOCK.

NOTE: USE HEAVY OIL FOR THIS OPERATION ONLY. (SAE 90 GEAR OIL.)

A. COVER TOP OF 920 SHAFT FLANGE AND HOUSING WITH AS MUCH OIL AS THEY WILL RETAIN.

B. WHILE HOLDING THE VENT PLUG, TOOL NO. 12 (SEE FIG. 3) WITH THE GROOVE SHOWING, INVERT OIL COVERED HOUSING DIRECTLY INTO OIL FILLED GEAR CASE, PUSH DOWN FIRMLY UNTIL IT STOPS ON GEAR PINS. TURN 920 SHAFT WITH ASSEMBLY TOOL NO. 6 (SEE FIG. 3) SO SHAFT HOLES ENGAGE GEAR PINS. PUSH THE HOUSING PAST THE SNAP RING GROOVE WITH ASSEMBLY TOOL NO. 7 (SEE FIG. 3). OIL WILL BE FORCED OUT GROOVE ON VENT PLUG, TOOL NO. 12. NOW PUSH TOOL NO. 12 PAST GROOVE, WHILE YOU DO NEXT OPERATION.

C. REPLACE 936 SNAP RING IN GEAR CASE BLOCK GROOVE USING NO. 1 TRUARC PLIERS. CLEAN EXCESS OIL OUT ABOVE SNAP RING.

D. REPLACE 928 FELT WASHER OVER TOP OF SHAFT AND INTO RECESS. (RETAIN AS MUCH OIL AS POSSIBLE IN FELT.)

20. COMPLETING 952 TUBE ASSEMBLY.

A. SET GEAR CASE ON END WITH 917 TUBE UP AND REMOVE TOOL NO. 12. PLACE SMALL DIAMETER OIL CAN SPOUT DEEP INTO TUBE AND PUMP IN OIL AS SPOUT IS WITHDRAWN UNTIL 918 SHAFT IS COVERED.

B. USE TOOL NO. 13 (SEE FIG. 3) AS A RAM BY PLACING IN TUBE UNTIL IT TOUCHES OIL. THEN, WITH YOUR THUMB OVER THE HOLE IN THE END OF THE TOOL, FORCE TOOL NO. 13 DOWN. THIS WILL PUSH THE SEAL HOUSING OUT AGAINST THE 936 SNAP RING. NOW, REMOVE THUMB FROM HOLE IN END OF TOOL NO. 13, THEN REMOVE TOOL NO. 13 FROM TUBE AND REFILL TUBE TO TOP.

C. PLACE 651 O-RING ON 924 FLOATING BEARING.

D. WRAP A CLOTH AROUND THE TOP OF TUBE TO CATCH EXCESS OIL THAT WILL BE EXPELLED. WITH 651 O-RING DOWN, PLACE 924 FLOATING BEARING IN TUBE. USING TOOL NO. 8 (SEE FIG. 3), PRESS BEARING DOWN OVER 918 SHAFT UNTIL TOOL NO. 8 BOTTOMS ON TOP OF SHAFT. WIPE EXCESS OIL FROM INSIDE AND OUTSIDE OF TUBE.

E. USE A FILM OF OIL ON END OF ASSEMBLY TOOL NO. 9 (SEE FIG. 3) TO PICK UP NEW 935 O-RING AND PLACE IT IN TUBE, OVER SHAFT, INTO GROOVE IN 924 FLOATING BEARING. THE O-RING HAS TO SLIP PAST A SMALL SHOULDER. ROCK ASSEMBLY TOOL NO. 9 ON O-RING TO POSITION IN GROOVE. CLEAN OUT EXCESS OIL FROM TUBE AND INSPECT TO BE CERTAIN O-RING IS IN GROOVE.

F. Place tool no. 9 (see fig. 3) over 918 shaft and press firmly on 935 o-ring. With firm pressure on the tool, the top edge of the 917 tube should not be above the second groove on the tool.

Note: If the top edge of the tube is past the second groove, there is too much air in the AE 9, and the entire assembly procedure must be repeated.

21. Installation of 942 register adapter (bowl).

A. Place bowl on bench upside down. While in this position, install 954 springs in their recesses and 951 seal housing through center hole of bowl.

B. While holding these two assemblies together, turn right side up and install 944 gasket over 951 housing.

C. Install 943 seal washer with bevel side down against 944 gasket.

D. Installation of 945 snap ring.

Note: This snap ring has to be hammered into position with Floco tool no. 11 (see fig. 3); however, before hammering, the 935 o-ring has to be held in position. To do this, insert tool no. 9 (see fig. 3) against 935 o-ring and press against an immovable hard object. While holding pressure against the o-ring, hammer 945 snap ring into position. When 945 snap ring is properly installed, the space between the open ends of snap ring will measure approximately .050". If this space is too wide, repeat preceding steps. If pressure was not maintained against 935 o-ring, it is possible the hammer blow has dislodged it.

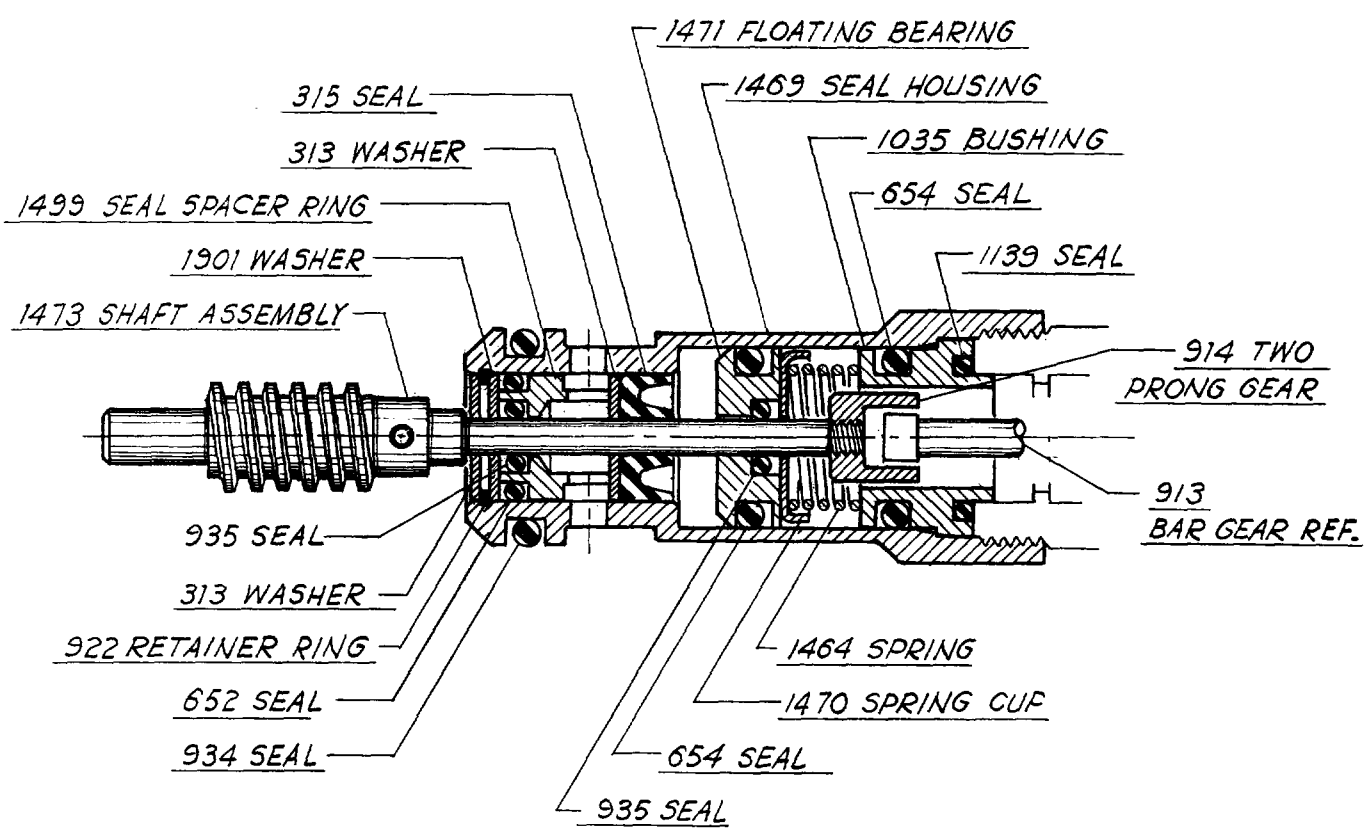
E. Recheck position of 935 o-ring with tool no. 9.

F. Drop 914 2-prong gear into hole with prongs up. Turn gear with assembly tool no. 10 (see fig. 3) until the gear threads on shaft all the way through its threaded portion.

