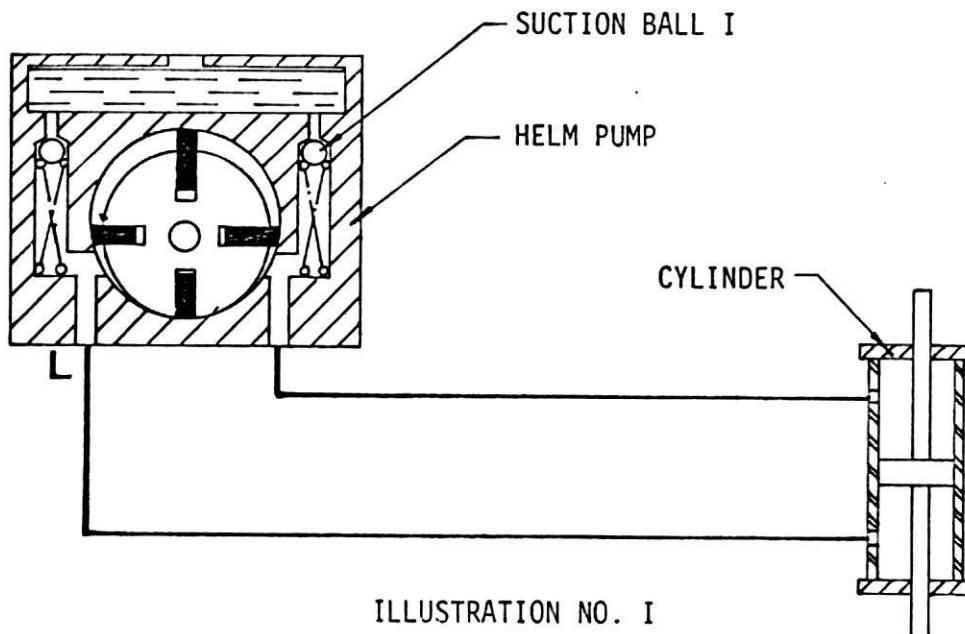

THE OPERATING PRINCIPLE OF MANUAL HYDRAULIC STEERING

HELM PUMPS

The helm pump is common to most systems. Any number may be used. The pumps are connected directly into the steering cylinder as indicated.

Turning the pump shaft to the right (clockwise,) while viewing from the shaft end, pumps oil out the right port of the pump, and sucks oil into the left port of the pump. If the steering wheel is turned quickly clockwise, a vacuum is created at pump port "L". This vacuum is not desirable since it allows air to enter the system through loose fittings. Suction ball No. 1 opens to allow oil from the reservoir to enter line "L" and thereby prevents the vacuum.



NOTE

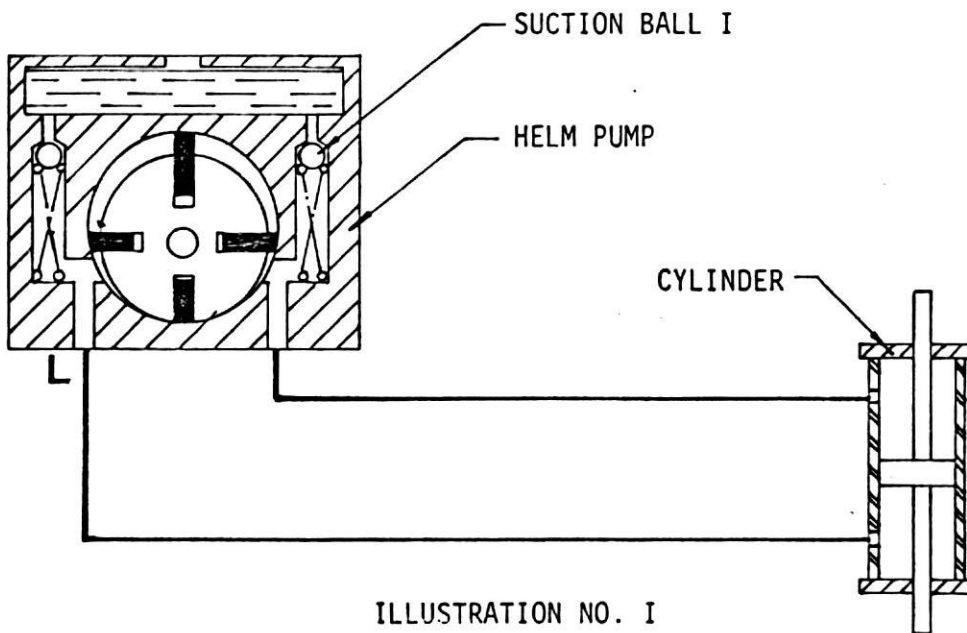
Wagner helm pumps are positive displacement axial piston pumps. In order to explain the operating principle of the helm pumps, a vane pump is shown for simplicity.

THE OPERATING PRINCIPLE OF MANUAL HYDRAULIC STEERING

HELM PUMPS

The helm pump is common to most systems. Any number may be used. The pumps are connected directly into the steering cylinder as indicated.

Turning the pump shaft to the right (clockwise,) while viewing from the shaft end, pumps oil out the right port of the pump, and sucks oil into the left port of the pump. If the steering wheel is turned quickly clockwise, a vacuum is created at pump port "L". This vacuum is not desirable since it allows air to enter the system through loose fittings. Suction ball No. 1 opens to allow oil from the reservoir to enter line "L" and thereby prevents the vacuum.



NOTE

Wagner helm pumps are positive displacement axial piston pumps. In order to explain the operating principle of the helm pumps, a vane pump is shown for simplicity.

HELM PUMP LOCK VALVE

A lock valve is required at each helm pump. The purpose of the lock valve is to prevent one helm station, when operated, from motoring another. The lock valve automatically isolates one station from another. All stations are active without the need to transfer control.

The lock valve is also used to prevent the force on the rudder from feeding back through the steering cylinder to the helm pump.

HOW THE LOCK VALVE OPERATES (See Illustration No. 2)

It can be seen that any external pressure applied to the bottom ports of the lock valves, either from the steering cylinder or another helm pump, will come solidly against the ball checks in the lock valve. This explains how helm pumps can be isolated from one another and from the cylinder feedback. When a helm pump is turned clockwise the right hand ball check is lifted off its seat and at the same time shifts the spool to the left to lift the left ball off its seat, and allow the return oil back to the helm pump.

