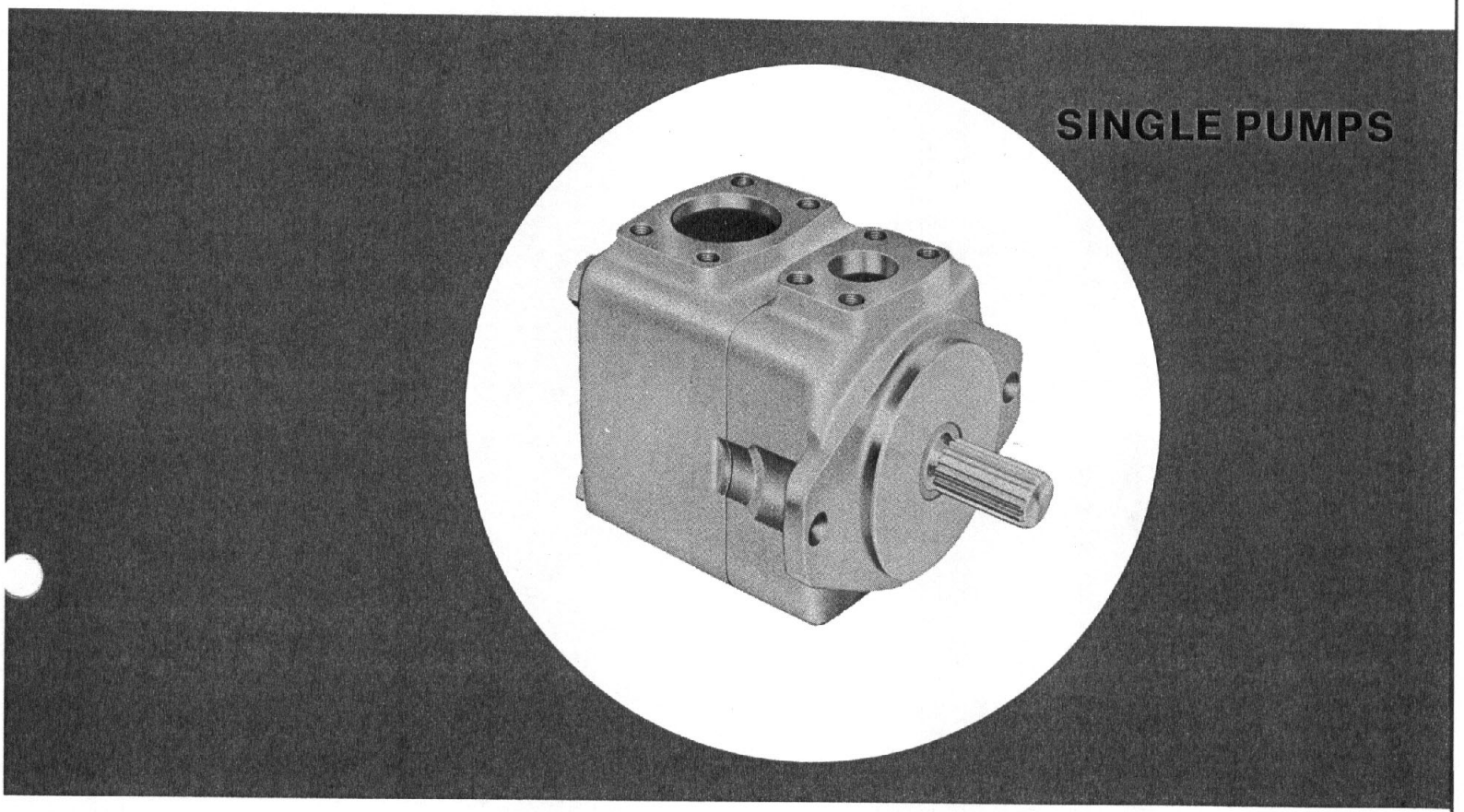
SPERRY VICKERS



OVERHAUL MANUAL

25V, 26V, 30V, 31V, 35V, 45V, 50V, AND 55V

SPERRY VICKERS
TROY, MI. 48084

Released 11-1-68

M-2100-S

TABLE OF CONTENTS

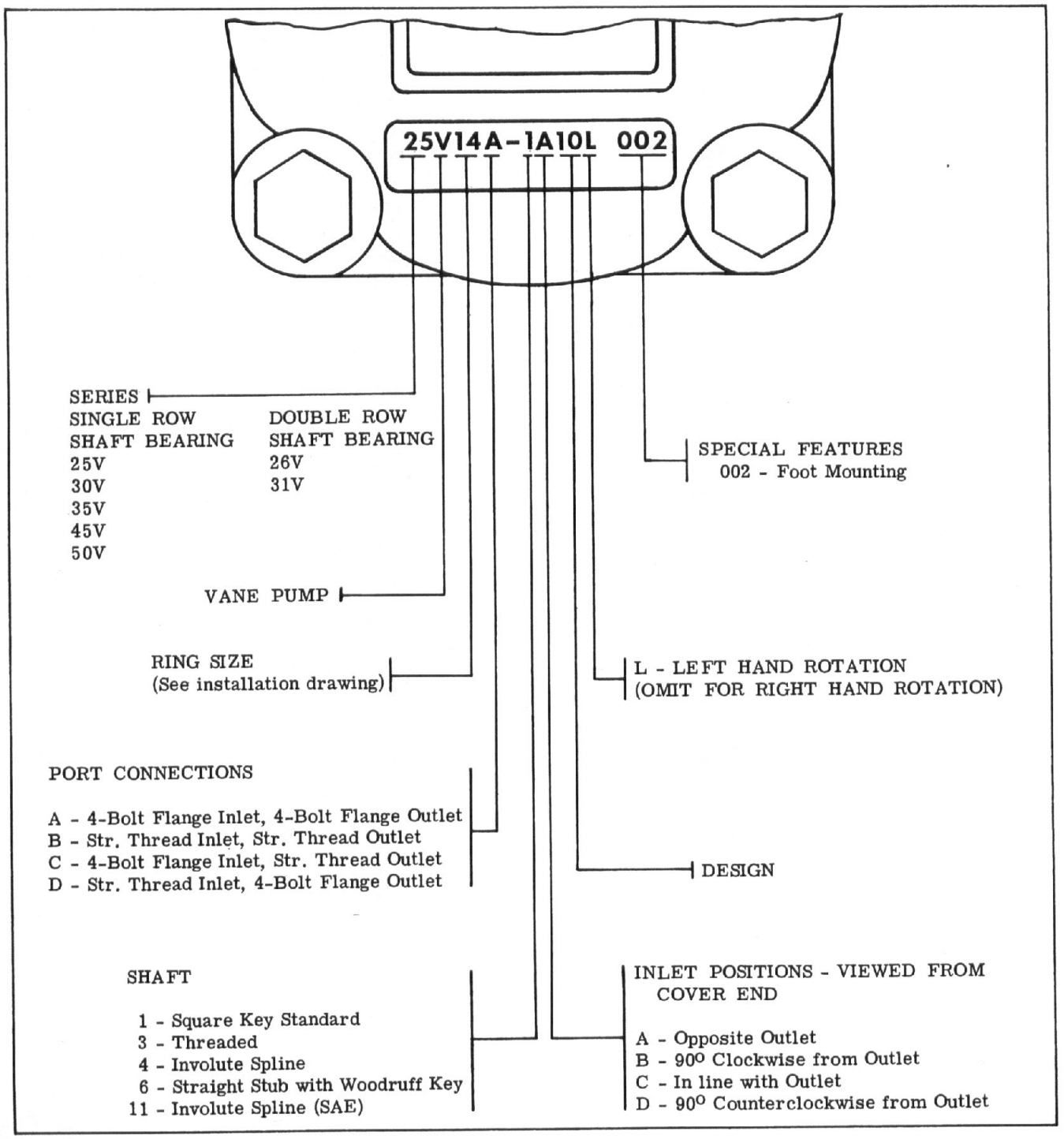
SECTION I - INTRODUCTION

A. PURPOSE OF MANUAL

This manual has been prepared to assist the users of Vickers High Performance single pumps in properly installing, maintaining and repairing their units. The single pumps are described in detail and their theory of operation is discussed in addition to instructions for installation, maintenance and overhaul.

The general series of models covered are 25V, 26V, 30V, 31V, 35V, 45V, 50V and 55V. The information given applies to the latest design series listed in Table I. Earlier designs are covered only insofar as they are similar to present equipment.

TABLE I MODEL CODE BREAKDOWN



B. GENERAL INFORMATION

1. Related Publications - Service parts information and installation dimensions are not contained in this manual. The parts catalogs and installation drawings listed in Table II are available from any Vickers Mobile Division application engineering office or from:

Vickers Mobile Hydraulic Division
Service Department
P. O. Box 302
Troy, Michigan

2. Model Codes - These are many variations within each basic model series, which are covered by variables in the model code. Table II is a complete breakdown of the codes covering these units. Service inquiries should always include the complete unit model number, which is stamped on the pump cover.

TABLE II

AVAILABLE PARTS CATALOGS AND INSTALLATION DRAWINGS

MODEL SERIES	PARTS CATALOG	INSTALLATION DRAWING
25V & 26V 30V & 31V	M-2101-S	M-242755 M-242756
35V 45V	M-2103-S	M-242757 M-242758
50V & 55V	M-2102-S	M-238565

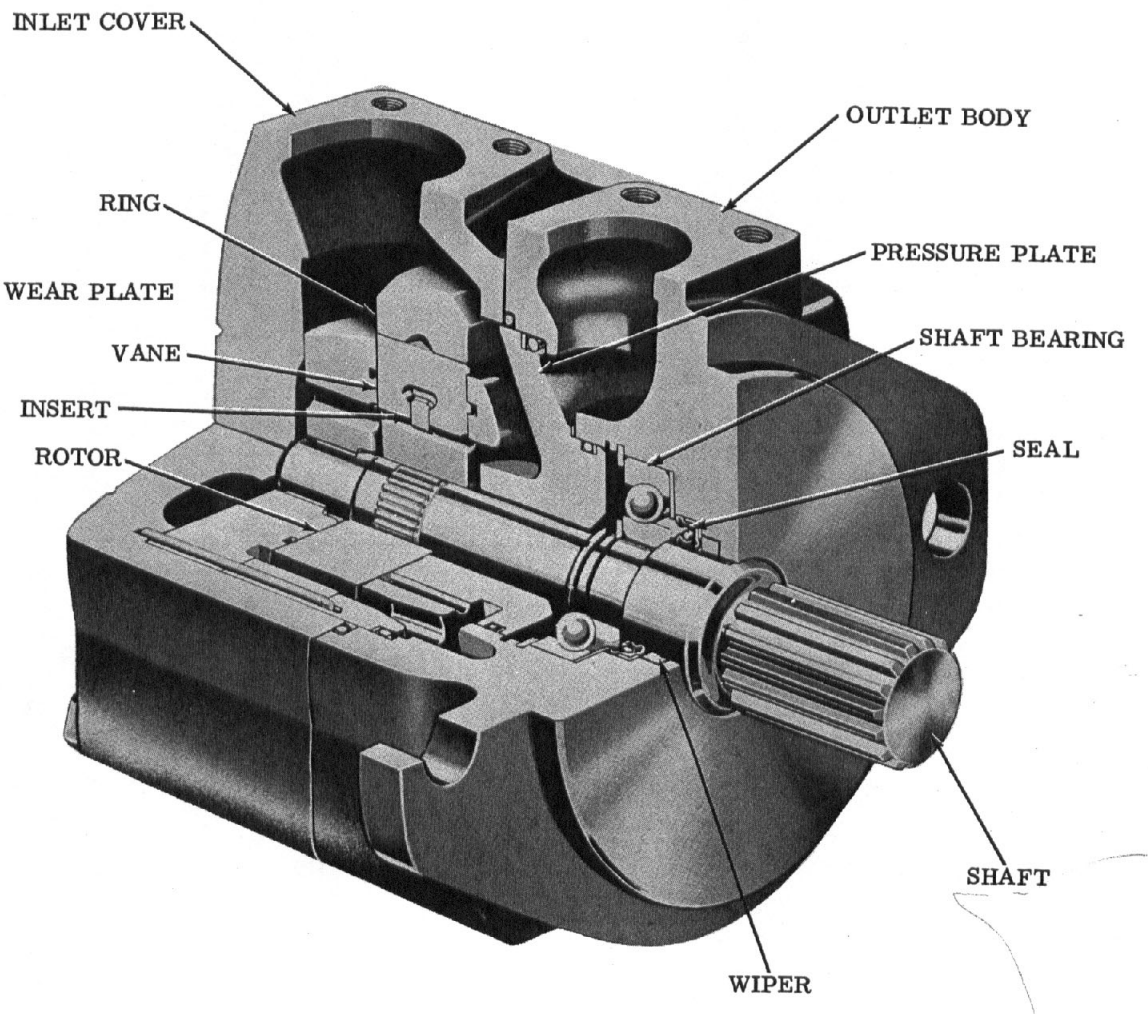


Figure 1 - Cutaway View of Typical High Performance Single Pump.

SECTION II - DESCRIPTION

A. GENERAL

Pumps in this series are used to develop hydraulic fluid flow for the operation of Mobile equipment. The positive displacement pumping cartridges are of the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

B. ASSEMBLY AND CONSTRUCTION

1. Basic Pumps - The pump illustrated in Figure 1 is representative of all single pumps in these series. The unit consists principally of an inlet cover, outlet body, driveshaft and pumping cartridge. The principal components of the cartridge are an elliptical cam ring, a slotted rotor splined to the driveshaft, a pressure plate, wear plate, and ten vanes and inserts fitted to the rotor slots. Fluid enters the cartridge through the inlet port in the cover and is discharged through the pressure plates to the outlet port in the body.

C. APPLICATION

Pump ratings in GPM, as shown in the model coding, are at 1200 RPM. For ratings at other speeds, methods of installation and other application information, refer to the applicable sales installation drawing or consult Vickers Mobile Division application engineering personnel.

SECTION III - PRINCIPLES OF OPERATION

A. PUMPING CARTRIDGE

As mentioned in Section II, fluid flow is developed in the pumping cartridge. The action of the cartridge is illustrated in Figure 2. The rotor is driven within the ring by the driveshaft, which is coupled to a power source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes them to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor causes the chamber volume between the vanes to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

This fluid is trapped between the vanes and carried past a sealing land and to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

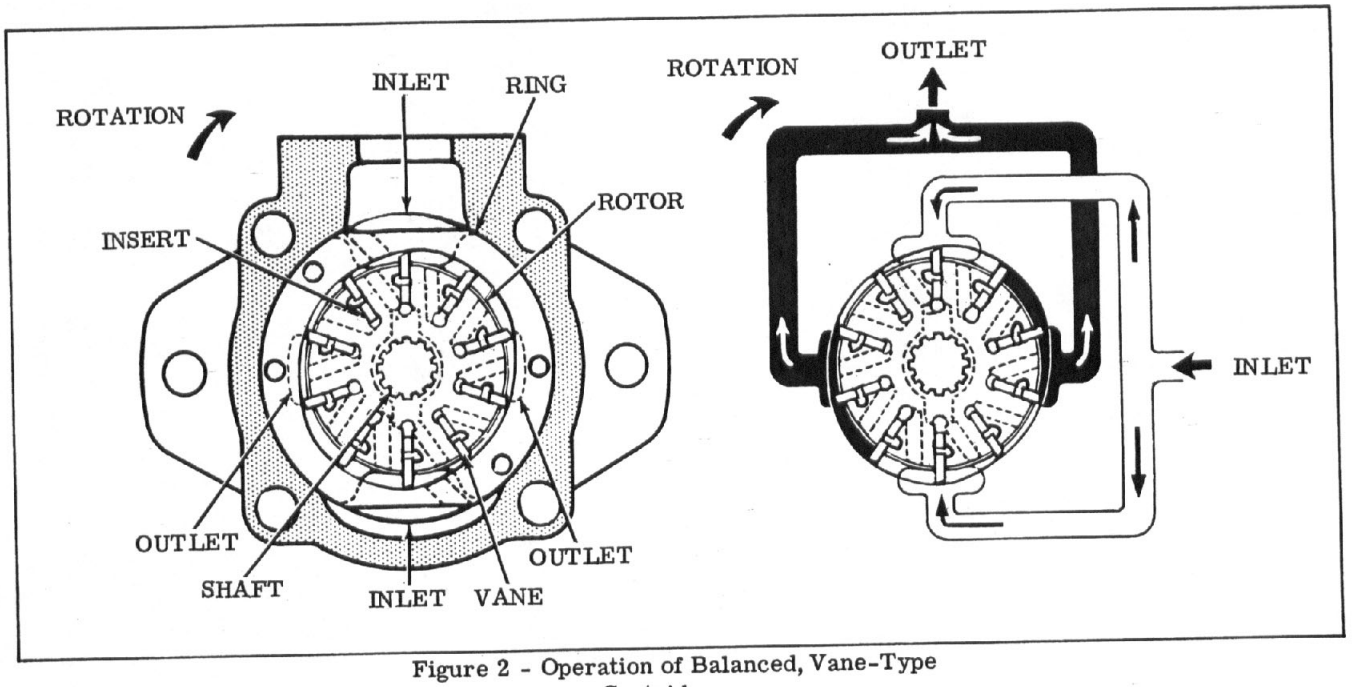


Figure 2 - Operation of Balanced, Vane-Type Cartridge.

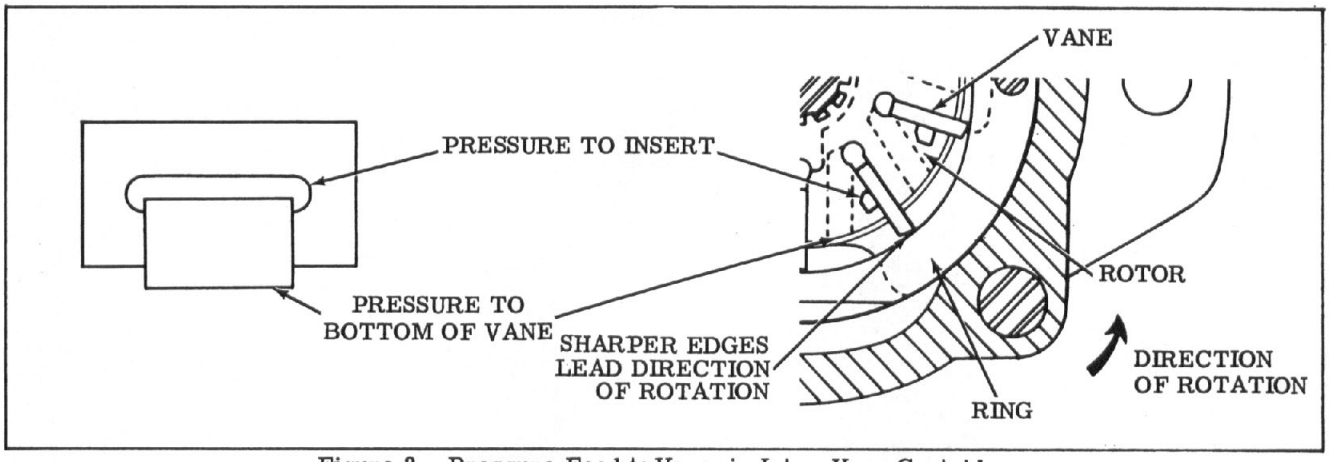


Figure 3 - Pressure Feed to Vanes in Intra-Vane Cartridge.

B. VANE PRESSURE FEED

The opportunity to compensate for tendency to wear is apparent as the vanes are forced outward and in contact with the ring.

The intra-vane design provides a means of controlling the outward thrust of the vane against the ring to maintain the tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied for outward vane thrust only over the area between the vane and insert. This area is small and thrust is correspondingly light. During vane travel through pressure areas, full system pressure is also applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 3. This selective application of pressure maintains the vane in substantially constant radial hydraulic balance in all positions.

C. HYDRAULIC BALANCE

The pump ring is shaped so that the two pumping chambers are formed 180 degrees apart (Figure 2). Thus, opposing hydraulic forces which would impose side loads on the shaft cancel each other out.

D. PRESSURE PLATE

The pressure plate seals the pumping chamber as shown in Figure 4. System pressure is effective against the area at the back of the plate, which is larger than the area exposed to the pumping cartridge.

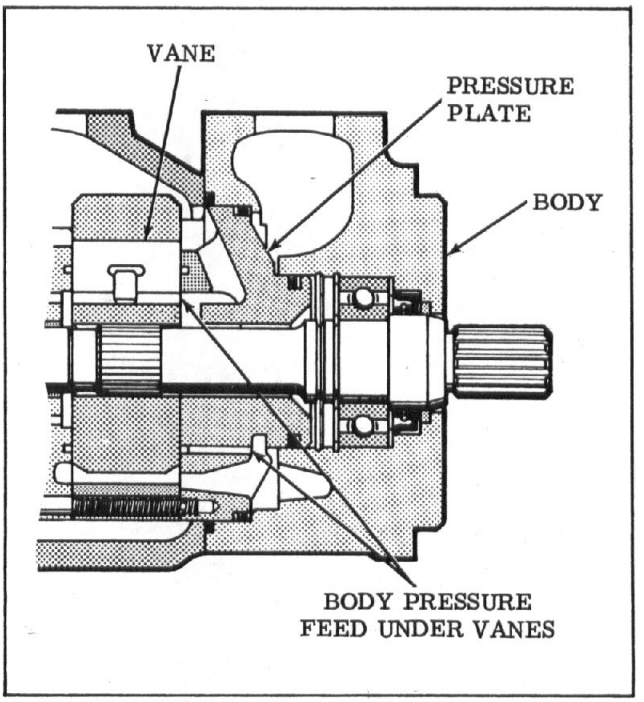


Figure 4 - Pressure Plate Operation

Thus, an unbalanced force holds the plate against the cartridge, sealing the cartridge and providing the proper running clearance for the rotor and vanes. The pressure plate also contains passages for feeding pressure to the space between the vanes and inserts (Figure 3).

SECTION IV - INSTALLATION AND OPERATING INSTRUCTIONS

A. INSTALLATION DRAWINGS

The installation drawings listed in Table II show the correct installation dimensions and optional port locations.

B. MOUNTING AND DRIVE CONNECTIONS

Vickers high performance vane pumps are designed for foot or face mounting.

1. Direct Drive - A pilot on the pump mounting

flange (Figure 5) assures correct mounting and shaft alignment, provided the pilot is firmly seated in the accessory pad of the power source. Care should be exercised in tightening all flange mounting screws to prevent misalignment.

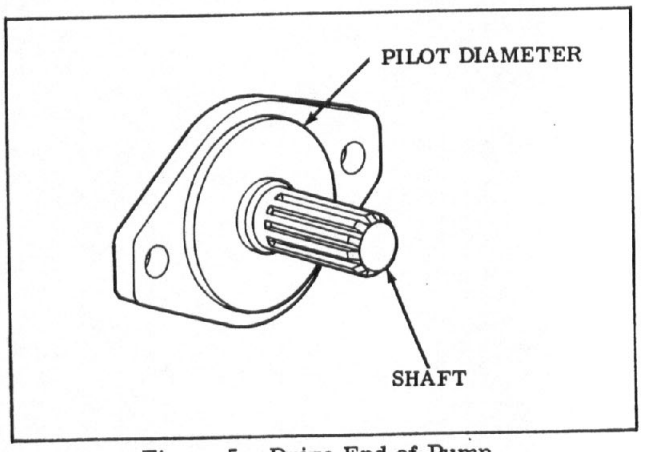


Figure 5 - Drive End of Pump.

If gaskets are used between flanges, they should be installed carefully so as to lie flat and should not be the type that will take a set. Shaft keys and couplings must be properly seated to avoid slipping and possible shearing.

Proper coupling alignment is essential to long pump life.

CAUTION

Vickers pump shafts are designed to be installed in couplings with a slip fit or very light press. Pounding a coupling end onto the shaft can injure the bearings. Shaft tolerances are shown on the pump installation drawings (See Table II).

2. Indirect Drive - Indirect drive is not recommended for these pumps.

C. SHAFT ROTATION

NOTE

Vickers pumps are normally assembled for right-hand (clockwise) rotation as viewed from their shaft ends. A pump made for left-hand rotation is identified by an "L" in the model code (See Table I).

If it is desired to reverse the direction of drive rotation, it is necessary to disassemble the pump and reverse the rings, rotors and vanes (See Section VI).

CAUTION

Never drive a pump in the wrong direction of rotation. Seizure may result, necessitating extensive repairs.

D. PIPING AND TUBING

1. All pipes, fittings, hose and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sand blasting, wire brushing and pickling.

NOTE

For instructions on pickling refer to Vickers instruction sheet M-9600.

2. To minimize flow resistance and the possibility of leakage, only as many fittings and connections as are necessary for proper installation should be used.

3. The number of bends in hydraulic lines should be kept to a minimum to prevent excessive turbulence and friction of oil flow and to minimize pressure drop in the lines. Tubing must not be bent too sharply. The generally accepted minimum radius for bends is three times the inside diameter of the tube.

E. HYDRAULIC FLUID RECOMMENDATIONS

The oil in a hydraulic system serves as the power transmission medium. It is also the system's lubricant and coolant. Selection of the proper oil is a prime requirement for satisfactory system performance and life. Oil must be selected with the same care as any other system component and with the assistance of a qualified supplier.

TWO IMPORTANT FACTORS IN SELECTING AN OIL ARE:

1. Antiwear Additives - The oil selected must contain the necessary additives to insure high antiwear characteristics.

2. Viscosity - The oil selected must have proper viscosity to maintain an adequate lubricating film at maximum system operating temperature.

SUITABLE TYPES OF OIL ARE:

1. Crankcase Oil Meeting API Service Classification MS - The MS (most severe) classification is the key to proper selection of crankcase oils for Mobile hydraulic systems.

2. Antiwear Type Hydraulic Oil - There is no common designation for oils of this type. However, they are produced by all major oil suppliers and provide the antiwear qualities of MS crankcase oils.

3. Certain Other Types of Petroleum Oils are suitable for mobile hydraulic service if they meet the following provisions:

(a) Contain the type and content of antiwear compounding found in MS crankcase oils or have passed pump tests similar to those used in developing the anti-wear hydraulic oils.

(b) Meet the viscosity recommendations shown in the following Table III.

(c) Have sufficient chemical stability for Mobile hydraulic system service.

The following types of oil are suitable if they meet the above three provisions and satisfy the requirements of Table III below:

- Series 3 Diesel Engine Oil
- Automatic Transmission Fluid Types A, F and DEXRON
- Hydraulic Transmission Fluid Types C-1 and C-2

Table III summarizes oil types recommended for use with Vickers equipment in mobile hydraulic systems by viscosity and service classification.

TABLE III - HYDRAULIC FLUID VISCOSITY RECOMMENDATIONS OPERATING TEMPERATURE

Hydraulic System Operating Temperature Range (Min. * To Max.)	SAE Viscosity Designation	American Petroleum Institute (API) Service Classification
0°F. to 180°F.	10W	MS
0°F. to 210°F.	10W-30**	MS
50°F. to 210°F.	20-20W	MS

*Ambient Start Up Temperature
**See paragraph on Viscosity Index

The temperatures shown in Table III are cold start-up to maximum operating. Suitable start-up procedures must be followed to insure adequate lubrication during system warm-up.

ARCTIC CONDITIONS

Arctic conditions represent a specialized field where extensive use is made of heating equipment before starting. If necessary, this and judicious use of SAE 5W or SAE 5W-20 oil in line with the viscosity guide lines shown in the table, may be used. Dilution of SAE 10W (MS) oil with maximum of 20% by volume of kerosene or low temperature diesel fuel is permissible. During cold start-up, avoid high speed operation of hydraulic system components until the system is warmed up to provide adequate lubrication. Operating temperature should be closely monitored to avoid exceeding a temperature of 130°F. with any of these light weight or diluted oils.

OTHER FACTORS IN SELECTING AN OIL ARE:

1. Viscosity - Viscosity is the measure of fluidity. In addition to dynamic lubricating properties, oil must have sufficient body (film strength) to provide adequate sealing effect between working parts of pumps, valves, cylinders and motors, but not enough to cause pump cavitation or sluggish valve action. Optimum operating viscosity of the oil should be between 80 SSU and 180 SSU. During sustained high temperature operation viscosity should not fall below 60 SSU.

2. Viscosity Index - Viscosity index reflects the way viscosity changes with temperature. The smaller the viscosity change, the higher the viscosity index. The viscosity index of hydraulic system oil should not be less than 90. Multiple viscosity oils, such as SAE 10W-30, incorporate additives to improve viscosity index (polymer thickened). Oils of this type generally exhibit both temporary and permanent decrease in viscosity due to the oil shear encountered in the operating hydraulic system. Accordingly, when such oils are selected, it is desirable to use those with high shear stability to insure that viscosity remains within recommended limits.

3. Additives - Research has developed a number of additive agents which materially improve various characteristics of oil for hydraulic systems. These additives are selected to reduce wear, increase chemical stability, inhibit corrosion, depress foam and depress the pour point. The most desirable oils for hydraulic service contain higher amounts of anti-wear compounding.

SPECIAL REQUIREMENTS

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your Vickers sales representative.

CLEANLINESS

High speed, high pressure pumps demand close tolerances on machined parts. Contamination can destroy finishes and fits. Thorough precautions should always be observed to insure that the hydraulic system is kept clean:

1. Clean (flush) entire system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminant into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during operation.

4. Provide continuous protection of system from entry of contamination originating in atmospheric work environments.

5. During usage, proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over-emphasized.

F. OVERLOAD PROTECTION

A relief valve must be installed in the system. The relief valve limits pressure in the system to a prescribed maximum to protect the system components from excessive pressure. The setting of the relief valve depends on the work requirements of the system and the maximum pressure ratings of the system components. Full flow pressure must be within the maximum operating pressure recommended for the pump.

G. START-UP

Whenever it is possible to do so, fill the pump ports with system hydraulic fluid prior to connecting it into the lines. This will make it easier for the pump to prime when it is first started.

No Load Starting - These pumps are designed to start up with no load on the pressure ports. They should never be started against a load or a closed center valve. It is recommended that a provision be made to purge air from the system on initial start-up -- such as cracking an outlet fitting or installing a valve in the outlet line to open it to the atmosphere. When there is a solid stream of fluid at the outlet, the fitting or valve should be closed.

Self-Priming - A minimum drive speed of 600 RPM is recommended for start-up. The pump should prime itself immediately if the above points are observed, and the inlet line is free of air leaks. After start-up, it is recommended that you run the pump for a short time at moderate speed and load.

H. PORT POSITIONS

1. If it should be necessary to change the inlet port positions, the pump cartridge must be rotated in accordance with the change of the cover position. The cover can be placed in four positions as shown in Figure 6.

Disassembly and assembly procedures are in Section VI.

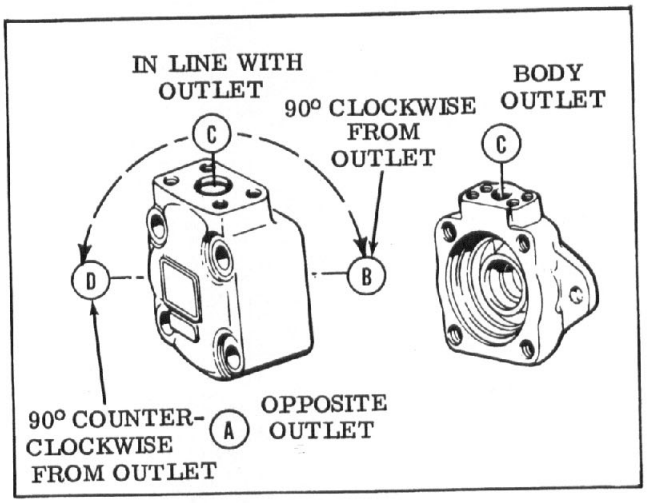


Figure 6 - Port Positions.

SECTION V - SERVICE, INSPECTION AND MAINTENANCE

A. SERVICE TOOLS

Two special tools are required to service these pumps. A driver should be used to assure installation of the shaft seal without damage, and a "bullet" placed over the end of the shaft to avoid damaging the seal lip when the shaft is installed.

The driver can be made from tubular stock as shown in Figure 7. The recess in the tool will be deep enough so uniform pressure is applied to the recessed area in the seal channel, rather than on the lip of the seal. The inside diameter of the tool will not interfere with the spring around the lip of the seal.

B. INSPECTION

Periodic inspection of the fluid condition and tube or piping connections can save time-consuming

PUMP SERIES	LENGTH A (INCHES)	UNDERCUT B (INCHES)	OD C (INCHES)	ID D (INCHES)
25V, 26V 30V, 31V	3-1/4	1/4	1-15/32	1-11/32
35V	3-1/4	1/4	1-25/32	1-11/16
45V	3-3/4	7/16	2-7/32	1-29/32
50V	3-3/4	7/16	2-11/32	2-5/32

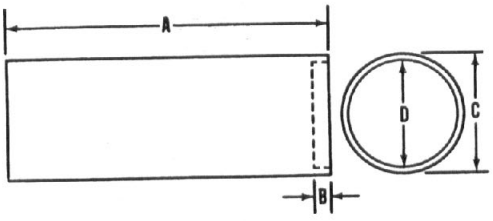


Figure 7 - Shaft Seal Driver.