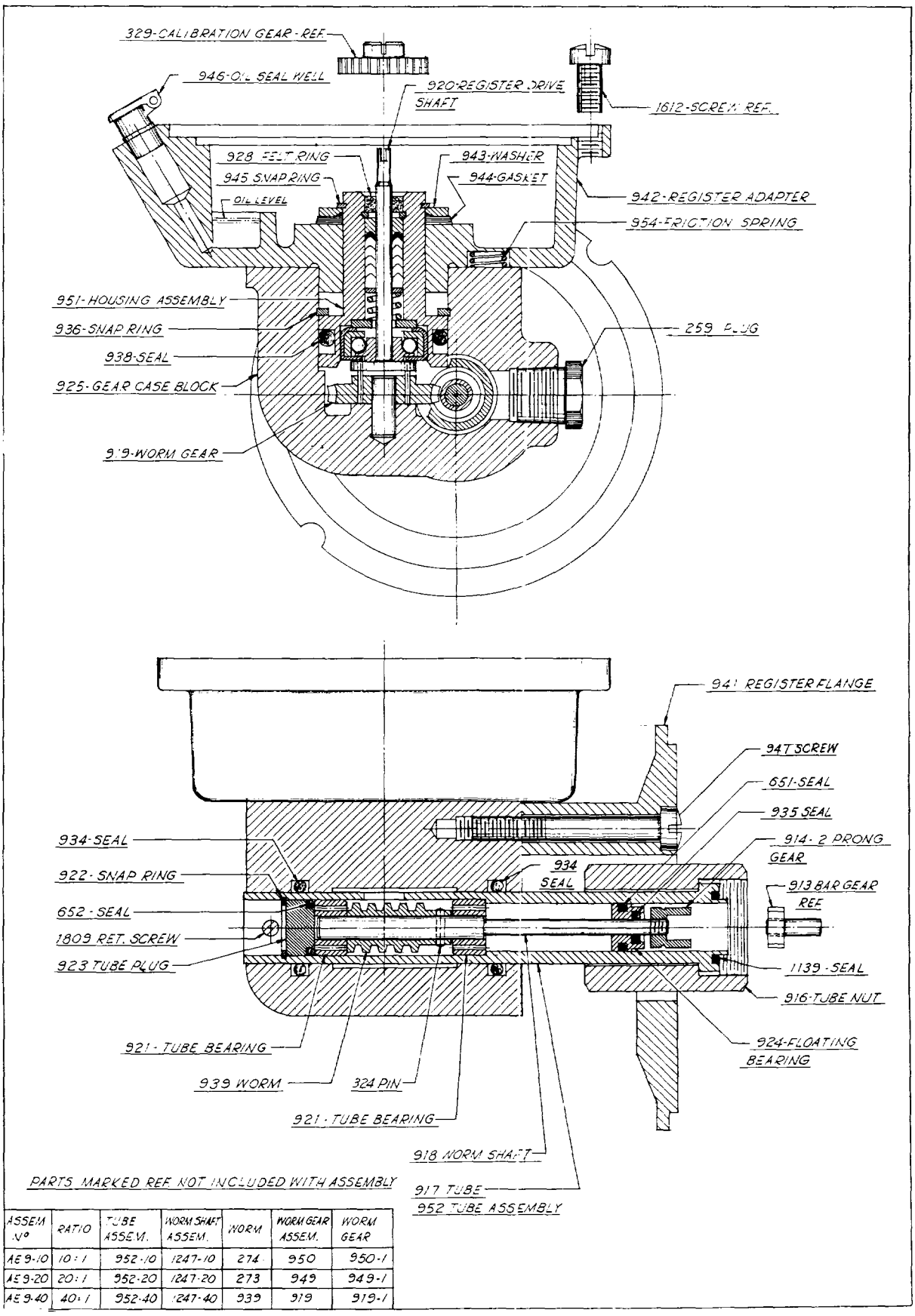
G. Replace 941 register flange with 947 screws.

H. Replace 329 calibration gear and register.

The AE 9 gear case assembly and register are now ready to place on meter.