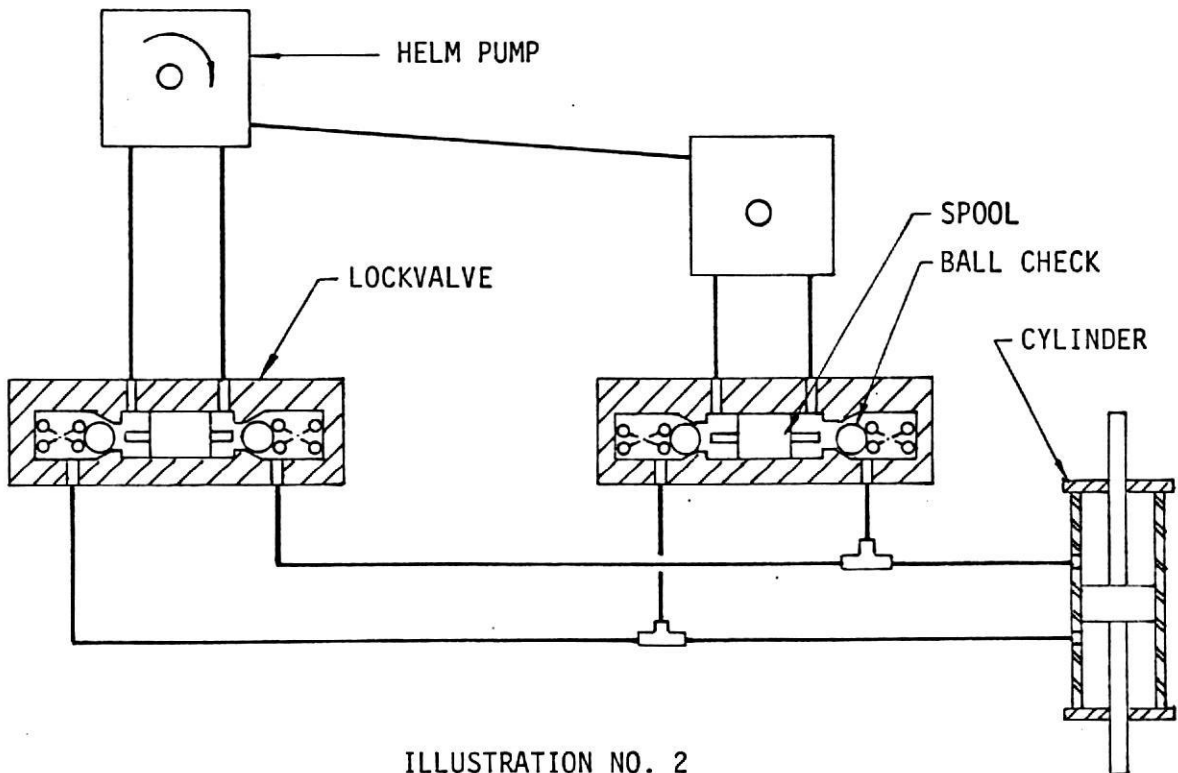


ILLUSTRATION NO. 2

BALANCED SPOOL LOCK VALVE

A second type of lock valve called a balanced spool type is often used with large helm pumps and power steering systems. The valve's function is identical to the one previously described, but the principle of operation is slightly different (See illustration No. 3).

Oil directed into port "R" of the valve lifts the right check ball off its seat and shifts the spool to the left. Return oil from the cylinder passes around the left ball up through the left slot in the valve body and around the spool (now shifted) into port "L" and back to the helm pump suction. The check balls again isolate one helm station from another and prevent feedback from the rudder.

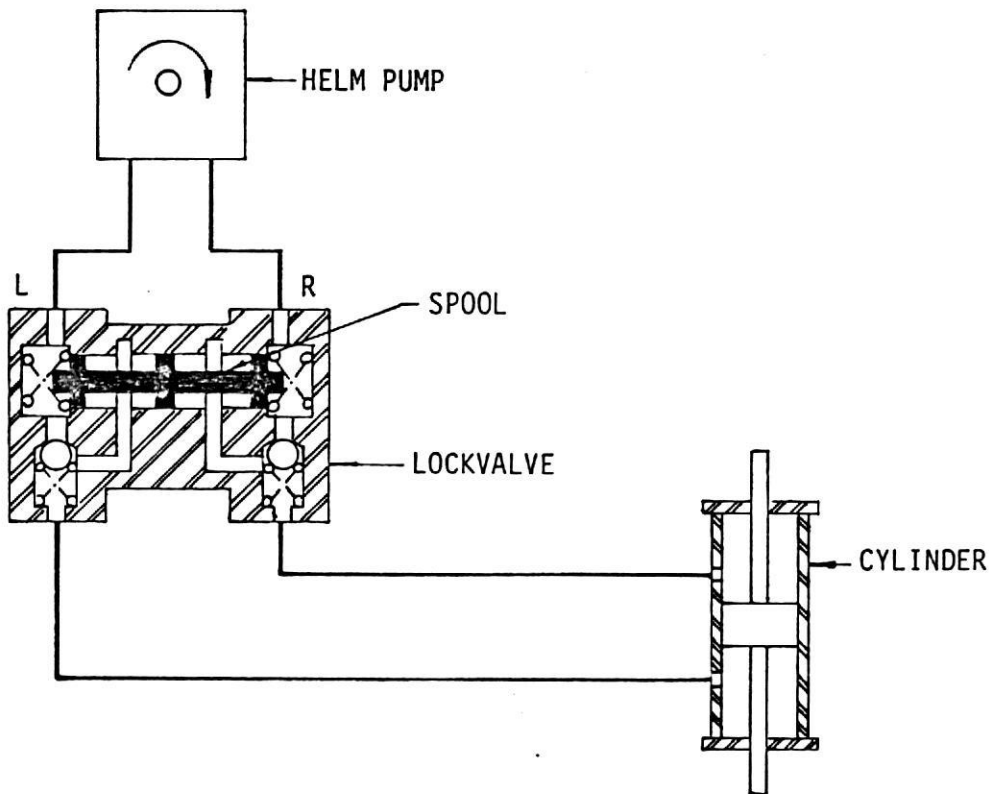
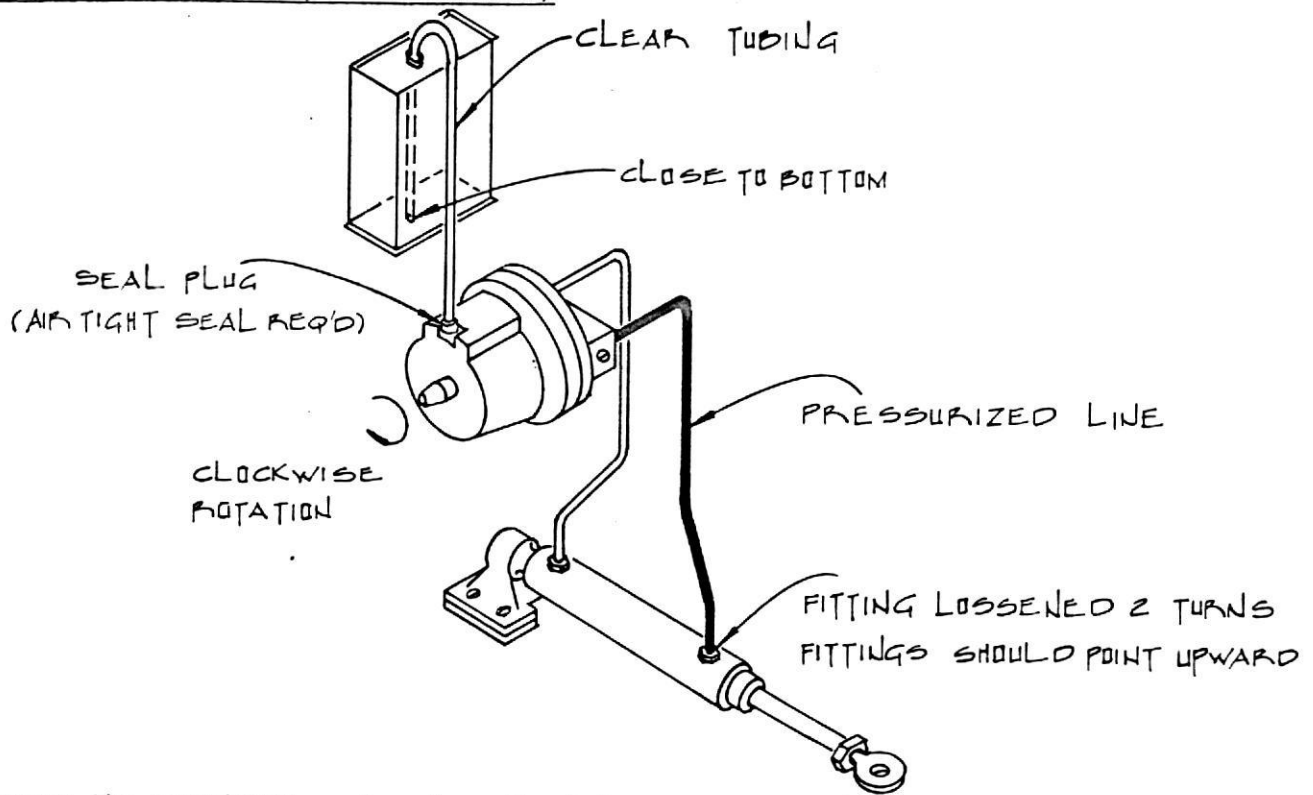