TABLE IV

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING OIL	Pump driven in wrong direction of rotation.	The pump cartridge must be reversed immediately to prevent damage. Check rotation to assure correct assembly.
	Pump drive shaft disengaged or sheared.	Remove pump from mounting pad and determine damage to pump cartridge. Replace damaged parts. Check input speed to determine whether it is higher than recommended.
	Fluid intake pipe in reservoir blocked or oil viscosity too heavy too pick up prime.	Drain complete system. Add new fluid of proper viscosity. Filter the new oil as recommended. Check all filters for dirt and sludge.
	Air leaks at intake. Pump not priming.	Circuit must be tested at inlet connections. Determine where air is being drawn into line connection and tighten. Check intake pipe. The oil level must be above intake opening in reservoir. Check minimum drive speed which may be too slow to prime the pump.
	Vane or vanes stuck in rotor slots.	Disassemble pump and inspect rotor slots for wedged chips or foreign particles. Thoroughly clean rotor, vanes and inserts. Replace all damaged parts. Flush complete system by recommended processes and fill system with new clean hydraulic oil.
INSUFFICIENT PRESSURE BUILD-UP IN THE SYSTEM	System relief valve set too low	Use pressure gages to set relief valves properly.
	Worn parts causing internal oil slippage.	Replace pump cartridge.
PUMP MAKING NOISE	Restricted or partially clogged intake line, strainer or filter.	Pump must receive intake oil freely or cavitation will result. Drain system and clean intake line and strainers. Add new oil and strain by recommended procedures
	Air leakage in intake or return line.	Determine where air is being drawn into the intake or return line. Tighten loose connections.
	Shaft oil seal leakage.	Check pump shaft oil seal for leakage and replace if necessary. Check shaft for scoring at seal contact area and replace shaft if grooving is evident.
	Coupling misalignment.	Re-align and replace oil seal if it has been damaged by shaft misalignment.

breakdowns and unnecessary parts replacement. The following should be checked regularly:

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the pump inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the systems, resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt, metal particles and other contaminants. If the fluid becomes contaminated, the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. Air bubbles in the reservoir also can be harmful to the pump and other components. If bubbles are seen, the air source should be found and eliminated.

5. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to replenish the system. it should always be poured through a fine wire screen - 200 mesh or finer.

It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

D. ADJUSTMENTS

No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

E. LUBRICATION

Internal lubrication is provided by the fluid flow in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

F. REPLACEMENT PARTS

Only genuine replacement parts manufactured or sold by Vickers and its distributors should be used. These are identified in the parts catalogs listed in Table II.

G. TROUBLE SHOOTING

Table IV lists possible difficulties experienced with vane pumps and hydraulic systems. It also indicated the probable causes and remedies for each of the troubles listed.

It should always be remembered that failures can also be due to improper installation, inadequate maintenance and other system component malfunctions. A thorough understanding of the system and its components is important for reliable trouble shooting.

SECTION VI - OVERHAUL

NOTE

Preassembled replacement cartridges are available for rapid field overhaul of these pumps. If a replacement cartridge is being used, proceed as in step B-1 following for disassembly and step D-2 for reassembly.

A. GENERAL

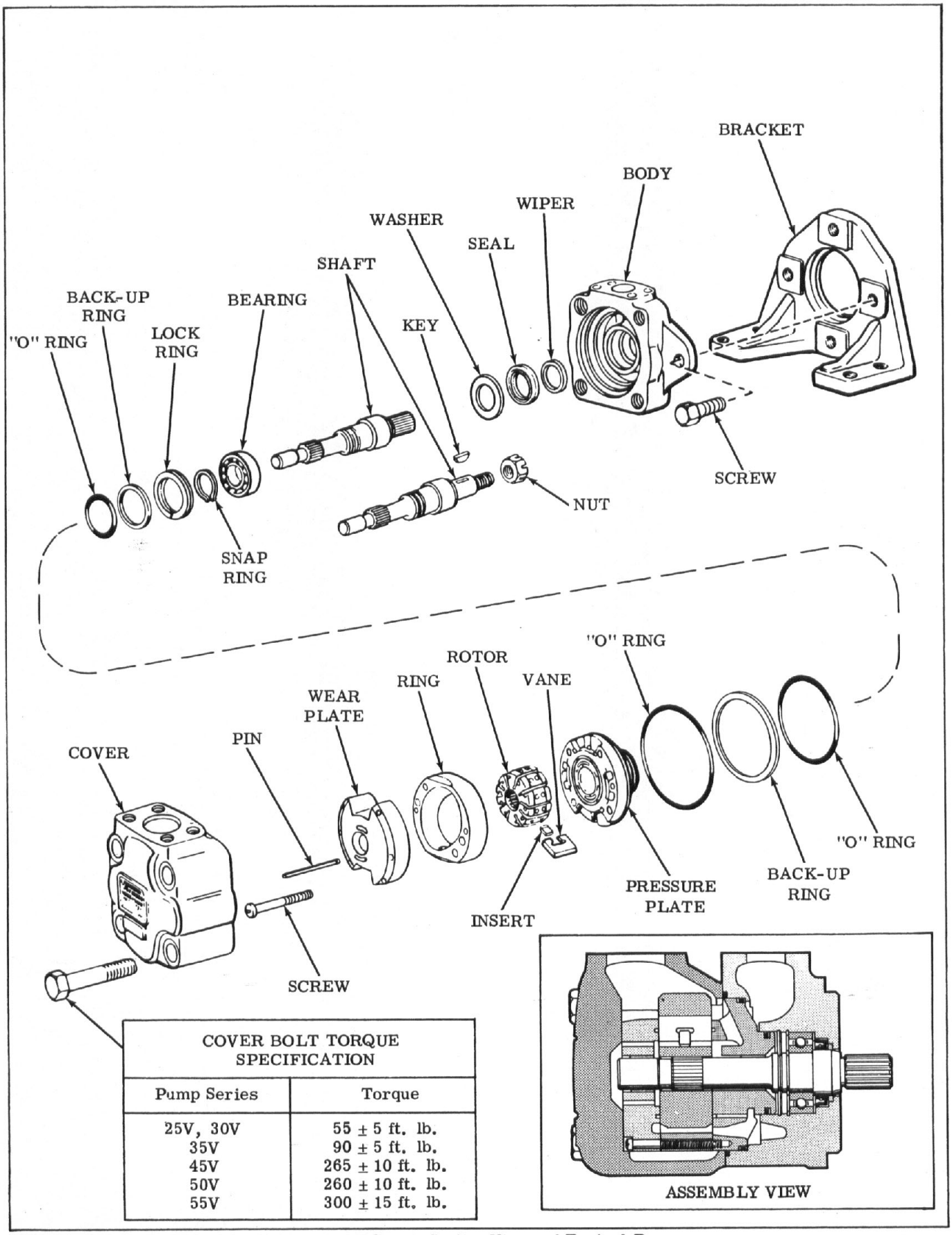
Plug all removed units and cap all lines to prevent the entry of dirt into the system during shut-down. During disassembly, pay particular attention to identification of the parts for correct reassembly.

Figure 8 shows the proper relationship of the parts for disassembly and reassembly. Various steps in the overhaul process are shown in Figures 9 through 14.

B. DISASSEMBLY

1. Basic Pump - Remove the foot mounting and shaft key, if used. Support the pump on blocks or clamp the body in a vise as shown in figure 10. If a vise is used, use protective jaws to avoid damage to the body and its machined surfaces.

Mark the pump body and cover for correct reassembly. Remove four cover screws and lift the cover off the pump. Remove the pressure plate



COVER BOLT TORQUE SPECIFICATION	
Pump Series	Torque
25V, 30V	55 ± 5 ft. lb.
35V	90 ± 5 ft. lb.
45V	265 ± 10 ft. lb.
50V	260 ± 10 ft. lb.
55V	300 ± 15 ft. lb.

Figure 8 - Exploded and Cross-Section Views of Typical Pump.

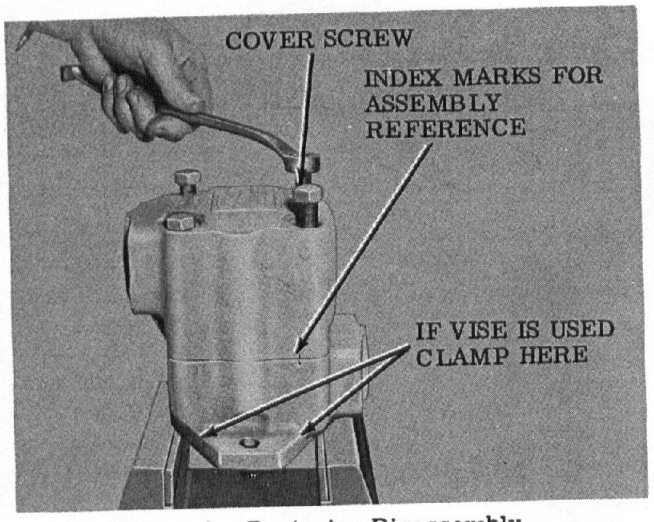


Figure 9 - Beginning Disassembly.

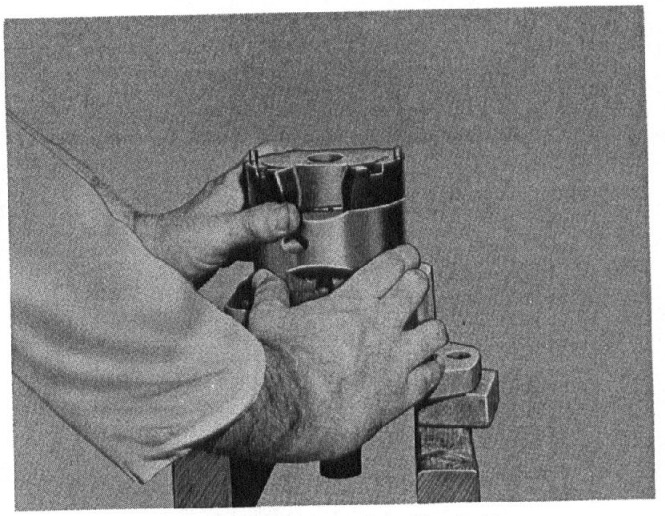


Figure 10 - Removing Cartridge.

spring (if used) and the cover "O" ring. Pull and/or pry out the cartridge as shown in Figure 10.

Next, remove the large snap ring and pull the shaft and bearing. Drive the shaft seal and wiper out from the shaft end of the body. If it is necessary to remove the shaft bearing, first remove the small snap ring and then press the shaft out of the bearing while supporting the bearing inner race.

2. Cartridge Assembly - Remove the "O" ring(s) and back-up ring(s) from the pressure plate. Remove the fillister head screws and lift off the wear plate. Note the position of the ring, rotor and vanes for correct reassembly. Separate the ring, rotor, vanes, locating pins and pressure plate.

C. INSPECTION AND REPAIR

1. Discard the shaft seal and all "O" rings and back-up rings. Use a new gasket kit for reassembly. Wash the metal parts in clean mineral solvent, blow them dry with filtered, dehydrated air and place them on a clean surface for inspection.

2. Check the wearing surfaces of the cartridge parts for scoring and excessive wear. Remove light score marks by lapping. Lubriting, Moly-Koteing or the equivalent is desirable after lapping to prevent seizure during start-up. Replace any heavily scored or badly worn parts.

NOTE

Replacement kits are available pre-assembled. If the old cartridge is worn extensively, a new kit should be used. Refer to the parts catalogs listed in Table I.

3. Inspect the vanes and inserts for burrs, wear and excessive play in the rotor slots. Replace the rotor if the slots are worn.

4. Rotate the bearing while applying pressure to check for wear, looseness and pitted or cracked races.

5. Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if marks cannot be removed by light polishing.

D. REASSEMBLY

NOTE

Coat all parts except seals and back-up rings with clean hydraulic fluid to facilitate reassembly and provide initial lubrication. Use small amounts of petroleum jelly to hold the "O" rings in place during assembly.

1. Cartridge - The direction of rotation is as viewed from the shaft end; right hand rotation is clockwise; left hand, counterclockwise.

Place the pressure plate on blocks as shown in Figure 11 and the rotor on the plate with the arrow pointed in the correct direction of rotation. Install the locating pins.

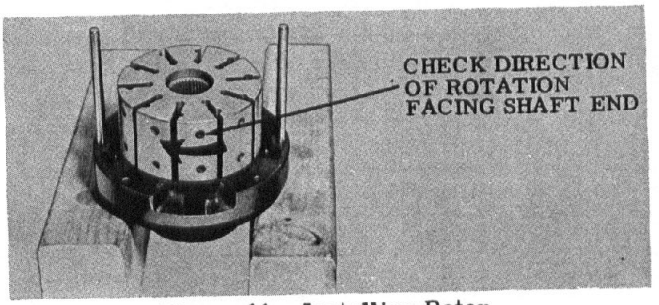


Figure 11 - Installing Rotor.

Position the ring over the pins and rotor, again observing the rotation arrow (Figure 12). Place the inserts in the vanes and install both in the rotor slots. Be sure the sharp edges are toward the direction of rotation (See Figure 13) and that both vanes and inserts move freely in the slots. Install the wear plate and screws (Figure 14).

2. Basic Pump - Soak a new shaft wiper in hydraulic fluid and install the wiper and seal. Use the seal installing tool (Figure 7) to prevent damaging the seal. Be certain the seal O.D. is below the chamfer in the body.

Clamp the body in a vise or place it on blocks as at disassembly and place the bearing spacer against the seal. Cover the end of the shaft with a "bullet" lubricated with grease or petroleum jelly to protect the seal. Press the shaft into the bearing in an arbor press, supporting the bearing inner race. Remove the "bullet". Install the small snap ring.

Tap the shaft and bearing gently into the body and install the snap ring.

Install the "O" ring and then the back-up ring on the cartridge pressure plate hub. Lay the body "O" ring in place and install the large back-up ring and then the "O" ring on the cartridge. Carefully install the cartridge in the body so one of the chamfers or flats on the ring will align with the inlet port when the inlet housing is installed. Install the cover and screws. Tighten the screws to the torque shown in Figure 8.

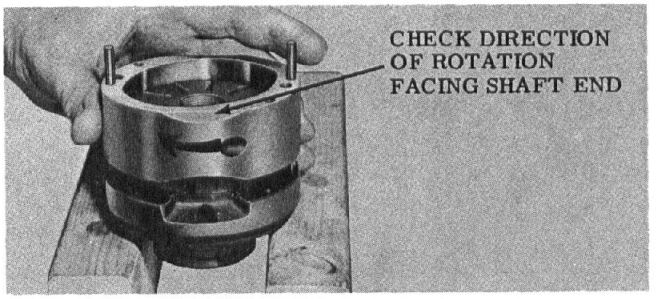


Figure 12 - Installing Ring

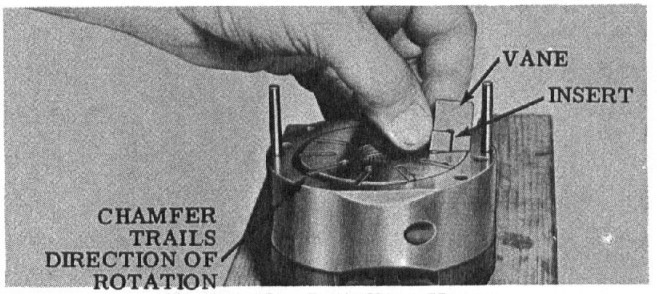


Figure 13 - Installing Vanes

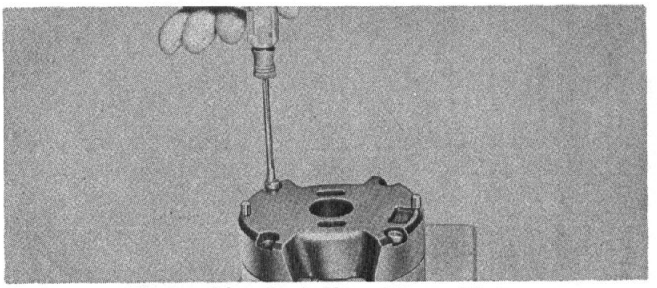
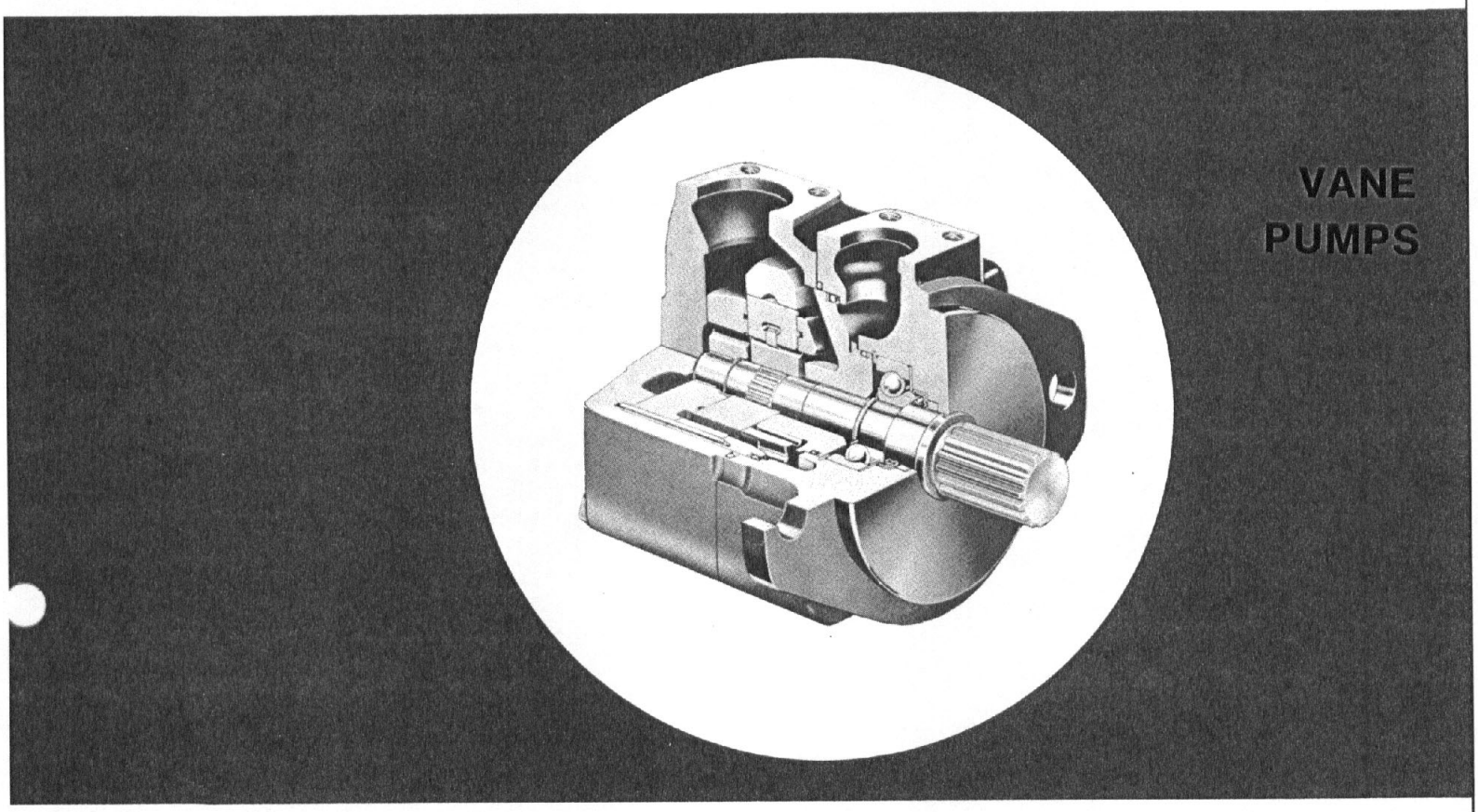


Figure 14 - Installing Wear Plate

SECTION VII - TESTING

Vickers Mobile Division application engineeing personnel should be consulted for test stand circuit requirements and construction. If test equipment is available, the pump should be tested at the recommended speeds and pressures shown on the installation drawings. (See Table I.)

SPERRY VICKERS



SERVICE PARTS INFORMATION

35V & 45 V SERIES
-10 DESIGN

SPERRY VICKERS
TROY, MI. 48084

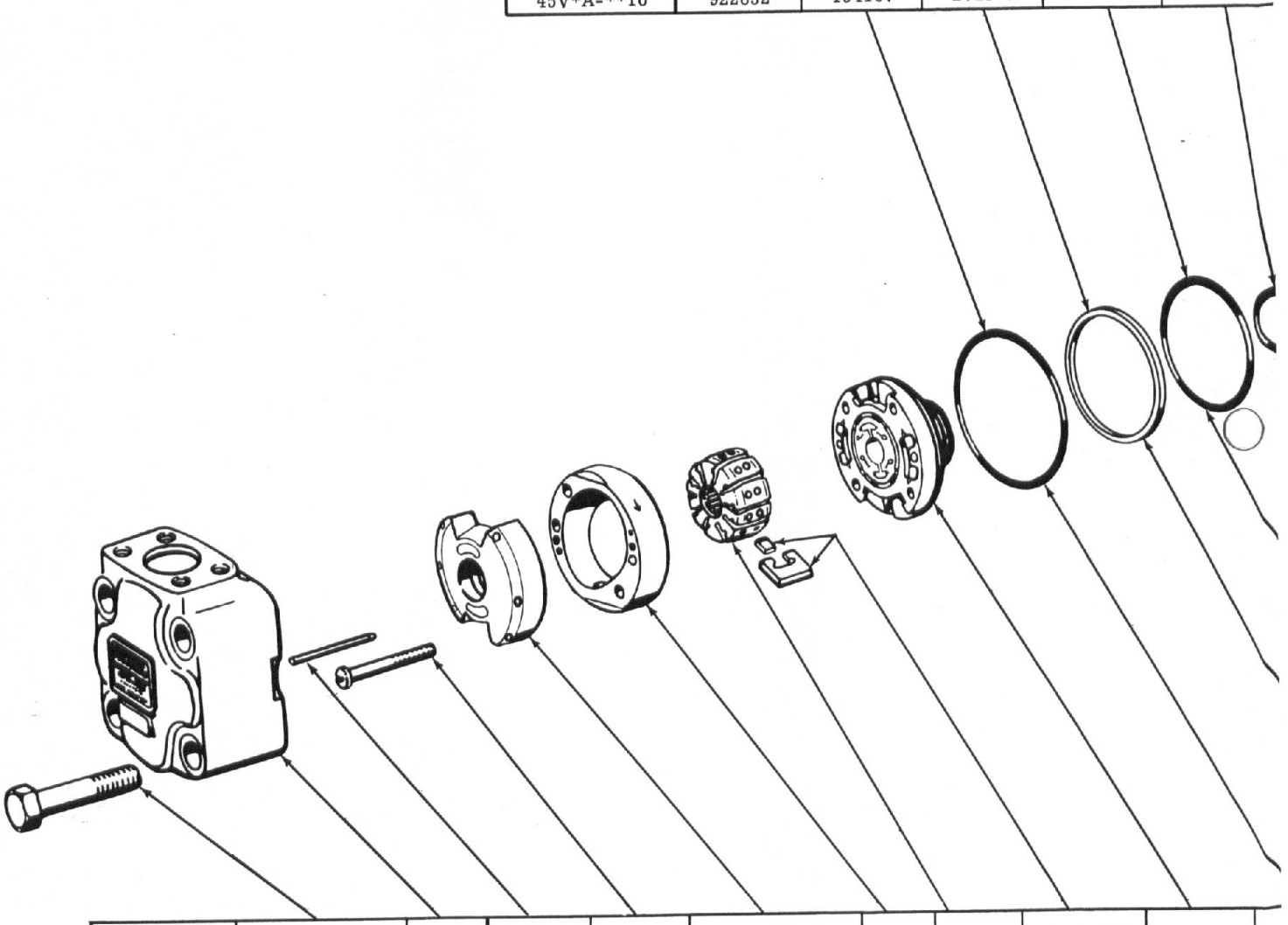
Revised 9-1 -74

M-2103-S

MODEL CODE

35, 45	V	*	*	—	*	*
SERIES DESIGNATION	VANE PUMP	CAPACITY 60 = 60 GPM	PORT CONNECTIONS A = 4 BOLT		SHAFT TYPE	OUTLET POSITIO

MODEL DESIGNATION	SEAL KIT	"O" RING	BACK-UP RING	"O" RING	"O" RING
	THESE PARTS ARE INCLUDE				
35V*A-**10	922851	154101	271811	154098	154084
45V*A-**10	922852	154107	271817	154104	154087



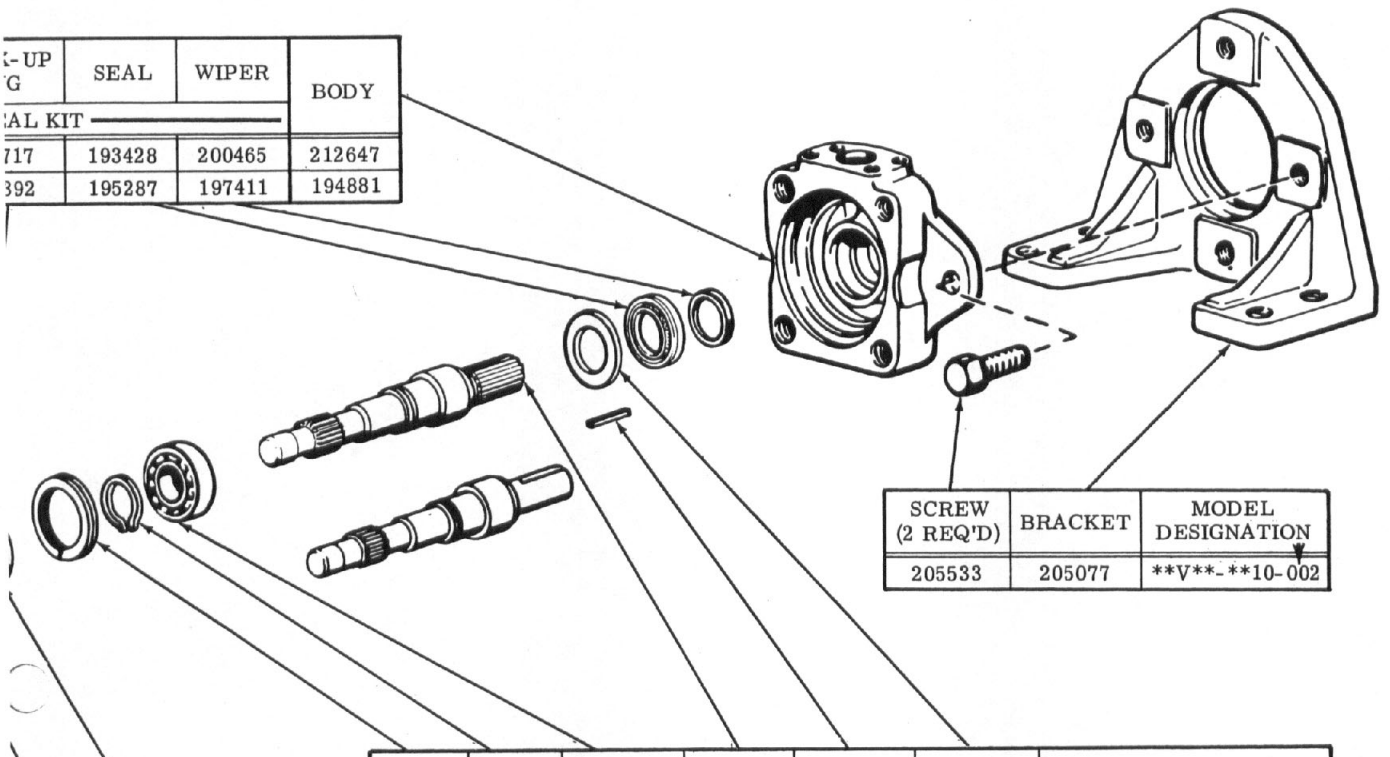
MODEL DESIGNATION	SCREW (4 REQ'D)	COVER	PIN (2 REQ'D)	SCREW (2 REQ'D)	WEAR PLATE SUB-ASSEMBLY	RING	ROTOR	VANE KIT (10 VANES 10 INSERTS)	PRESSURE PLATE	"C
			THESE PARTS ARE SERVICED IN CARTRI							
35V 25A-**10	11173 TORQUE TO 85-95 FT. LBS.	234248	280031	289475	325450	319396	262154	922700	325452	1
35V 30A-**10						319397				
35V 35A-**10						319398				
35V 38A-**10						319399				
45V 42A-**10	61321 TORQUE TO 255-275 FT. LBS.	229633	220888	289476	327010	297510	283871	922701	327012	1
45V 47A-**10						297718				
45V 50A-**10						297502				
45V 60A-**10						297503				

INCLUDE COMPLETE MODEL NUMBER ON ALL PARTS ORDERS

10 — L — ***

SIGN — LEFT HAND ROTATION — SPECIAL FEATURES

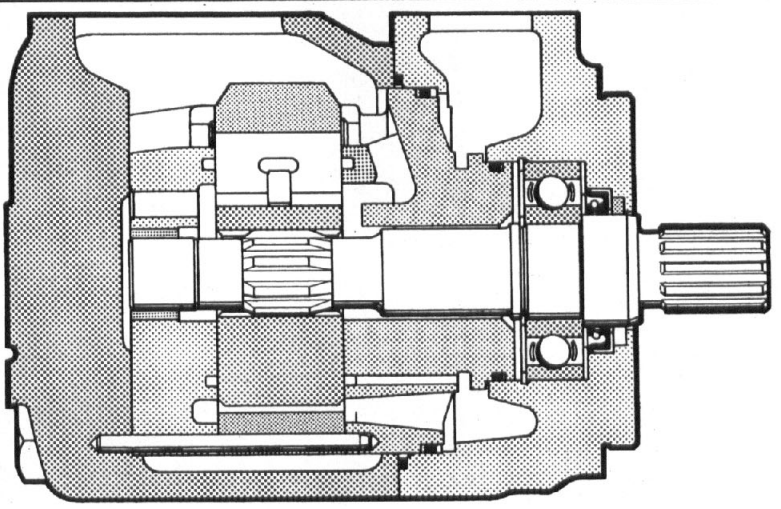
K-UP G	SEAL	WIPER	BODY
AL KIT			
717	193428	200465	212647
392	195287	197411	194881



SCREW (2 REQ'D)	BRACKET	MODEL DESIGNATION
205533	205077	**V**-**10-002

LOCK RING	SNAP RING	BEARING	SHAFT	KEY	WASHER	MODEL DESIGNATION
193144	119982	218585	233624	88678	193220	35V**- 1*10
			247803	—		35V**- 4*10
			242287	—		35V**-11*10
158630	102949	131812	233369	217596	194878	45V**- 1*10
			233370	—		45V**- 4*10
			242885	—		45V**-11*10

BACK-UP RING	"O" RING	"O" RING	BACK-UP RING	CARTRIDGE KIT
271811	154098	154084	263717	923259
				923260
				923261
				923262
271817	154104	154087	266392	923031
				923032
				923033
				923034



ASSEMBLY VIEW

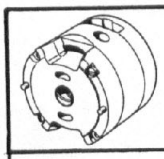
SEE SERVICE MANUAL M-2100-S FOR MAINTENANCE INFORMATION

SPARE PARTS STOCK RECOMMENDATIONS (FOR EACH 100 UNITS IN OPERATION)

		35,45 ▼	V ▼	* ▼	* - * ▼		* ▼	10 ▼	L ▼	*** ▼		
PART NUMBER	NAME	SERIES DESIGNATION	VANE PUMP	CAPACITY (GPM)	PORT CONNECTIONS	SHAFT TYPE	OUTLET POSITION	DESIGN	LEFT HAND ROTATION	SPECIAL FEATURES	QUANTITY PER UNIT	QUANTITY RECOMMENDED FOR STOCK
11173	SCREW	35									4	10
61321	SCREW	45									4	10
234248	COVER	35			A						1	2
229633	COVER	45			A						1	2
SEE PAGE 1	SCREW										• 2	5
SEE PAGE 1	PIN										• 2	5
SEE PAGE 1	WEAR PLATE S. A.										• 1	15
SEE PAGE 1	RING										• 1	15
SEE PAGE 1	ROTOR										• 1	15
SEE PAGE 1	VANE KIT										• 1	15
SEE PAGE 1	PRESSURE PLATE										• 1	15
923259	CARTRIDGE KIT	35		25							1	15
923260	CARTRIDGE KIT	35		30							1	15
923261	CARTRIDGE KIT	35		35							1	15
923262	CARTRIDGE KIT	35		38							1	15
923031	CARTRIDGE KIT	45		42							1	15
923032	CARTRIDGE KIT	45		47							1	15
923033	CARTRIDGE KIT	45		50							1	15
923034	CARTRIDGE KIT	45		60							1	15
193144	LOCK RING	35									1	10
158630	LOCK RING	45									1	10
119982	SNAP RING	35									1	10
102949	SNAP RING	45									1	10
218585	BEARING	35									1	7
131812	BEARING	45									1	7
88678	KEY	35				1					1	7
217596	KEY	45				1					1	7
SEE PAGE 2	SHAFT					1,4, 11					1	7
193220	WASHER	35									1	5
194878	WASHER	45									1	5
212647	BODY	35			A						1	2
194881	BODY	45			A						1	2
205533	SCREW									002	2	5
205077	BRACKET									002	1	2
922851	SEAL KIT	35									1	25
922852	SEAL KIT	45									1	25

CONTACT VICKERS APPLICATION ENGINEER FOR SPECIAL FEATURE INFORMATION.