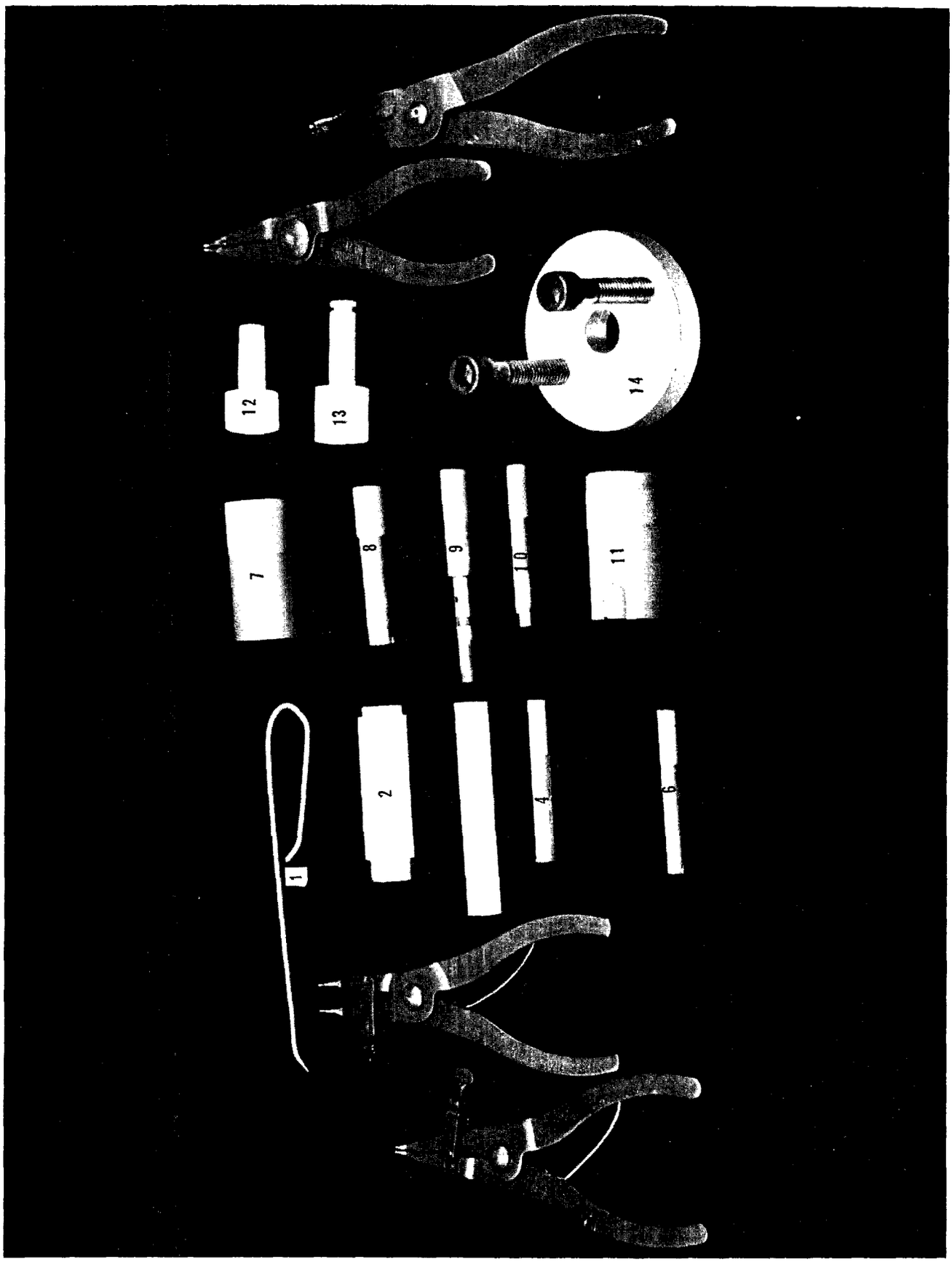
LOW PRESSURE SEAL
FIG. 1



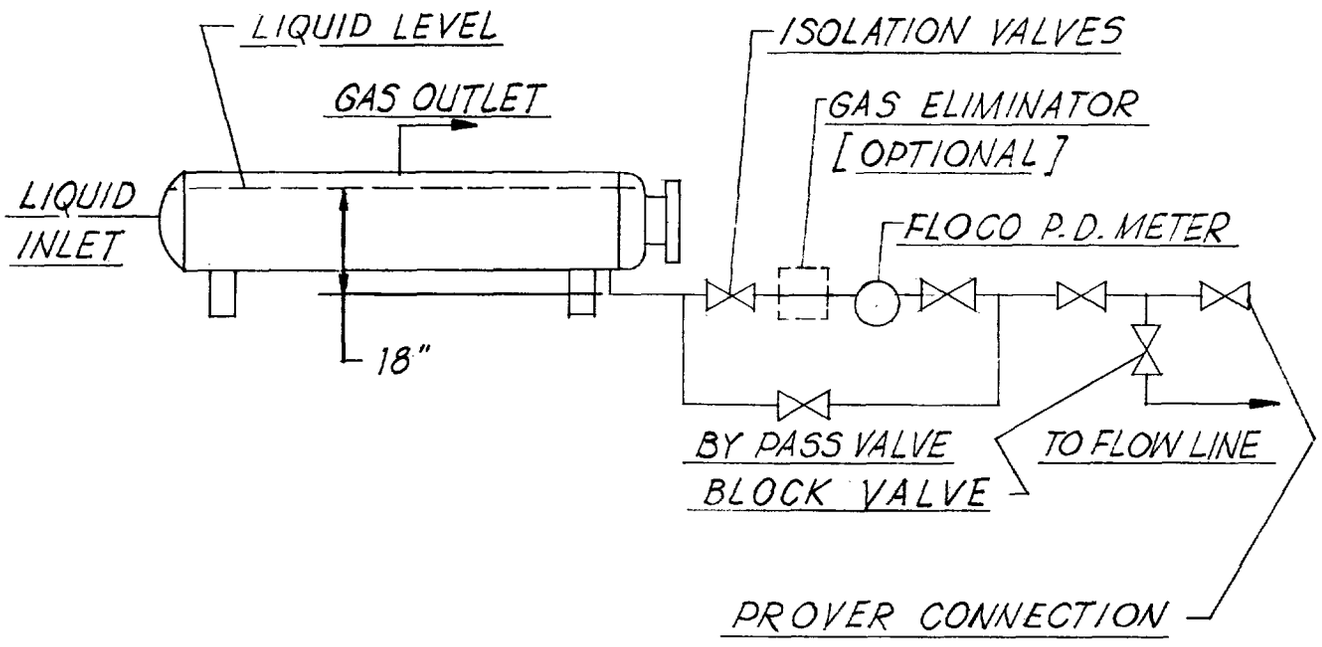
PARTS MARKED REF NOT INCLUDED WITH ASSEMBLY

ASSEM. N°	RATIO	TUBE ASSEM.	WORM SHAFT ASSEM.	WORM	WORM GEAR ASSEM.	WORM GEAR
AE 9-10	10:1	952-10	1247-10	274	950	950-1
AE 9-20	20:1	952-20	1247-20	273	949	949-1
AE 9-40	40:1	952-40	1247-40	939	919	919-1

AE 9 GEAR CASE ASSEMBLY
FIG. 2



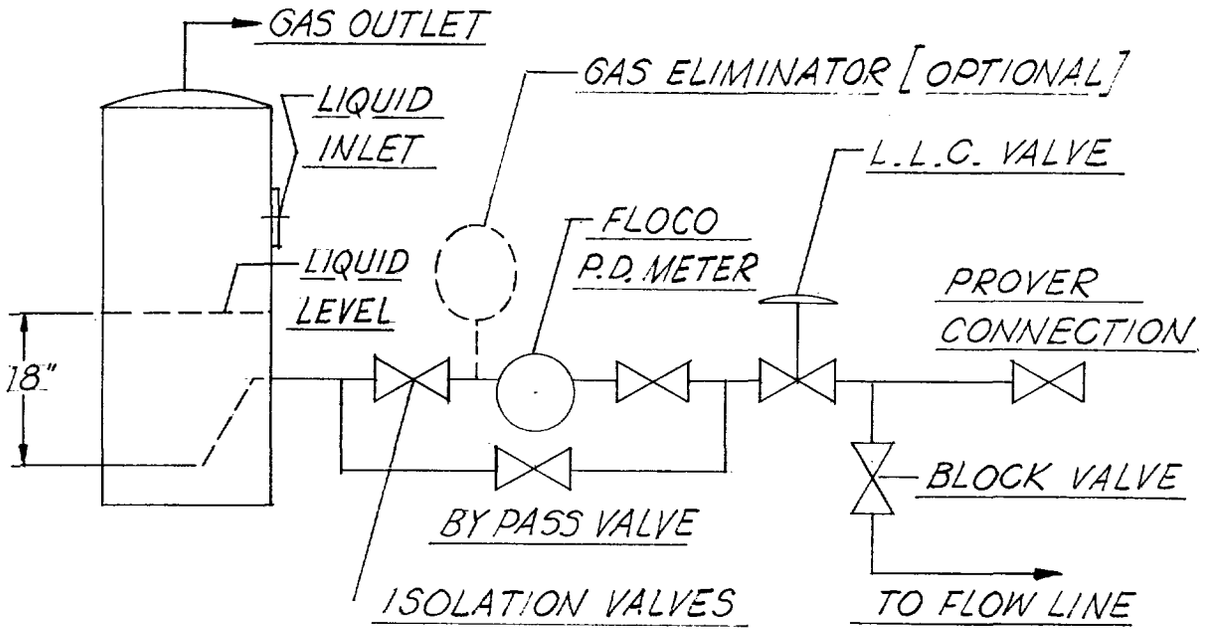
AE 9 SPECIAL TOOLS
FIG. 3



START-UP

1. OPEN BYPASS VALVE AND BLOCK VALVE. CLOSE ISOLATION VALVES AND PROVER CONNECTION.
2. ALLOW SUFFICIENT FLOW THROUGH BYPASS LOOP TO PURGE VESSEL AND PIPING OF GAS AND DEBRIS.
3. SET LIQUID LEVEL CONTROL VALVE TO MAINTAIN MAXIMUM HEIGHT PRACTICABLE ABOVE OIL OUTLET.
4. SLOWLY OPEN UPSTREAM ISOLATION VALVE TO EQUALIZE PRESSURE AND CHARGE FLOCO P.D. METER.
5. SLOWLY OPEN DOWNSTREAM ISOLATION VALVE TO PERMIT METER TO OPERATE.
6. CLOSE BYPASS VALVE.

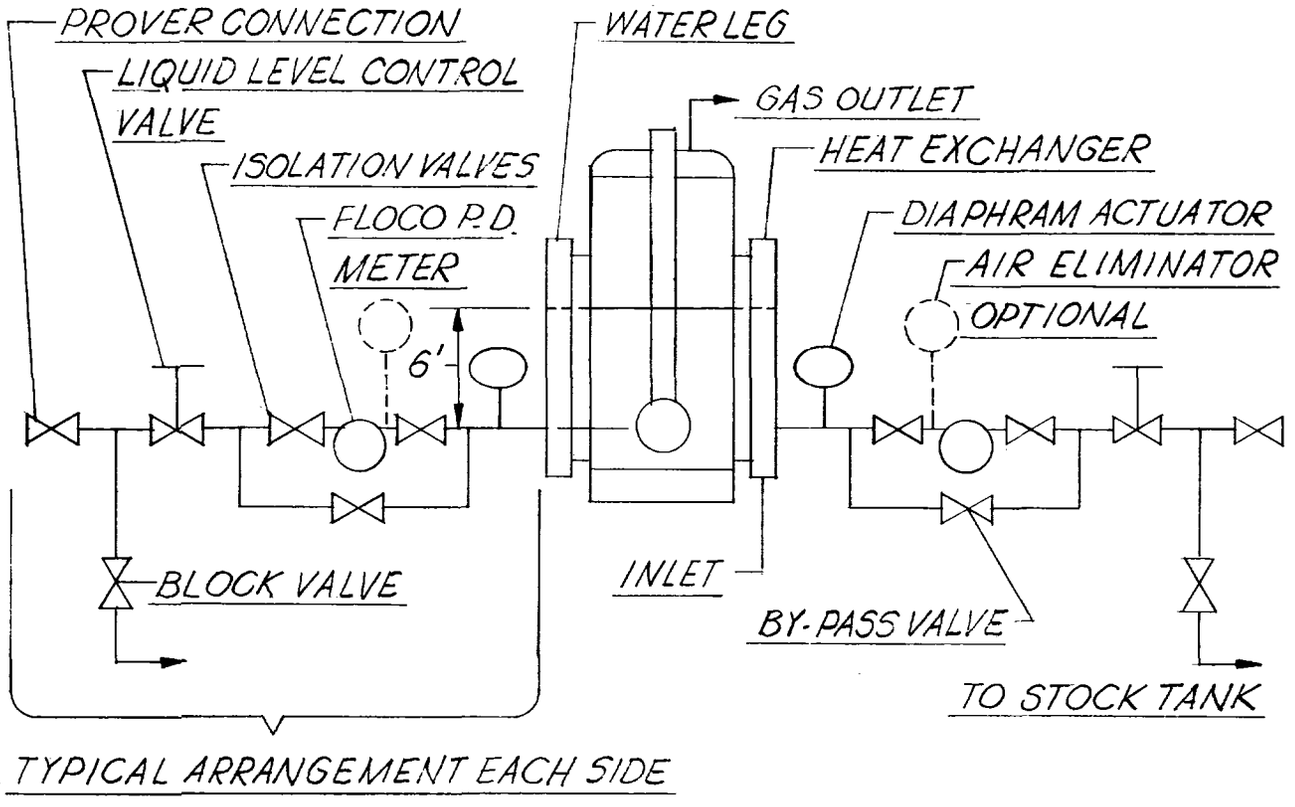
HORIZONTAL SEPARATOR, LIQUID FLOW
FIG. 4



START-UP

1. Open bypass valve and block valve. Close isolation valves and prover connection.
2. Allow sufficient flow through bypass loop to purge vessel and flow lines of gas and debris.
3. Set liquid level control valve to maintain a minimum level of 18" above oil outlet.
4. Slowly open upstream isolation valve to equalize pressure and charge the Floco P.D. Meter.
5. Slowly open downstream isolation valve to permit meter to operate.
6. Close bypass valve.