ILLUSTRATION NO. 3

FILLING THE SYSTEM (SINGLE STATION)



Remove the vent/filler plug from the helm pump. Screw the seal plug on the clear filler tube firmly into the helm pump vent/filler hole to insure an air tight seal. Place the other end of the clear tubing into the open oil container keeping the tip close to the bottom. Support the oil container preferably above the helm pump. Be certain all fittings are tight or system will not fill.

Follow the line from the right rear of the helm pump (viewed from the steering wheel side) down to the cylinder fitting. Loosen this cylinder fitting 2 turns and extend the piston rod out exposing the piston rod on the same end of the cylinder as the fitting. Begin turning the steering wheel clockwise at approximately 1 revolution per second until the system comes up solid. Tighten the cylinder fitting. Loosen the second cylinder fitting by 2 turns and turn the steering wheel in an anti-clockwise direction until the system becomes solid. Tighten the cylinder fitting.

Install the vent/filler plug insuring that a small 1/32 (1mm) through hole has been drilled in the top of this plug. Remove plug from pump before drilling. A small amount of air remaining in the lines will not affect the system performance. The remaining air will eventually vent through the vent/filler plug.

RECOMMENDED OILS

ISO Shell Tellus # 10

ISO Chevron EP Machine # 10

Any hydraulic oil with equivalent viscosity may be used. Oils of heavier viscosity will increase effort at the helm.

FILLING THE SYSTEM (DOUBLE STATION)

With a 2 station system fill exactly as indicated in a single station system starting at the top station. Replenish the oil container leaving it connected at the top station and move to the bottom station turning the wheel hard over to hard over exerting pressure in the hard over positions. Leave the clear plastic filler tube connected into the oil container while operating both upper and lower stations to avoid overflowing oil when air is trying to escape from the helm units.

Be certain that the upper station of a two station system has its vent/filler plug drilled through as indicated above, and that the bottom station vent/filler plug is tightly closed. The interconnecting line must also be installed.

BALANCED SPOOL LOCK VALVE

A second type of lock valve called a balanced spool type is often used with large helm pumps and power steering systems. The valve's function is identical to the one previously described, but the principle of operation is slightly different (See illustration No. 3).

Oil directed into port "R" of the valve lifts the right check ball off its seat and shifts the spool to the left. Return oil from the cylinder passes around the left ball up through the left slot in the valve body and around the spool (now shifted) into port "L" and back to the helm pump suction. The check balls again isolate one helm station from another and prevent feedback from the rudder.