• MAY BE PURCHASED IN CARTRIDGE KIT.

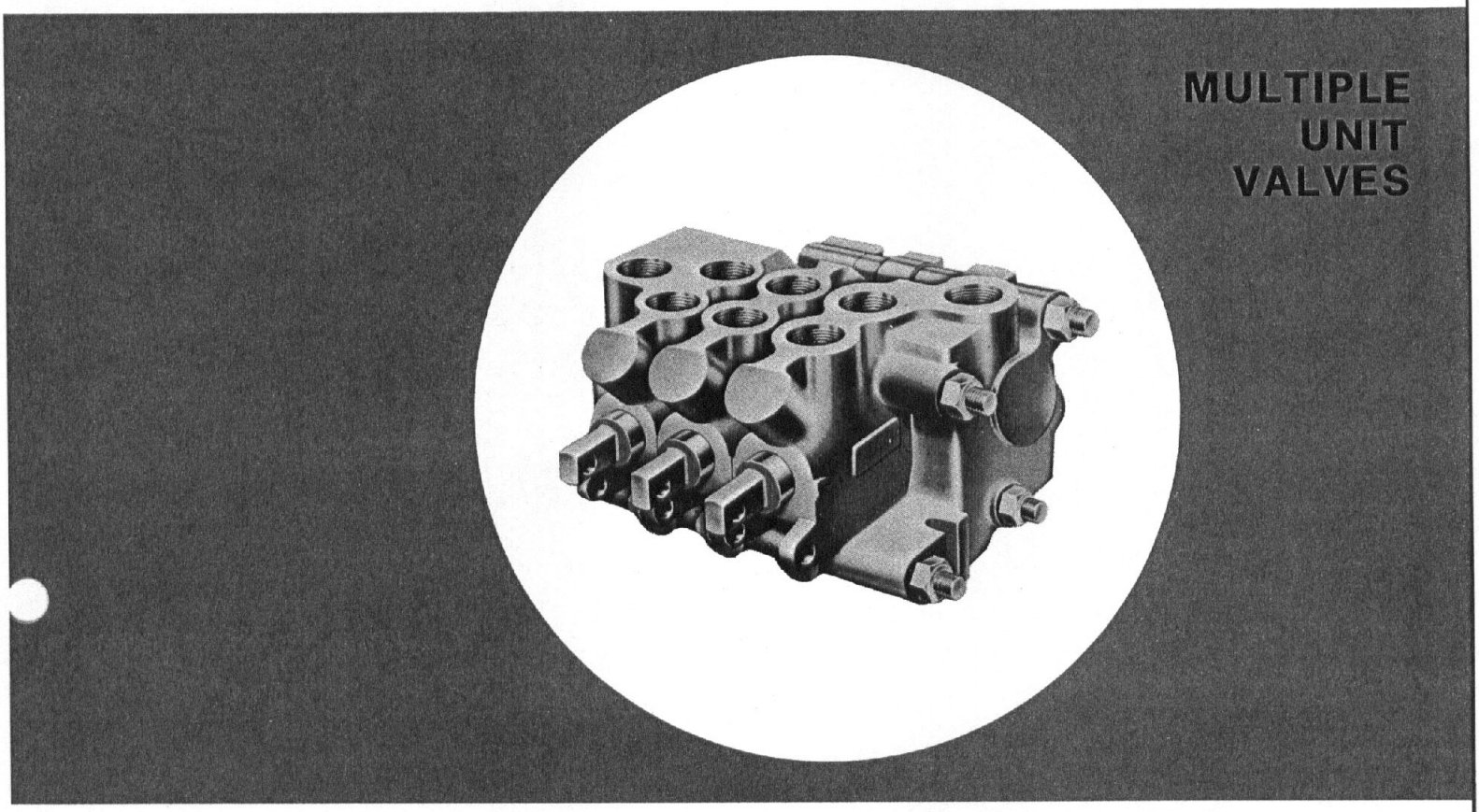


WHEN ORDERING SPARE CARTRIDGE PARTS, IT IS RECOMMENDED THEY BE OBTAINED IN CARTRIDGE KITS. KITS ARE ASSEMBLED AND TESTED BY VICKERS FOR EITHER RIGHT OR LEFT HAND ROTATION. IF LEFT HAND ROTATION IS REQUIRED IT SHOULD BE SPECIFIED ON PARTS ORDER BY ADDING SUFFIX "L" TO CARTRIDGE KIT NUMBER: FOR EXAMPLE, 923259-L.

To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. For information pertaining to Vickers economical 10 micron filters, see installation drawing M 229847.

LITHO IN U.S.A.

SPERRY VICKERS



OVERHAUL MANUAL

CM2 & CM3 SERIES-20 DESIGN
CM2 & CM3 SERIES-30 DESIGN

SPERRY VICKERS
TROY, MI. 48084

Released 12-1-65

M-2400-S

FOREWARD

This manual illustrates and describes the recommended procedure for servicing the CM2 and CM3 series valves.

Valves of the -30 design will be referred to throughout this manual, but this information is essentially the same for the -20 design valves. Service parts are generally interchangeable between the -20 and -30 design valves, however, it is recommended that the catalogs referenced in Table I be consulted for service parts for the respective design. Customers who wish to incorporate -30 design sections in -20 design valves can do so without concern. In this instance, a tie bolt must be left out. This does not affect the operation or function of the valve as one tie bolt on the -20 design is redundant.

To service these valves, read this manual thoroughly, and follow the instructions carefully.

TABLE OF CONTENTS

SECTION I - INTRODUCTION

A. PURPOSE OF MANUAL

This manual has been prepared to assist the users of Vickers CM2 and CM3 Series-20/-30 Design Multiple Unit Valves in properly maintaining and repairing their units. In the sections which follow, the multiple unit valves are described in detail, their theory of operation is discussed and instructions are given for their proper installation, maintenance and overhaul.

B. GENERAL INFORMATION

1. Related Publications - Service parts information and installation dimensions are not contained in this manual. The parts catalogs and installation drawings listed in Table I are available from your local Vickers Mobile Division application engineering office, or from:

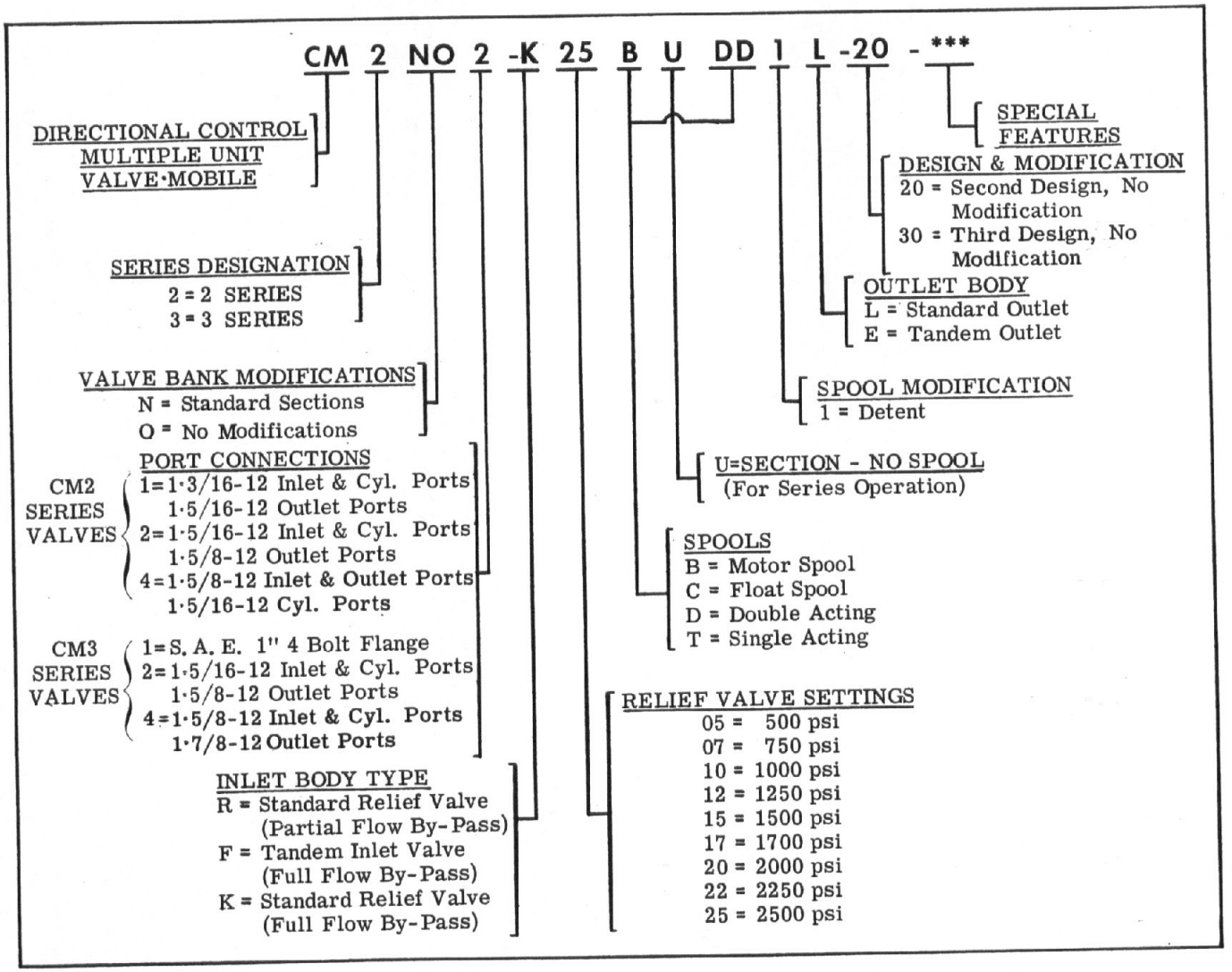
Vickers
Mobile Hydraulics Division
P. O. Box 302, Troy, Michigan 48084
Attn: Mobile Service Department

2. Model Codes - There are many variations within each basic model series, which are covered by variables in the model code. Table II is a complete breakdown of the codes covering these units. Service inquiries should always include the complete unit model number, which is stamped on the valve bodies.

TABLE I
AVAILABLE PARTS CATALOGS AND INSTALLATION DRAWINGS

MODEL SERIES	PARTS CATALOGS	INSTALLATION DRAWINGS
CM2-20 CM2-30	M-2401-S M-2403-S	M-259218
CM3-20 CM3-30	M-2402-S M-2404-S	M-259219

TABLE II - MODEL CODE BREAKDOWN



SECTION II - DESCRIPTION

A. GENERAL

CM2 and CM3 Series -20/-30 Design Valves are made up of directional control valve sections mounted in banks and connected internally to common pressure and tank return passages. A valve bank usually consists of an inlet and operating (R*, F*, or K*), a number of operating sections (*) and an operating and outlet section (*L or *E). Each operating section contains a sliding spool (for example B, C, D or T Spool). In valve banks where only one operating section is required, an R* section is used with an L or E tank plate section.

B. ASSEMBLY AND CONSTRUCTION

Figure 1 is a cross-sectional view showing the construction and assembly of a three-section valve. Each section normally contains a sliding spool with centering springs and a check valve. The inlet section also contains a relief valve assembly.

Passages between the bodies connect each section to the common inlet and tank ports. Seal rings between the sections seal the connecting passages. Sections are held together by studs and nuts.

C. DETENT FEATURES

1. Spool Detents - A spool detent assembly consists of a special end cap with a spring loaded plunger and a spool extension. The plunger engages in grooves of the spool extension to hold the spool in the desired position (see Figure 9).

D. MOUNTING

CM2 and CM3 Series -20/-30 Design Valves have mounting lugs cast into the inlet and outlet sections.

E. INSTALLATION DRAWING

Vickers Mobile Hydraulics Division application engineers should be consulted for valve ratings and applications. (Refer to the installation drawing listed in Table I for the performance information.)

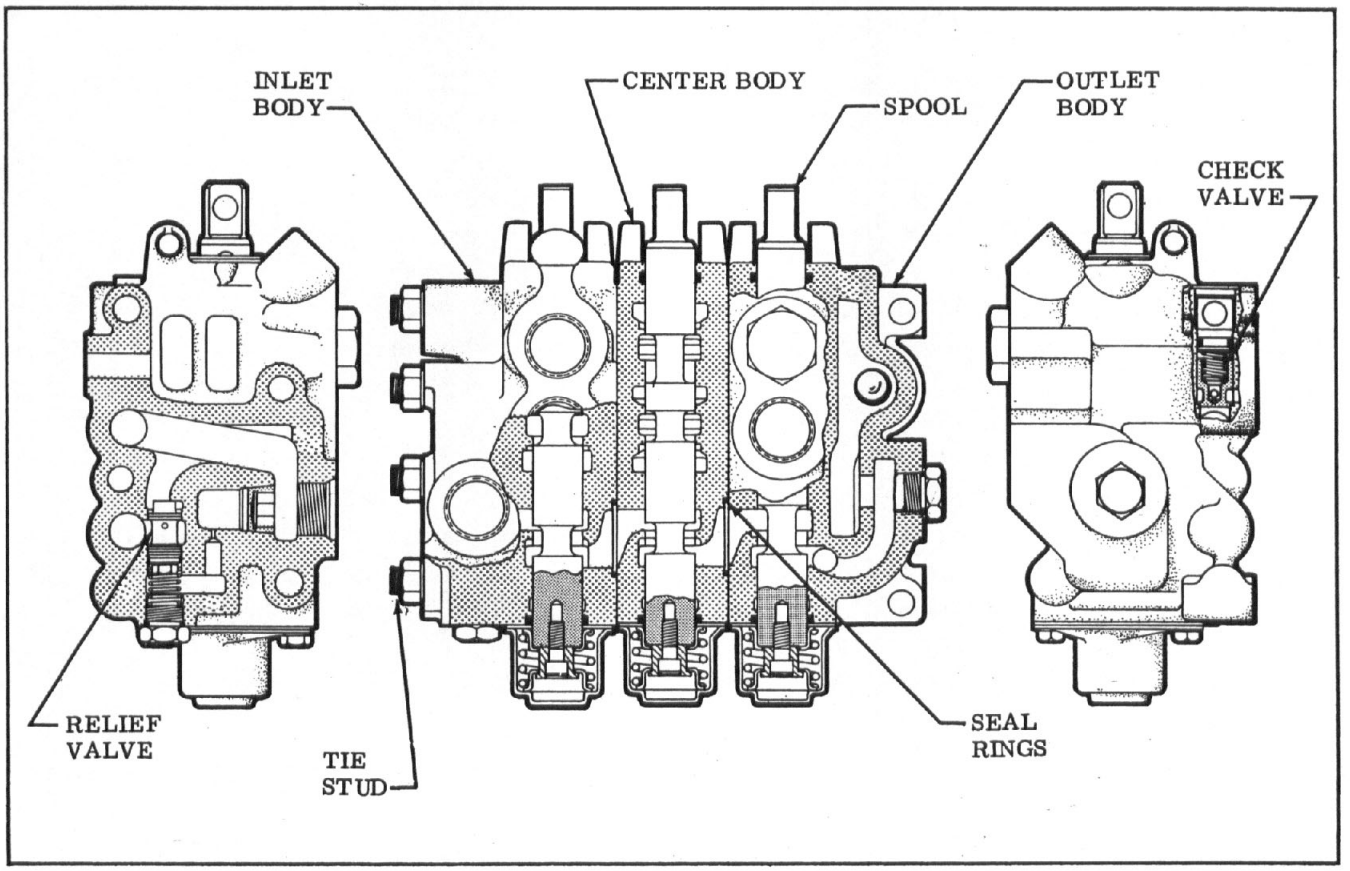


Figure 1

SECTION III - PRINCIPLES OF OPERATION

A. GENERAL

Figure 2 is a schematic illustration of a four section valve, showing the cylinder ports and the by-pass pressure and tank passages. The pressure passage is used to carry fluid to the cylinder ports when the the spools are shifted. The by-pass passage permits flow directly to the outlet when the spools are not being operated. The tank passages carry fluid to the tank port by return flow from the cylinder ports or fluid diverted past the flow control and relief valve.

The spools are shown in the centered or neutral position. Under these conditions, fluid in the pressure passage is blocked from the cylinder ports by the spool lands. Flow through the valve is through the by-pass and tank passage to the tank port.

B. OPERATING SECTIONS

1. Inlet Section - The CM2 and CM3 series valve banks may be obtained with operating, R*, F*, or K*, inlet sections. These sections are available with B, C, D, or T, type spools.

These sections are individually described below.

(a) R* Section - The R* section is equipped with an integral relief valve for overload protection. It is built to accept a check valve to prevent return flow through the valve.

The integral relief valve, with an orifice plug, also acts as a partial flow control valve. This feature lowers the pressure drop between the inlet and outlet ports. (See paragraph 4 for relief valve and flow control operation.)

The relief valve cracking pressure is pre-set at the factory. The pre-set cracking pressures range up to 2500 psi maximum. (See Table II Model Code for pressure settings.)

(b) F* Section - The F* section has two pressure connections. One connection is made to the pump source and the second connection is made with a preceding valve assembly to accept the by-pass flow for tandem operation.

The F* section like the R* section is built to accept a check valve to prevent return flow when this feature is required. However, F* sections do not employ relief valve or partial flow by-pass.

(c) K* Section - The K* section is essentially the same as the R* section except it has a full flow by-pass feature.

2. Outlet Sections

(a) *L Section - When two or more spools are required in a valve bank, the last section will be an *L section. The "*" denotes the spool type. This section contains the exhaust oil port and also is built to accept a check valve to prevent back flow when this feature is required.

(b) *E Section - This section is used for tandem operation by providing an outlet connection through which the by-pass feature for pump unloading is extended on to a subsequent valve bank. It is used in conjunction with an "F*" type inlet section in the next valve bank. Like the *L section it contains an operating spool and is built to accept a check valve to prevent back flow when this feature is required.

3. Spool Operation

General - Four standard spool designs are available ("B," "C," "D," or "T"). Any combination of spools may be used with a valve bank to perform a variety of operations. All operating spools are equipped with centering springs which return the spools to neutral.

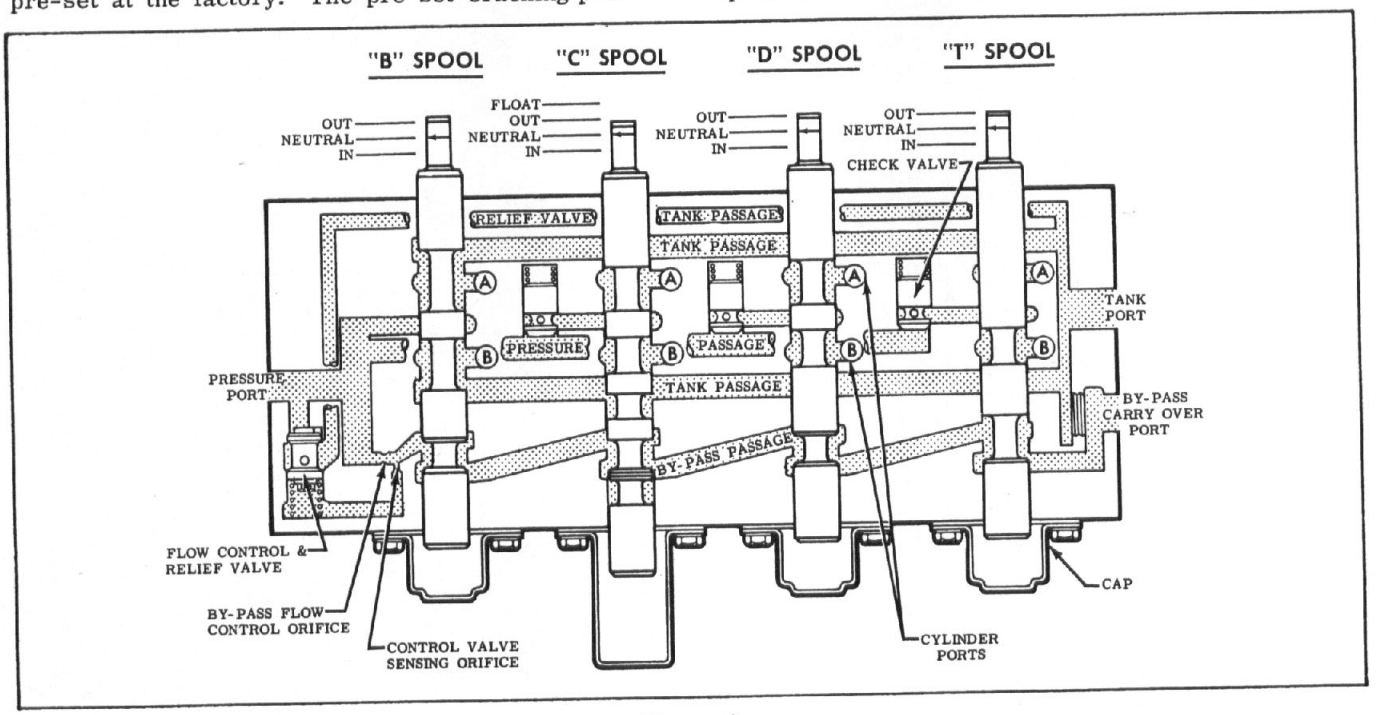
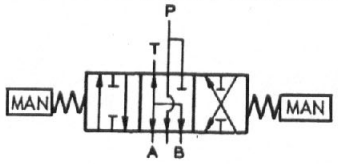


Figure 2

For convenience A. S. A. symbols (Y32. 10-1958) are also shown with the following descriptions of each spool.

(a) "B" - Motor Spool - "B" spools are used when flow is directed to the operation of a hydraulic motor instead of a cylinder. These spools are double acting in character so that the motor may be rotated in either direction. The cylinder ports are left partially open in the neutral position to allow free flow of oil between the motor and reservoir. See Figure 3 for spool position vs. flow characteristics.



"B" MOTOR SPOOL

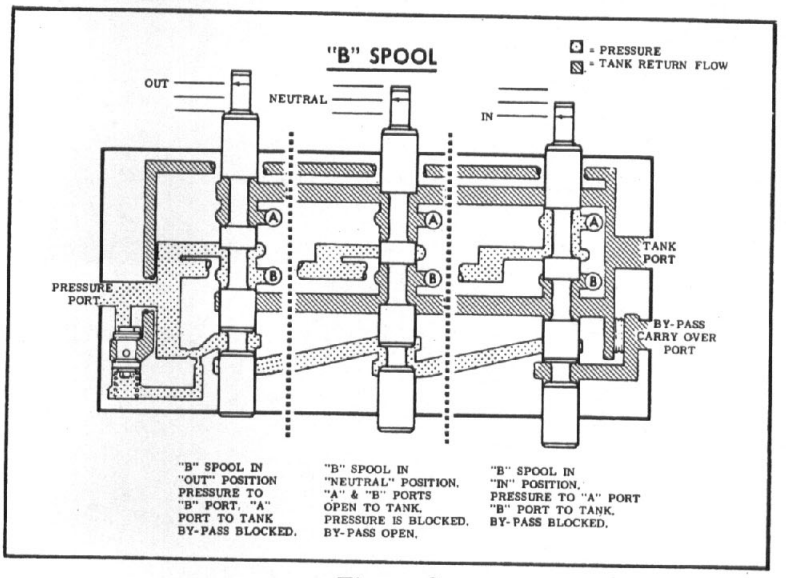
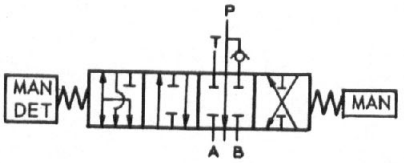


Figure 3

(b) "C" Float Spools - "C" spools are double acting with an additional float position. The spool is retained in the float position by a detent, and it is spring centered to neutral from the "in" and "out" positions. Both cylinder ports are open to the tank in the float position to permit free flow of oil in either direction. See Figure 4 for spool position versus flow.



"C" FLOAT SPOOL

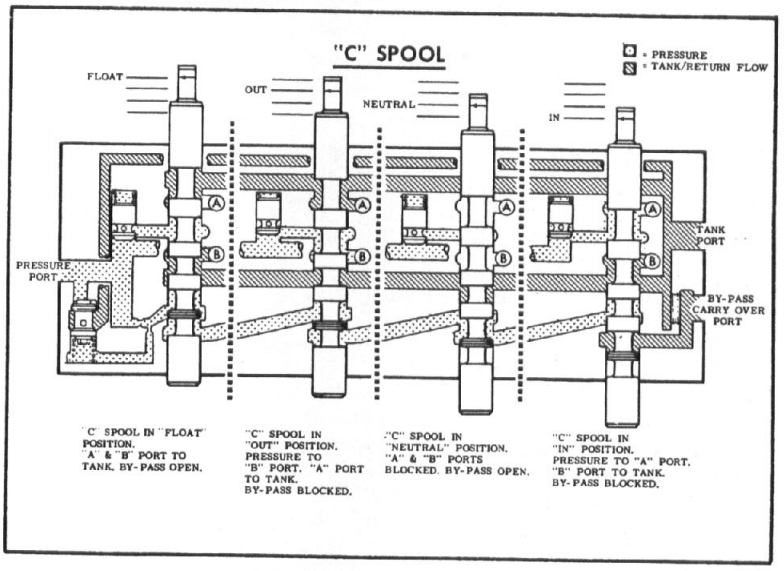
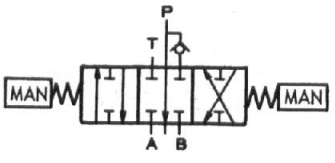


Figure 4

(c) "D" Double Acting Spool - "D" spools are used for applications where pump flow must be directed to either end of a cylinder, depending on the direction of movement required. The end of the cylinder not under pressure has its return flow directed to tank via internal coring of the valve sections. See Figure 5 for spool position versus flow.



"D" DOUBLE ACTING SPOOL

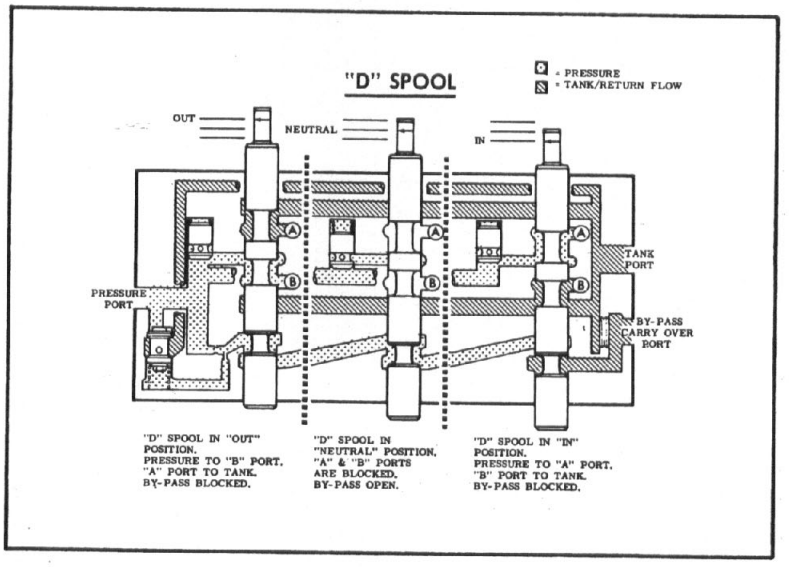
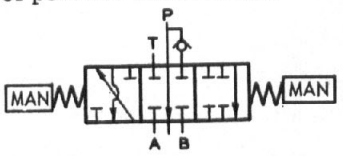


Figure 5

(d) "T" Single Acting Spool - "T" spools direct flow to one end of an operating cylinder only as in the example of the lift mechanism on a fork-type truck. Return flow is from the same end of operating cylinder and relies on gravity or mechanical means. See Figure 6 for spool position versus flow.



"T" SINGLE ACTING SPOOL

4. Flow Control and Relief Valve

General - The partial flow by-pass system in the CM2 and CM3 series valves makes use of a compound type flow control and relief valve arrangement. By sensing the pressure drop across an orifice at the entrance to the by-pass, the valve acts as a flow control to limit flow through the by-pass.

When a spool is completely shifted, the flow control is inoperative and full pump volume is available to the system. The control valve then functions as an overload relief valve. System pressure is limited to a prescribed maximum by the action of this valve.

(a) Flow Control - Figure 7A shows the flow control valve operation with the spool in neutral. Flow across the by-pass orifice results in a pressure drop The decreased pressure is sensed at the spring end of the valve sub-assembly through a sensing orifice. The slightly higher pressure at the other end of the valve permits it to shift down, diverting excess flow to the tank passage. With less than rated flow, shown on the installation drawing, there would be insufficient pressure drop across the by-pass orifice and the flow control valve would return to the closed position. Since the control valve is held closed by the large spring and all flow would be through the by-pass passage.

(b) Relief Valve - Operation of the relief valve feature is shown in Figure 7B. Here an operating spool would be shifted, porting fluid to the system and blocking the by-pass.

Figure 7B shows operation at less than the relief valve setting. There is no flow over the by-pass orifice, so full system pressure is sensed at the spring end of the control valve, as well as the

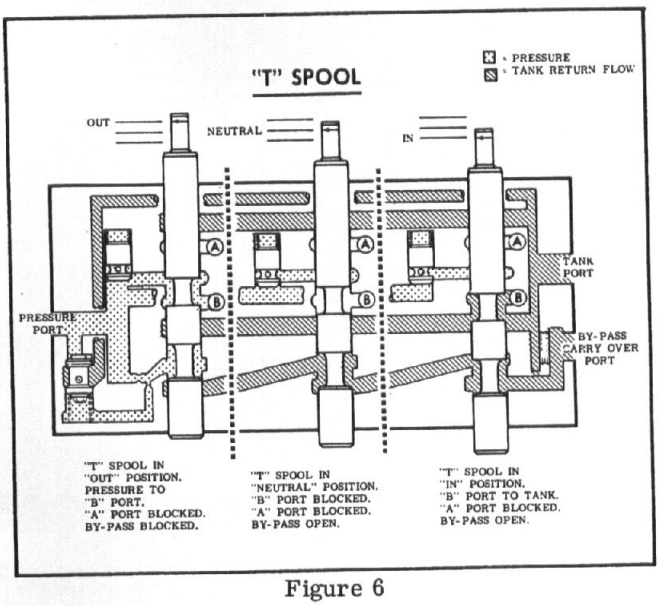


Figure 6

opposite end. The valve is thus hydraulically balanced and the large spring holds it closed.

Maximum pressure is determined by the setting of the small spring inside the control valve assembly. When system pressure is high enough to overcome this small spring, the poppet is forced off its seat. (See Figure 7C) Fluid immediately flows past the poppet to the tank passage. This flow creates a pressure drop across the sensing orifice and the control valve is no longer hydraulically balanced. balanced. When this pressure differential is great enough to overcome the large spring, the valve shifts permitting flow to the tank passage.

5. Check Valve - Timing of the valve spools is such that the cylinder port opens to pressure and tank before the by-pass passage is completely blocked. To prevent return flow from passing into the pressure passage, check valves are provided in each operating section except the "B" section. The load is thus prevented from dropping.

6. Detent - The spool detent consists of a special end cap with a spring loaded plunger. The plunger engages in a groove in the spool extension and holds the spool in the desired position. Detent parts are illustrated in the exploded view in Figure 9A.