VERTICAL SEPARATOR, LIQUID FLOW
FIG. 5

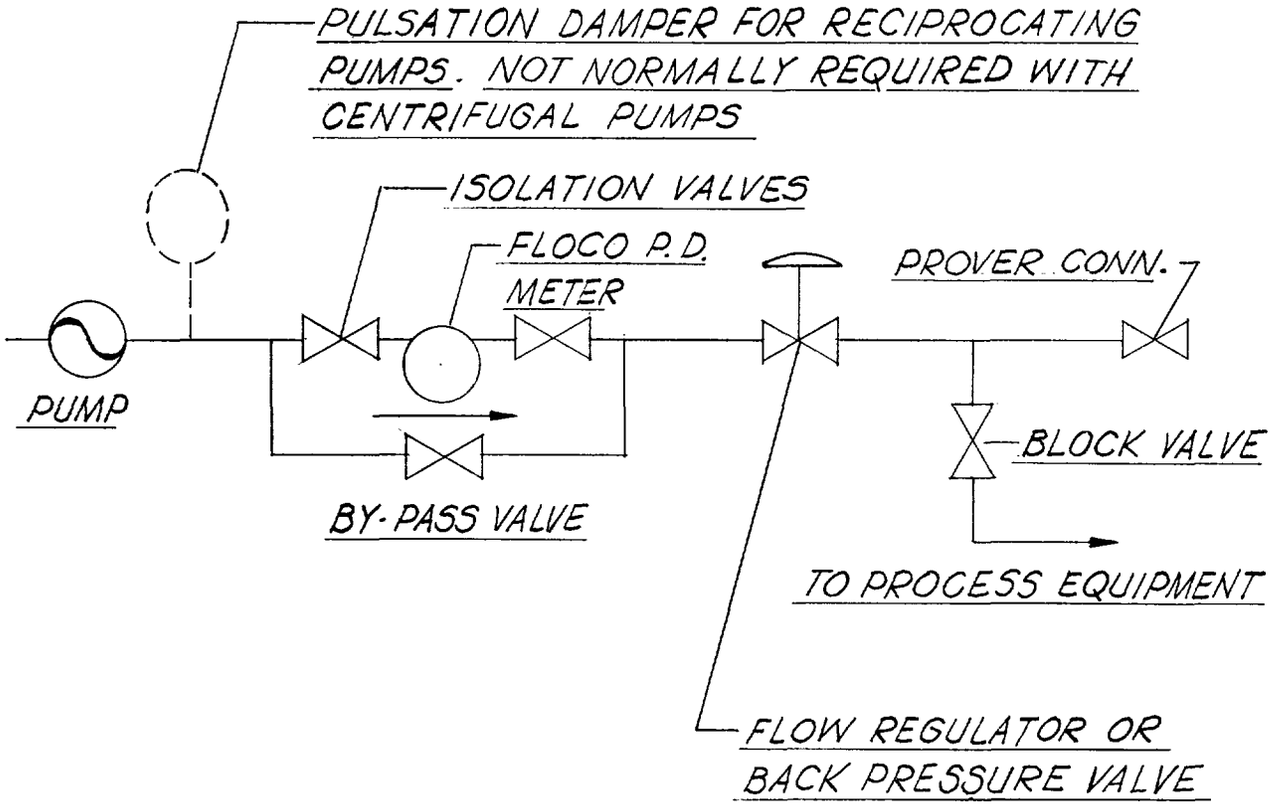


START-UP

1. Close all valves until liquid level has been established in treater.
2. Open both block valves and bypass valves.
3. Allow sufficient flow to purge lines of gas and debris.
4. Set liquid level controls on each side to maintain a minimum height of 6 feet above liquid outlet.

   Caution : Water leg and oil leg should be approximately two pipe diameters, or 4" OD minimum.
5. Open upstream isolation valves slowly to permit pressure to equalize and to charge Floco P. D. Meter.
6. Open downstream valves to permit meter to operate.
7. Close bypass valves.

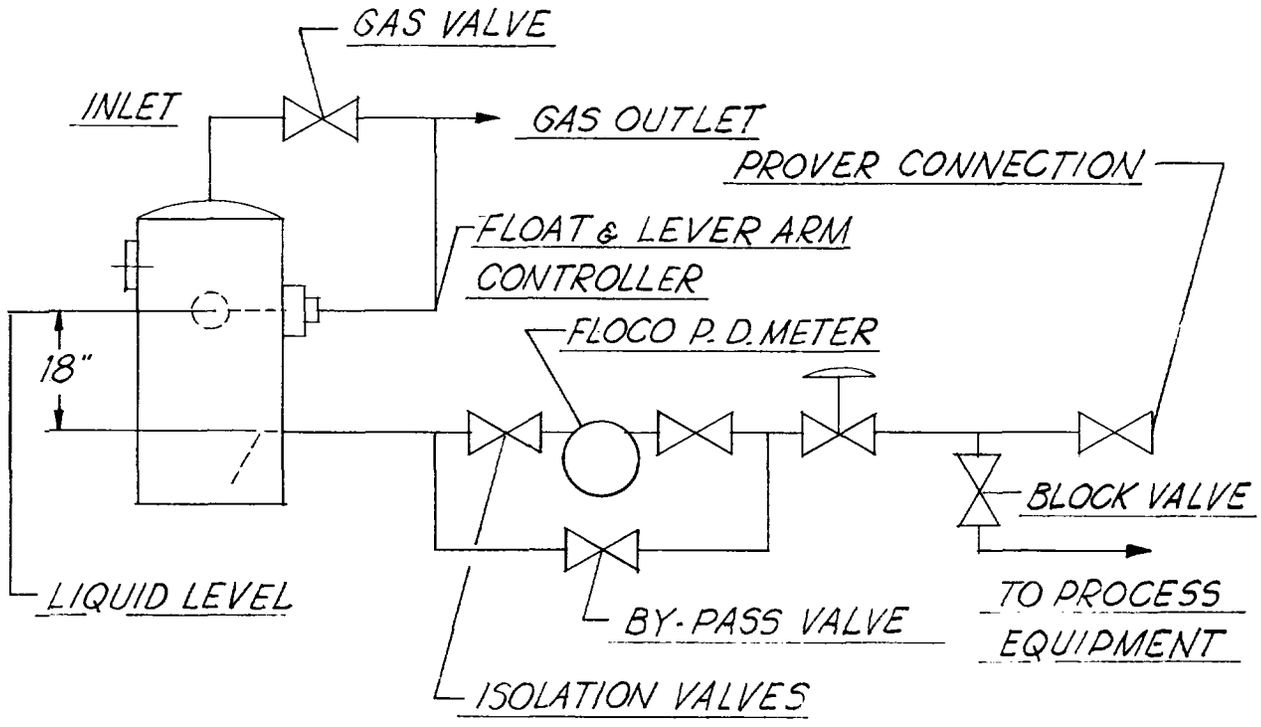
OIL TREATER, LIQUID FLOW
FIG. 6



START-UP

1. OPEN BYPASS VALVE AND BLOCK VALVE. CLOSE ISOLATION VALVES AND PROVER CONNECTION.
2. START PUMP, AND SET BACK PRESSURE VALVE TO CONTROL FLOW RATE OR BACK PRESSURE.
3. ALLOW SUFFICIENT FLOW THROUGH BYPASS LOOP TO PURGE FLOW LINES OF GAS AND DEBRIS.
4. OPEN UPSTREAM ISOLATION VALVE SLOWLY TO EQUALIZE PRESSURE AND CHARGE FLOCO P.D. METER.
5. OPEN DOWNSTRAM VALVE SLOWLY TO PERMIT METER TO OPERATE.
6. CLOSE BYPASS VALVE.