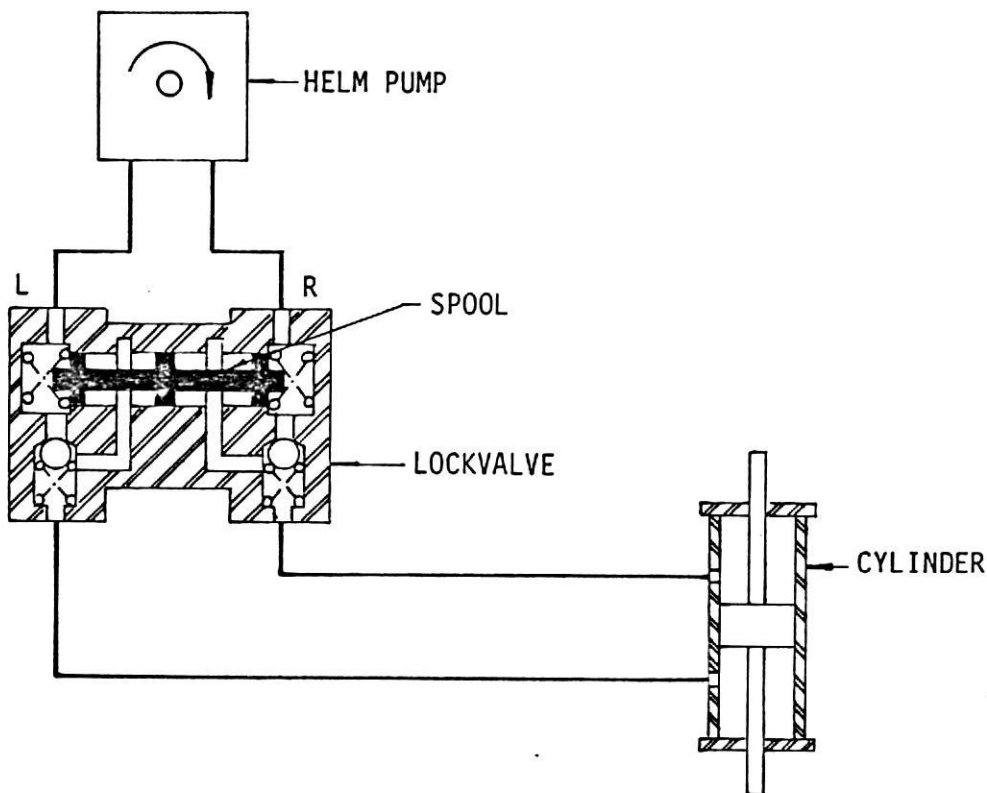
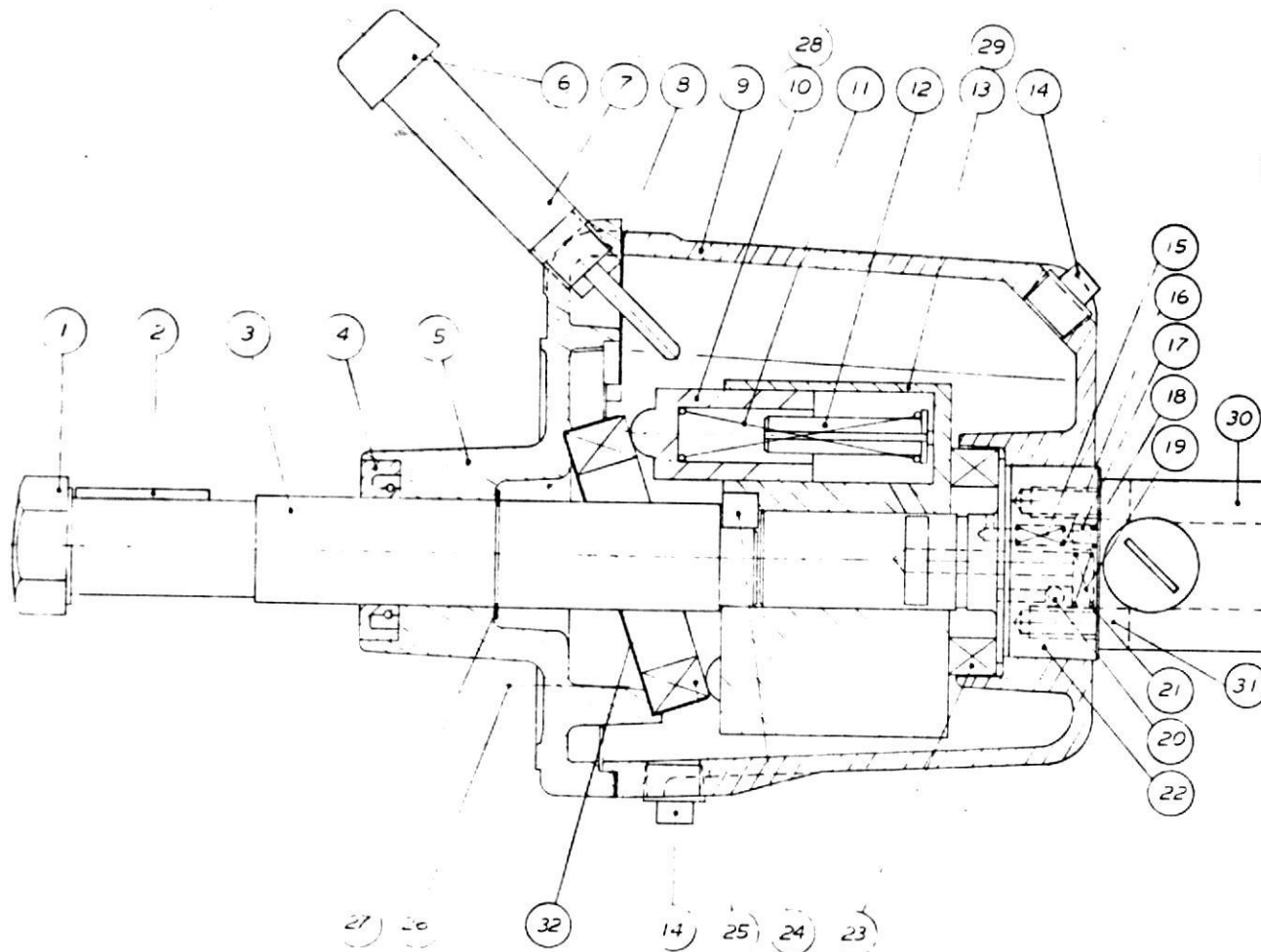


ILLUSTRATION NO. 3



32	1	91-990003	BEARING CAGE
31	2	51-200020	CAPSCREW
1	1	320-0063	STEERING WHEEL BOLT
2	1	51-102007	KEY
3	1	320-0064	SHAFT
4	1	10-500009	SIMMER RING
5	1	320-0065	FRONT PLATE
6	1	91-998009	DIPSTICK
7	1	91-998010	DIPSTICK TUBE
8	1	10-300014	GASKET
9	1	320-0066	HOUSING
10	7	320-0067	PISTON (B1 PUMP)
11	7	31-100040	SPRING
12	7	92-991004	PISTON INSERT
13	1	320-0069	ROTOR (B1 PUMP)
14	2	41132002	PLUG
15	1	31-100033	SPRING
16	1	21-300009	SPILL BALL
17	1	320-0070	PINTLE SPILL INSERT
18	1	11-106006	O-RING
19	2	31-100020	SPRING
20	2	21-300002	SUCTION BALL
21	2	11-106016	O-RING
22	1	320-0071	PINTLE
23	1	21-100006	BEARING
24	1	320-0072	DOWEL PIN
25	1	21-100002	BEARING
26	4	51-200001	CAPSCREW
27	1	51-300003	SNAPPING
28	7	320-0073	PISTON (B2 PUMP)
29	1	320-0074	ROTOR (B2 PUMP)
30	1	400-0002	LOCK VALVE
ITEM	QTY	PART NO.	DESCRIPTION

ASSEMBLY NO.