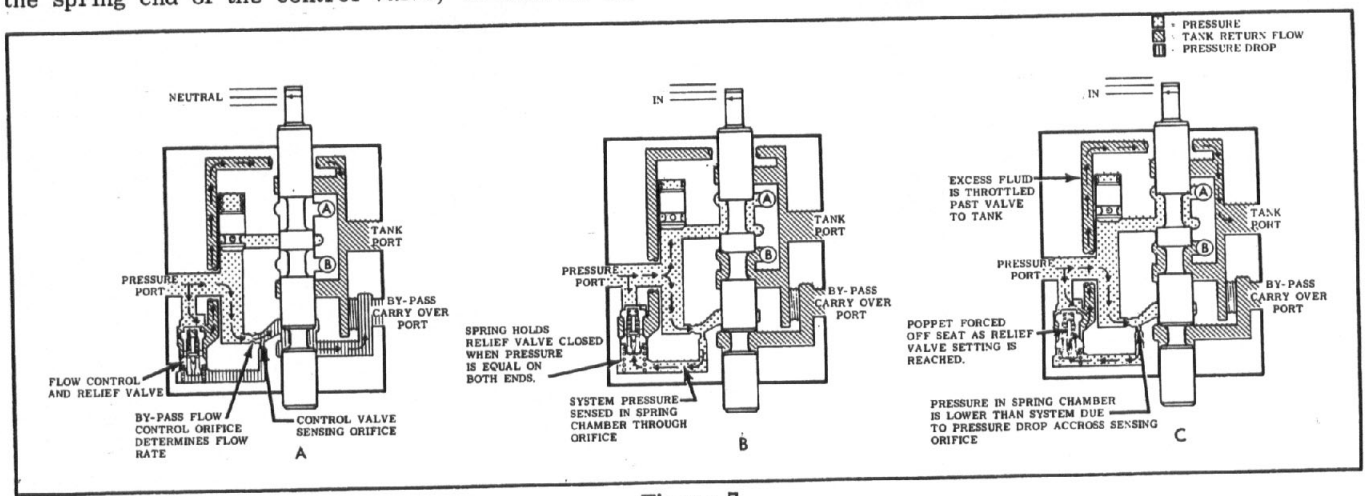


Figure 7

7. Tandem Operation - Tandem operation permits operation of two banks of valves from the same pumping source. An internal plug in the outlet section of the first bank (see Figure 8) separates the by-pass passage from the tank passage. Cylinder exhaust oil is returned to tank via the alternate discharge port, and by-pass oil is directed out the primary discharge port to the by-pass port of the bank.

In Figure 8, either bank can be operated separately or both simultaneously. This is possible because of the tandem by-pass connection from the inlet connection of the first bank to the F inlet connection of the second bank. If neither bank is operating, part of the fluid flows through both by-pass passages directly to tank. The balance is diverted through the tank passage of the first section as shown in Figure 2.

In some cases, it is desirable to have tandem valves connected in series where, the second bank is dependent upon the operation of the first bank. The first bank has control priority because the tandem by-pass connection is not used. The cylinder by-pass oil of the first bank is directed out of primary discharge port to the inlet port of the second bank. Use a "K" inlet section in the first bank if full flow is desired to the second bank. Otherwise reduced flow will be encountered.

C. NON-OPERATING SECTIONS

1. General - The CM2 valve non-operating sections are the "E" and "L" outlet sections and a center "U" section. These sections do not have operating spools. The functions of these sections are as follows:

(a) "E" Outlet Section - The "E" type section provides an outlet section by which the by-pass feature for pump unloading is extended to a subsequent valve bank (tandem operation). It is generally used in conjunction with the "F" type inlet section on the subsequent valve bank assembly. This "E" type section is only used with one spool banks.

(b) "L" Outlet Section - The "L" type section is basically the same section as the "E" section except it provides only one connection for exhaust oil and is used as the last section on a single spool bank where tandem operation is not required.

(c) "U" Center Section - The "U" section, when mounted between two operational sections, permits the operation of two cylinders or motors in series. This is accomplished by porting the outlet of the first operating section to the inlet of the second operating section.

NOTE

It should be noted that the pressure drop across the valve, when used in series operation, will be the sum of the pressure drops for each section.

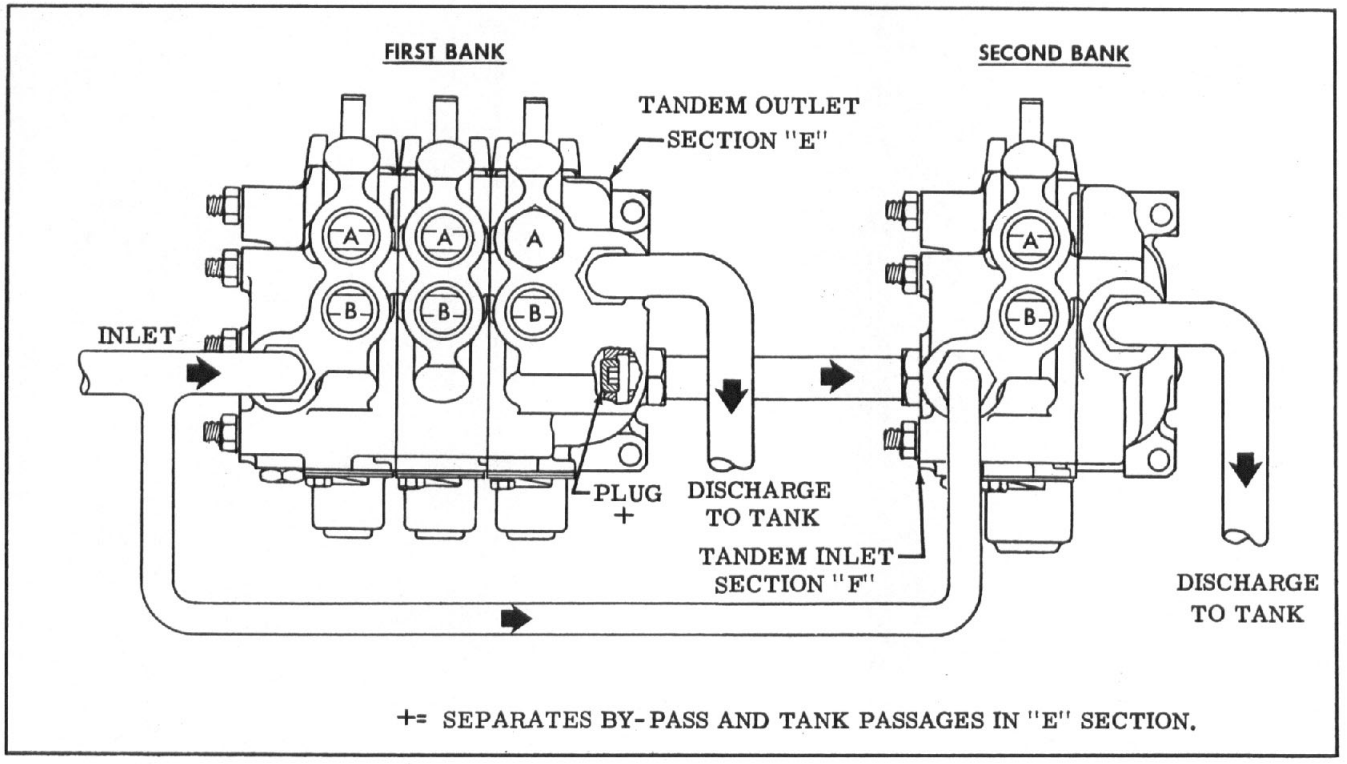


Figure 8

SECTION IV - INSTALLATION AND OPERATING INSTRUCTIONS

A. INSTALLATION DRAWINGS

Installation drawings M-259218 and M-259219 should be consulted for installation dimensions.

B. MOUNTING

These valves can be mounted in any position. Enough clearance must be left to provide access to the port connections and to permit actuating the control mechanism. The valves should be securely bolted to the mounting surface.

NOTE

Valves should be mounted on a relatively flat surface to prevent possible distortion of the valve bodies.

C. PORT CONNECTIONS

All connections are compatible with standard SAE fittings and "O" ring seals. It is only necessary to tighten fittings so that there is a firm metal-to-metal contact.

D. RELIEF VALVE

Relief valve sub-assemblies in the inlet section are preset and tested by Vickers for given pressure settings. Selection of the relief valve setting is based on the work requirements of the system. If a different relief valve setting is required, the valve sub-assembly should be replaced (see parts catalog M-2401-S, M-2402-S, M-2403-S or M-2404-S).

E. TANDEM INSTALLATION

1. Piping arrangement for tandem series operation is shown in Figure 8.

2. The outlet section of the first bank must be an "E" section which is equipped with a plug (see Figure 8) to block the primary discharge port from tank. The discharge to tank port must be connected to tank.

NOTE

Slight leakage past the internal plug is permissible. The plug should not be tightened excessively, as there is the danger of distorting the body and causing the spool to bind.

F. HYDRAULIC TUBING

NOTE

For instructions on pickling, refer to Vickers Instruction Sheet M-9600.

1. All tubing must be thoroughly cleaned before installation to remove dirt, rust and scale. Recommended methods of cleaning are sand blasting, wire brushing and pickling.

2. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow.

3. Tubing should not be bent too sharply. The minimum radius for bends is three times the inside diameter of the tube.

4. To minimize flow resistance and the possibility of leakage, only as many fittings and connections as are necessary for proper installation should be used.

G. HYDRAULIC FLUID RECOMMENDATIONS

The oil in a hydraulic system serves as the power transmission medium. It is also the system's lubricant and coolant. Selection of the proper oil is a requirement for satisfactory system performance and life. Oil must be selected with care and with the assistance of a reputable supplier.

TWO IMPORTANT FACTORS IN SELECTING AN OIL ARE:

1. Antiwear Additives - The oil selected must contain the necessary additives to insure high antiwear characteristics.

2. Viscosity - The oil selected must have proper viscosity to maintain adequate lubricating film at system operating temperature.

SUITABLE TYPES OF OIL ARE:

1. Crankcase Oil meeting API service classification MS. The MS (most severe) classification is the key to proper selection of crankcase oils for Mobile hydraulic systems.

2. Antiwear Type Hydraulic Oil - There is no common designation for oils of this type. However, they are produced by all major oil suppliers and provide the antiwear qualities of MS crankcase oils.

3. Certain Other Types of Petroleum Oils are suitable for Mobile hydraulic service if they meet the following provisions:

(A) Contain the type and content of antiwear compounding found in MS crankcase oils or have passed pump tests similar to those used in developing the antiwear type hydraulic oils.

(B) Meet the viscosity recommendations shown in the following table.

(C) Have sufficient chemical stability for Mobile hydraulic system service.

The following types of oil are suitable if they meet the above three provisions:

Series 3 Diesel Engine Oil
Automatic Transmission Fluid Types A, F and DEXRON
Hydraulic Transmission Fluid Types C-1 and C-2

The following table summarizes oil types recommended for use with Vickers equipment in Mobile hydraulic systems by viscosity and service classification.

TABLE III

Hydraulic System Operating Temperature Range (Min. * To Max.)	SAE Viscosity Designation	American Petroleum Institute (API) Service Classification
0°F. to 180° F.	10W	MS
0°F. to 210° F.	10W-30**	MS
50°F. to 210° F.	20-20W	MS

* Ambient Start Up Temperature
** See paragraph on Viscosity Index

OPERATING TEMPERATURE:

The temperatures shown in table III are cold start-up to maximum operating. Suitable start-up procedures must be followed to insure adequate lubrication during system warm-up.

ARCTIC CONDITIONS:

Arctic conditions represent a specialized field where extensive use is made of heating equipment before starting. If necessary, this, and judicious use of SAE 5W or SAE 5W-20 oil in line with the viscosity guide lines shown in the table, may be used. Dilution of SAE 10W (MS) oil with maximum of 20% by volume of kerosene or low temperature diesel fuel is permissible. During cold start-up, avoid high speed operation of hydraulic system components until the system is warmed up to provide adequate lubrication. Operating temperature should be closely monitored to avoid exceeding a temperature of 130° F. with any of these light weight or diluted oils.

OTHER FACTORS IN SELECTING AN OIL ARE:

1. Viscosity - Viscosity is the measure of fluidity. In addition to dynamic lubricating properties, oil must have sufficient body to provide adequate sealing effect between working parts of pumps, valves, cylinders and motors, but not enough to cause pump cavitation or sluggish valve action. Optimum operating viscosity of the oil should be between 80 SSU and 180 SSU. During sustained high temperature operation viscosity should not fall below 60 SSU.

2. Viscosity Index - Viscosity index reflects the way viscosity changes with temperature. The smaller the viscosity change the higher the viscosity index. The viscosity index of hydraulic system oil should not be less than 90. Multiple viscosity oils, such as SAE 10W-30, incorporate additives to improve viscosity index (polymer thickened). Oils of this type generally exhibit both temporary and permanent decrease in viscosity due to the oil shear encountered in the operating hydraulic system. Accordingly, when such oils are selected, it is desirable to use those with high shear stability to insure that viscosity remains within recommended limits.

3. Additives - Research has developed a number of additive agents which materially improve various characteristics of oil for hydraulic systems. These additives are selected to reduce wear, increase chemical stability, inhibit corrosion and depress the pour point. The most desirable oils for hydraulic service contain higher amounts of antiwear compounding.

SPECIAL REQUIREMENTS:

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your Vickers sales representative.

CLEANLINESS:

Thorough precautions should always be observed to insure that the hydraulic system is clean:

1. Clean (flush) entire system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminant into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

4. Provide continuous protection of system from entry of airborne contamination.

5. During usage, proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over-emphasized.

SECTION V - INSPECTION AND MAINTENANCE

A. SERVICE TOOLS

No special tools are required to service Vickers CM2 or CM3 series multiple unit valves.

B. INSPECTION

Periodic inspection of spool operation, oil condition and pressure connections saves time-consuming breakdowns and unnecessary parts replacement.

1. All hydraulic connections must be tight. Loose connections not only allow leakage but also permit air to be drawn into the system, resulting in noisy and erratic operation.

2. Spools should return to neutral automatically when the control is released. The centering spring force is approximately 60 to 120 pounds. If more force is necessary, the spool may be binding or control linkage may be faulty.

3. System filters and reservoir should be checked periodically for foreign particles. If excessive contamination is found, the system should be drained. The reservoir must be cleaned thoroughly before refilling.

C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to the system, it should be pumped through a 25 micron filter. If such a filter is not available, or practical to use in the field, a funnel with a fine wire screen (200 mesh or better) can be used.

It is important that oil be clean and free of all substance which will cause improper operation and excessive wear of the pump or other hydraulic units in the system. Be sure to purge all air from the system.

D. LUBRICATION

Internal lubrication is provided by system oil.

E. REPLACEMENT PARTS

Only genuine parts manufactured or sold by Vickers should be used as replacement parts for these valves. Only Vickers knows the true quality level required of each part. These are listed in parts catalogs M-2401-S, M-2402-S, M-2403-S and M-2404-S copies of which are available on request.

F. TROUBLE SHOOTING

Table IV lists the difficulties which may be experienced with the unit and hydraulic system. It indicates the cause and remedy for each of the troubles listed. It should always be remembered that pressure and delivery are factors which are usually dependent upon each other. Adequate pressure gage equipment and a thorough understanding of the operation of the complete hydraulic system are essential to diagnose improper operation.

TABLE IV - TROUBLE, CAUSE AND REMEDY CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks at either end of spool.	Defective "O" rings in valve body.	Replace "O" rings.
Spring-centered spools do not return to neutral.	Broken springs.	Replace springs.
	Bent spool.	Replace with new section of same size and type.
	Foreign particles.	Clean system and valve.
	Misalignment of operating linkage.	Check linkage for binding condition.
	Valve tank improperly torque.	Retorque nuts to specified ratings.
Detent type spools will not stay in detent position.	Worn detent barrel.	Replace detent barrel.
	Weak or broken detent spring.	Replace detent spring.
No motion, slow or jerky action of hydraulic system.	Relief valve not properly set, or stuck in base and/or worn.	Repair, clean and readjust.
	Dirt or foreign particles lodged between relei valve control poppet and seat.	Disassemble, clean and reassemble.
	Valve body cracked inside.	Replace valve section.
	Spool not moved to full stroke.	Check travel.
No relief valve action (High Pressure)	Small particle of dirt plugging orifice in relief valve sub-assembly.	Remove relief valve and check hole. If blocked, clear hole.
	Relief Valve S.A. installed backwards.	Install properly.
Load will not hold.	Oil by-passing between spool and body.	Replace valve.
	Oil by-passing piston in cylinder.	Repair or replace cylinder.
	Spool not centered	Refer to above spool remedies.
Load drops when spool is moved from neutral to a power position.	Dirt or foreign particles lodged between check valve poppet and seat.	Disassemble, clean and reassemble.
	Scored or sticking check valve poppet.	Replace poppet.

SECTION VI - OVERHAUL

A. GENERAL

During disassembly, particular attention should be given to identification of parts for reassembly. Spools are selectively fitted to valve bodies and must be returned to the same bodies from which they were removed. Valve sections should be reassembled in the same order.

Figure 9 and 9A is an exploded view showing the proper relationship for reassembly. Reference is made to these figures in the procedures which follow.

B. DISASSEMBLY

1. Controls - Be sure the unit is not subjected to pressure. Disconnect and cap all lines and disconnect linkage to the spool. If hand levers are used, remove the "E" rings which retain the fulcrum rod and remove the links, levers and retaining rings.

2. Attaching Parts - Remove the four tie studs and nuts and separate the valve sections. Be careful not to destroy or lose spacers.

3. End Caps - Remove the two screws which secure the spool and cap and remove the cap. If the cap has a detent assembly, screw out the detent plug and remove the spring and piston. Remove the "O" ring from the body.

4. Operating Spool - Slide the spool out of its bore from the cap end and remove the "O" rings from the valve body around the spool bore. Do not remove the centering spring and retainers unless it is necessary to replace them.

5. Check Valve - Grip the stem of the check valve plug with pliers and pull it out of the valve body. Remove the "O" ring and back-up ring. Remove the spring and poppet from the valve body.

6. Relief Valve Sub-Assy - Screw out the plug which retains the relief valve and remove the "O" ring from the plug. Remove the spring and the relief valve sub-assembly. In F* sections, remove the solid plug.

7. Valve Body - Remove the plug and "O" ring from the blocked cylinder port on models with a single acting spool. If the alternate discharge port is plugged, it is not necessary to remove the plug unless the body is to be replaced.

C. CLEANING, INSPECTION AND REPAIR

1. Discard all old seals. Wash all parts in a clean mineral oil solvent and place them on a clean surface for inspection.

2. Carefully remove burrs by light stoning or lapping. Be certain there is no paint or burrs on matting surfaces of valve bodies.

3. Inspect the valve spools and bores for burrs and scoring. If scoring is not deep enough to cause objectionable leakage, the surfaces can be stoned or polished with crocus cloth. If scoring is excessive, the valve body and spool must be replaced by ordering a new section. Check the valve spool for freedom of movement in the bore.

4. Check the relief valve for smooth movement in its bore. The valve should move from its own weight.

D. ASSEMBLY

NOTE

Coat all parts with clean hydraulic oil to facilitate reassembly and provide initial lubrication. Petroleum jelly can be used to hold seal rings in place on assembly.

1. Valve Body (Figure 9) - On models with single-acting spool, install the "O" ring on the port plug and plug the appropriate cylinder port. Tighten the plug securely, but DO NOT over tighten.

2. Relief Valve - Install the "O" ring on the relief valve plug. Place the relief valve assembly in its bore, hex nut end towards opening. Install the spring and plug and tighten the plug securely but DO NOT over tighten.

3. Check Valve - Install a new back-up ring and "O" ring on the check valve plug with the "O" ring toward the spring and poppet. Place the poppet and spring in the body and install the plug.

4. Operating Spool - If centering spring and spool have been removed, install new "O" rings in the "O" ring groove in the body at each end of the spool bore. Install spool in bore from the cap end. Install the flat retainer, guide and screw. Tighten the screw securely. Align the flat retainer by shifting the spool. Spool bind is an indication of flat retainer misalignment. Install the end cap and attaching screws. Tighten the end cap screws securely. On models with detents grease all the detent parts and install the piston, spring and plug. Be sure to screw the plug in all the way.

5. Assembly of Unit Sections.

CAUTION

Make sure all mating surfaces of valve bodies are free of burrs and paint.

Install seal rings in the grooves in the body of each inlet and center section. Use petroleum jelly to hold the seals in place. For CM2 valves, install the spacers to insure against spool bind when the studs are tightened. With the mounting feet on a flat surface carefully place the sections together in the same order in which they were removed. The mounting feet must be maintained in a flat plane to prevent spool bind (due to body distortion) when the valve is mounted for operation. If levers are used, install pins in each spool and assembly the levers, fulcrum rod and "E" rings. Tighten the nuts on the CM2 to 45-50 foot pounds torque and on the CM3 to 55-60 foot pounds torque.

SECTION VII-VALVE OPTIONS

A. GENERAL - Operating sections can be supplied with anti-cavitation check valves, and combination anti-cavitation check valves with cylinder port relief valves. The use of these accessories will be identified by a special feature suffix on the model number. Refer to the installation drawings listed in Table 1 for these options.

1. Anti-Cavitation Check Valve - To eliminate cavitation created in the system, an anti-cavitation check valve may be employed. The valve can be installed on each cylinder port of any operating section where required. When the system pressure is less than tank pressure, a vacuum is created. The anti-cavitation check valve equalizes the unbalanced pressure condition by metering fluid from the tank passage back to the pressure port. The anti-cavitation check valve is located in valve operating sections next to the cylinder ports and function when the spool is in neutral and operating position.

2. Anti-Cavitation Check With Cylinder Port Relief Valve - The anti-cavitation check with cylinder port relief valve is a combination of anti-cavitation check valve with an integral cylinder port relief valve sub-assembly. The operation of the anti-cavitation check feature is described in paragraph VII, A, 1. The cylinder port relief sub-assembly limits the maximum pressure in the cylinder port. The relief sub-assembly normally functions when the valve spool is in the neutral position. Fluid is discharged from the cylinder port to the tank passage of the directional valve. The pressure setting is generally higher than the main system relief valve. The relief valve sub-assemblies are pre-set at the factory.

SECTION VIII-TESTING

Vickers Mobile Division application engineering personnel should be consulted for recommendations on test stand circuit requirements and construction. If test equipment is available, valves should be tested at the recommended flow and pressure shown on installation drawings M-259218 and M-259219.

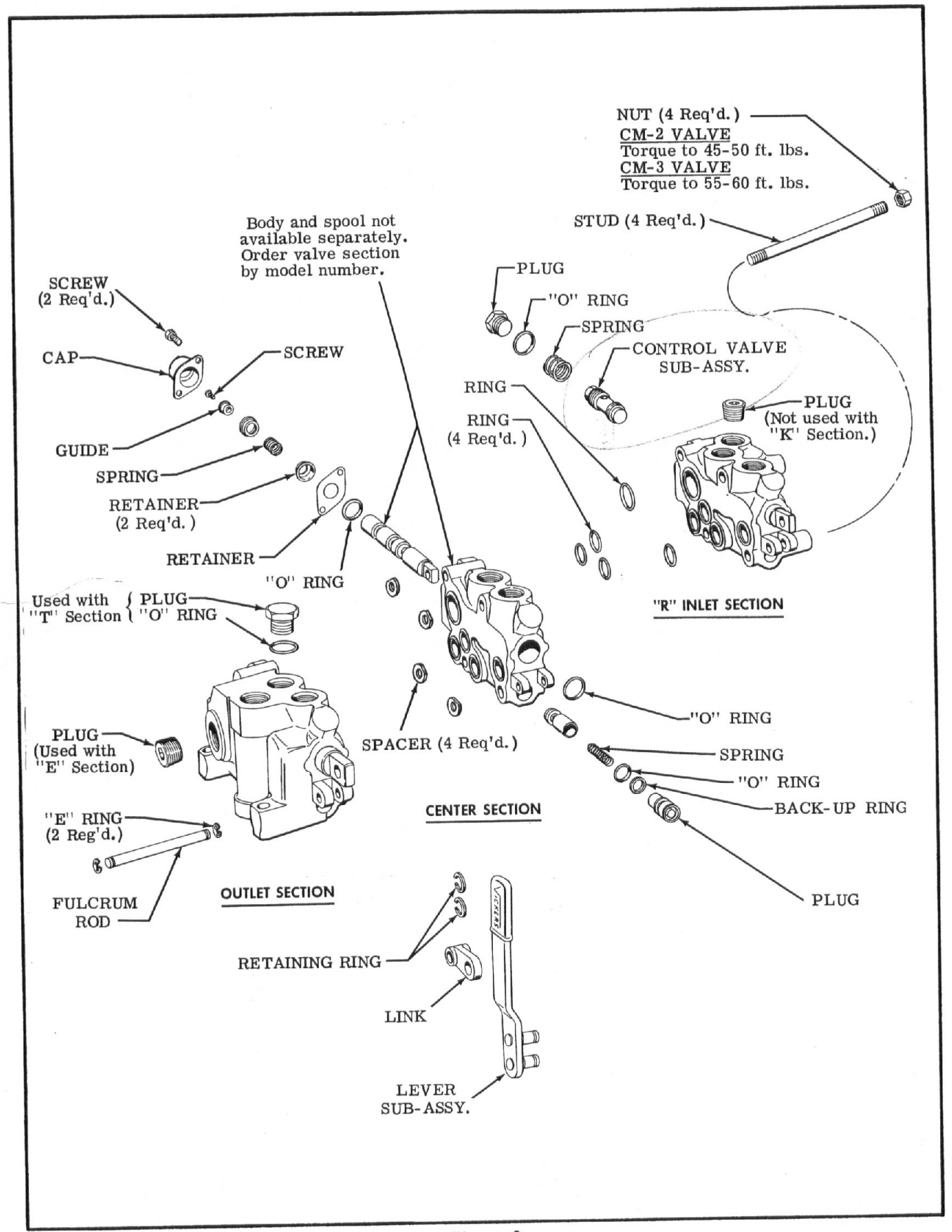
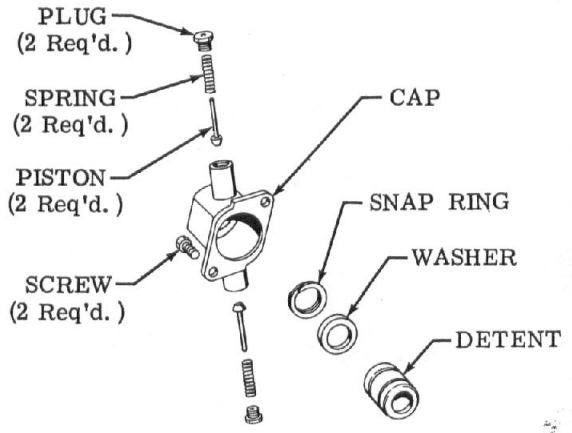
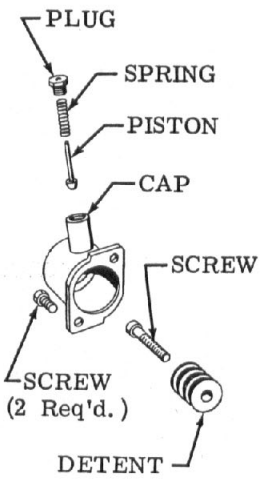

NUT (4 Req'd.)
CM-2 VALVE
Torque to 45-50 ft. lbs.
CM-3 VALVE
Torque to 55-60 ft. lbs.
STUD (4 Req'd.)
Body and spool not available separately. Order valve section by model number.
SCREW (2 Req'd.)
CAP
SCREW
GUIDE
SPRING
RETAINER (2 Req'd.)
RETAINER
"O" RING
PLUG
"O" RING
SPRING
CONTROL VALVE SUB-ASSY.
RING
RING (4 Req'd.)
PLUG (Not used with "K" Section.)
"R" INLET SECTION
Used with "T" Section
PLUG
"O" RING
PLUG (Used with "E" Section)
SPACER (4 Req'd.)
"O" RING
SPRING
"O" RING
BACK-UP RING
PLUG
"E" RING (2 Reg'd.)
FULCRUM ROD
CENTER SECTION
OUTLET SECTION
RETAINING RING
LINK
LEVER SUB-ASSY.

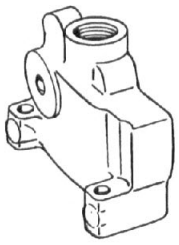
Figure 9



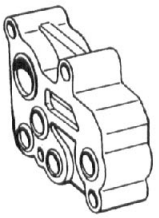
DETENT USED ON "C" FLOAT SECTION



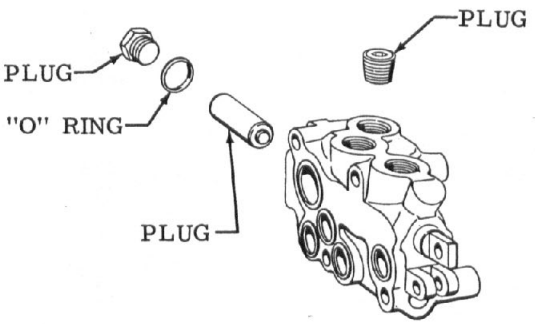
DETENT USED ON "I" SECTION



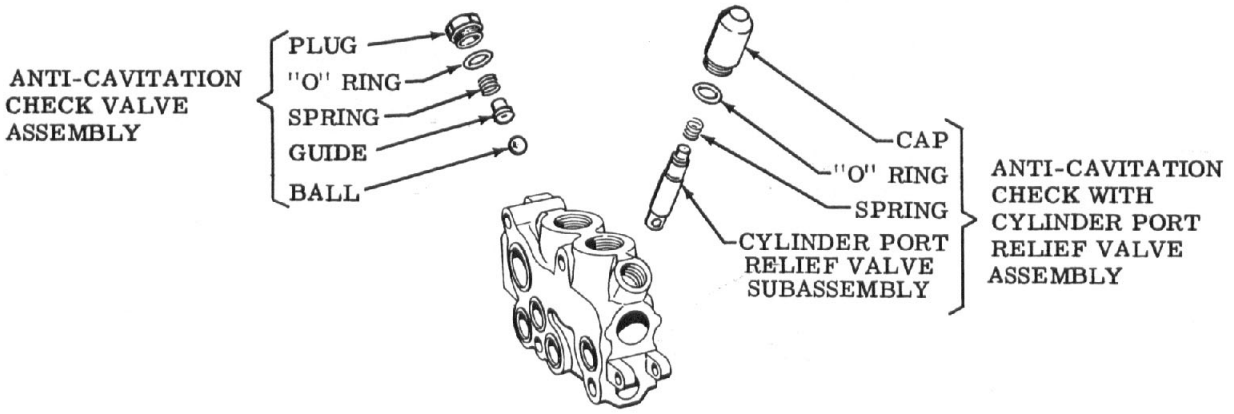
"L" SECTION



"U" SECTION



"F" INLET SECTION

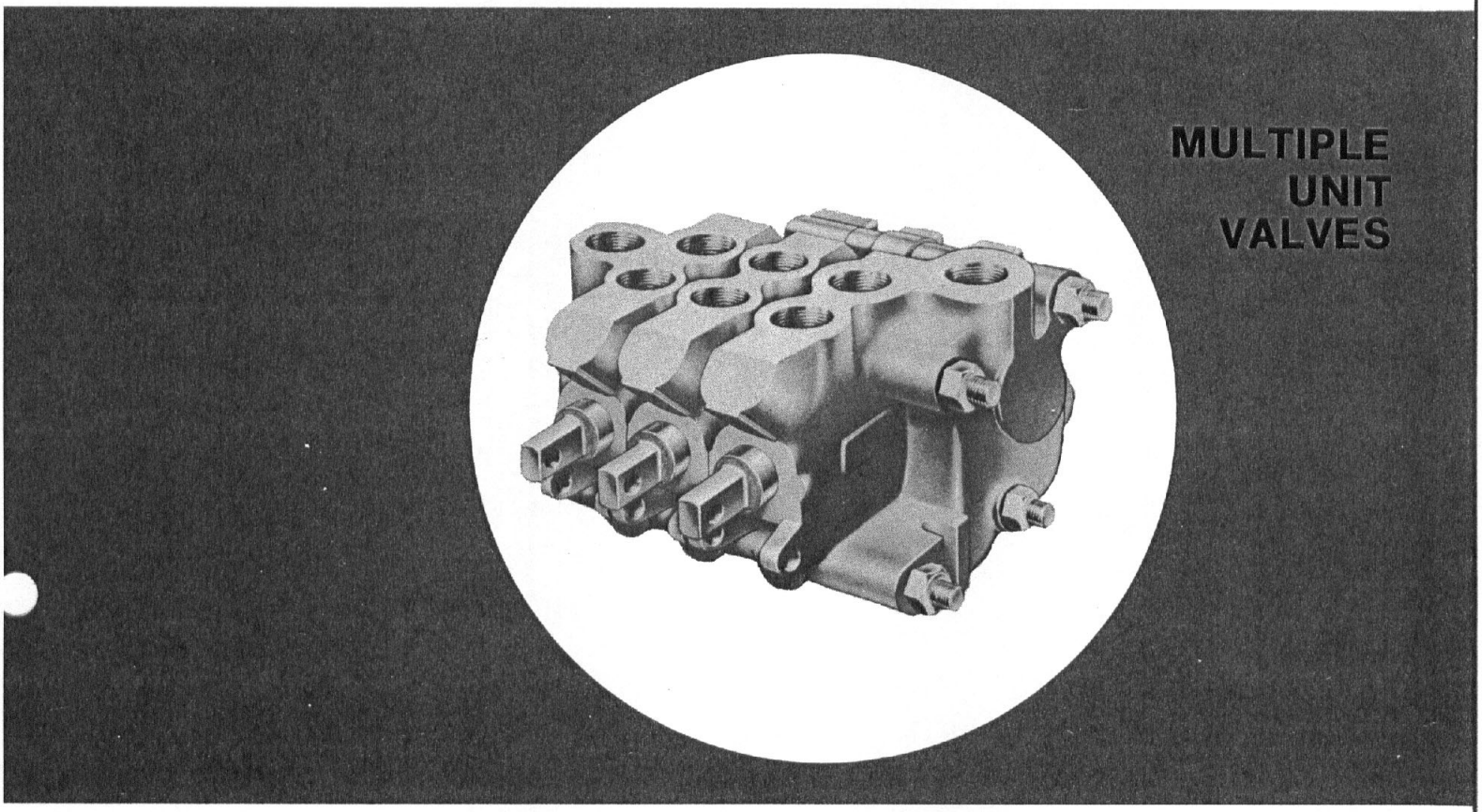


CHECK AND CYLINDER PORT RELIEF OPTIONS

Figure 9A

LITHO IN U. S. A.