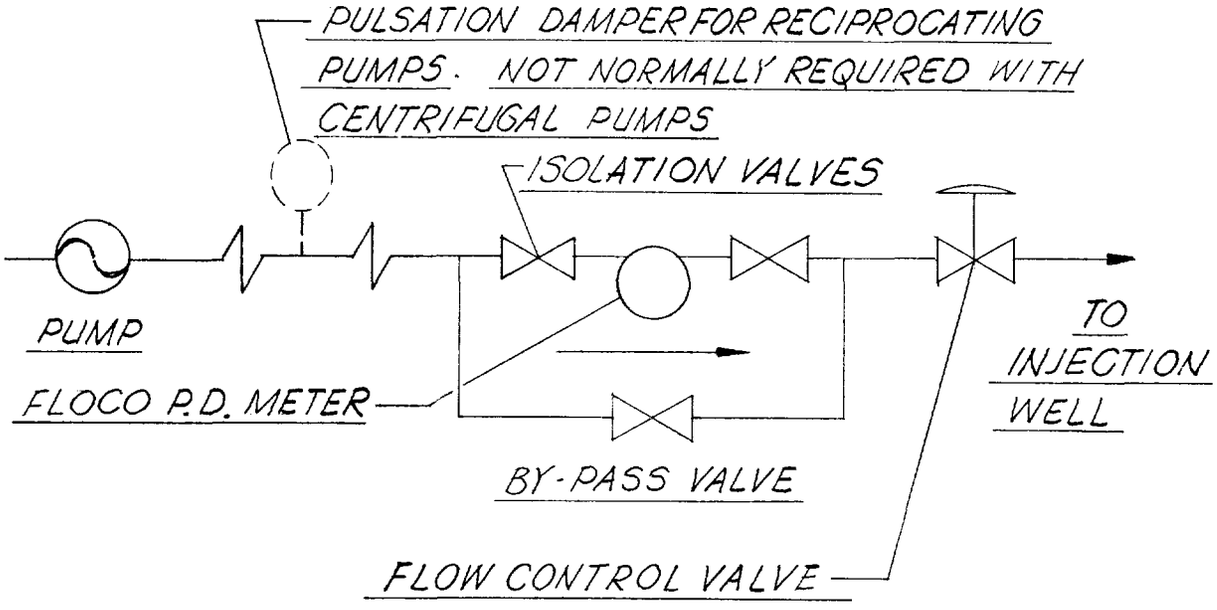
FLOW LINE, LIQUID FLOW
FIG. 7



START-UP

1. Close prover connection and isolation valves. Open bypass valve and block valve.
2. Allow sufficient flow through bypass loop to purge the vessel and piping of excessive gas and debris.
3. Adjust lever arm float controller to open gas valve when liquid level falls below 18" above oil outlet. Set back pressure valve to correct back pressure.
4. Open upstream isolation valve slowly to equalize pressure and charge the Floco P.D. Meter.
5. Open downstream isolation valve slowly to permit meter to operate.
6. Close bypass valve.

GAS ELIMINATOR, LIQUID FLOW
FIG. 8



START-UP

1. Close isolation valves. Open bypass valve and flow control valve.
2. Start pump and allow sufficient flow through bypass loop to purge flow line of air, gas, and debris.
3. Open upstream isolation valve slowly to equalize pressure and charge Floco P.D. Meter.
4. Open downstream isolation valve slowly to permit Floco meter to operate.
5. Close bypass valve.
6. Set proper flow rate by adjusting flow control valve.

WATER INJECTION, LIQUID FLOW
FIG. 9

TROUBLE SHOOTING SUGGESTIONS FLOCO P.D. METERS

NOTE: VISUAL INSPECTION OF THE ROTOR ASSEMBLY AND LOW PRESSURE SEAL ASSEMBLY WILL SHOW MOST CAUSE FOR MALFUNCTIONS IN THE FLOCO METERS.

TROUBLE	POSSIBLE SOURCES	MALFUNCTION	REMEDY
NO FLOW INDICATION ON REGISTER	ROTOR HINGE	HINGE BROKEN.	*REPLACE HINGE.
	LPS	LOST OIL SEAL.	*REPAIR OR REPLACE LPS.
	AE 9 GEAR CASE ASSEMBLY	LOST OIL SEAL OR PRESSURIZED GEAR CASE.	*REPAIR OR REPLACE AE 9.
	ROTOR SHAFT	BROKEN SHAFT, WORN FLATS ON ROTOR SHAFT.	*REPLACE ROTOR HUB IF WEAR IS SEVERE, AND REPLACE 2-PRONG GEAR IN LPS OR AE 9.
			* INSPECT BEARING SURFACES; WEAR COULD BE CAUSE OF THESE FAILURES.
LOW FLOW INDICATION	BYPASS VALVES	LEAKY VALVE.	REPAIR OR REPLACE VALVE.
	WEARPLATES	EXCESSIVE WEAR.	REVERSE OR REPLACE WEARPLATES.
	CALIBRATION GEARS	WORN OR INCORRECT GEARS.	**REPLACE GEARS.
	BRIDGE SEALS	WORN SEALS.	REPLACE BRIDGE SEALS.
	ROTOR HINGE	WORN OR BROKEN HINGES.	REPLACE HINGES.
			** ON LOW FLOW RATES OR LOW VISCOSITY LIQUIDS A VARIETY OF CALIBRATION GEARS ARE AVAILABLE TO OBTAIN ACCURACY OF 100 PERCENT PLUS OR MINUS 1/2 PERCENT.
HIGH FLOW INDICATION	GAS IN LIQUID	EXCESSIVE SPINNING OF ROTOR.	INSTALL GAS ELIMINATOR AHEAD OF METER, OR RAISE LIQUID LEVEL IN VESSEL TO SUFFICIENT HEIGHT TO PREVENT GAS BLOW. ALSO INSPECT ROTOR ASSEMBLY FOR WEAR AND DAMAGE.

FIG. 10

PART NO. AND NAME	INSPECTION	PROBABLE CAUSE
WORM	IF THE TOP OF THE TEETH ARE THIN OR SHARP, ESPECIALLY IN THE CENTER AREA, REPLACE.	WATER GETTING INTO WORM AND WORM GEAR AREA OR MISALIGNMENT BETWEEN WORM AND WORM GEAR. WRONG WORM AND WORM GEAR RATIO.
	NOTE: IF EITHER THE WORM OR WORM GEAR NEED REPLACING DUE TO NORMAL WEAR, BOTH SHOULD BE REPLACED.	IF LPS HAS BEEN IN SERVICE FOR SOME-TIME, WEAR OF THE TEETH WOULD BE CLASSED AS NORMAL.
313 WASHERS	CHECK FOR "EGG" SHAPED BORE, IF FOUND REPLACE.	BADLY WORN ROTOR BEARINGS OR ROTOR SHAFT.
315 U-CUP	REPLACE THIS U-CUP SEAL EVERYTIME THE UNIT IS REPAIRED	
652 SEAL	CHECK O-RINGS THOROUGHLY FOR ANY CUTS OR GOUGES, IF FOUND, REPLACE.	OCCASIONALLY O-RING WILL BE PINCHED BETWEEN THE 1499 SPACER RING AND THE 1469 HOUSING DURING DISASSEMBLY OPERATION NO. 5
654 SEAL	THESE TWO O-RINGS SHOULD BE REPLACED EVERY TIME THE UNIT IS REPAIRED.	
914 OR 687 2-PRONG GEAR	IF END OF PRONGS SHOW WEAR FROM RIDING OVER END OF ROTOR SHAFT, REPLACE.	WEAR OF OTHER PARTS, SUCH AS BEARINGS.
922 RETAINING RING	IF RING IS DISTORTED OR CORRODED, IT SHOULD BE REPLACED.	
934 SEAL	CHECK OUTSIDE DIAMETER OF THIS O-RING FOR SMALL GOUGES OR CUTS, REPLACE IF FOUND.	THE REGISTER ADAPTER OR SAMPLER BODY CAN PINCH OUT SMALL PIECES OF THE O-RING DURING INITIAL ASSEMBLY OF LPS IF CARE IS NOT EXERCISED.
935 SEAL	THESE TWO O-RINGS SHOULD BE REPLACED EVERY TIME THE UNIT IS REPAIRED.	
1035 BUSHING	INSPECT O-RING GROOVES FOR NICKS OR ROUGH PLACES, REPLACE IF FOUND.	CORROSION OR IMPROPER ASSEMBLY.
1139 SEAL	IF O-RING IS GOUGED OR CUT, REPLACE.	LPS NOT BEING TIGHT WHEN THE METER IS PLACED IN SERVICE OR LOOSENING AND RE-TIGHTENING OF THE LPS WHILE THE METER IS UNDER PRESSURE.
1464 SPRING	IF SPRING APPEARS TO BE WEAK OR BROKEN, REPLACE.	NORMAL WEAR IF WEAK. CORROSION OR IMPROPER ASSEMBLY IF BROKEN.
1467 AND 1468 SHAFT	ANY WEAR THAT CAN BE FELT WITH YOUR FINGERNAIL IS CAUSE FOR REPLACEMENT. THIS ROUGHNESS WILL CAUSE EXCESSIVE WEAR OF 935 O-RINGS AND PREMATURE NEED FOR REPAIR.	IF WEAR PATTERN IS EVEN, THIS IS NORMAL WEAR. IF PATTERN IS UNEVEN THIS IS A RESULT OF WORN SIDEPLATE OR ROTOR BEARINGS.
1469 HOUSING	IF THERE IS ANY EVIDENCE OF PITS OR ROUGHNESS IN THE BORE, REPLACE.	PITS ARE CAUSED BY CORROSION. ROUGH-NESS OR GROOVES CAUSED BY ROTOR BEARING OR ROTOR SHAFT WEAR.
1470 SPRING CUP	IF EDGES ARE BROKEN OR SMALL HOLE IN CENTER IS "EGG" SHAPED, REPLACE.	EDGES BROKEN, CORROSION OR IMPROPER ASSEMBLY. "EGG" SHAPED HOLE INDICATES WORN ROTOR BEARINGS.
1471 FLOATING BEARING	IF THE SMALL BORE SHOWS EXCESSIVE WEAR, REPLACE.	WEAR IN THE BORE OF THE BEARING INDICATES WORN ROTOR BEARINGS OR WORN ROTOR SHAFT.
1499 SEAL SPACER RING	CHECK O-RING GROOVES FOR NICKS OR ROUGH PLACES. REPLACE IF FOUND.	WATER AND/OR FOREIGN PARTICLES GETTING INTO BACK OF SEAL.
1901 WASHER	CHECK FOR "EGG" SHAPED BORE, IF FOUND, REPLACE.	WORN ROTOR BEARINGS OR ROTOR SHAFT.