B1 PUMP : 300-0008

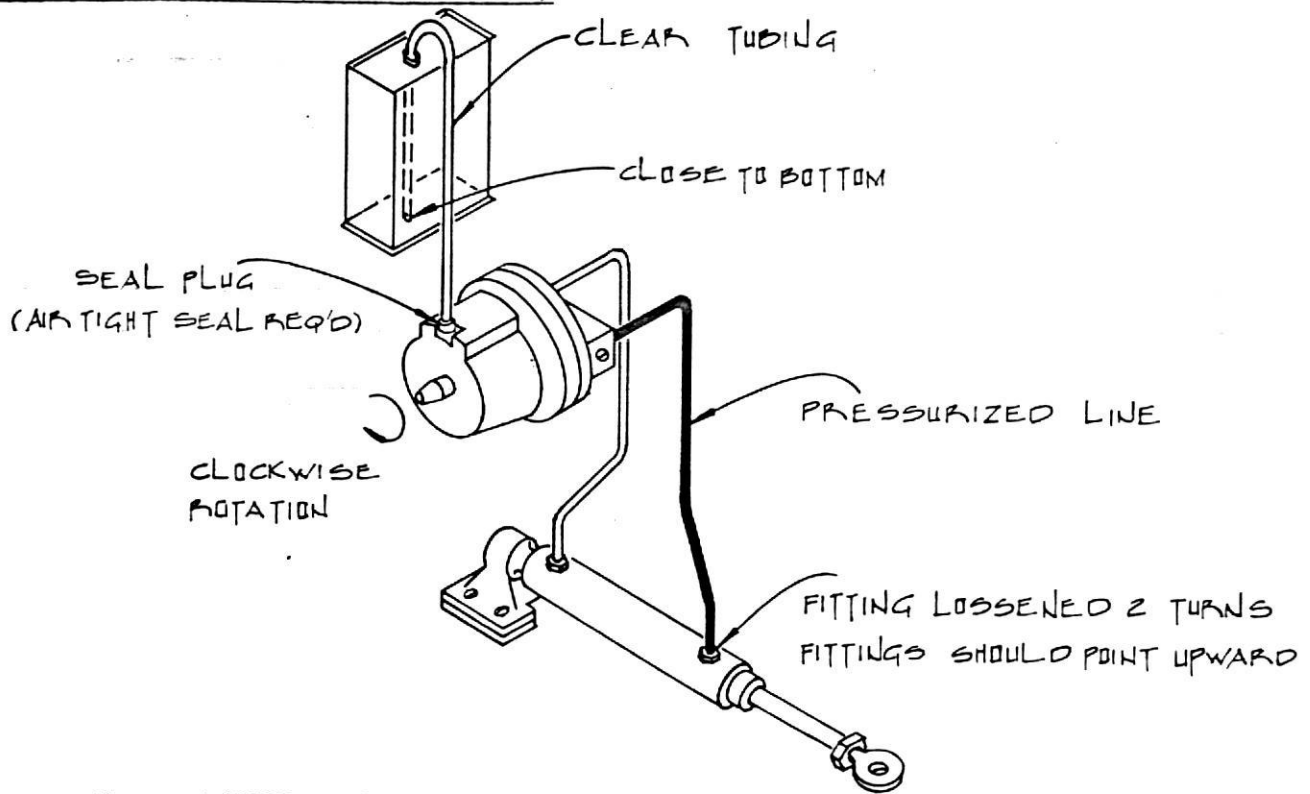
B2 PUMP : 300-0009

WAGNER ENGINEERING LTD
 40 GOSICK PLACE, NORTH VANCOUVER, B. C. CANADA V7M 3K6
 Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOT

TITLE
 PARTS LIST FOR
 MODEL B1/B2 HELM PUMPS

DRAWN S.C.	DATE JULY 80	SCALE NTS	QUOTE NO
REVISION NOTES 01 Rev. 80. CAPSCREW CHANGED. 02 Rev. 80. Update Add 30. Dist. W.			DRAWING NO C-1-346

FILLING THE SYSTEM (SINGLE STATION)



Remove the vent/filler plug from the helm pump. Screw the seal plug on the clear filler tube firmly into the helm pump vent/filler hole to insure an air tight seal. Place the other end of the clear tubing into the open oil container keeping the tip close to the bottom. Support the oil container preferably above the helm pump. Be certain all fittings are tight or system will not fill.

Follow the line from the right rear of the helm pump (viewed from the steering wheel side) down to the cylinder fitting. Loosen this cylinder fitting 2 turns and extend the piston rod out exposing the piston rod on the same end of the cylinder as the fitting. Begin turning the steering wheel clockwise at approximately 1 revolution per second until the system comes up solid. Tighten the cylinder fitting. Loosen the second cylinder fitting by 2 turns and turn the steering wheel in an anti-clockwise direction until the system becomes solid. Tighten the cylinder fitting.

Install the vent/filler plug insuring that a small 1/32 (1mm) through hole has been drilled in the top of this plug. Remove plug from pump before drilling. A small amount of air remaining in the lines will not affect the system performance. The remaining air will eventually vent through the vent/filler plug.