SPERRY VICKERS



MULTIPLE
UNIT
VALVES

SERVICE PARTS INFORMATION

CM2 SERIES -30 DESIGN

SPERRY VICKERS
TROY, MI. 48084

Revised 3-1-76

M-2403-S

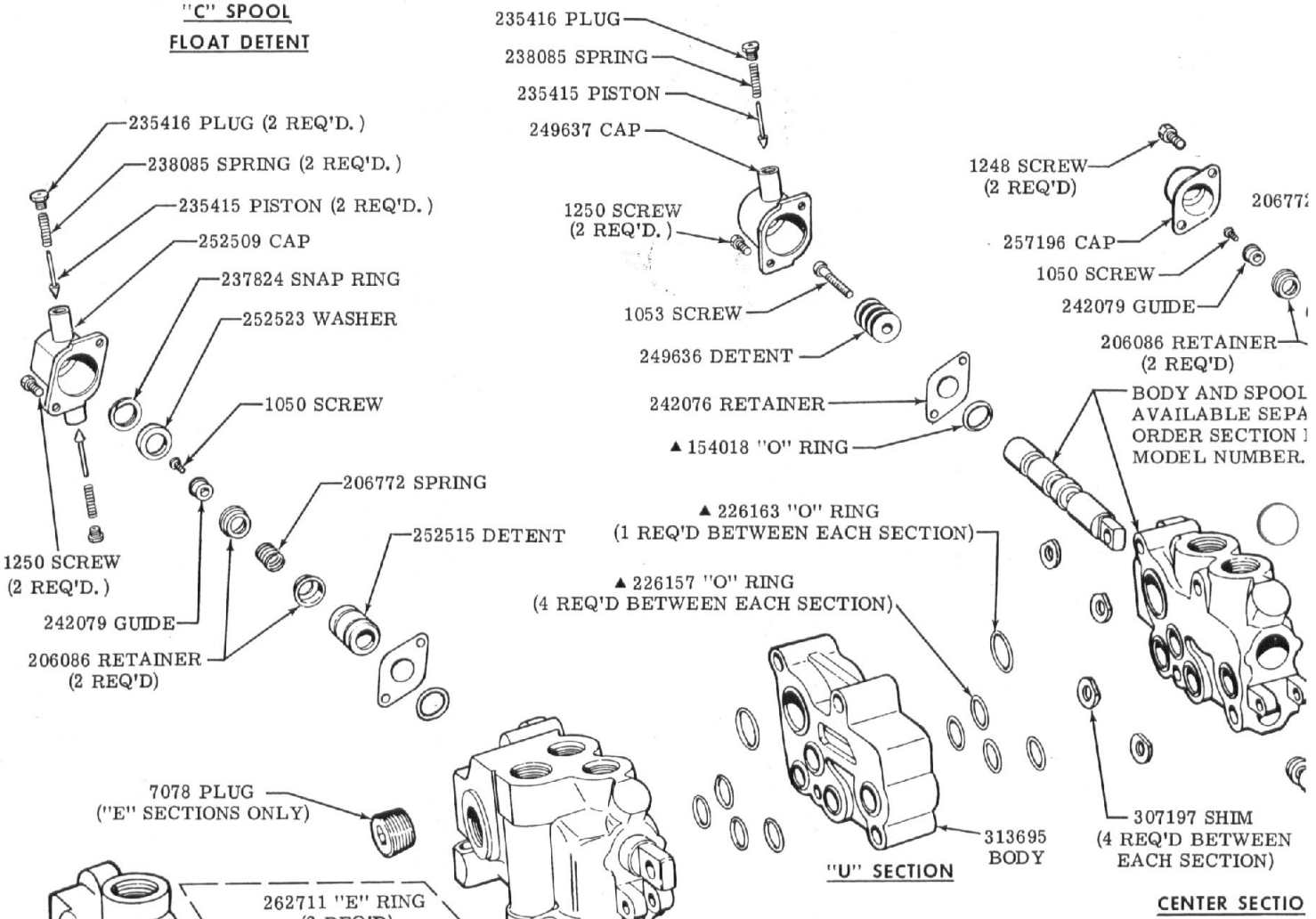
MODEL CODE

CM	2	NO	*	—	*	*	*	U
MULTIPLE UNIT VALVE	SERIES DESIGNATION	VALVE BANK MODIFICATION	PORT CONNEC-TIONS		INLET BODY TYPE	RELIEF VALVE SETTING	INLET SECTION SPOOL	NO SPOOL SECTION

Fig 9

SPOOL MODIFICATION
"I" DETENT

"C" SPOOL
FLOAT DETENT



BODY	MODEL DESIGNATION
313693	CM2NO1-L-30
313713	CM2NO2-L-30

FULCRUM ROD	NUMBER OF OPERATING SECTIONS	LEVER KIT MODEL DESIGNATION
262721	1	CM2-H1-30
262722	2	CM2-H2-30
262723	3	CM2-H3-30
262724	4	CM2-H4-30
262725	5	CM2-H5-30
262726	6	CM2-H6-30
262727	7	CM2-H7-30
262728	8	CM2-H8-30
262729	9	CM2-H9-30
262730	10	CM2-H10-30

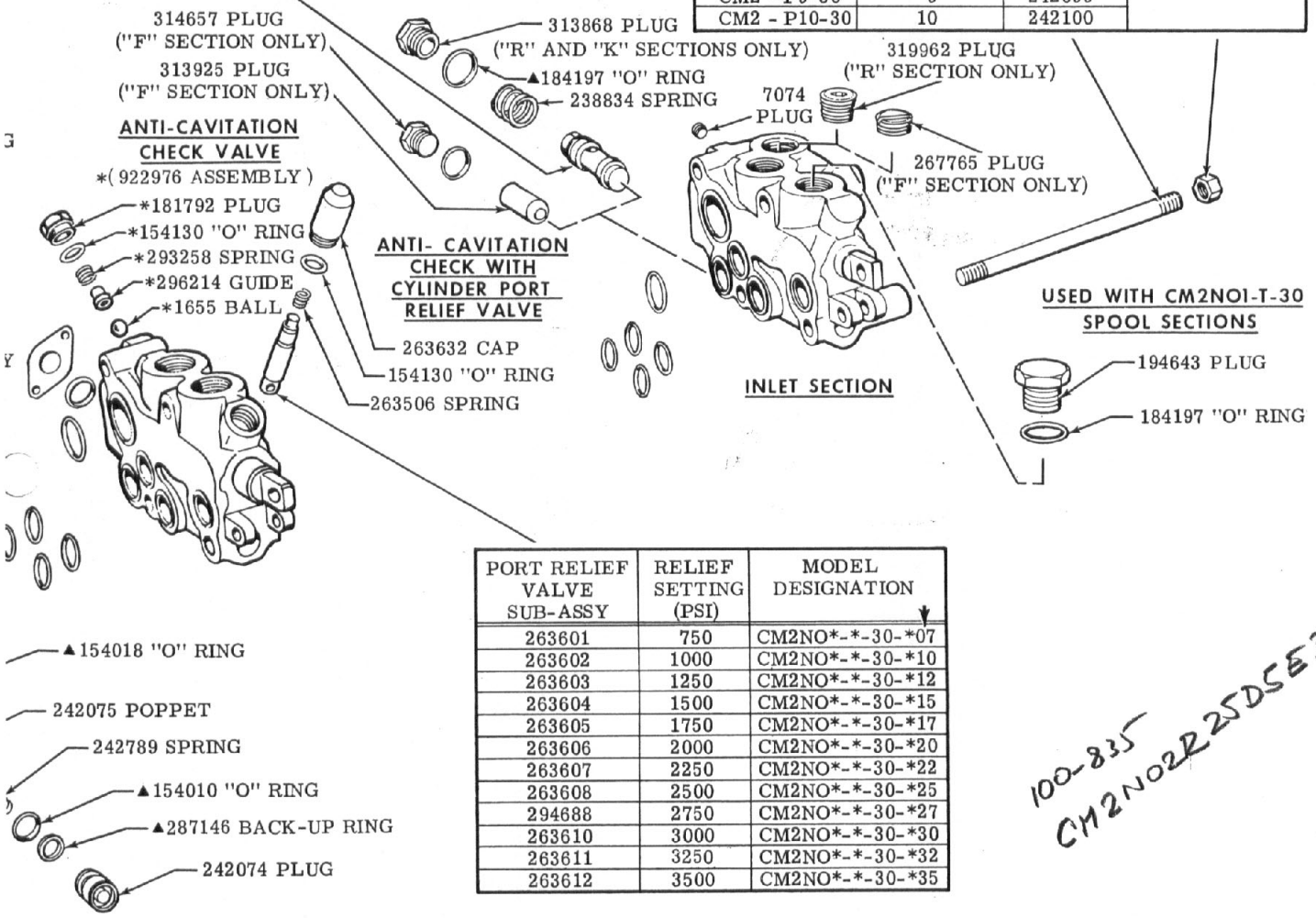
INCLUDE COMPLETE MODEL NUMBER ON ALL PARTS ORDERS

SEE SERVICE MANUAL M-

*	*	1	*	— 30 —	***
NTER TION OL(S)	OUTLET SECTION SPOOL	SPOOL MODIFICATION 1 = DETENT	OUTLET BODY TYPE	DESIGN	SPECIAL FEATURES

CONTROL VALVE SUB-ASSY	RELIEF SETTING (PSI)	MODEL DESIGNATION ↓
319693	500	CM2NO*-*05*-30
319694	750	CM2NO*-*07*-30
319695	1000	CM2NO*-*10*-30
319696	1250	CM2NO*-*12*-30
319697	1500	CM2NO*-*15*-30
319698	1750	CM2NO*-*17*-30
319699	2000	CM2NO*-*20*-30
319700	2250	CM2NO*-*22*-30
319701	2500	CM2NO*-*25*-30

STUD KIT MODEL DESIGNATION ↓	NUMBER OF OPERATING SECTIONS	STUD (4 REQ'D.)	NUT (4 REQ'D.) TORQUE TO 45-50 FT. LBS.
CM2 -P1-30	1	280786	1458
CM2 -P2-30	2	242092	
CM2 -P3-30	3	242093	
CM2 -P4-30	4	242094	
CM2 -P5-30	5	242095	
CM2 -P6-30	6	242096	
CM2 -P7-30	7	242097	
CM2 -P8-30	8	242098	
CM2 -P9-30	9	242099	
CM2 - P10-30	10	242100	

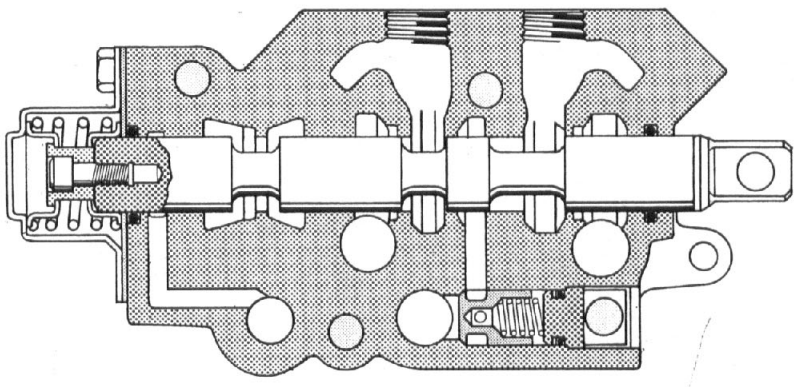


PORT RELIEF VALVE SUB-ASSY	RELIEF SETTING (PSI)	MODEL DESIGNATION ↓
263601	750	CM2NO*-*-30-*07
263602	1000	CM2NO*-*-30-*10
263603	1250	CM2NO*-*-30-*12
263604	1500	CM2NO*-*-30-*15
263605	1750	CM2NO*-*-30-*17
263606	2000	CM2NO*-*-30-*20
263607	2250	CM2NO*-*-30-*22
263608	2500	CM2NO*-*-30-*25
294688	2750	CM2NO*-*-30-*27
263610	3000	CM2NO*-*-30-*30
263611	3250	CM2NO*-*-30-*32
263612	3500	CM2NO*-*-30-*35

100-835
CM2NO2R25DSE3D

▲= SERVICED IN SEAL KIT 922926

5 FOR MAINTENANCE INFORMATION



ASSEMBLY VIEW

SPARE PARTS STOCK RECOMMENDATIONS (FOR EACH 100 UNITS IN OPERATION)

CM2NO * - * * * * * * * * - 30 - ***

PART NUMBER	NAME	PORT CONNECTIONS	INLET BODY TYPE	RELIEF VALVE SETTING	INLET SECTION SPOOL	NO SPOOL SECTION	CENTER SECTION SPOOL(S)	OUTLET SECTION SPOOL	SPOOL MODIFICATION	OUTLET BODY TYPE	DESIGN	SPECIAL FEATURES	QUANTITY PER SECTION	QUANTITY RECOMMENDED FOR STOCK
313693	BODY	1								L			1	2
313713	BODY	2								L			1	2
7078	PLUG									E			1	5
235416	PLUG				C		C	C					2	5
238085	SPRING				C		C	C					2	15
235415	PISTON				C		C	C					2	15
252509	CAP				C		C	C					1	5
1250	SCREW				C		C	C					2	5
237824	SNAP RING				C		C	C					1	10
252523	WASHER				C		C	C					1	5
252515	DETENT				C		C	C					1	5
1050	SCREW												1	5
242079	GUIDE												1	5
206086	RETAINER												2	10
206772	SPRING												1	10
194643	PLUG				T		T	T					1	5
313695	BODY					U							1	2
307197	SHIM												4	10
235416	PLUG								1				1	5
238085	SPRING								1				1	15
235415	PISTON								1				1	15
249637	CAP								1				1	5
1250	SCREW								1				2	5
1053	SCREW								1				1	5
249636	DETENT								1				1	5
242076	RETAINER												1	10
242075	POPPET												1	5
242789	SPRING												1	10
242074	PLUG												1	5
1248	SCREW												2	5
257196	CAP												1	5
922976	PORT CHECK VALVE											A, B	1	5
263632	CAP											A**, B**	1	5
263506	SPRING											A**, B**	1	10
SEE PAGE 2	PORT RELIEF VALVE											***	1	10
314657	PLUG		F										1	5
313925	PLUG		F										1	5
313868	PLUG		R, K										1	5
238834	SPRING		R, K										1	10
SEE PAGE 2	CONTROL VALVE			***									1	10
7074	PLUG		R, K										1	5
319962	PLUG		R										1	5
267765	PLUG		F										1	5
922926	SEAL KIT												1	25

CONTACT VICKERS SALES ENGINEER FOR SPECIAL FEATURE INFORMATION.

HAND OPERATED LEVER KITS, WHEN REQUIRED, SHOULD BE SPECIFIED BY MODEL NUMBER IN ADDITION TO VALVE ASSEMBLY SELECTED.

EXAMPLE:
ONE (1) CM2NO2 - FDBT - DCL-30 VALVE BANK
ONE (1) CM2-H5-30 LEVER KIT

REFER TO PAGE 1 FOR LEVER KIT NUMBERS.

CM2-H * -30

PART NUMBER	NAME	CONTROL LEVER	NUMBER OF OPERATING SECTIONS	DESIGN	QUANTITY PER UNIT	QUANTITY RECOMMENDED FOR STOCK
262711	"E" RING				2	10
SEE PAGE 1	FULCRUM ROD		*		1	5
261768	LEVER SUB-ASSY				1	5
261342	LINK				1	5
122546	RETAINING RING				2	10

REPLACEMENT STUD AND NUT KITS ARE AVAILABLE AND SHOULD BE ORDERED BY MODEL NUMBERS LISTED ON PAGE 2.

EXAMPLE:
CM2-P1-30

CM2-P * -30

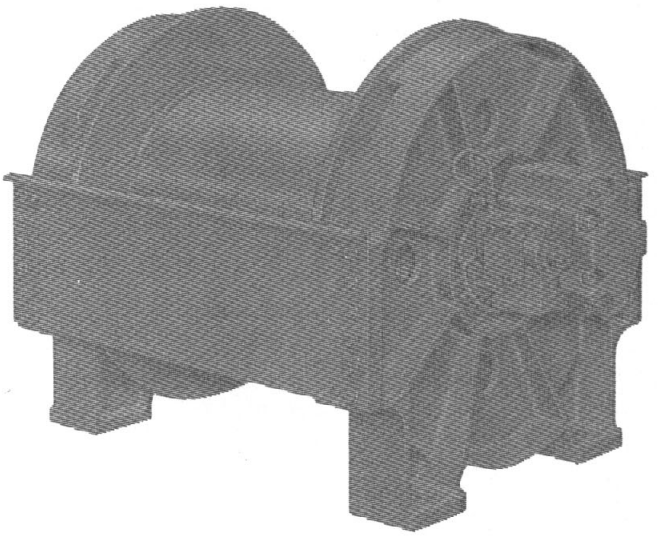
PART NUMBER	NAME	ATTACHING PARTS	NUMBER OF OPERATING SECTIONS	DESIGN	QUANTITY PER UNIT	QUANTITY RECOMMENDED FOR STOCK
SEE PAGE 2	STUD		*		4	20
1458	NUT				4	20

To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. For information pertaining to Vickers economical 10 micron filters, see installation drawing M 229847.

Litho in U. S. A.

CONSTRUCTION
EQUIPMENT
DIVISION

BRADEN INDUSTRIES, INC., BROKEN ARROW, OKLAHOMA



BRADEN MODEL CH22 CONSTRUCTION HOIST INSTALLATION, MAINTENANCE AND SERVICE

11-7507-12

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

WARNING: GOODS ARE NOT INTENDED FOR USE IN THE LIFTING OR MOVING OF PERSONS.

The winches described herein are neither designed nor intended for use or application to equipment used in the lifting or moving of persons.

The cable clamps alone on winches are not designed to hold rated loads. Therefore a minimum of 5 wraps of cable must be left on the drum barrel to achieve rated load.

THIS SALE IS MADE ON THE EXPRESS UNDERSTANDING THAT THERE IS NO IMPLIED WARRANTY THAT THE GOODS SHALL BE FIT FOR THE PURPOSE OF LIFTING OR MOVING PERSONS OR OTHER IMPROPER USE AND THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY FOR SUCH PURPOSES.

DESCRIPTION OF WINCH

The winch has three basic component parts:

1. Tie Plates and End Brackets
2. Hydraulic Motor and Brake Valve
3. Cable Drum Assembly

The Cable Drum Assembly is made up of four basic assemblies:

1. Cable Drum
2. Brake Assembly
3. Primary Planetary Reducer
4. Final Planetary Reducer

The hydraulic motor is bolted to one end bracket. The bearing support is bolted and doweled to this end bracket. The motor end of the cable drum, which houses a large bushing, is supported by the bearing support. The brake housing (brake cylinder) is bolted and doweled to the bearing support. The ring gear of both planetary reducers is splined to the brake housing.

The final planet carrier is supported through a roller bearing by a shaft projecting from the other end bracket. The cable drum is supported on this end by the final planet carrier to which it is splined.

HOW IT OPERATES

The hydraulic motor drives the sun gear of the primary planetary reducer. The output is transmitted, by the planet carrier, to the sun gear of the final planetary reducer.

This output is transmitted directly to the cable drum by a splined fitting between the planet carrier and the drum.

THE BRAKE SYSTEM

The automatic braking system consists of a dynamic braking sub-system and a static braking sub-system.

The dynamic braking sub-system has two operating component parts:

1. Brake Valve Assembly
2. Hydraulic Motor

The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in a hoisting direction of rotation, and a pilot operated check valve that prevents flow of oil out of the motor when the operating valve is placed in neutral. When the operating valve is placed in the reverse or lowering position the check valve remains closed until sufficient pressure is present for the pilot piston to open the check valve. After the check valve cracks open, the pilot pressure becomes flow-dependent and modulates the check valve opening which controls the rate of descent of the load. The brake valve also contains a small pressure relief valve set to prevent excessive shocks on the motor when a lowering operation is stopped abruptly.

The static braking sub-system has three operating component parts:

1. Spring Applied, Multiple Disc Friction Brake
2. Over-riding Cam Clutch
3. Hydraulic Piston and Cylinder (Brake Release and Balance)

The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated check valve. This sequence assures that dynamic braking takes place in the brake valve and that little if any, heat is absorbed by the friction brake.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load.

The over-riding clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in a rotation to raise a load and force the brake discs to turn with the shaft in rotation to lower a load.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs. This is a double-acting cylinder and is balanced to back pressure when the winch is not being operated.

HOW IT OPERATES

When the winch is powered in a hoisting direction, the drive from the motor to the primary sun gear runs free. The over-riding clutch between the primary sun gear shaft and the brake discs allows complete freedom of rotation in this direction. The brake remains fully engaged as the brake release piston is balanced to back pressure.

When the lifting operation is stopped, the brake, being fully engaged, prevents the load from lowering.

When the winch is powered to reverse, the motor cannot rotate until sufficient pressure is present to open the brake valve. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which this valve will open will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower, the opening in the brake valve to decrease, slowing down the descent of the load.

When the operating valve is shifted to neutral the pressure will drop, the brake valve will close, stopping the load. The friction brake will engage after the valve has closed and hold the load.

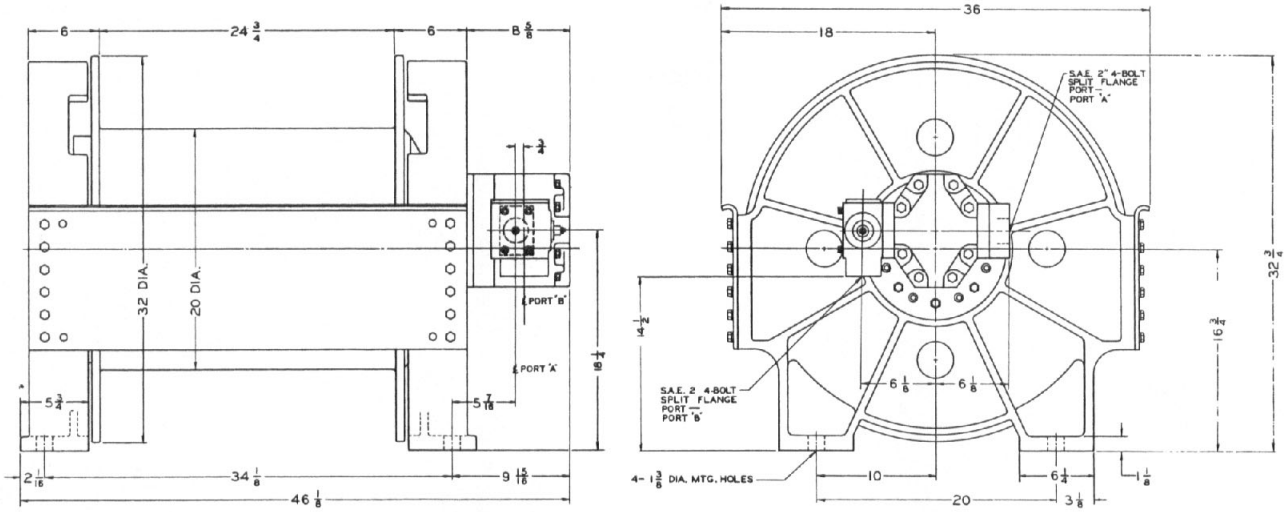
When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own leakage. This feature results in a very slow speed and extremely accurate positioning.

SUMMARY

The winch, in raising a load, is not affected by any braking action. When lowering a load the brake valve has complete control of the speed at which it is lowered. When the winch is stopped by returning the control lever to neutral — the brake valve restricts the flow of oil through the motor, stopping the load. The friction brake engages, after the valve is closed, holding the load.

Thus the brake receives very little wear in lowering operations. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated. The only heat absorbed by the winch in either hoisting or lowering is due to the efficiency losses within the winch itself.

DIMENSIONAL DATA

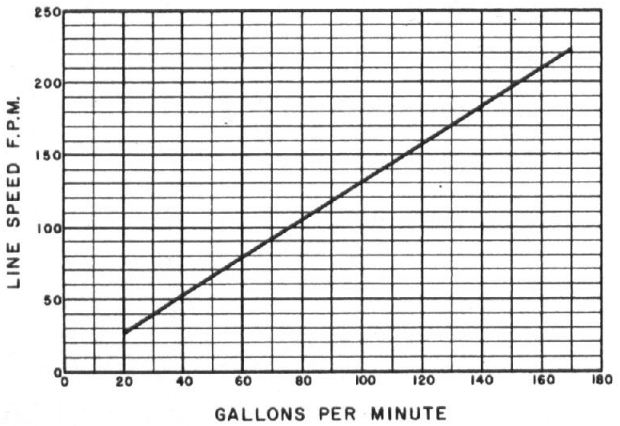


PERFORMANCE DATA

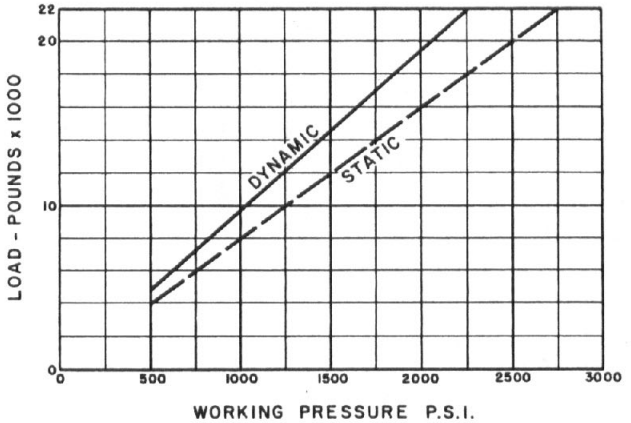
*100 G.P.M. @ 2750 P.S.I. STATIC, 2250 P.S.I. DYNAMIC (170 G.P.M. MAXIMUM ALLOWABLE)

7/8" CABLE				1" CABLE				1 1/8" CABLE			
LAYER	CAPACITY		LINE SPEED *(F.P.M.)	LAYER	CAPACITY		LINE SPEED *(F.P.M.)	LAYER	CAPACITY		LINE SPEED *(F.P.M.)
	CABLE, (FT.)	HOIST, (LB.)			CABLE, (FT.)	HOIST, (LB.)			CABLE, (FT.)	HOIST, (LB.)	
1	155	22,000	130	1	135	22,000	131	1	120	22,000	132
2	310	20,300	141	2	285	20,000	144	2	245	19,800	146
3	500	18,800	152	3	450	18,500	155	3	410	18,100	161
4	700	17,500	163	4	625	17,100	168	4	565	16,700	174
5	900	16,400	174	5	815	15,900	181	5	730	15,400	189
6	1,100	15,500	185	6	1,020	14,900	194	—	—	—	—

CABLE SPEED

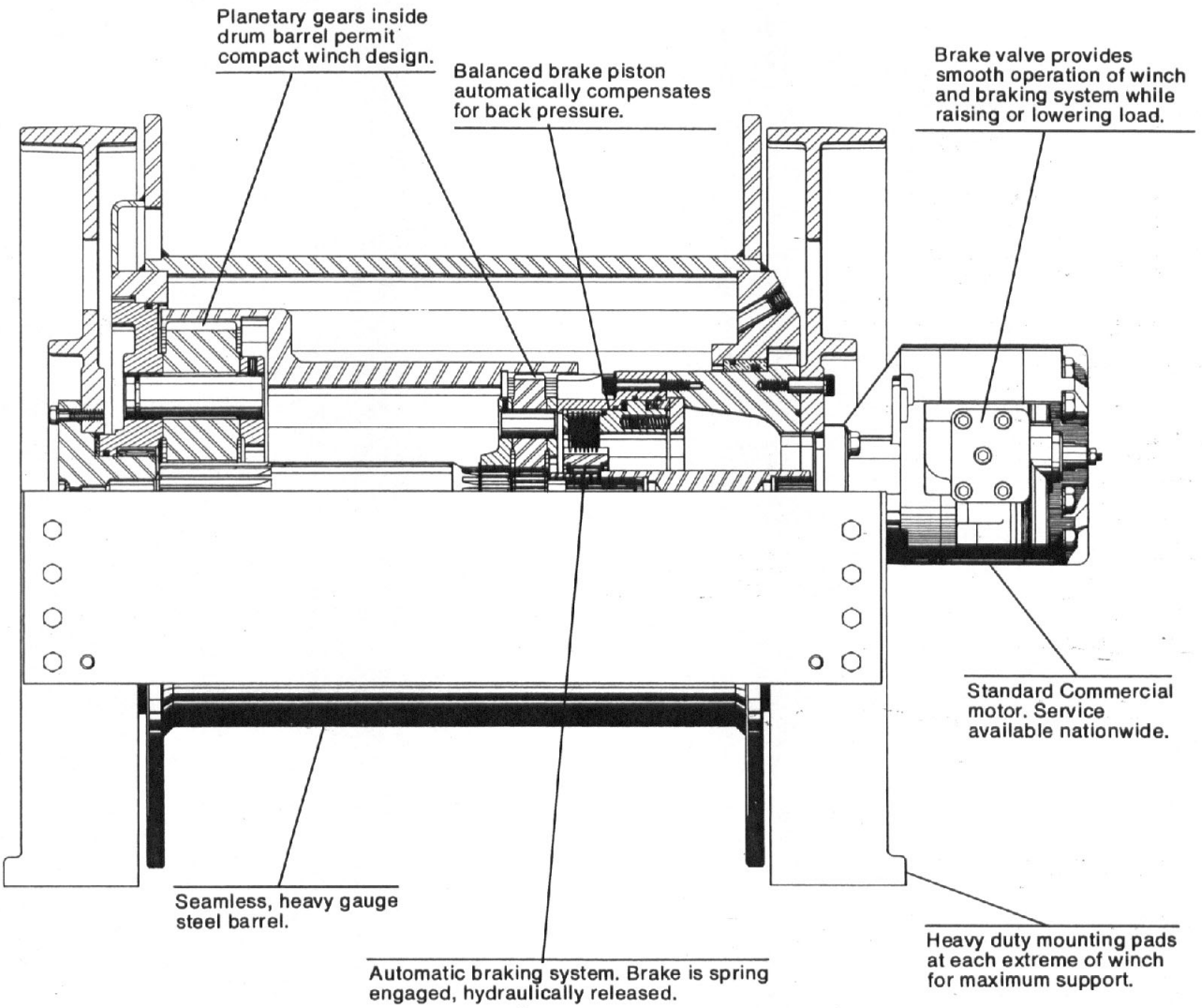


CABLE PULL



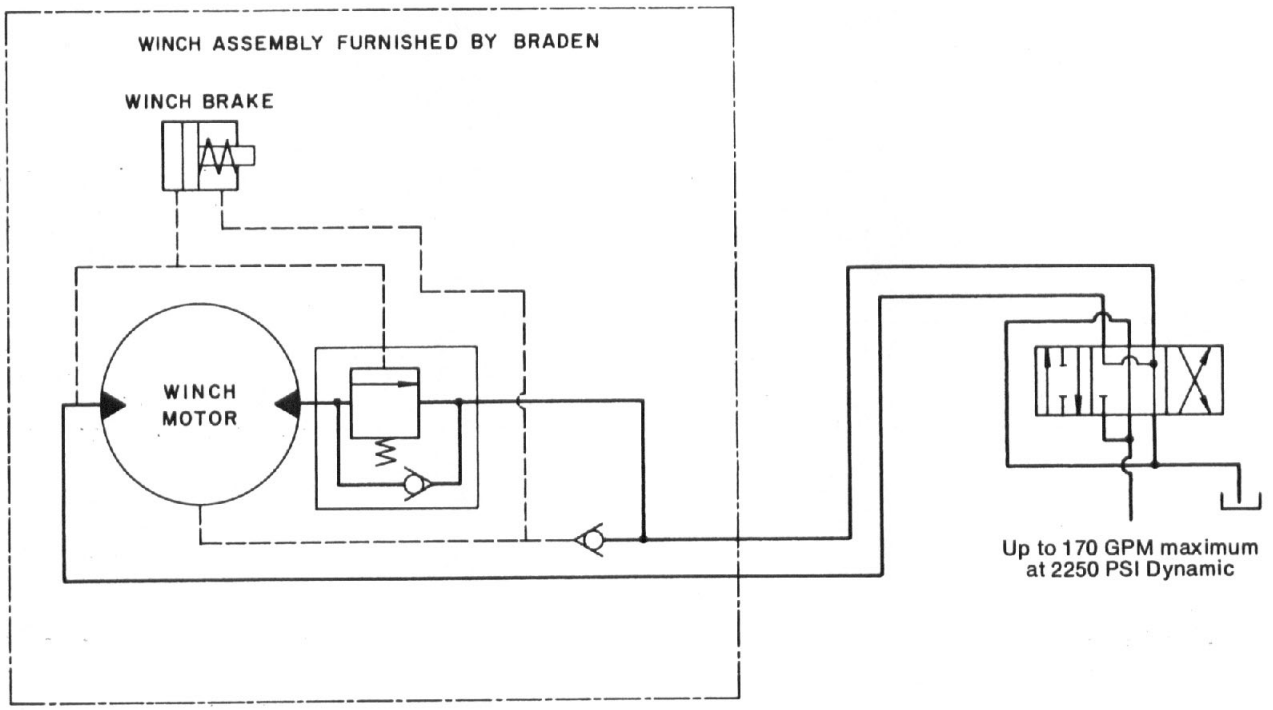
*Ratings and speeds shown are on the first layer of cable.