LOW PRESSURE SEAL PARTS INSPECTION PROCEDURE
FIG. 11

PART NO. AND NAME	INSPECTION	PROBABLE CAUSE
1139 SEAL	IF O-RING HAS A FRINGE OR LITTLE LOOSE SLIVERS OF RUBBER ON THE OUTSIDE DIAMETER, REPLACE.	916 NUT NOT BEING TIGHT WHEN METER IS PUT INTO SERVICE OR THE LOOSENING AND RETIGHTENING OF 916 NUT WHILE THE METER IS STILL UNDER PRESSURE.
914 2-PRONG GEAR	IF END OF PRONGS SHOW WEAR FROM RIDING OVER 913 BAR GEAR OR END OF ROTOR SHAFT, REPLACE.	WEAR OF OTHER PARTS.
935 SEAL	THIS O-RING SHOULD BE REPLACED EVERY TIME THE UNIT IS REPAIRED.	
651 SEAL	IF O-RING HAS A FRINGE OR LITTLE LOOSE SLIVERS OF RUBBER ON THE OD, REPLACE.	924 FLOATING BEARING JAMMING AGAINST 921 TUBE BEARING.
918 WORM SHAFT	ANY VISIBLE WEAR THAT CAN BE FELT WITH THE FINGERNAIL IS CAUSE FOR REPLACEMENT. THIS ROUGHNESS WILL CAUSE EXCESSIVE WEAR OF 935 O-RING AND PREMATURE NEED FOR REPAIR.	IF WEAR PATTERN IS EVEN, THIS IS NORMAL WEAR. IF WEAR PATTERN IS UNEVEN, THIS IS RESULT OF WORN SIDEPLATE OR ROTOR BEARINGS.
939 WORM	IF CENTER TEETH OF THE WORM ARE NOTICEABLY THINNER THAN THE REST, IT SHOULD BE REPLACED. (SEE NOTE ON 919 WORM GEAR.	NORMAL WEAR.
919 WORM GEAR	IF TEETH ARE VISIBLY THINNER THAN A NEW GEAR, IT SHOULD BE REPLACED.	NORMAL WEAR.
	IF MOST OF THE TEETH LOOK GOOD AND ONE OR TWO TEETH ARE BENT, REPLACE. NOTE: IF EITHER THE 939 WORM OR 919 WORM GEAR NEEDS REPLACING FROM NORMAL WEAR, THEY SHOULD BOTH BE REPLACED.	IMPROPER REMOVAL FROM METER OR ATTEMPTING TO REMOVE 917 TUBE BEFORE 919 WORM GEAR.
652 O-RING	CHECK AROUND OUTSIDE OF O-RING. IF ANY PORTION OF O-RING IS MISSING, REPLACE.	OCCASIONALLY O-RING WILL BE PINCHED BETWEEN 921 TUBE BEARING AND 922 SNAP RING GROOVE, DURING DISASSEMBLY OPERATION.
923 TUBE PLUG	IF THE TUBE PLUG SHOWS A WEAR PATTERN FROM THE 921 BEARING OR 918 SHAFT, REPLACE.	EXCESSIVE THRUST ON 918 SHAFT CAUSED BY 924 FLOATING BEARING WHEN IT REACHES 921 TUBE BEARING.
922 SNAP RING	IF RING IS DISTORTED OR CORRODED IT SHOULD BE REPLACED.	
934 SEAL	CHECK THE INSIDE DIAMETER OF THESE O-RINGS FOR SMALL GOUGES. IF FOUND, REPLACE.	THE 917 TUBE CAN PINCH OUT SMALL PIECES OF THE O-RING DURING ASSEMBLY OR DISASSEMBLY IF CARE IS NOT EXERCISED, SINCE THE OPENINGS OF 917 TUBE PASS OVER O-RINGS.
920 REGISTER DRIVE SHAFT	SAME AS 918 SHAFT (ANY VISIBLE WEAR THAT CAN BE FELT WITH FINGERNAIL), REPLACE. SEE NOTE ON 951 ASSEMBLY.	NORMAL WEAR. (THIS WEAR IS GREATLY ACCELERATED WHEN WATER GETS IN THE GEAR CASE.)
951 HOUSING ASSEMBLY	NOTE: THIS ASSEMBLY SHOULD ALWAYS BE REPLACED WHENEVER THE 920 SHAFT IS REPLACED DUE TO WEAR, EVEN IF IT HAS NOT LEAKED.	IF THIS USED SEAL IS REASSEMBLED WITH A NEW SHAFT, IT WILL PROBABLY LEAK RESULTING IN ANOTHER REPAIR VERY SOON.
	IF THE BALL THRUST BEARING IS ROUGH OR FROZEN, REPLACE 951 ASSEMBLY.	WATER IN THE GEAR CHAMBER.
917 TUBE	AFTER TUBE IS CLEAN AND DRY LOOK FOR PITS OR GROOVES IN THE BORE WHERE THE FLOATING BEARING RIDES. IF EITHER IS PRESENT IN AREA BETWEEN THE 924 FLOATING BEARING AND THE 921 TUBE BEARING AS SHOWN IN FIG. 2, REPLACE.	PITS BY CORROSION. (EARLIER MODELS WERE NOT STAINLESS STEEL.) GROOVES CAUSED BY EXCESSIVE SIDEPLATE OR ROTOR BEARING WEAR.

AE 9 PARTS INSPECTION PROCEDURE
FIG. 12

Floco® Positive Displacement Meter

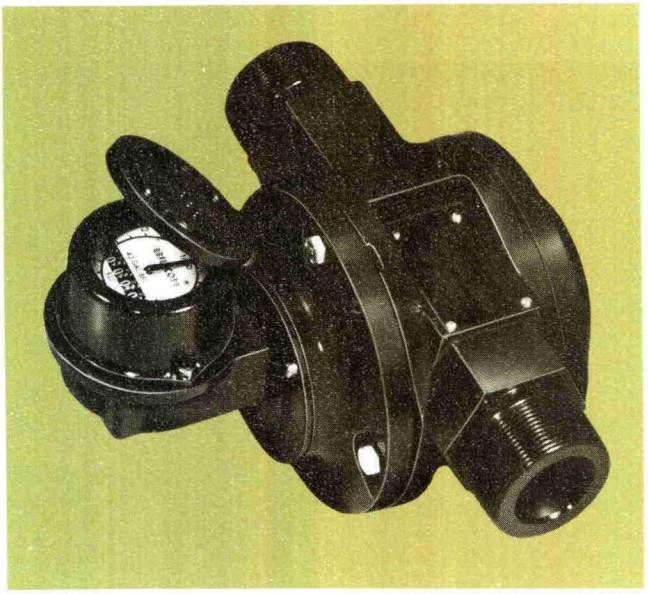
Product Description The *Floco* Meter is designed to meter mildly corrosive and abrasive liquids accurately, with a minimum of attention and maintenance. The meter was originally marketed specifically for oil field metering of salt water and sour crude oil commingled with abrasive sediments. However, its long life and dependable accuracy under these adverse metering conditions has led to its quick acceptance in meeting the demand for a compact rugged meter in many other industries.