RECOMMENDED OILS

ISO Shell Tellus # 10

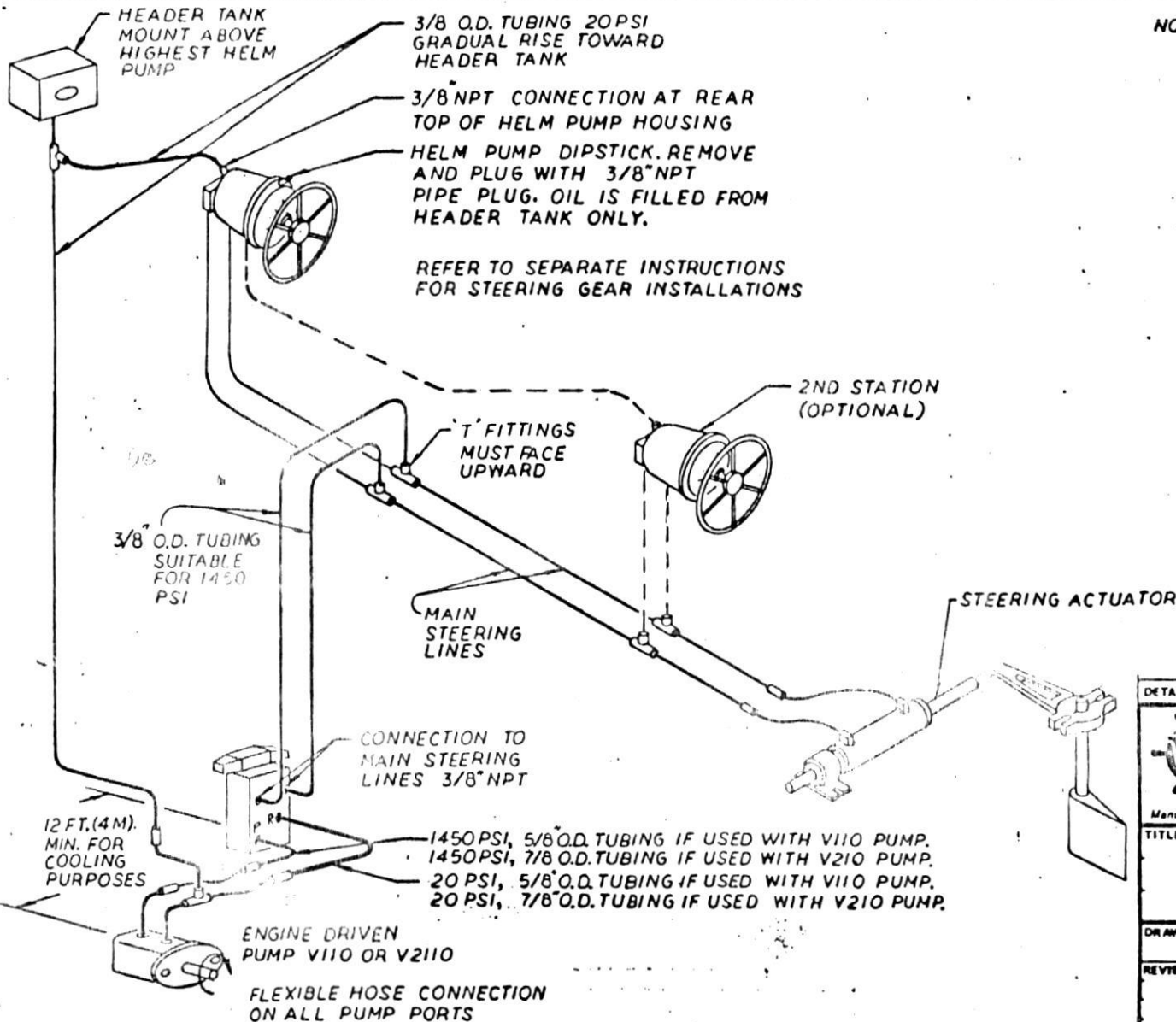
ISO Chevron EP Machine # 10

Any hydraulic oil with equivalent viscosity may be used. Oils of heavier viscosity will increase effort at the helm.

FILLING THE SYSTEM (DOUBLE STATION)


With a 2 station system fill exactly as indicated in a single station system starting at the top station. Replenish the oil container leaving it connected at the top station and move to the bottom station turning the wheel hard over to hard over exerting pressure in the hard over positions. Leave the clear plastic filler tube connected into the oil container while operating both upper and lower stations to avoid overflowing oil when air is trying to escape from the helm units.

Be certain that the upper station of a two station system has its vent/filler plug drilled through as indicated above, and that the bottom station vent/filler plug is tightly closed. The interconnecting line must also be installed.

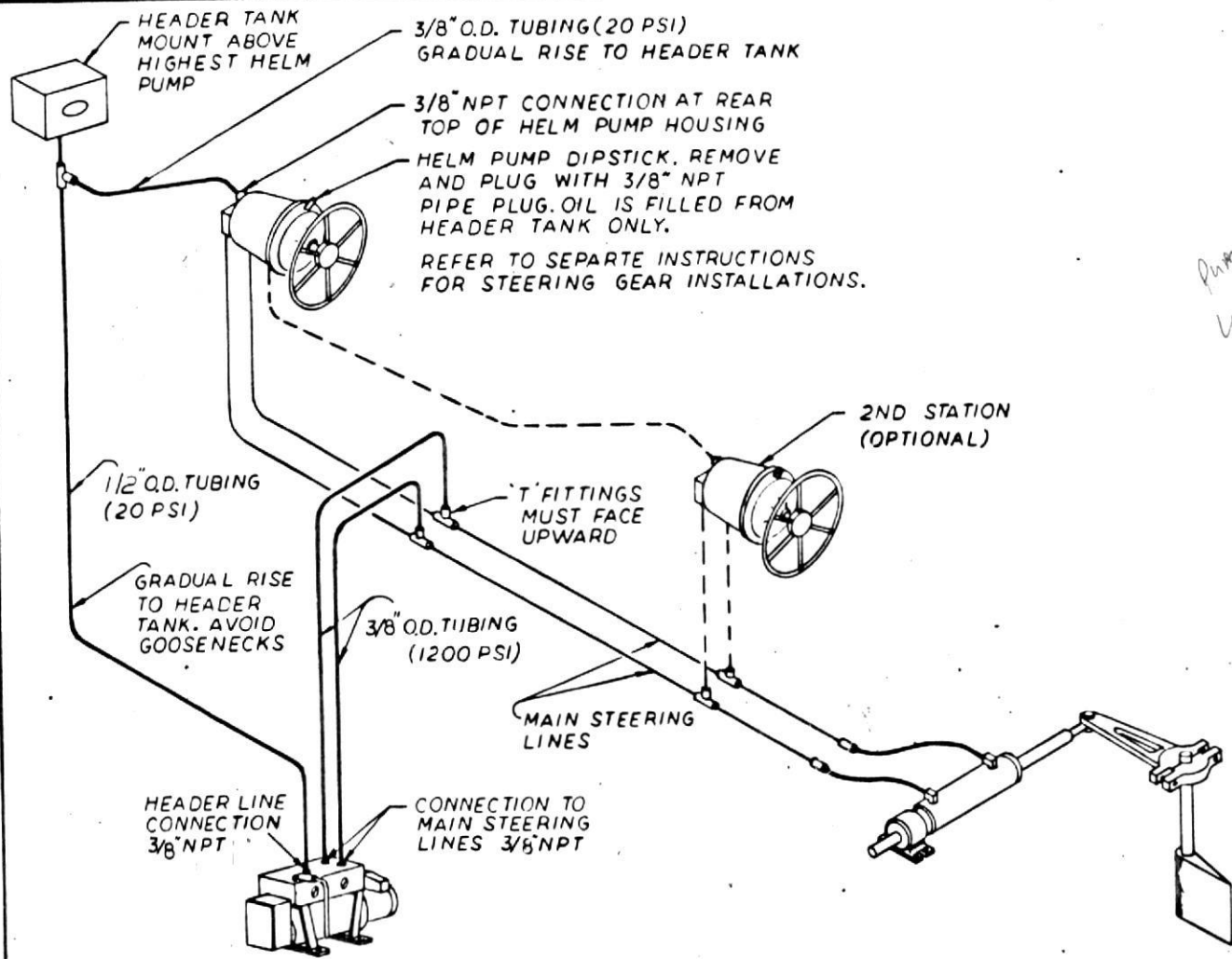


NOTE. DO NOT USE FLEXIBLE HOSE OTHER THAN THE SHORT LENGTH AT THE HYDRAULIC PUMP. FLEXIBLE HOSE HOSE CANNOT DISSIPATE HEAT AND PRODUCES "SPONGY" STEERING.

Part of Sol. of Electric Valve Clutch.


DETAIL	QUANTITY	DESCRIPTION	MATERIAL
 WAGNER ENGINEERING LTD. 40 GOSTICK PLACE NORTH VANCOUVER B C CANADA V7M3G2 Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS			
TITLE			
HYDRAULIC CONNECTION FOR ENGINE DRIVEN PUMP			
DRAWN	DATE	SCALE	QUOTE NO
	JULY / 01		
REVISION NOTES			DRAWING NO
			B-5-918
			REV.