CROSS-SECTIONAL VIEW



WINCH CONTROL CIRCUIT

NOTES:
1. For parallel, tandem or series circuits, use valve with work ports blocked to open center passage, but open to exhaust passage (motor spool).
2. For series circuit, locate valve down stream from all other valves in bank. (Contact Braden engineers for recommendation.)



The winch directional control valve must be 4-way, free flow with motor spool. Work ports must open directly into tank in neutral position.

INSTALLATION SUGGESTIONS

1. The winch should be mounted with the centerline of the cable drum in a horizontal position. The mounting plane can be in any position around this horizontal centerline.
2. It is important that the winch is mounted on a surface that will not flex when the winch is used, since this would bind working parts of the winch. Be sure that the winch is not mounted on an uneven surface. If necessary, use shim stocks to insure even mounting. Mounting surfaces should be co-planar within $\pm$.020".
3. Hydraulic lines that operate the winch should be of sufficient diameter to assure that back pressure at the winch will not exceed 150 P.S.I.
4. The winch directional control valve must be 4-way, 3 position, parallel circuit with motor type spool. Work ports must open directly into tank in neutral position.
5. Hydraulic oil filter should have 10 micron nominal rating and be a full flow type.

MAINTENANCE SUGGESTIONS

I. CHECKING OIL LEVEL

Turn cable drum until 3/4" pipe plug in cable drum hub next to motor is seen through the hole in top web of right end bracket. Remove other 3/4" pipe plug through the hole in one of the side webs of right end bracket. The oil should be level with this plug hole. Add a good grade of 90 weight worm gear oil through the top 3/4" opening, if necessary.

II. OIL CHANGE INFORMATION

1. Oil should be drained after the first two (2) months operating time.
2. Fill winch with clean kerosene and run for 15 minutes in each direction. Drain kerosene and add proper amount of a good grade of 90 weight worm gear oil. Oil should then be changed every six (6) months.

III. OIL CAPACITY RECOMMENDATIONS

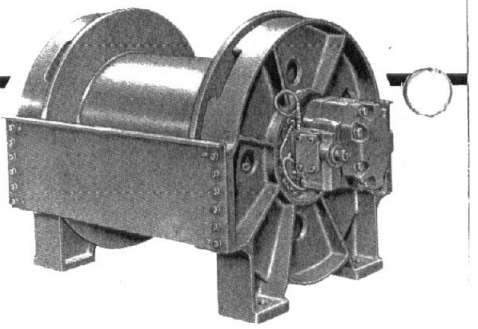
Model CH22 oil capacity is 85 pints.

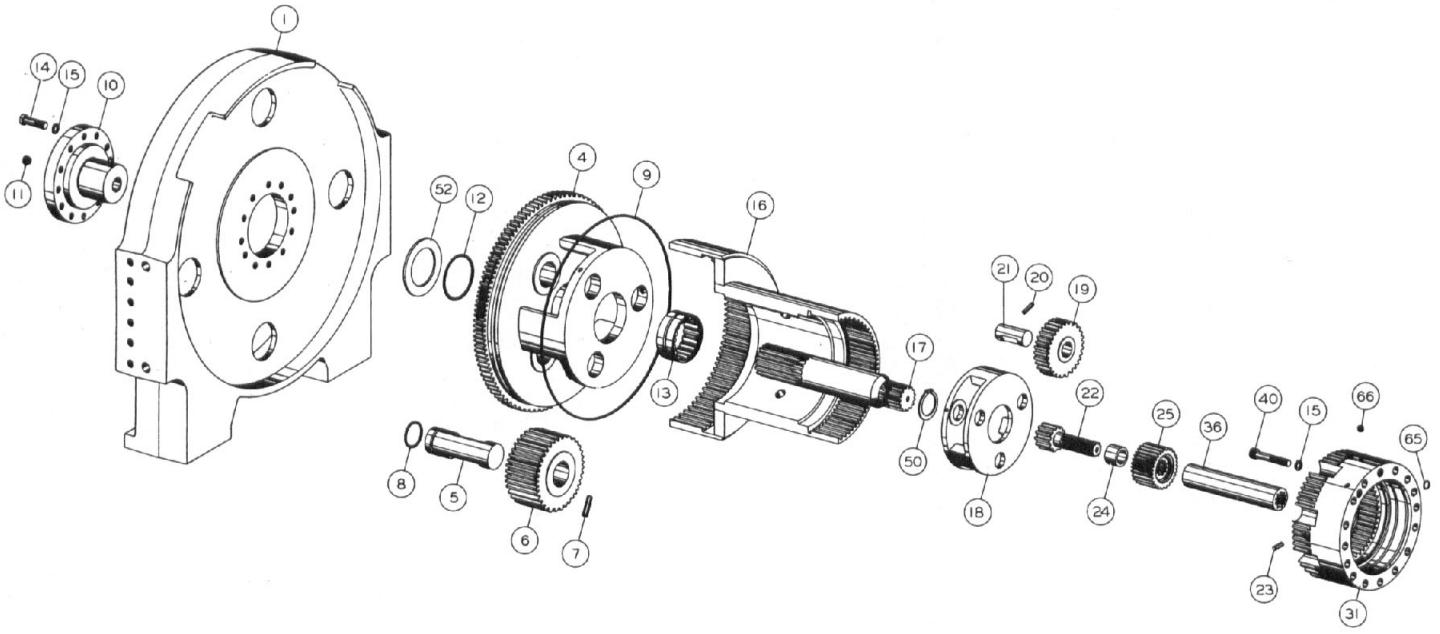
A regular program of preventive maintenance will tend to eliminate the need for much emergency servicing and insure a long life and trouble-free service from your planetary winch.

SOME THINGS TO REMEMBER IN YOUR SERVICING OPERATIONS:

- Work in a clean, dust free area as cleanliness is of utmost importance when servicing any hydraulic equipment.
- Inspect all replacement parts, prior to installation, to detect any damage which might have occurred in shipment.
- Use only factory certified replacement parts for optimum results. Never re-use expendable parts such as oil seals, backup washers and O-rings. Although they may appear to be in good condition, many times they are not.
- Clean all parts and inspect all machined surfaces for excessive wear or damage . . . before reassembly operations are begun.
- Lubricate all O-rings and oil seals with grease prior to installation.

COMPONENTS — MODEL CH22





MODEL CH22 O-RING KIT NO. 61346*

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
8	3	13542	1875012	O Ring
9	1	23270	23270	O Ring
12	1	23272	23272	Quad Ring
32	2	22357	22357	O Ring
33	2	22685	22685	O Ring
38	1	21040	1885003	O Ring
41	1	23285	23285	Quad Ring
54	1	10330	10330	O Ring
63	1	22574	22574	O Ring
65	2	22356	22356	O Ring
67	1	22355	22355	O Ring

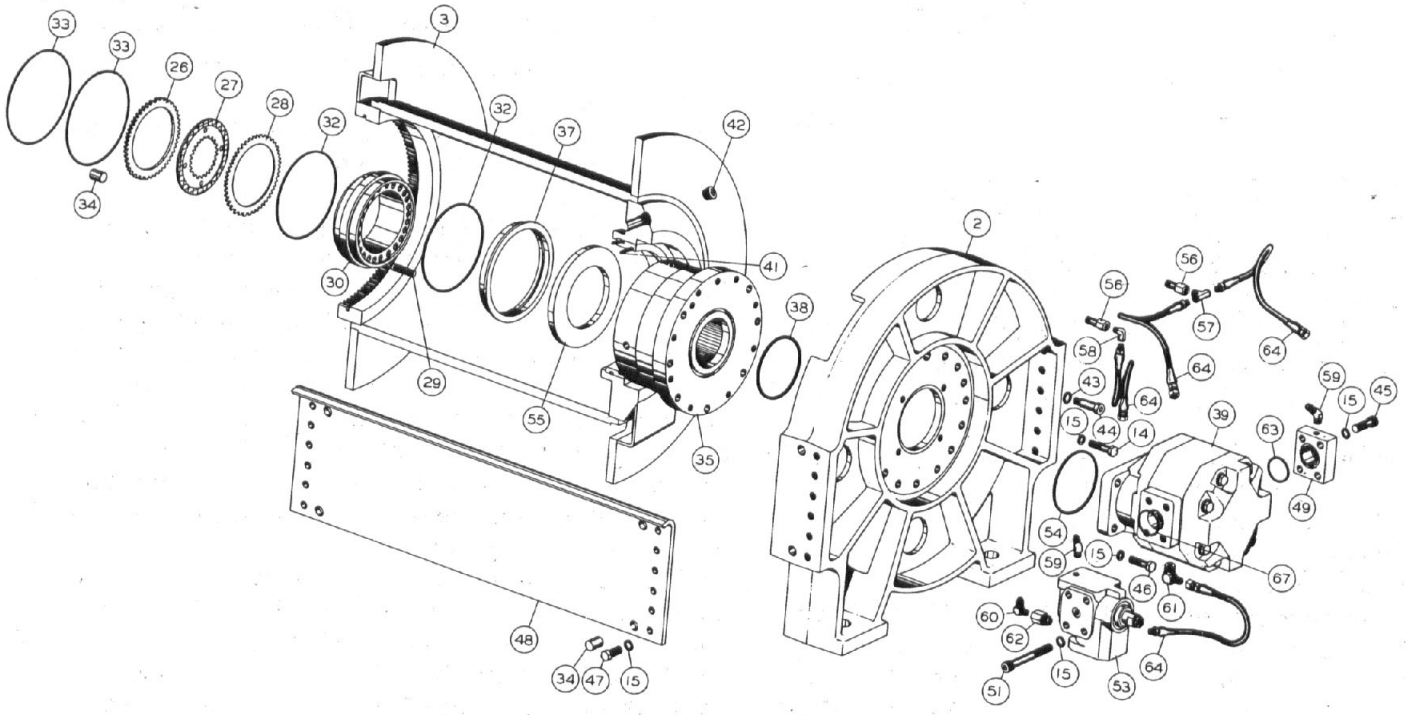
* When O-ring replacements are required, order complete O-Ring Kit No. 61346.

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

MATERIAL LIST

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	23260	23260	End Bracket, Left
2	1	23261	23261	End Bracket, Right
3	1	81507	81507	Cable Drum Assembly
4	1	23267	23267	Final Planet Carrier
5	3	23268	23268	Planet Gear Shaft
6	3	23269	23269	Planet Gear
7	3	13650	R37-175	Rollpin
8	3	13542	1875012	O Ring
9	1	23270	23270	O Ring
10	1	23271	23271	Drum Support
11	1	18062	28-FTD-2	Vent Plug
12	1	23272	23272	Quad Ring
13	1	23273	23273	Roller Bearing
14	20	13421	SO50-20PH5	Capscrew
15	64	11026	AO50	Lockwasher
16	1	23274	23274	Ring Gear
17	1	23275	23275	Final Sun Gear
18	1	23276	23276	Primary Planet Carrier
19	3	23277	23277	Planet Gear
20	3	21058	R18-100	Rollpin
21	3	23278	23278	Planet Gear Shaft
22	1	23279	23279	Primary Sun Gear
23	3	22471	22471	Dowel Pin
24	1	23280	23280	Spacer
25	1	81324	851040	Brake Clutch Assembly
26	1	22656	22656	Back-up Plate
27	8	22660	22660	Friction Disc
28	8	22661	22661	Brake Disc

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
29	24	22346	22346	Brake Spring
30	1	22644	22644	Brake Release Piston
31	1	23281	23281	Brake Cylinder
32	2	22357	22357	O Ring
33	2	22685	22685	O Ring
34	15	21112	2085001	Dowel Pin
35	1	23282	23282	Bearing Support
36	1	23283	23283	Motor Coupling
37	1	22670	22670	Piston Cylinder
38	1	21040	1885003	O Ring
39	1	23284	M125C878BEOX22-7	Hydraulic Motor
40	8	22663	SO50-32A	Capscrew
41	1	23285	23285	Quad Ring
42	2	11085	EO75WC	Pipe Plug
43	7	11028	AO62	Lockwasher
44	7	23286	23286	Shoulder Screw
45	4	21908	SO50-15A	Capscrew
46	4	22364	SO50-17PH5	Capscrew
47	24	13938	SO50-12PH5	Capscrew
48	2	23287	23287	Tie Plate
49	1	23288	23288	Manifold
50	1	21149	1951001	Retaining Ring
51	4	22564	SO50-40A	Capscrew
52	1	23289	23289	Thrust Washer
53	1	23290	23290	Counterbalance Valve
54	1	10330	10330	O Ring
55	1	23126	23126	Spacer
56	2	22350	22350	Nipple
57	1	22934	22934	Tee
58	1	13708	13708	Street Elbow — 90°
59	2	21165	2685010	Tubing Elbow — 45° Male
60	1	21163	2685008	Tubing Elbow — 90° Male
61	1	22630	2685016	Tubing Elbow — 90° Male
62	1	81339	851220	Check Valve Assembly
63	1	22574	22574	O Ring
64	4	13706	13706	Hose Assembly — 16" Long
65	2	22356	22356	O Ring
66	2	22374	EO12A	Pipe Plug
67	1	22355	22355	O Ring



PROCEDURE FOR DISASSEMBLY OF MODEL CH22 CONSTRUCTION HOIST

Disassembly of winch may be done from either end. Remove the winch from the equipment on which it is mounted.

For complete disassembly, place the winch in a horizontal position, drain the oil and flush.

For partial disassembly, from either end, the oil need not be drained.

DISASSEMBLY FROM THE DRUM SUPPORT END

Stand winch in vertical position on motor end with end bracket, Item 2, resting on blocks high enough from the work surface to allow clearance for hydraulic motor, manifold and brake valve.

Remove twenty-four (24) capscrews and lockwashers, Items 47 and 15, from tie plates, Item 48. Remove two (2) tie plates.

Remove end bracket, Item 1, drum support, Item 10, and vent plug, Item 11, as an assembly. Remove the drum support from the end bracket by removing twelve (12) capscrews and lockwashers, Items 14 and 15.

Remove thrust washer, Item 52.

The final planet carrier assembly (Items 4, 5, 6, 7, 8, 9, 12, and 13) can now be removed with the aid of two (2) ½ inch eye bolts screwed into the puller holes in the planet carrier, Item 4, and a hoist. If there is evidence of oil leakage through the planet carrier around the planet gear shafts, refer to page 14 for disassembly and reassembly of final planet carrier assembly.

Remove final sun gear, Item 17, with retaining ring, Item 50.

Remove ring gear, Item 16, using two (2) eye bolts and hoist.

Remove cable drum assembly, Item 3, being careful to pull straight to avoid damaging the cable drum bushing. Remove quad ring, Item 41, from groove in cable drum bushing and discard.

Remove primary planet carrier assembly (Items 18, 19, 20 and 21). For disassembly of primary planet carrier assembly, refer to page 13.

Remove primary sun gear, Item 22.

Remove spacer, Item 24.

Remove brake clutch assembly, Item 25. For disassembly of brake clutch assembly, refer to page 13.

Remove motor coupling, Item 36.

Turn remaining assembly over and stand on end of brake cylinder, Item 31.

Remove four (4) hose assemblies, Item 64.

Remove four (4) capscrews and lockwashers, Items 46 and 15.

Remove hydraulic motor, Item 39, and O-ring, item 54. Discard O-ring.

Remove tee, Item 57, street elbow, Item 58, and two (2) nipples, Item 56.

Remove seven (7) shoulder screws and lockwashers, Items 44 and 43.

Remove eight (8) capscrews and lockwashers, Items 14 and 15.

Remove end bracket, Item 2.

Remove and discard O-ring, Item 38, from groove in bearing support, Item 35.

Refer to page 12 for disassembly and reassembly of bearing support and brake cylinder assembly.

PROCEDURE FOR REASSEMBLY OF BRADEN MODEL CH22 CONSTRUCTION HOIST

Assemble brake clutch assembly per instructions on page 13.

Assemble final planet carrier assembly per instructions on page 14.

Assemble primary planet carrier assembly per instructions on page 13.

Assemble bearing support and brake cylinder assembly per instructions on page 12.

Install drum support, Item 10, into left end bracket, Item 1, and secure with twelve (12) capscrews and lockwashers, Items 14 and 15. Install vent plug, Item 11.

Lay left end bracket assembly, Items 10, 11, 12, 13 and 14, down on work surface with shaft of drum support, Item 10, up.

Slip thrust washer, Item 52, onto shaft of bearing support, Item 10.

Install final planet carrier assembly, (Items 4, 5, 6, 7, 8, 9, 12 and 13). Care should be taken to prevent damage to the quad ring, Item 12, and the roller bearing, Item 13.

Install retaining ring. Item 50, in groove in final sun gear, Item 17.

Insert gear teeth of final sun gear, Item 17, into planet gears, Item 16, in final planet carrier assembly.

Install ring gear, Item 16, engaging teeth of planet gears, Item 6, in final planet carrier assembly.

Install primary planet carrier assembly, (Items 18, 19, 20 and 21), engaging the planet carrier splines with the final sun gear splines and the planet gear teeth with those in the ring gear. The hub of the planet carrier, Item 18, must rest against the retaining ring, Item 50, on final sun gear, Item 17.

Install two (2) pipe plugs, Itew 42, in cable drum, Item 3. Install well greased quad ring, Item 41, in groove in cable drum bushing.

Check to be sure O-ring, Item 9, is in the groove in final planet carrier, Item 4. Coat the surface of the planet carrier around the O-ring with grease.

Install cable drum, Item 3, engaging the teeth in the cable drum with the teeth on the planet carrier,

being careful to avoid damaging the O-ring, Item 9.

Secure with two (2) capacrews, a short length of chain, or similar lifting device, to bearing support, Item 35. With the aid of a hoist, lift the bearing support and brake cylinder assembly and lower straight down into the cable drum bushing, being careful to avoid damaging the quad ring and bushing.

Install right end bracket, Item 2, carefully aligning all holes. Be sure the two 3/4" diameter clearance holes are in alignment with the 1/8" pipe tapped holes in the bearing support, Item 35. Install seven (7) shoulder screws and lockwashers, Items 44 and 43. Install eight (8) capscrews and lockwashers, Items 14 and 15. Tighten all screws securely.

Attach two (2) tie plates, Item 48, using twenty-four (24) capscrews and lockwashers, Items 47 and 15. Install eight (8) dowel pins, Item 34. Tighten capscrews securely.

Slip spacer, Item 24, onto primary sun gear, Item 22.

IMPORTANT: Check rotation of brake clutch assembly, Item 25.

Hold the brake clutch in the right hand and insert the primary sun gear and spacer from the bottom. Rotate the sun gear in a clockwise direction. If the rotor of the brake clutch turns in this direction, it is ready to install. If it will not turn in this direction, remove the brake clutch from the sun gear, turn it over and replace on sun gear.

If the brake clutch is installed opposite to the above procedure, the winch will be working against the brake, the brake will not release and there will be no forward rotation of the winch.

Install the primary sun gear, spacer and brake clutch assembly in place, engaging the teeth of the primary sun gear, Item 22, into the planet gear teeth, Item 19, and the brake clutch teeth, Item 25, into the friction disc teeth, Items 27.

Insert motor coupling, Item 36, into place engaging spline on primary sun gear, Item 22.

Install two (2) nipples, Item 56. Use a good grade of thread compound with Teflon on these and all hydraulic fittings.

Install tee, Item 57, into top nipple, Item 56. Install elbow, Item 58, into other nipple, Item 56.

Grease O-ring, Item 54, and slip onto pilot of hydraulic motor, Item 39.

Install hydraulic motor, Item 39, in place on the right end bracket, Item 2, inserting the splined motor shaft into the motor coupling, Item 36. Secure with four (4) capscrews and lockwashers, Items 46 and 15.

Install O-ring, Item 67, in counterbore of counterbalance valve, Item 53. Secure this assembly to motor with four (4) capscrews and lockwashers, Items 51 and 15.

Install O-ring, Item 63, in counterbore of manifold, Item 49. Secure this assembly to motor with four (4) capscrews and lockwashers, Items 45 and 15.

Install 45° male elbow, Item 59, in manifold.

Install 45° male elbow, Item 59, in counterbalance valve.

Install check valve assembly, Item 62, in counterbalance valve.

Install male elbow, Item 60, in check valve.

Install male elbow, Item 61, in motor drain.

Install hose assembly, Item 64, from manifold, Item 49, to tee, Item 57.

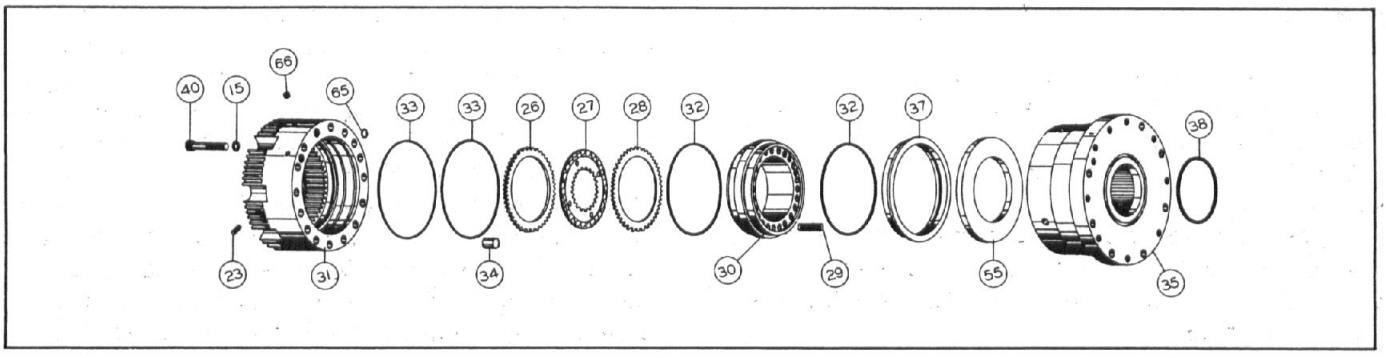
Install hose assembly, Item 64, from check valve, Item 62, to elbow, Item 58.

Install hose assembly, Item 64, from counterbalance valve, Item 53, to tee, Item 57.

Install hose assembly, Item 64, from check valve, Item 62, to elbow, Item 61, in motor drain.

If oil was drained from the winch, refill with a good grade of 90 weight All-purpose Worm Gear Oil. Winch capacity is 85 pints.

BEARING SUPPORT AND BRAKE CYLINDER ASSEMBLY PART NO. 61428 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
15	8	11026	AO50	Lockwasher
23	3	22471	22471	Dowel Pin
26	1	22656	22656	Back-up Plate
27	8	22660	22660	Friction Disc
28	8	22661	22661	Brake Disc
29	24	22346	22346	Brake Spring
30	1	22644	22644	Brake Release Piston
31	1	23281	23281	Brake Cylinder
32	2	22357	22357	O Ring

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
33	2	22685	22685	O Ring
34	7	21112	2085001	Dowel Pin
35	1	23282	23282	Bearing Support
37	1	22670	22670	Piston Cylinder
38	1	21040	1885003	O Ring
40	8	22663	SO50-32A	Capscrew
55	1	23126	23126	Spacer
65	2	22356	22356	O Ring

DISASSEMBLY PROCEDURE

Place bearing support and brake cylinder assembly on work surface with motor side of bearing support, Item 35, down.

Remove eight (8) socket head capscrews and lockwashers, Items 40 and 15.

Insert two (2) scpscrews in threaded holes in brake cylinder, Item 31, to provide means for pushing the brake cylinder assembly from the bearing support, Item 35. When this is done, some or all of the twenty-four (24) brake springs, Item 29, will probably fall out. Remove any that do not fall out.

Turn brake cylinder assembly over and set on work surface.

Remove two (2) O-rings, Item 65, and discard.

Remove piston cylinder, Item 37. Remove O-ring, Item 32, from groove in piston cylinder and discard.

Remove brake release piston, Item 30.

Remove eight (8) each of brake discs, Item 28, and Friction discs, Item 27.

Remove back-up plate, Item 26.

Remove O-ring, Item 32, and two (2) O-rings, Item 33, from grooves in brake cylinder, Item 31, and discard.

REASSEMBLY PROCEDURE

Set the brake cylinder, Item 31, down on the work surface with the external splines down.

It is recommended that a light lubricating grease be used on O-rings and the surfaces to be sealed.

Install O-ring, Item 32, and two (2) O-rings, Item 33, in grooves in brake cylinder.

Install back-up plate, Item 26.

Insert a friction disc, Item 27, and a brake disc, Item 28. Continue to alternate discs until eight (8) of each are in place.

Insert brake release piston, Item 30, into brake cylinder, using a plastic or rubber hammer to seat the piston, being sure the spring holes are up.

Install O-ring, Item 32, in groove in piston cylinder, Item 37.

Install piston cylinder, Item 37, using a plastic or rubber hammer to seat in place.

Insert twenty-four (24) brake springs, Item 29, into holes in brake release piston, Item 30, using a small amount of grease on each spring to hold it in place during attachment to bearing support.

Place two (2) O-rings, Item 65, in counterbores provided in brake cylinder.

It is recommended that brake clutch assembly, Item 25, be inserted into the friction discs, Item 27, to align the teeth while the discs can be freely rotated.

Be sure that two (2) pipe plugs, Item 66, are installed in the holes in the outside of the brake cylinder, Item 31.

Stand bearing support, Item 35, on work surface with large end down.

Insert spacer, Item 55, into its seat in bearing support.

Install seven (7) dowel pins, Item 34.

Turn the brake cylinder assembly over and install on bearing support, Item 35, using care to align brake control oil holes. A few taps with a plastic or rubber hammer may be required to seat the brake cylinder on the dowel pins, Item 34. Be sure that O-rings, Item 65, are properly seated in the counterbores.

Install eight (8) socket head capscrews and lockwashers, Item 40 and 15, and tighten securely.

Install three (3) dowel pins, Item 23, in holes in brake cylinder splines, seat until ends of pins are flush or below tops of teeth.

At this point the brake cylinder and bearing support assembly should be tested for leakage. Observe two holes with 1/8" NPT threads. These two holes are the pressure inputs into the brake cylinder which operate the brake. When pressure is applied to one side, the brake is released and the winch can be operated in a reverse direction for lowering the load. The second is for balancing the floating piston to back pressure.

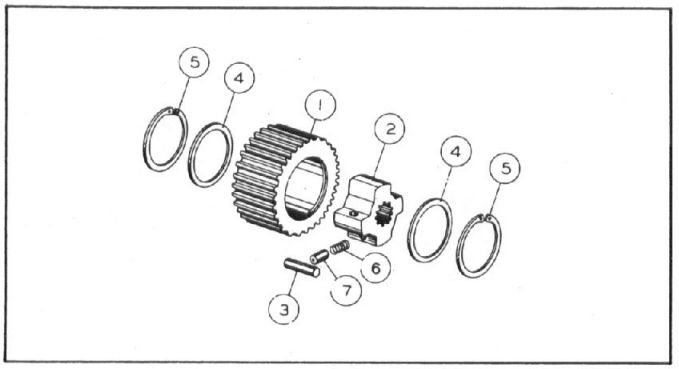
Attach the hose of a hydraulic hand pump, which is equipped with a dial gauge that reads 600 P.S.I. or more, to the brake release port (the right port of the two when they are at the top).

Apply 600 P.S.I. pressure into the brake cylinder and hold for about five minutes. If the pressure holds, the installation of the brake piston is proper. A slight drop in pressure may be evident; but, after the brake is operated a few times, the O-rings will seat and the pressure will hold. Check the brake balancing input (left port) in the same way.

If leaks occur during these tests, re-check all O-ring installations and re-test.

If the brake friction discs have not been previously aligned and centered, this should be done when the brake release port is pressurized.

BRAKE CLUTCH ASSEMBLY, PART NO. 81324 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	21094	850690	Brake Race
2	1	21093	850670	Brake Cam
3	4	21097	850730	Brake Roller
4	2	12592	630300	Brake Roller Retainer
5	2	12913	MU7-121	Retaining Ring
6	4	12050	238-148-5	Spring
7	4	12049	238-148-4	Plunger

DISASSEMBLY PROCEDURE

Remove retaining rings, Item 5.

Remove brake roller retainers, Item 4.

This will release the brake cam, Item 2, brake rollers, Item 3, plungers, Item 7, and springs, Item 6, from the brake race, Item 1.

Check for wear on race and rollers.

REASSEMBLY PROCEDURE

Insert brake cam, Item 2, into brake race, Item 1, just far enough to insert springs, Item 6, plungers, Item 7, and rollers, Item 3.

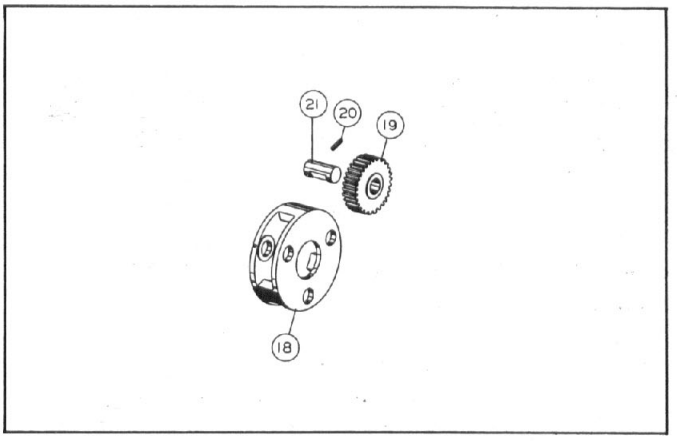
By using the primary sun gear (Item 22 on Material List, page 9) to hold the cam, the springs, plungers and rollers can be inserted with the aid of a small screwdriver.

After the springs, plungers and rollers are installed and the cam is in place, install the brake roller retainers, Item 4, and secure with retaining rings, Item 5.

After all parts have been installed, rotate the brake with the aid of the primary sun gear. It should rotate in one direction.

PRIMARY PLANET CARRIER ASSEMBLY, PART NO. 61403, MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
18	1	23276	23276	Primary Planet Carrier
19	3	23277	23277	Planet Gear
20	3	21058	R18-100	Rollpin
21	3	23278	23278	Planet Gear Shaft



DISASSEMBLY PROCEDURE

Remove rollpin, Item 20, by inserting a 3/16" punch into hole provided in planet carrier, Item 18. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 21, thus allowing removal of the shaft and planet gear, Item 19, for inspection.

Drive old rollpin completely from the shaft and use new rollpin, 3/16" x 1", for reassembly.

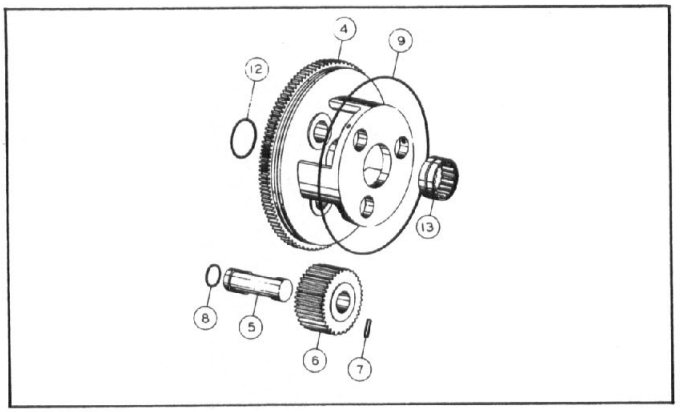
REASSEMBLY PROCEDURE

Install planet gear, Item 19, into planet carrier, Item 18. Insert planet gear shaft, Item 21, into planet carrier through hole provided, passing it through planet gear and into planet carrier. Align rollpin holes. Install new rollpin, Item 20. This pin should be countersunk to 3/16" below the surface of the planet carrier. With a centerpunch, dimple the edge of the rollpin hole to keep the pin from backing out.