The success of the *Floco* meter is primarily based on the unique rotor design. Elimination of metal to metal contact reduces wear and maintains the close tolerances necessary for sustained accuracy.

The *Floco* meter is never obsolete. Continuity of parts design permits low cost modernization through past, present and future improvements.

Operation The *Floco* meter is a positive displacement meter which measures the liquid passing through it by separating the liquid into segments and counting them. Liquid enters through the inlet port of the meter and strikes the bridge. The bridge deflects the liquid downward to strike the rotor blades and turn the rotor. The liquid passes out of the outlet port, which is in direct line with the inlet port. The unique rotor design allows solid particles and sediment to pass through the meter without causing damage or malfunction. Bridge seats prevent liquid from passing to the outlet port without being measured.

Accuracy All *Floco* meters are calibrated at the factory with hydraulic oil having a specific gravity of 0.935 at 60°F (21° API) and a viscosity of 110 SSU at 100°F. When metering liquids of other properties, if accuracy within $\pm\frac{1}{2}\%$ is required, it is recommended that the meter be calibrated on stream. Calibration corrections, if required, may be easily made by changing calibration gears, even while the meter is in operation. Once calibrated, the accuracy and repeatability of the meter is unexcelled.



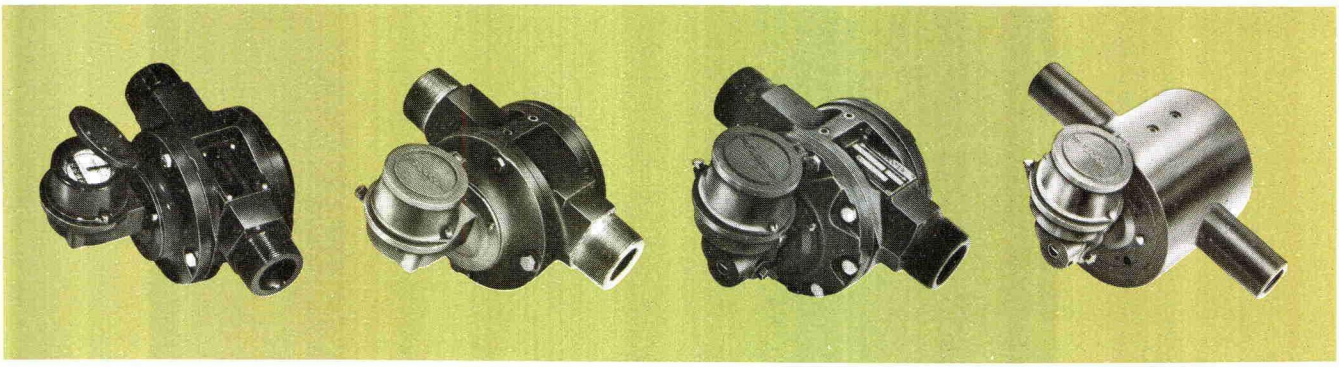
F 500-2

Application A wide variety of liquids are successfully metered with the *Floco* meter. Its versatility is indicated by the following partial list of liquids it can handle:

Acetate Solutions	Coffee	Petrolatum
Alcohol	Corn Syrup	Shellac
Ammonia Solutions	Crude Oil	Soap
Asphalt Emulsion	Kerosene	Sodium Chloride
Brine	Liquor	Starch Solutions
Bunker C Oil	Paint	Vinegar
Castor Oil	Paraffin	Water

Maintenance *Floco* meters may be serviced without removal from the line. No special tools are required to maintain a *Floco* meter. Each meter is shipped with an assembly drawing and parts list which enables untrained personnel to service any *Floco* meter. Field experience has proven that *Floco* meters may be economically maintained in the toughest service.

Floco Meters



Carbon Steel 500 Lb. | **316 S. S. 500 Lb.** | **Carbon Steel 2500 Lb.** | **Carbon Steel 5000 Lb.**

Floco meters are available in a wide range of models, with pressure ratings to 5000 psi. They have an operating temperature range of −30°F to +180°F (to +350°F on special order), and flow rate capacity from 1 GPM to 90 GPM based upon 20° API gravity oil.

The *Floco* meter can be furnished to register in almost any units of measurement desired. Standard units are U.S. gallons or 42 gallon barrels. Registration in other units, such as Imperial gallons or barrels, cubic meters or liters, is available on special order.

To meet special corrosion or sanitary requirements, the F500-2 meter is now available in all 316 stainless steel, with special elastomers on the rotor.

As illustrated below, the *Floco* meter consists of four basic parts: Body, rotor, sideplates, and register with gear case assembly. An important feature is almost complete interchangeability of spare parts in all pressure ratings.

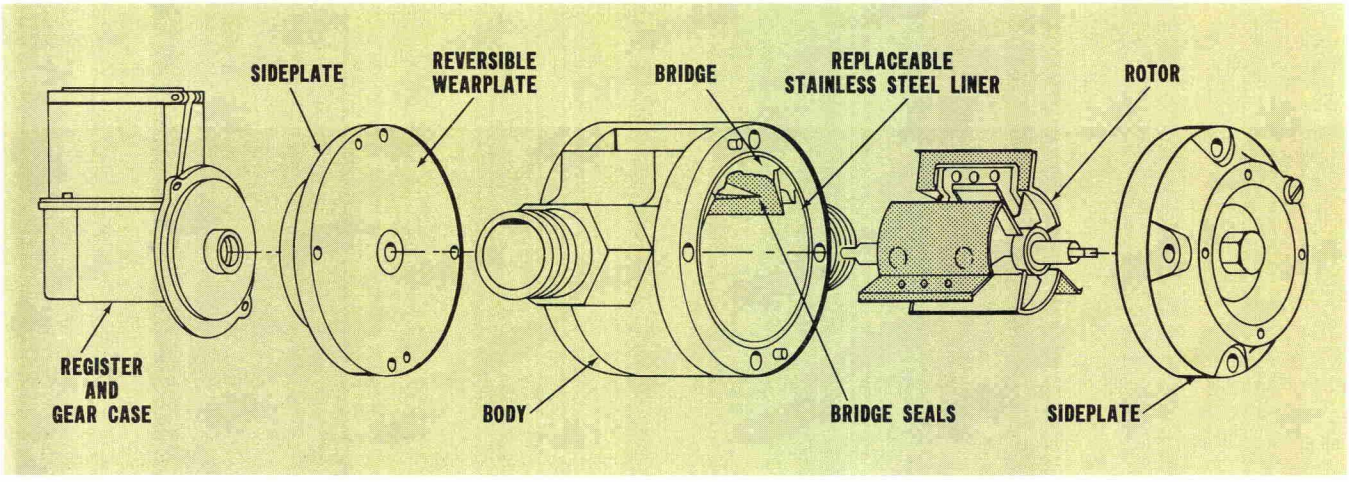
Construction

Bodies available in carbon steel or 316 stainless steel with a field replaceable, stainless steel liner. The polished liner assures a low-friction seal with the rotor blades. Standard connections are 1″ female, 2″ and 3″ male NPT threads, or 2″ grooved ends. Flanged ends are available on special order.

Rotor is precision balanced, and has specially treated and ground bearing areas on the shaft. It is constructed of 316 stainless steel and the highest quality synthetic compounds to assure long life and sustained accuracy. Special 316 stainless steel and Teflon rotor is available for specific applications.

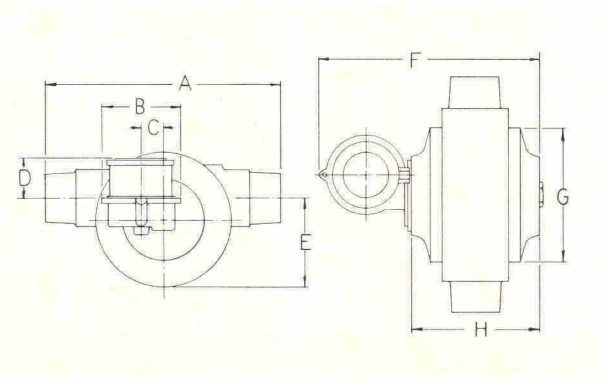
Sideplates do not contact the metered liquid. The sideplate assembly includes a reversible, stainless steel wearplate, which is easily replaced in the field. Rotor bearings are of low-friction corrosion-resistant material, and require no lubrication. No special tools are required for bearing replacement.

Register and Gear Case Assembly is sealed from contact with the metered liquid, thus assuring accurate registration and long life.