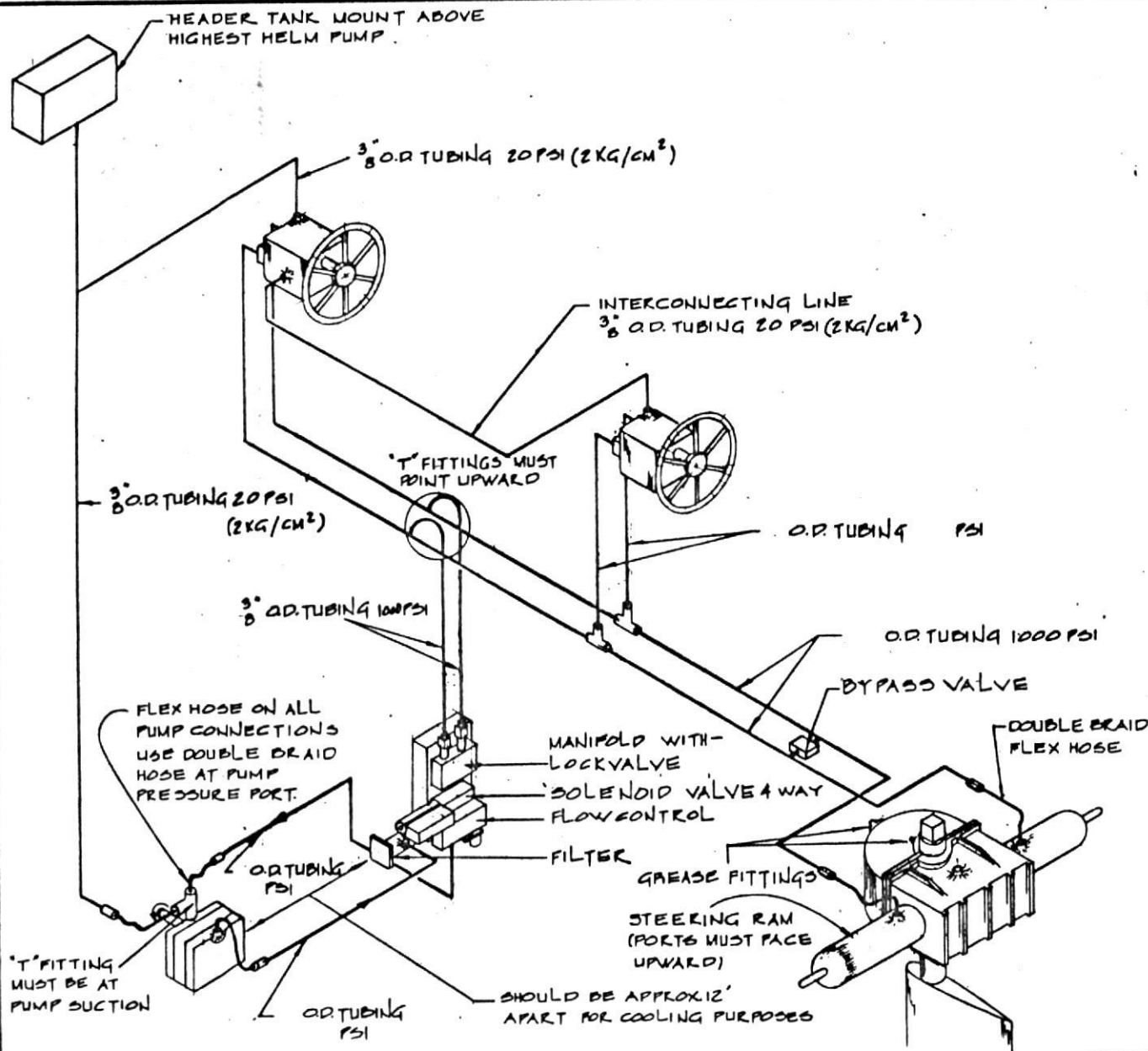
KOL 1058-B-101



NOTE: DO NOT USE FLEXIBLE HOSE
FLEXIBLE HOSE CANNOT
DISSIPATE HEAT AND PRODUCES
"SPONGY" STEERING.


*Pump - \$100.00
Lock Valve - \$100.00
Make up in part
Motor
Controller*

DETAIL	QUANTITY	DESCRIPTION	MATERIAL
 WAGNER ENGINEERING LTD 40 GOSTICK PLACE NORTH VANCOUVER B C CANADA V7M 3G2 Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS			
TITLE			
HYDRAULIC CONNECTION FOR TYPE 2A PUMPSET			
DRAWN	DATE	SCALE	QUOTE NO
	JUNE/81	-	
REVISION NOTES			DRAWING NO
			B-5-914
			REV.
			CI



NOTE:

- MANIFOLD MUST BE MOUNTED AS SHOWN, SO THAT A LINE DRAWN THROUGH THE LENGTH OF THE 4-WAY VALVE IS HORIZONTAL.
- T-MODEL HOUSING MUST BE COMPLETELY PACKED WITH GREASE, SEE INSTALLATION INSTRUCTION FOR DETAILS.
- ALL PIPING AND FITTINGS SUPPLIED BY YARD

DETAIL	QUANTITY	DESCRIPTION	MATERIAL
 WAGNER ENGINEERING LTD. 1742 WEST 2nd AVENUE, VANCOUVER, B.C., CANADA Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS			
TITLE			
MANUAL HYDRAULIC WITH NON-FOLLOW-UP POWER			
DRAWN F.C.	DATE OCT 30/75	SCALE —	QUOTE NO
REVISION NOTES			DRAWING NO B-1-932
			REV.

HELM PUMP LOCK VALVE

A lock valve is required at each helm pump. The purpose of the lock valve is to prevent one helm station, when operated, from motoring another. The lock valve automatically isolates one station from another. All stations are active without the need to transfer control.

The lock valve is also used to prevent the force on the rudder from feeding back through the steering cylinder to the helm pump.

HOW THE LOCK VALVE OPERATES (See Illustration No. 2)

It can be seen that any external pressure applied to the bottom ports of the lock valves, either from the steering cylinder or another helm pump, will come solidly against the ball checks in the lock valve. This explains how helm pumps can be isolated from one another and from the cylinder feedback. When a helm pump is turned clockwise the right hand ball check is lifted off its seat and at the same time shifts the spool to the left to lift the left ball off its seat, and allow the return oil back to the helm pump.