Install remainder of gears, shafts and pins in the manner described.

FINAL PLANET CARRIER ASSEMBLY, PART NO. 61404, MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
4	1	23267	23267	Final Planet Carrier
5	3	23268	23268	Planet Gear Shaft
6	3	23269	23269	Planet Gear
7	3	13650	R37-175	Rollpin
8	3	13542	1875012	O Ring
9	1	23270	23270	O Ring
12	1	23272	23272	Quad Ring
13	1	23273	23273	Roller Bearing



DISASSEMBLY PROCEDURE

Remove O-ring, Item 9, and discard.

Remove rollpin, Item 7, by inserting a 3/8" punch into hole provided in planet carrier, Item 4. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 5, thus allowing removal of the shaft, planet gear, Item 6, and O-ring, Item 8, for inspection. Discard all O-rings and rollpins.

After removing all shafts, gears and pins, the roller bearing, Item 13, may be removed.

Remove quad ring, Item 12, and discard.

REASSEMBLY PROCEDURE

Press roller bearing, Item 13, into planet carrier, Item 4.

Install O-ring, Item 8, in groove of planet gear shaft, Item 5, and coat lightly with all-purpose grease.

Insert rollpin end of shaft into hole in planet carrier on O-ring side, pass through gear. Press or tap lightly until pin end of shaft is aligned with rollpin hole in planet carrier.

Install new rollpin, Item 7, to lock shaft in place and prevent rotation. Countersink rollpin to 3/16" below surface of planet carrier. Dimple edge of hole with centerpunch to prevent pin from backing out.

Install remainder of gears, shafts, O-rings and rollpins in the manner described.

Coat O-ring, Item 9, with all-purpose grease and install in groove in planet carrier.

BRAKE VALVE INFORMATION

The brake valve assembly, Item 53, is a purchased component, manufactured to exacting Braden specifications. Should a failure occur, or repairs be needed in this assembly, it is suggested that the entire part be removed from the winch and forwarded to the Braden factory for inspection and replacement.

BRAKE VALVE ADJUSTMENT

The brake valve contains an adjusting screw and lock nut which allow pressure adjustments to be made.

If the winch oscillates when lowering a load, turn the adjusting screw one-half (½) turn in a clockwise direction. If oscillation continues, again turn adjusting screw one-half (½) turn in a clockwise direction.

Use caution in this adjustment and be certain that pressure when lowering does not exceed 1500 p.s.i. A good lowering pressure is approximately 800 p.s.i. Excessive pressure could damage the O-ring seal located inside the brake cylinder.

BRAKE VALVE INSPECTION

If lowering pressure is erratic, and cannot be controlled by the adjusting screw, a defect might exist in the O-ring or back-up rings inside the brake valve.

To gain entry to the valve, remove the large nut, being careful of the springs and spring retainers.

Grasp the spool with a pair of long nosed pliers, or similar device, and pull straight out of the brake valve housing. The O-ring and back-up rings can now be inspected.

Replace the spool, springs and retainers and replace nut.

SUGGESTIONS FOR TROUBLE SHOOTING

A. Winch will not lower load.

1. This is probably caused by stoppage of the orifice plug in the brake valve or jamming of the brake release piston.
2. To check orifice plug, remove hose, Item 64, and tubing elbow, Item 59, from top of brake valve, Item 53. Remove the plug, using a 5/32" Allen wrench. Check the hole in the plug with a wire of less than .020" diameter. If the hole is open, the fault is probably not in the brake valve.
3. Disassemble the winch brake cylinder and release piston to determine cause of non-release of brake.

B. Winch leaks a large volume of oil through the vent plug.

1. This is caused by hydraulic oil leaking into the winch from one or both of the following; damaged or worn hydraulic motor shaft seal, damaged O-ring in the winch brake mechanism.
2. Disconnect the hoses, Item 64, and tee, Item 57, from the brake release port. Attach the hose of a hydraulic hand pump, which is equipped with a dial gauge that reads 600 P.S.I. or more, to the nipple just exposed. Apply 600 P.S.I. to the brake. The brake should hold this pressure for ten minutes. If pressure holds, detach the pump hose and connect it to the brake balancing input, and repeat the pressure test.
3. If the preceding test fails, the winch should be returned to the factory for repair.
4. If pressure holds on the preceding test, then the hydraulic motor seal is leaking and should be replaced.

C. Winch will not hoist rated load.

1. Be certain that the winch has not been mounted on an uneven surface. If necessary, shim stock should be used.
2. Check for proper hydraulic pressure to the inlet port in the bottom of the brake valve. This pressure should be checked right at the valve for accurate readings.
3. Be certain that the hydraulic system which operates the winch is not running more than 180° F.
4. Remember that the winch ratings are established on the first layer of cable.
5. Be certain that any cable sheaves, used with the winch, are operating efficiently.

D. Winch runs hot (over 200°) or makes escessive noise.

1. Make certain that the winch has not been mounted on an uneven surface.
2. Be certain that the hydraulic system which operates the winch is not running more than 180° F.

E. Winch chatters while raising rated capacity load.

1. The relief valve in the hydraulic system may be trying to by-pass.
2. The flow of hydraulic fluid to the motor may be low.

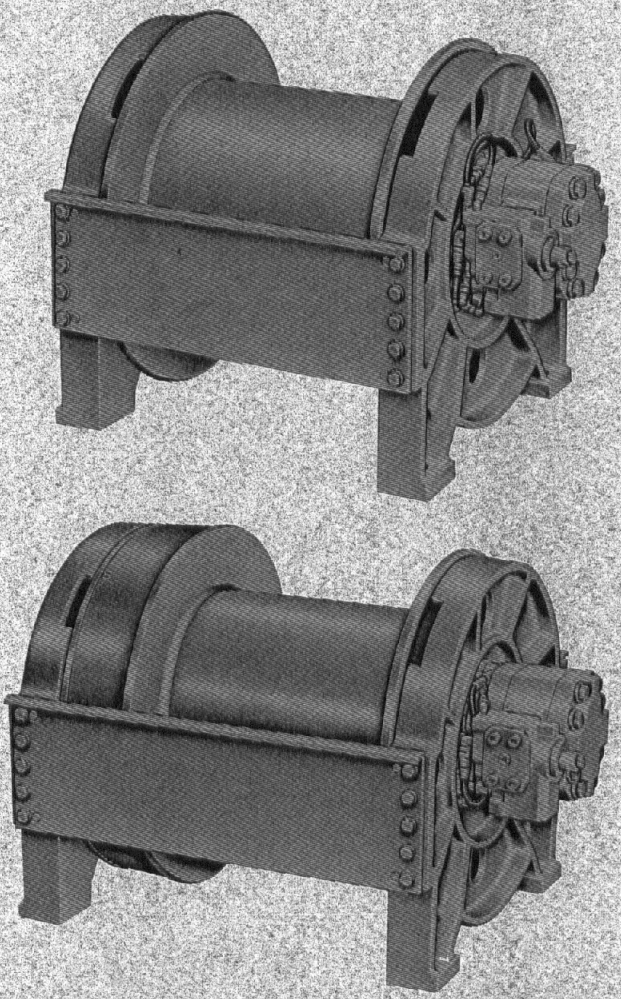
F. Winch vibrates or chatters when lowering rated capacity load.

1. The orifice plug in the brake valve is probably loose. Remove hose, Item 64, and tubing elbow, Item 59, from top of brake valve, Item 53. Check orifice plug for tightness. This plug should be snug in the orifice hole. Use a 5/32" Allen wrench to snug-up the orifice plug in the hole. Do not damage the part by over-tightening. Replace elbow and hose. Readjust brake valve pressure, per instructions on page 14, if required.

FOR ANY PROBLEM NOT COVERED ABOVE, CONSULT THE FACTORY FOR ASSISTANCE

CONSTRUCTION
EQUIPMENT
DIVISION

BRADEN INDUSTRIES, INC., BROKEN ARROW, OKLAHOMA



BRADEN CONSTRUCTION HOISTS
MODELS C2H16 & C2H16D
INSTALLATION, MAINTENANCE AND SERVICE

11-7405-8

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

WARNING: GOODS ARE NOT INTENDED FOR USE IN THE LIFTING OR MOVING OF PERSONS.

The winches described herein are neither designed nor intended for use or application to equipment used in the lifting or moving of persons and it is understood that all such use shall be at the sole risk of the user.

The cable clamps on winches are not designed to hold rated loads. A minimum of 4-6 wraps of cable must be left on drum barrel to guarantee holding of rated load.

THIS SALE IS MADE ON THE EXPRESS UNDERSTANDING THAT THERE IS NO IMPLIED WARRANTY THAT THE GOODS SHALL BE FIT FOR THE PURPOSE OF LIFTING OR MOVING PERSONS OR OTHER IMPROPER USE AND THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY FOR SUCH PURPOSES.

DESCRIPTION OF WINCH

The winch has three basic component parts:

1. Tie Plates and End Brackets
2. Hydraulic Motor and Brake Valve
3. Cable Drum Assembly

The cable drum assembly is made up of five basic assemblies in the C2H16 and six in the C2H16D:

1. Cable Drum
2. Two-Speed Clutch Assemblies and Primary Planetary Reducer
3. Brake Assembly
4. Secondary Planetary Reducer
5. Final Planetary Reducer
6. Free Fall Clutch Assembly (C2H16D only)

The hydraulic motor is bolted to the end bracket. The two-speed assembly housing is bolted and doweled to the end bracket. The brake assembly housing is bolted and doweled to the two-speed assembly housing. The ring gear of the secondary planetary reducer and final planetary reducer is splined to the brake housing. The cable drum is supported by the two-speed assembly housing through a large ball bearing. A spring loaded oil seal prevents oil leakage.

In the C2H16 the cable drum is supported on the other end by the final planet carrier to which it is splined. The carrier is supported by an anti-friction roller bearing on a ground and polished shaft projecting from the end bracket.

In the C2H16D the cable drum is supported on the other end by a bronze bushing running on the drop clutch hub. The drop clutch hub is supported by the final planet carrier to which it is splined. The carrier is supported by an anti-friction roller bearing on a ground and polished shaft projecting from the end bracket. A series of friction discs and drive discs are positioned between a splined land on the drop clutch hub and an internally splined area in the cable drum. Fifteen large, heavy-duty springs supply the pressure to engage the clutch. A large single acting hydraulic cylinder and piston located between the final planet carrier and the clutch pressure plate can, when pressurized, completely release the spring pressure on the clutch allowing the cable drum to rotate freely.

TWO-SPEED ASSEMBLY

This assembly has five operating component parts:

1. Primary Planetary Reducer
2. Floating Ring Gear
3 High Speed Friction Clutch (Spring Loaded)
4. Low Speed Friction Clutch
5. Double Acting Hydraulic Piston

The friction elements of the high speed clutch are located between the planet carrier and the ring gear of the primary planetary reducer assembly. When engaged, the high speed clutch locks the ring gear to the planet carrier causing it to rotate with the planet assembly, directly connecting the motor shaft to the sun gear of the secondary planetary reducer.

The friction elements of the low speed clutch are located between the ring gear of the planet assembly and the stationary two-speed assembly housing. When engaged, the low-speed clutch locks the ring gear to the housing causing the planetary assembly to function as a reducer, increasing the ratio of the gear train between the hydraulic motor and the cable drum with resulting lower drum speed and greater hoisting capacity.

The high speed clutch is engaged by the brake springs. The low speed clutch is engaged by the movement of the hydraulic, clutch operating piston. Further movement of this piston compresses the brake springs, releasing the high speed clutch. Directing oil to the opposite side of the piston moves the piston away from the low speed clutch allowing the brake springs to fully engage the high speed clutch.

As no neutral exists during the change from one speed to the other, the winch will not drop its load if the shift is made in either raising or lowering operations.

CAUTION

Both clutches are momentarily engaged during the shift. Excessive wear will result on the high speed clutch if the speed change is repeatedly and unnecessarily made while the winch is in operation.

Hydraulic pressure must always be present on one or the other side of the clutch operating piston when the winch is operated. Rapid wear of the low speed clutch will result if the piston is not moved

completely away from the clutch so there will be no dragging of the low speed clutch when the spring pressure engages the high speed clutch.

The valve used to operate the shift must be of the type that has no neutral position. A spring offset, four way, solenoid valve is highly recommended.

HOW IT OPERATES

The hydraulic motor drives the sun gear of the small primary planetary reducer. In high speed this speed and torque is transmitted directly to the sun gear of the secondary planetary reducer. In low speed a reduced speed and higher torque is transmitted to the secondary sun gear. The output of the secondary planetary reducer is transmitted by the planet carrier to the sun gear of the final planetary reducer. In the C2H16 the output of this reducer is transmitted directly to the cable drum by the spline between the planet carrier and the drum. In the C2H16D the output of the final planetary reducer is transmitted to the large free fall clutch and thence to the cable drum.

THE BRAKE SYSTEM

The automatic braking system has four operating component parts:

1. Brake Valve attached to Hydraulic Motor
2. Spring Loaded Friction Brake
3. Over-riding Cam Clutch
4. Hydraulic Piston and Cylinder

The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in a hoisting direction of rotation, and a pilot operated check valve that prevents flow of oil out of the motor when the operating valve is placed in the reverse or lowering position until sufficient pressure is present for the pilot piston to open the check valve. It also contains a small pressure relief valve set to prevent excessive shocks on the motor when a lowering operation is stopped.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or stopping the descent of a load.

The over-riding clutch is splined to the secondary sun gear shaft between the primary planet carrier and the secondary sun gear. It will allow this shaft to turn freely in a rotation to raise a load and force the brake discs to turn with the shaft in rotation to lower a load.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs. This is a double-acting cylinder and is balanced to back pressure when the winch is not being operated.

HOW IT OPERATES

When the winch is powered in a hoisting direction, the drive from the motor thru the primary planet carrier to the secondary sun gear runs free. The over-riding clutch between the secondary sun gear shaft and the brake discs allows complete freedom of rotation in this direction. The brake remains fully engaged as the brake release piston is balanced to back pressure up to 200 P.S.I.

When the lifting operation is stopped, the brake, being fully engaged, prevents the load from lowering.

When the winch is powered to reverse, the motor cannot rotate until sufficient pressure is present to open the brake valve. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which this valve will open will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower, the opening in the brake valve to decrease, slowing down the descent of the load.

When the operating valve is shifted to neutral the pressure will drop, the brake valve will close, stopping the load. The friction brake will engage after the valve has closed and hold the load.

When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own leakage. This feature results in a very slow speed and extremely accurate positioning.

SUMMARY

The winch, in raising a load, is not affected by any braking action. When lowering a load the brake valve has complete control of the speed at which it is lowered. When the winch is stopped by returning the control lever to neutral — the brake valve stops the load and the friction brake engages to hold the load.

Thus the brake receives very little wear in lowering operations. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated. The only heat absorbed by the winch in either hoisting or lowering is due to the efficiency losses within the winch itself.

FREE FALL VALVE — C2H16D ONLY

The free fall clutch is a spring loaded hydraulically released multiple disc clutch.

The free fall clutch control contains nine operating component parts:

1. A sensitive pressure reducing valve
2. Double acting hydraulic piston and cylinder
3. Control lever
4. Movable rod with a center detent to operate winch directional control valve
5. Single acting hydraulic piston with spring return
6. Steel ball poppet
7. Four way, spring offset, solenoid valve
8. Micro switch in lever to operate solenoid
9. Micro switch in lever to operate two speed

The pressure reducing valve can direct oil pressure to the free fall clutch spring pressure release cylinder.

The double acting piston, when pressurized on one side, can move to compress the spring of the pressure reducing valve to increase the pressure to the free fall clutch release cylinder. When pressurized on the other side, the piston and piston rod is locked in an out position.

The control lever is pivotally attached to this piston rod and also pivotally attached to the winch directional control actuating rod.

The single acting hydraulic piston, when pressurized, locks the winch control actuating rod in its center or neutral position.

The spring, in this piston cylinder also applies pressure to the steel ball poppet forming the neutral detent in the winch control rod.

The four way, spring offset, solenoid valve is bolted to the pressure reducing valve housing and normally directs oil pressure to the double acting hydraulic piston to lock it in its out position.

The two micro switches, in the control handle, are momentary contact type switches and must be held down to maintain winch operation. One switch energizes the solenoid of the two speed valve. This valve should normally direct oil to place the winch in low speed; and, when its solenoid is energized, shift the winch to high speed. The other switch energizes the solenoid of the valve fastened to the free fall control valve and places the winch in free fall operation.

HOW IT OPERATES

This one lever controls all of the winch functions. With neither switch depressed the double acting piston rod is locked in its out position forming the pivot point for the lever. Moving the lever will operate the winch in low speed raise or lower. Depressing the high speed switch and moving the lever will operate the winch in high speed raise or lower.

When the free fall switch is depressed, oil pressure is directed to the single piston locking the directional control valve actuating rod in its center or neutral position. This forms a new pivot point for the lever. Oil pressure is also directed to the pressure reducing valve and to the double acting piston to move it in the direction to compress the spring of this valve. The piston must move compressing the spring before free fall can occur. As the piston rod is attached to the lever, the lever must also move. The force of the compressed spring determines the amount of oil pressure that is directed to the free fall clutch release cylinder.

If the lever is allowed to be pulled forward, increasing the oil pressure to the free fall clutch release cylinder, free fall will occur. If the lever is pulled back against the force of the piston the oil pressure will drop and the clutch re-engage, stopping the descent of the load. The maximum force that can be exerted by the piston is 125 pounds. With a 10:1 lever ratio the maximum pull on the lever handle is twelve and one-half pounds.

This free fall control is accident proof. The switch button must remain depressed and the lever must move before free fall can occur. If at any time during free fall operation the lever or switch button is released, the clutch will be instantly and fully engaged.

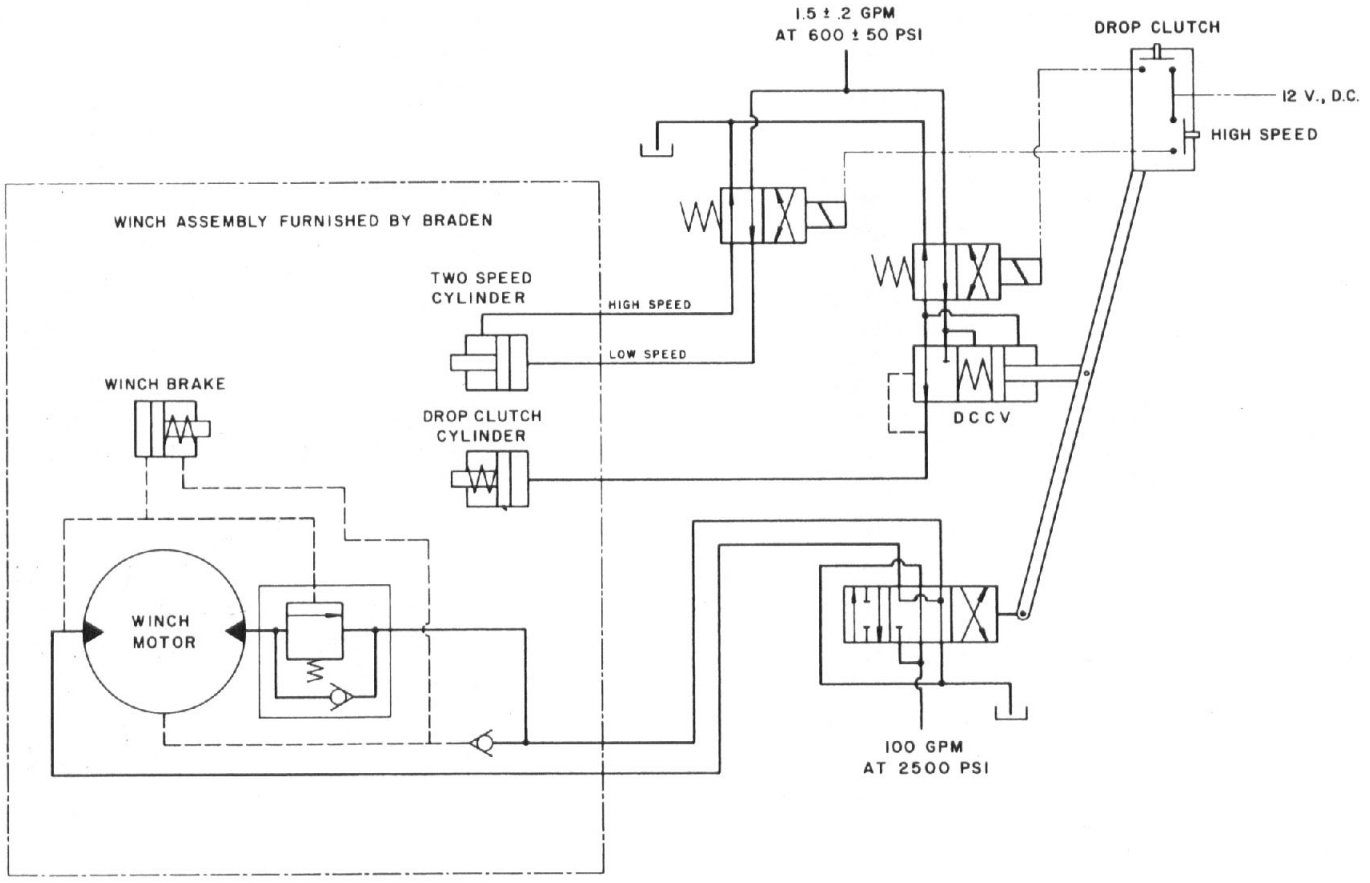
CAUTION

The thermal capacity of the free fall clutch is 100,000 ft. lbs. per minute. That is, a 1,000 pound load can be dropped and caught from a height of 100 feet once every minute; or, a 2,000 pound load can be allowed to free fall and be caught from a height of 100 feet every two minutes.

No load heavier than 4,500 pounds should be dropped and caught.

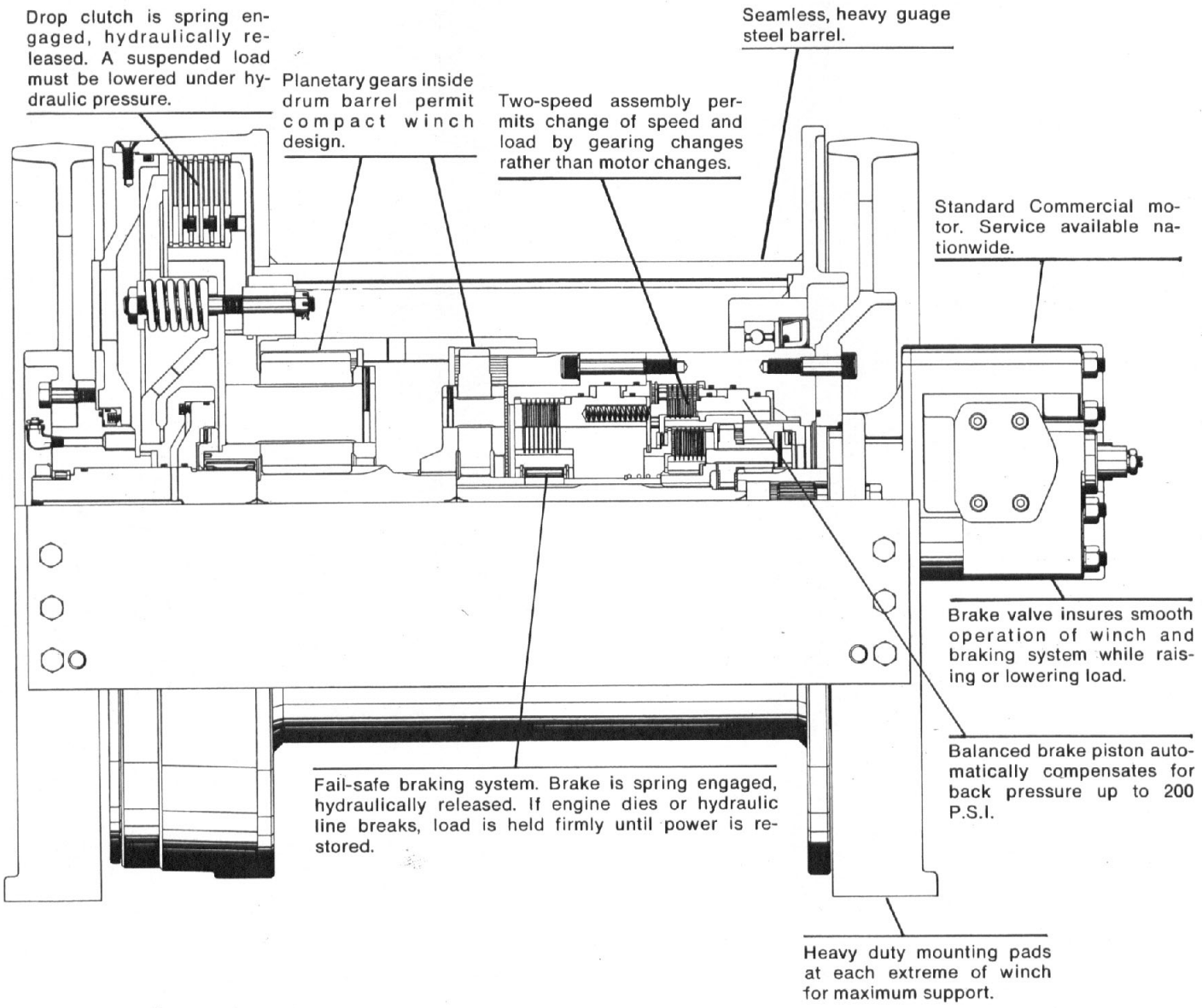
In pile driving operations, as no heat is absorbed by the clutch, there is no load or time limit.

WINCH CONTROL CIRCUIT



Drop Clutch Control Valve (DCCV) shown is available from Braden as an option. Part Number 61256.

CROSS-SECTIONAL VIEW



Model C2H16D Illustrated

PERFORMANCE DATA

MODEL C2H16

100 G.P.M. @ 2,500 P.S.I. STATIC, 2,100 P.S.I. DYNAMIC (115 G.P.M. MAXIMUM ALLOWABLE)

5/8" CABLE						3/4" CABLE						7/8" CABLE					
	LOW SPEED		HIGH SPEED		DRUM		LOW SPEED		HIGH SPEED		DRUM		LOW SPEED		HIGH SPEED		DRUM
LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)	LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)	LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)
1	16,000	150	7,600	338	133	1	16,000	151	7,600	341	112	1	16,000	152	7,600	344	97
2	14,900	160	7,100	365	280	2	14,700	165	7,000	370	230	2	14,500	170	6,900	380	200
3	13,900	175	6,600	390	430	3	13,600	180	6,400	400	370	3	13,200	185	6,300	415	320
4	13,000	185	6,200	415	590	4	12,600	190	6,000	430	510	4	12,200	200	5,800	450	450
5	12,300	195	5,800	440	770	5	11,800	205	5,600	465	660	5	11,300	215	5,400	485	580
6	11,600	205	5,500	465	950	6	11,000	220	5,200	495	820	—	—	—	—	—	—
7	10,700	225	5,100	500	1145	—	—	—	—	—	—	—	—	—	—	—	—

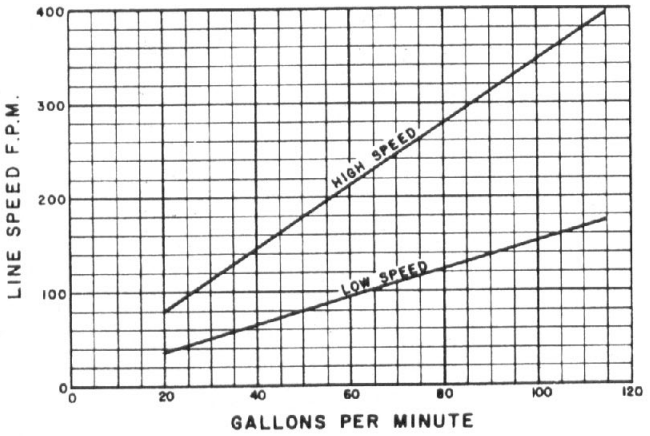
MODEL C2H16D

100 G.P.M. @ 2,500 P.S.I. STATIC, 2,100 P.S.I. DYNAMIC (115 G.P.M. MAXIMUM ALLOWABLE)

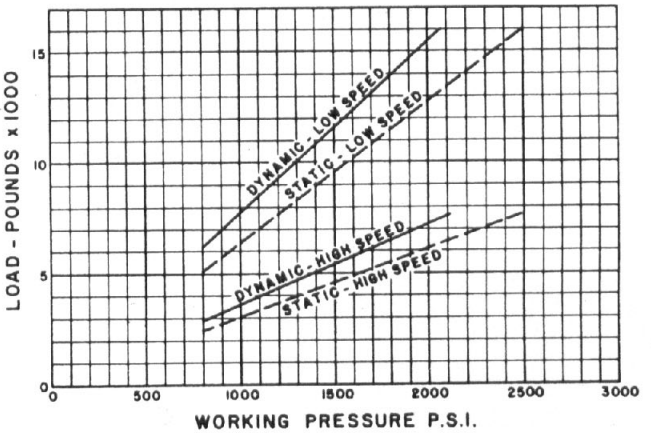
5/8" CABLE						3/4" CABLE						7/8" CABLE					
	LOW SPEED		HIGH SPEED		DRUM		LOW SPEED		HIGH SPEED		DRUM		LOW SPEED		HIGH SPEED		DRUM
LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)	LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)	LAYER	HOIST (LBS)	LINE SPEED (FPM)	HOIST (LBS)	LINE SPEED (FPM)	CABLE CAPACITY (FEET)
1	16,000	150	7,600	338	125	1	16,000	151	7,600	341	105	1	16,000	152	7,600	344	91
2	14,900	160	7,100	365	260	2	14,700	165	7,000	370	220	2	14,500	170	6,900	380	190
3	13,900	175	6,600	390	405	3	13,600	180	6,400	400	345	3	13,200	185	6,300	415	300
4	13,000	185	6,200	415	560	4	12,600	190	6,000	430	480	4	12,200	200	5,800	450	420
5	12,300	195	5,800	440	720	5	11,800	205	5,600	465	620	5	11,300	215	5,400	485	550
6	11,600	205	5,500	465	895	6	11,000	220	5,200	495	775	—	—	—	—	—	—
7	10,700	255	5,100	500	1075	—	—	—	—	—	—	—	—	—	—	—	—

MODELS C2H16 & C2H16D

CABLE SPEED



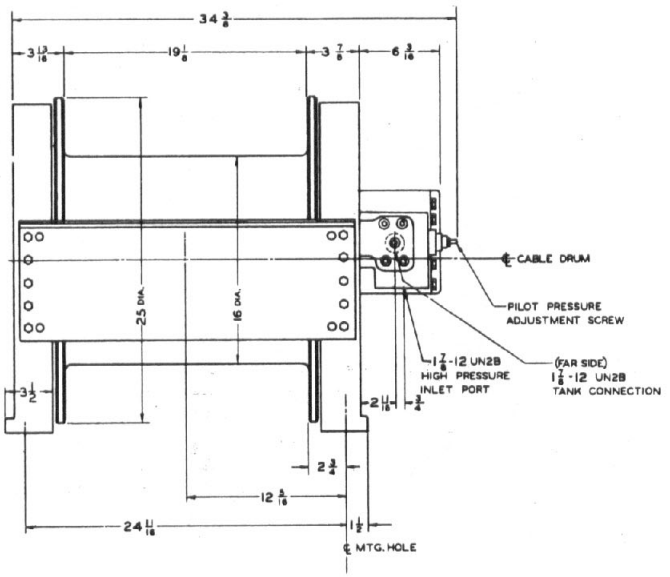
CABLE PULL

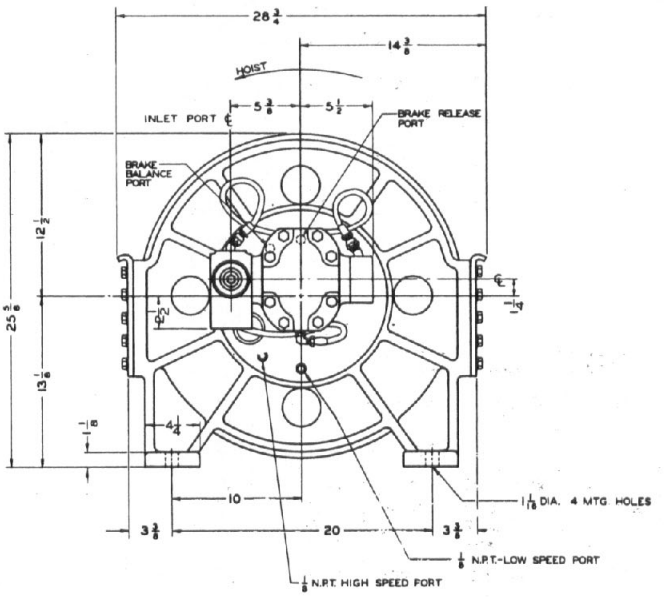


Ratings and speeds shown are on the first layer of cable.