General Specifications

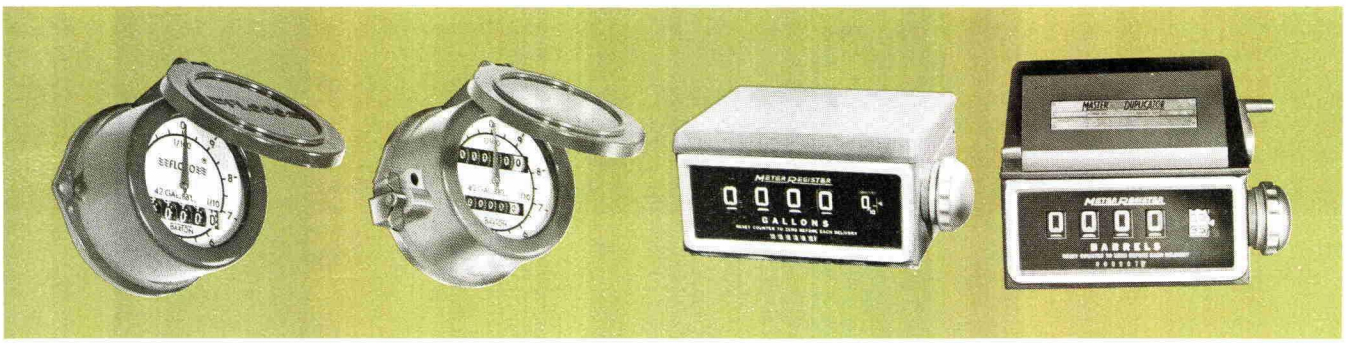
Model	N. P. T. Pipe Size	Capacity G. P. M. Min.	Capacity G. P. M. Max.	Max. Temp. Fahr.	Max. W. P.	Approx. Net Weight
F500-1	1" FEMALE	1	60	180	500	31
F500-2	2" MALE	1	60	180	500	31
F500-3	3" MALE	3	90	180	500	47
F500-1 S.S.	1" FEMALE	1	60	180	500	43
F500-2 S.S.	2" MALE	1	60	180	500	41
F500-3 S.S.	3" MALE	3	90	180	500	59
F2500-1	1" FEMALE	1	60	180	2500	37
F2500-2	2" MALE	1	60	180	2500	37
F2500-3	3" MALE	3	90	180	2500	52
F5000-1	1" FEMALE	1	60	180	5000	44



Dimensions
(inches)

Model	A	B	C	D	E	F	G	H
F500-1	10	3½	1	1⅞	4	9 13/16	6	5¾
F500-2	10½	3½	1	1⅞	4	9 13/16	6	5¾
F500-3	12	3½	1	1⅞	4	12 13/16	6	8¾
F500-1 S.S.	10	3½	19/32	2 15/16	4	9 13/16	6	5¾
F500-2 S.S.	10½	3½	19/32	2 15/16	4	9 13/16	6	5¾
F500-3 S.S.	12	3½	19/32	2 15/16	4	12 13/16	6	8¾
F2500-1	10	3½	19/32	2 15/16	4	9 13/16	6	5¾
F2500-2	10½	3½	19/32	2 15/16	4	9 13/16	6	5¾
F2500-3	12	3½	19/32	2 15/16	4	12 13/16	6	8¾
F5000-1	12½	3½	19/32	3 7/16	3½	9 15/16	6	6

Registers



331 **2351** **1608** **1609**

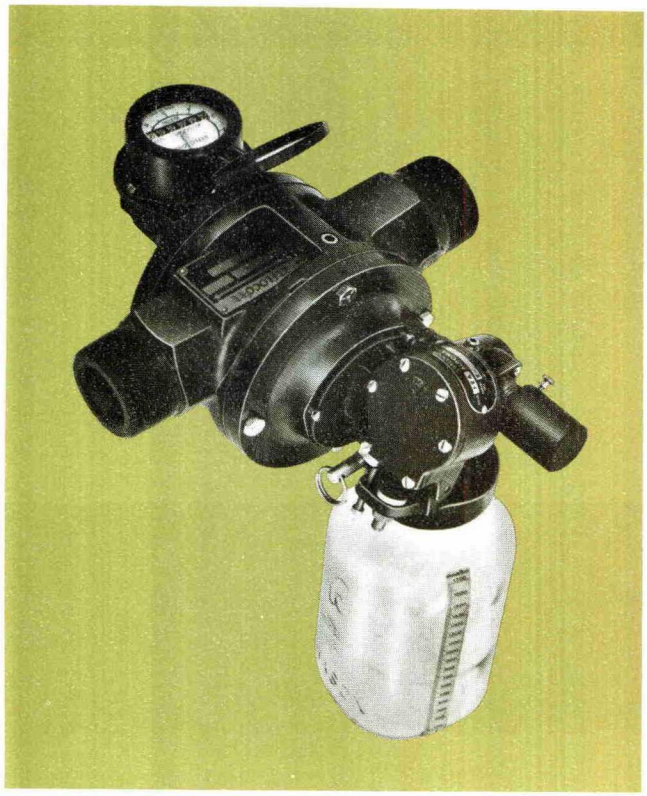
***Standard Register 331,** is a 6-wheel (five digits and tenths) barrel totalizer, with a sweep indicator reading in hundredths.

***Reset Register 2351,** optional at extra cost, is a 6-wheel (five digits and tenths) barrel totalizer, with a sweep indicator reading in hundredths and a 5-wheel (four digits and tenths) manual reset register.

***Reset Register 1608,** optional at extra cost, is a large numeral, 5-wheel (four digits and tenths) manual reset register, with a 7-wheel (six digits and tenths) barrel totalizer.

***Reset Register 1609,** optional at extra cost, combines Reset Register 1608 with a ticket printer to provide permanent records.

**This unit is available for measurement in gallons, liters, and other units of measure, on special order, at no extra cost.*

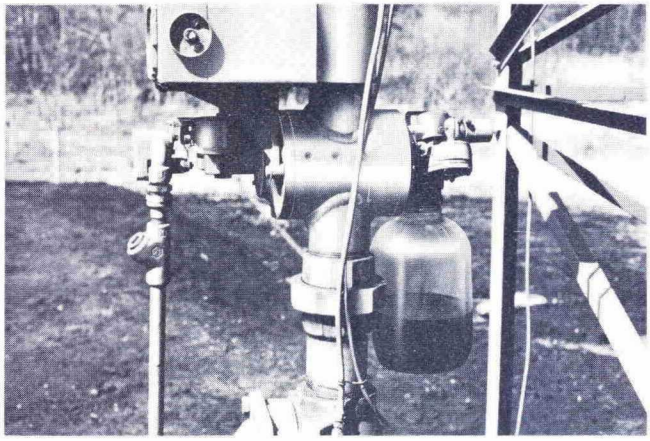


Model FRA Automatic Sampler

Meter Accessories

The *Floco* FRA Automatic Sampler is a proportional type sampler designed for use with the F500 series meters. The sampler is constructed of the finest materials to give accurate sampling, even with corrosive liquids.

When used with the standard ½ gallon sample container, the sampler may be set to automatically shut off when the container fills to a pre-set quantity. The sample volume is externally adjustable from 1 to 7.74 cc per sample. Standard sample frequency is at the rate of 5.5 samples per 42 gallon barrel. Rates of 11 or 22 samples per barrel are available on special order. Optional containers are available either vented or pressurized in capacities from ½ gallon to 15 gallons.



Impulse Transmitter

The *Floco* Impulse Transmitter will supply either electric or pneumatic signals proportional to the units measured by the meter. This compact device will operate remote registration equipment, start and stop pumps, or control other functions. It is easily installed on any *Floco* meter between the register adapter and the register box with only two screws, even while the meter is in operation.

Other Floco® Products

Model E700 Controller is a snap-acting liquid level controller. It is actuated by a float lever arm.

Portable Metering Unit has been designed for economical testing of wells. This unit gives accurate, dependable measurement of oil and gas production

Gravimetric Prover utilizes a method recommended by the American Petroleum Institute for economic and accurate meter proving.

Liquid Level Control Valves will handle up to 3000 BPD of abrasive and corrosive liquid. All wetted parts are constructed of stainless steel or Buna-N. (Viton optional on special order.)

Power Take-Off, Model 1945, will provide one or ten revolutions of a flexible steel shaft for each metered barrel or gallon.

Additional *Floco* product information is available upon request.

Floco® Meter Ordering Information

Please specify:

- Maximum line pressure
- Minimum and maximum flow rates
- Desired units of registration
- Pipe size
- Liquid to be metered
- Liquid specific gravity and viscosity
- Spare parts orders should include the meter serial number

Controls and Instruments ITT
580 Monterey Pass Road, Monterey Park, Calif. 91754