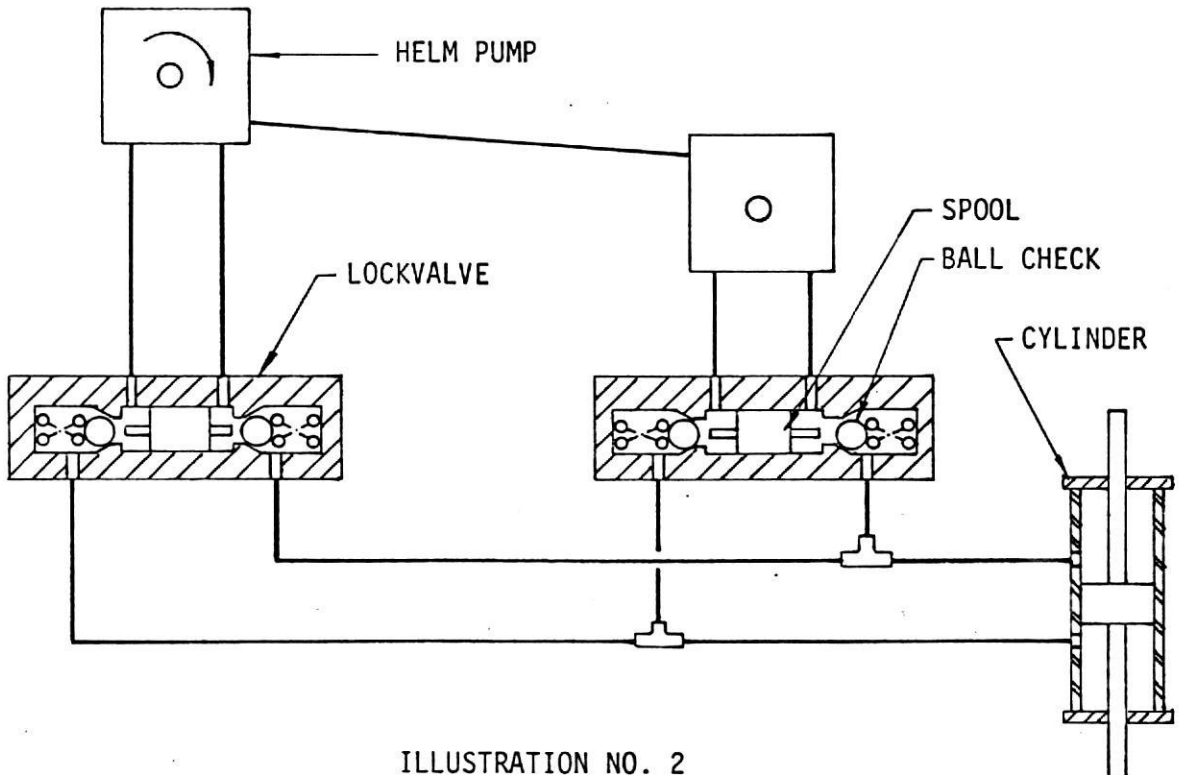


ILLUSTRATION NO. 2

CHART FOR ADJUSTING PUMPSET

CYLINDER DISPLACEMENT (IN ³)	WAGNER CYLINDER MODEL	NUMBER OF TURNS ON PUMPSET ADJUSTING SCREW
65 - 70	- N80-300 -	FULLY CCW
60 - 65		FULLY CCW
55 - 60	- TWIN N50-300 -	FULLY CCW
50 - 55	- T10, T11 -	FULLY CCW
45 - 50	- N80-190 -	FULLY CCW
40 - 45	- T5 -	1 1/2 CCW
35 - 40	- TWIN N50-190 -	1 1/4 CCW
30 - 35	- N50-300, T4 -	3/4 CCW
25 - 30		1/2 CCW
20 - 25	- TWIN N40-190 -	1/4 CCW
18, 19	- N50-190, T3 -	NO ADJUSTMENT
16, 17		1/4 CW
14, 15	- TWIN N40-120 -	1/2 CW
12, 13	- N40-190 -	1/2 CW
10, 11	- 1 1/2 X 7* -	3/4 CW
8, 9	- 1 1/4 X 9*, N40-120 -	3/4 CW
6, 7	- 1 1/4 X 7* -	1 CW
4, 5		1 CW

The pumpset is factory preset at 0.4 GPM when shipped.

CW - clockwise

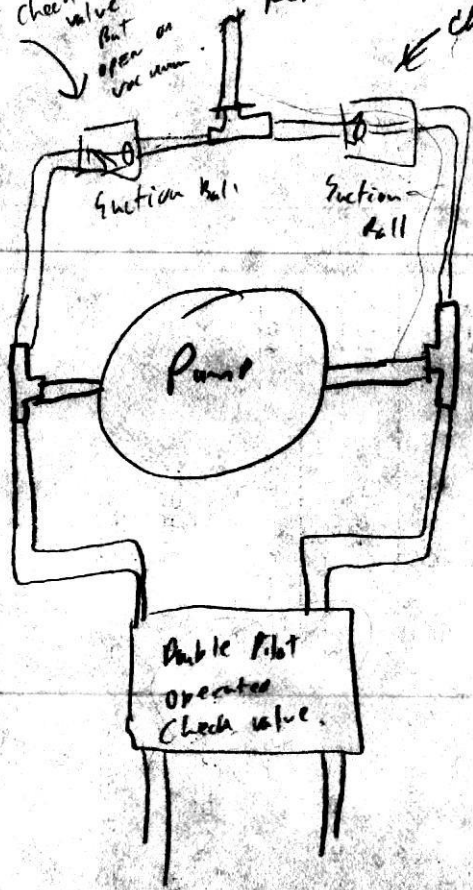
CCW - counter clockwise

* indicates a 700 Series cylinder

Higher than
than check
Cracking
value
But open on
vacuum

from
Reservoir

check valve



Double flange
operated
check valve.

WIRE SIZE =	7207	00250	CIRCULAR MILS
GAUGE =	12	8	
URNS/INCH =	11	8	
MARGINS =	0.250	0.250	INCHES
WINDING LENGTH (L) =	2.500	2.500	
URNS/LAYER =	28	19	
NUMBER OF LAYERS =	5.3	2.6	
MEAN TURN LENGTH =	12.00	14.72	INCHES
WIRE LENGTH =	147.70	61.25	FEET
WIRE RESISTANCE =	0.035	0.039	OHMS
n =	0.894		
P _{1p} =	21.686		WATTS PRIMARY LOSS
P _{1s} =	28.128		WATTS SECONDARY LOSS
P _{1i} =	62.699		WATTS IRON LOSS

P _{loss} =	112.513		WATTS TOTAL LOSS
BUILD:			
COPPER	0.504	0.128	
PAPER	0.050	0.030	
COVER	0.050	0.009	

TOTAL	0.604	0.167	
BULGE FACTOR =	15%	0.091	0.025

TOTAL (R)	0.695	0.192	
BOBBIN THICKNESS =	0.130		
TOTAL BOBBIN (B) =	0.887		
SPACE LEFT IN BOBBIN =	0.763		