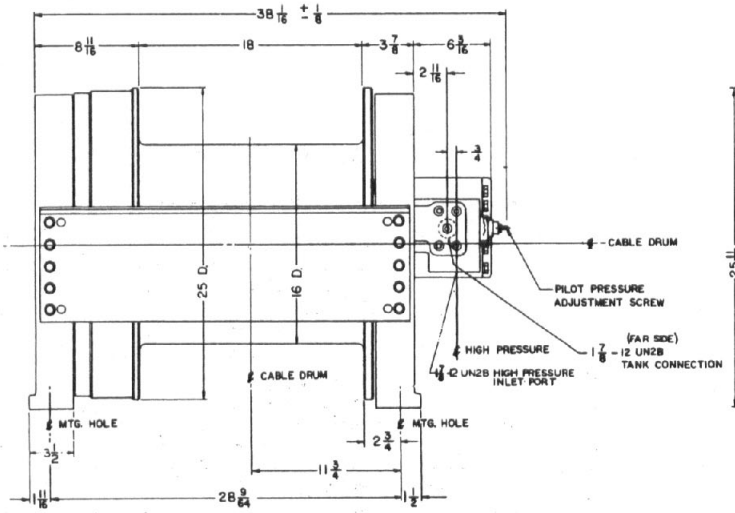
DIMENSIONAL DATA

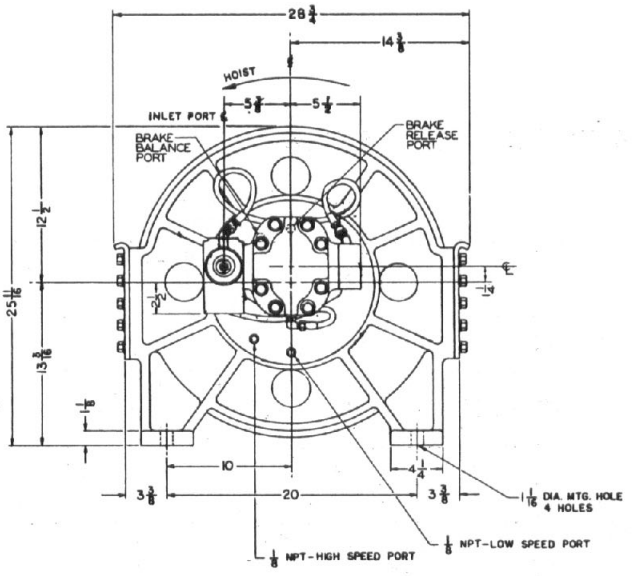
CONSTRUCTION HOIST MODEL C2H16



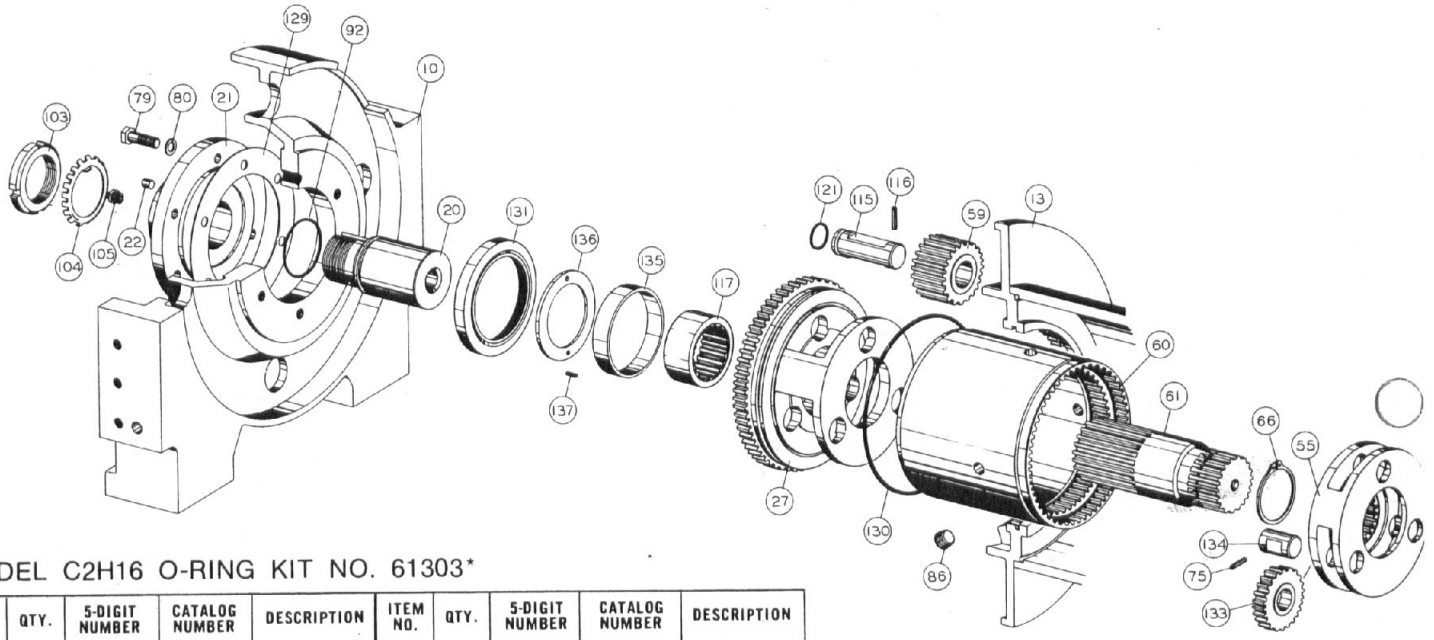


CONSTRUCTION HOIST MODEL C2H16D





COMPONENTS — MODEL C2H16

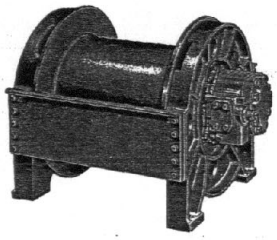


MODEL C2H16 O-RING KIT NO. 61303*

ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION	ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION
1	1	10467	10467	O-Ring	6	1	22666	22666	O-Ring
2	2	22358	22358	O-Ring	7	4	13542	1875012	O-Ring
3	4	22357	22357	O-Ring	8	1	22574	22574	O-Ring
4	1	10330	10330	O-Ring	9	2	22685	22685	O-Ring
5	1	22976	22976	O-Ring					

*When O-ring replacements are required, order complete O-Ring Kit No. 61303

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.



CONSTRUCTION HOIST

MATERIAL LIST–C2H16

ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION
1	1	22300	22300	Bearing Support
2	1	22639	22639	Brake Cylinder
3	1	22302	22302	Planet Carrier
4	3	22303	22303	Planet Gear Shaft
5	1	23099	23099	Sun Gear Shaft
6	1	22641	22641	Motor Gear
7	1	22306	22306	Motor Gear Bushing
8	3	22307	22307	Planet Cluster Gear
9	1	22642	22642	End Bracket, Right
10	1	22643	22643	End Bracket, Left
11	1	22644	22644	Brake Release Piston
12	1	22645	22645	Spacer
13	1	81451	81451	Cable Drum Assembly
20	1	22647	22647	Carrier Bearing Shaft
21	1	22648	22648	Bearing Shaft Support
22	1	22323	22323	Carrier Bearing Shaft Key
27	1	22649	22649	Final Planet Carrier
31	2	22650	22650	Tie Plate
36	1	23224	23224	Clutch Back-Up Plate
37	6	22337	22337	Clutch Disc
38	5	22338	22338	Friction Disc
39	1	22339	22339	Clutch Piston
40	1	22340	22340	Ring Gear
41	1	22341	22341	Thrust Bearing Support
42	1	22342	22342	High Speed Clutch Hub
43	1	22343	22343	Ring Gear Spacer
44	1	23225	23225	Clutch Pressure Plate
45	1	22345	22345	Planet Carrier Spring
46	24	22346	22346	Brake Spring
47	1	22347	22347	Piston Guide
48	1	22651	22651	Hydraulic Motor
49	4	22350	22350	Nipple
50	3	13705	13705	Hose Assembly — 14" Long
51	1	13706	13706	Hose Assembly — 16" Long
52	1	13708	13708	Street Elbow — 90°
53	1	21163	2685008	Elbow — 90° Male
54	1	81324	851040	Brake Clutch Assembly
55	1	22652	22652	Secondary Planet Carrier
56	1	22557	22557	Counterbalance Valve
57	1	22655	22655	Sun Gear
58	1	22656	22656	Back-Up Plate
59	3	22657	22657	Final Planet Gear
60	1	22658	22658	Ring Gear
61	1	22659	22659	Final Sun Gear
62	8	22660	22660	Friction Disc
63	8	22661	22661	Brake Disc
64	1	22471	22471	Dowel Pin
65	1	22565	22565	Manifold
66	2	21149	1951001	Retaining Ring
67	1	12035	21-RD6-1	Retaining Ring
68	2	18050	1457001	Thrust Bearing
70	2	22685	22685	O-Ring
71	4	22357	22357	O-Ring

ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION
72	1	10330	10330	O-Ring
74	1	10467	10467	O-Ring
75	3	21049	R18-075	Rollpin
76	12	21112	2085001	Dowel Pin
77	8	22563	SO50-32AD	Capscrew
78	36	11056	AO50	Lockwasher
79	6	11776	SO37-12PH5	Capscrew
80	6	18003	AO37	Lockwasher
81	20	13938	SO50-12PH5	Capscrew
84	6	11028	AO62	Lockwasher
85	3	22374	EO12A	Pipe Plug
86	1	11085	EO75WC	Pipe Plug
87	4	22351	22351	Thrust Bearing Race
89	1	22352	22352	Ball Bearing
90	1	22353	22353	Oil Seal
92	1	22976	22976	O-Ring
93	2	22356	22356	O-Ring
94	2	22358	22358	O-Ring
96	1	22360	22360	Thrust Bearing Race
97	3	22375	R12-112	Rollpin
98	4	22361	22361	Shoulder Screw
99	2	22362	SO62-17PH5	Capscrew
101	8	22364	SO50-17PH5	Capscrew
103	1	22366	22366	Bearing Locknut
104	1	22367	22367	Bearing Lockwasher
105	1	18062	28-FTD-2	Vent Plug
106	2	23251	23251	Retaining Ring
107	4	22573	SO50-20A	Capscrew
108	1	22574	22574	O-Ring
110	9	22379	22379	Brake Disc
111	8	22380	22380	Friction Disc
115	3	22664	22664	Planet Gear Shaft
116	3	18055	R25-150	Rollpin
117	1	22665	22665	Roller Bearing
118	1	21186	850930	Cable Clamp
120	2	21165	2685010	Tubing Elbow — 45°
121	4	13542	1875012	O-Ring
122	4	22664	SO50-40A	Capscrew
123	1	81339	851220	Check Valve Assembly
124	1	22934	22934	Tee
126	1	22670	22670	Piston Cylinder
128	1	18063	EO25W	Pipe Plug
129	1	22926	22926	Gasket
130	1	22666	22666	O-Ring
131	1	22922	22922	Oil Seal
132	1	22630	2685016	Tubing Elbow — 90°
133	3	22653	22653	Secondary Planet Gear
134	3	22654	22654	Secondary Planet Gear Shaft
135	1	22667	22667	Wear Sleeve
136	1	22668	22668	Thrust Washer
137	2	21060	850460	Pin
138	1	23226	23226	Retaining Ring

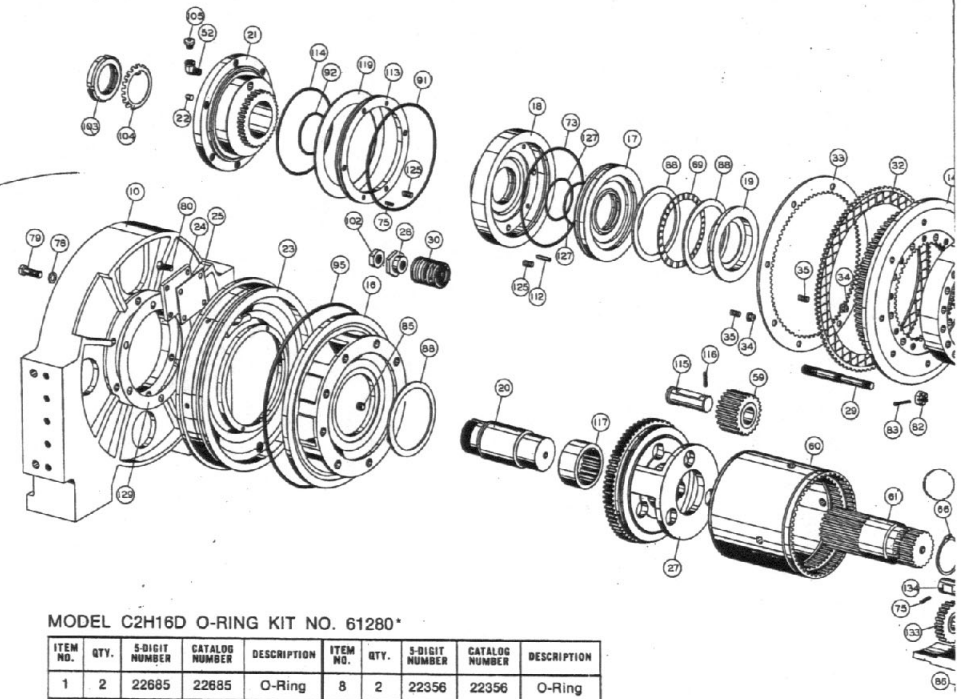
FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

MATERIAL LIST–C2H16D

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	22300	22300	Bearing Support
2	1	22639	22639	Brake Cylinder
3	1	22302	22302	Primary Planet Carrier
4	3	22303	22303	Planet Gear Shaft
5	1	23099	23099	Input Sun Gear Shaft
6	1	22641	22641	Motor Gear
7	1	22306	22306	Motor Gear Bushing
8	3	22307	22307	Planet Cluster Gear
9	1	22642	22642	End Bracket, Right
10	1	22706	22706	End Bracket, Left
11	1	22644	22644	Brake Release Piston
12	1	22645	22645	Spacer
13	1	81460	81460	Cable Drum Assembly
14	1	22707	22707	Drop Clutch Hub
15	1	22708	22708	Drum Bushing Support
16	1	22709	22709	Pressure Plate
17	1	22710	22710	Drop Clutch Release Piston
18	1	22711	22711	Drop Clutch Release Cylinder
19	1	22712	22712	Thrust Bearing Support
20	1	22713	22713	Bearing Shaft
21	1	22714	22714	Bearing Shaft Support
22	1	22323	22323	Bearing Shaft Support Key
23	1	22715	22715	Clutch Cover
24	1	22325	22325	Clutch Cover Plate
25	1	22326	22326	Gasket
26	1	22716	22716	Drum Bushing
27	1	22649	22649	Final Planet Carrier
28	15	22329	22329	Adjustment Nut
29	15	22330	22330	Clutch Spring Stud
30	15	22331	22331	Clutch Spring
31	2	22717	22717	Tie Plate
32	6	22718	22718	Friction Disc
33	6	22719	22719	Drive Disc
34	48	22335	22335	Spring Retainer
35	48	22233	22233	Clutch Plate Spring
36	1	23224	23224	Clutch Back-Up Plate
37	6	22337	22337	Clutch Disc
38	5	22338	22338	Friction Disc
39	1	22339	22339	Clutch Piston
40	1	22340	22340	Ring Gear
41	1	22341	22341	Thrust Bearing Support
42	1	22342	22342	Clutch Hub
43	1	22343	22343	Ring Gear Spacer
44	1	23225	23225	Clutch Pressure Plate
45	1	22345	22345	Planet Carrier Spring
46	24	22346	22346	Brake Spring
47	1	22347	22347	Piston Guide
48	1	22651	22651	Hydraulic Motor
49	4	22350	22350	Nipple
50	3	13705	13705	Hose Assembly — 14" Long
51	1	13706	13706	Hose Assembly — 18" Long
52	2	13708	13708	Street Elbow — 90°
53	1	21163	2685008	Elbow — 90° Male
54	1	81324	851040	Brake Clutch Assembly
55	1	22652	22652	Secondary Planet Carrier
56	1	22557	22557	Counterbalance Valve
57	1	22655	22655	Sun Gear
58	1	22656	22656	Back-Up Plate
59	3	22657	22657	Final Planet Gear
60	1	22658	22658	Ring Gear
61	1	22659	22659	Final Sun Gear
62	8	22660	22660	Friction Disc
63	8	22661	22661	Brake Disc
64	1	22471	22471	Dowel Pin
65	1	22565	22565	Manifold
66	2	21149	1951001	Retaining Ring

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
67	1	12035	21-RD6-1	Retaining Ring
68	2	18050	1457001	Thrust Bearing
69	1	22720	22720	Thrust Bearing
70	2	22685	22685	O-Ring
71	4	22357	22357	O-Ring
72	1	10330	10330	O-Ring
73	1	22721	22721	O-Ring
74	1	10467	10467	O-Ring
75	7	21049	R18-075	Rollpin
76	12	21112	2085001	Dowel Pin
77	8	22663	SO50-32AD	Capscrew
78	42	11026	AO50	Lockwasher (½")
79	6	21908	SO50-15A	Capscrew
80	4	11765	SO31-07AF	Flathead Capscrew
81	20	13938	SO50-12PH5	Capscrew
82	15	11055	BO50E	Slotted Nut
83	15	13959	D12-125	Cotter Pin
84	6	11028	AO62	Lockwasher (⅝")
85	6	22374	EO12A	Pipe Plug
86	1	16137	EO75W	Pipe Plug
87	4	22351	22351	Thrust Bearing Race
88	3	22722	22722	Thrust Bearing Race
89	1	22352	22352	Ball Bearing
90	1	22353	22353	Oil Seal
91	1	10450	10450	O-Ring
92	1	22355	22355	O-Ring
93	2	22356	22356	O-Ring
94	2	22358	22358	O-Ring
95	1	22723	22723	O-Ring
96	1	22360	22360	Thrust Bearing Race
97	3	22375	R12-112	Rollpin
98	4	22361	22361	Shoulder Screw
99	2	22362	SO62-17PH5	Capscrew
100	6	22363	SO37-10AF	Flathead Capscrew
101	8	22364	SO50-17PH5	Capscrew
102	15	22365	BO62J	Jam Nut
103	1	22366	22366	Bearing Locknut
104	1	22367	22367	Bearing Lockwasher
105	1	18062	28-FTD-2	Vent Plug
106	2	23251	23251	Retaining Ring
107	4	22573	SO50-20A	Capscrew
108	1	22574	22574	O-Ring
110	9	22379	22379	Clutch Disc
111	8	22380	22380	Friction Disc
112	4	12005	R18-087	Rollpin
113	1	22465	22465	Face Seal Plate
114	1	10052	1858003	O-Ring
115	3	22664	22664	Planet Gear Shaft
116	3	18055	R25-150	Rollpin
117	1	22666	22665	Roller Bearing
118	1	21186	850930	Cable Clamp
119	1	22770	22770	Face Seal Washer
120	2	21165	2685010	Tubing Elbow — 45°
121	1	13542	1875012	O-Ring
122	4	22564	SO50-40A	Capscrew
123	1	81339	851220	Check Valve Assembly
124	1	22934	22934	Tee
125	12	22566	22566	Face Seal Spring
126	1	22670	22670	Piston Cylinder
127	2	22991	22991	O-Ring
128	1	19063	EO25W	Pipe Plug
129	1	22990	22990	Gasket
132	1	22630	2685016	Tubing Elbow — 90°
133	3	22653	22653	Secondary Planet Gear
134	3	22654	22654	Secondary Planet Gear Shaft
138	1	23226	23226	Retaining Ring

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

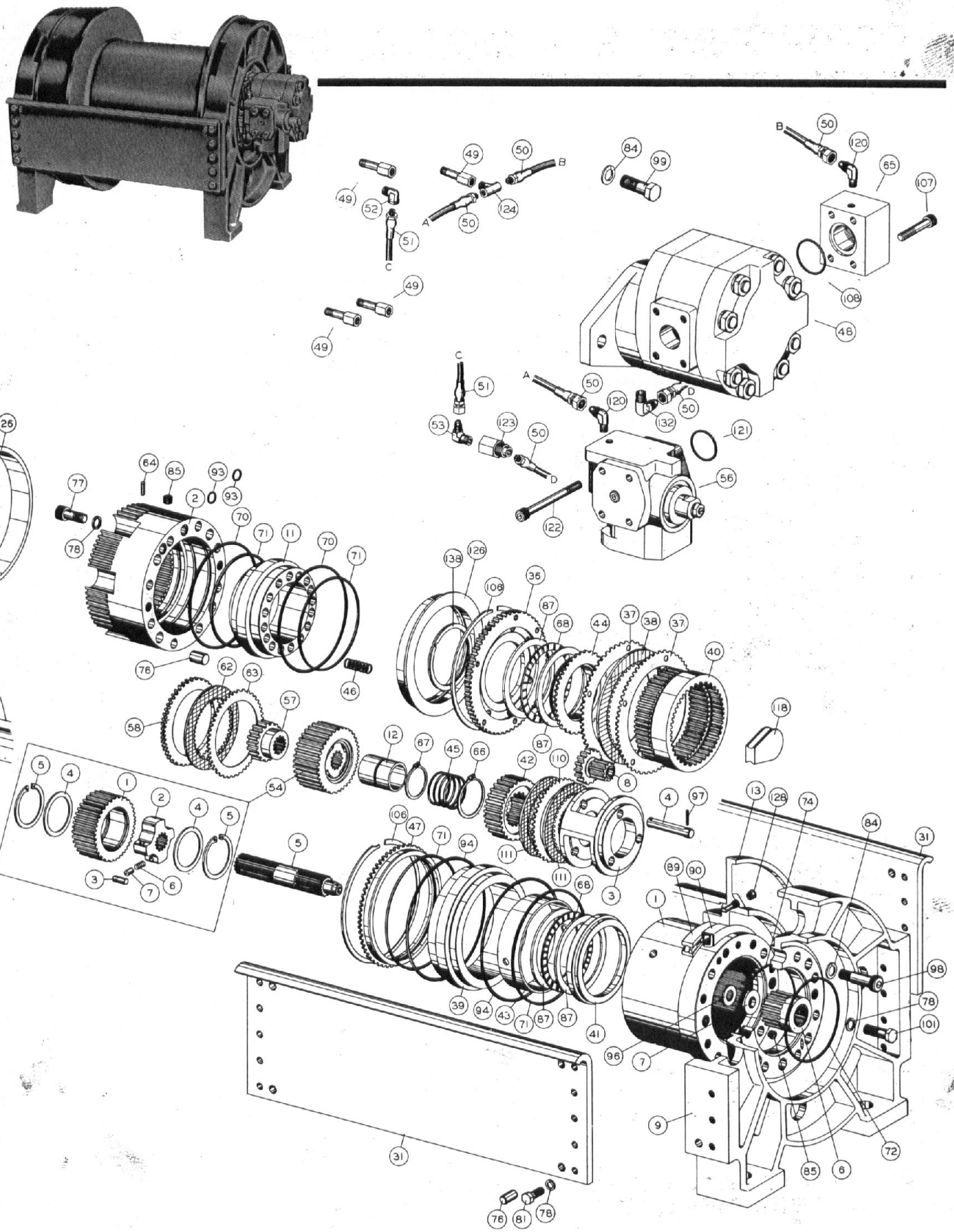


MODEL C2H16D O-RING KIT NO. 61280*

ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION	ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION
1	2	22685	22685	O-Ring	8	2	22356	22356	O-Ring
2	4	22357	22357	O-Ring	9	2	22358	22358	O-Ring
3	1	10330	10330	O-Ring	10	1	22723	22723	O-Ring
4	1	22721	22721	O-Ring	11	1	22574	22574	O-Ring
5	1	10467	10467	O-Ring	12	1	10052	1858003	O-Ring
6	1	10450	10450	O-Ring	13	2	22991	22991	O-Ring
7	1	22355	22355	O-Ring	14	1	13542	1875012	O-Ring

*When O-ring replacements are required, order complete O-Ring Kit No. 61280

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.



ONSTRUCTION HOIST

PROCEDURE FOR DISASSEMBLY OF BRADEN CONSTRUCTION HOIST

MODELS C2H16 and C2H16D

Disassembly of winch may be done from either end. Remove the winch from the equipment on which it is mounted.

For complete disassembly, place the winch in a horizontal position, drain the oil and flush.

For partial disassembly, from either end, the oil need not be drained.

DISASSEMBLY FROM THE MOTOR END

Stand winch in vertical position, resting on end bracket, Item 10.

Remove four (4) hose assemblies, Items 50 and 51.

Remove two (2) capscrews and lockwashers, Items 99 and 84.

Remove hydraulic motor, Item 48, and O-ring, Item 72.

Remove four (4) nipples, Item 49.

Remove eight (8) capscrews and lockwashers, Items 101 and 78.

Remove four (4) shoulder screws and lockwashers, Items 98 and 84.

Remove twenty (20) capscrews and lockwashers, Items 81 and 78, from tie plates, Item 31. Remove tie plates.

Remove end bracket, Item 9.

Remove and discard O-ring, Item 74.

The end of the bearing support, Item 1, is now exposed.

Remove input sun gear, Item 6. Input sun gear bushing, Item 7, should come out with the gear.

Remove thrust bearing race, Item 96.

Secure with two (2) capscrews, a short length of chain, or similar lifting device, to bearing support, Item 1. With the aid of a hoist, lift bearing support, Item 1, and brake cylinder, Item 2, from cable drum, Item 13, being careful to pull the assembly straight out to avoid binding which could damage the bearing or oil seal.

Remove planet carrier spring, Item 45. Remove spacer, Item 12, with retaining ring, Item 67.

Remove secondary sun gear shaft, Item 5.

Remove brake clutch assembly, Item 54.

Remove secondary sun gear, Item 57.

Remove, as an assembly, the secondary planet carrier, Item 55, planet gears, Item 133, planet gear shafts, Item 134, and rollpins, Item 75.

Remove the final sun gear, Item 61, with retaining ring, Item 66.

Remove ring gear, Item 60.

Disassembly procedures for hoist Models C2H16 and C2H16D are identical to this point.

To reassemble the winch from this point reverse the foregoing procedure.

NOTE 1 — It is important to check the rotation of the brake clutch assembly, Item 54, when it is re-installed in the winch. Insert the secondary sun gear shaft, Item 5, into the brake clutch assembly, Item 54. Place the brake clutch in the left hand and rotate the shaft in a clockwise direction. If the rotor of the brake clutch assembly turns in this direction install it in place. If it will not turn in this direction, turn the brake clutch assembly over and insert the shaft in the other side.

If the brake clutch is installed opposite to the above procedure, the winch will be working against the brake, the brake will not release, and there will be no forward rotation of the winch.

NOTE 2 — In reassembly it is important to carefully align all splines to enable the parts to seat properly.

Note 3 — Install new O-rings to replace those removed.

If complete disassembly of the winch is desired, turn winch over and rest on end of cable drum and proceed according to the following instructions applying to your particular winch.

DISASSEMBLY FROM THE DRUM SUPPORT END, MODEL C2H16

Stand winch in a vertical position on the motor end with right end bracket, Item 9, resting on blocks high enough from the work surface to allow clearance for hydraulic motor, manifold and brake valve. If complete disassembly was started on other end, the blocks will not be necessary.

If complete disassembly was started on the other end, bypass the remainder of this paragraph and proceed with the next paragraph. Remove twenty (20) capscrews and lockwashers, Items 81 and 78, from tie plates, Item 31. Remove tie plates.

Remove, as an assembly, left end bracket, Item 10, bearing shaft support, Item 21, carrier bearing shaft, Item 20, bearing locknut and lockwasher, Items 103 and 104, vent plug, Item 105, O-ring, Item 92, oil seal, Item 131, gasket, Item 129, key, Item 22, and capscrews and lockwashers, Items 79 and 78.

The final planet carrier assembly (Items 27, 59, 115, 116, 117, 121, 135, 136 and 137) can now be removed with the aid of small hook inserted into bearing area. If carrier is tight, use a grease seal removing tool to obtain leverage. If there is evidence

of oil leakage through the planet carrier around the planet gear shafts, refer to page 23 for disassembly and reassembly of final planet carrier assembly.

If complete disassembly was started on the other end, this completes disassembly of the winch.

If disassembly was started on this end, continue as follows:

Remove ring gear, Item 60.

Remove final sun gear, Item 61, with retaining ring, Item 66.

Remove, as an assembly, the secondary planet carrier, Item 55, planet gears, Item 133, planet gear shafts, Item 134, and rollpins, Item 75.

Remove sun gear, Item 57.

Remove brake clutch assembly, Item 54.

Remove secondary sun gear shaft, Item 5.

Remove spacer, Item 12, with retaining ring, Item 67.

Remove planet carrier spring, Item 45.

Turn winch over and rest on end of cable drum.

Refer to procedure for disassembly from the motor end, page 16, to complete disassembly of winch. Follow that procedure through the removal of the bearing support, Item 1, and brake cylinder, Item 2, except the removal of the tie plates, Item 31, which is already done.

DISASSEMBLY FROM THE DRUM SUPPORT END, MODEL C2H16D

Stand winch in a vertical position on motor end with right end bracket, Item 9, resting on blocks high enough from the work surface to allow clearance for hydraulic motor, manifold and brake valve. If complete disassembly was started on other end the blocks will not be necessary.

If complete disassembly was started on other end bypass the remainder of this paragraph and proceed with next paragraph. Remove twenty (20) capscrews and lockwashers, Items 81 and 78, from tie plates, Item 31. Remove tie plates.

Remove, as an assembly, left end bracket, Item 10, bearing shaft support, Item 21, bearing shaft, Item 20, key, Item 22, street elbow, Item 52, capscrews, Item 79, lockwashers, Item 78, O-ring, Item 92, bearing locknut, Item 103, bearing lockwasher, Item 104, vent plug, Item 105, O-ring, Item 114, and gasket, Item 129. Remove O-ring, Item 114, from groove in bearing shaft support, Item 21, and discard.

Remove face seal washer, Item 119.

Being careful of springs, Item 125, remove face seal plate, Item 113. Remove O-ring, Item 91, from groove in face seal plate and discard.

Remove six (6) flathead capscrews, Item 100.

Remove clutch cover, Item 23, Remove O-ring, Item 95, from groove in clutch cover and discard.

Attach a lifting device to the clutch spring studs, Item 29. Remove the drop clutch assembly and final planet carrier assembly from the cable drum assembly, Item 13.

If complete disassembly was started on the other end, this completes disassembly of the winch.

If disassembly was started on this end continue as follows:

Remove ring gear, Item 60.

Remove final sun gear, Item 61, with retaining ring, Item 66.

Remove, as an assembly, the secondary planet carrier, Item 55, planet gears, Item 133, planet gear shafts, Item 134, and rollpins, Item 75.

Remove sun gear, Item 57.

Remove brake clutch assembly, Item 54.

Remove secondary sun gear shaft, Item 5.

Remove spacer, Item 12, with retaining ring, Item 67.

Remove planet carrier spring, Item 45.

Turn winch over and rest on end of cable drum.

Refer to procedure for disassembly from the motor end, page 16, to complete disassembly of winch. Follow that procedure through the removal of the bearing support, Item 1, and brake cylinder, Item 2, except the removal of the tie plates, Item 31, which is already done.

DISASSEMBLY OF DROP CLUTCH FINAL PLANET CARRIER ASSEMBLY, MODEL C2H16D

Set assembly on work surface, resting on the final planet carrier, Item 27.

Remove fifteen (15) jam nuts, Item 102, adjustment nuts, Item 28, and clutch springs, Item 30.

Remove pressure plate, Item 16.

Remove six (6) drive discs and friction discs, Items 33 and 32, and forty-eight (48) clutch plate springs and spring retainers, Items 35 and 34.

Remove thrust bearing race, Item 88.

Remove drop clutch release cylinder, Item 18. Remove O-ring, Item 127, from groove in release cylinder and discard.

Remove four (4) springs, Item 125. It is recommended that new springs be installed when reassembling winch.

Remove drop clutch release piston, Item 17. Remove O-rings, Items 73 and 127, from grooves in release piston and discard.

Remove thrust bearing, Item 69, and two (2) thrust bearing races, Item 88. Replace these items if rough or badly worn.

Remove thrust bearing support, Item 19.

The final planet carrier assembly (Items 27, 59, 115, 116 and 117) should now be standing free on the work surface. Refer to page 23 for disassembly and reassembly of final planet carrier assembly.

Turn drop clutch hub, Item 14, over and inspect drum bushing support, Item 15. It is not necessary to disassemble the drop clutch hub, drum bushing support, clutch spring studs, nuts and cotters if the drum bushing support or drop clutch hub is not being replaced.

The drum bushing, Item 26, should be inspected.

DISASSEMBLY OF BEARING SUPPORT AND BRAKE CYLINDER ASSEMBLY, MODELS C2H16 and C2H16D

Place bearing support and brake cylinder assembly on work surface with motor side of bearing support, Item 1, down.

Remove eight (8) socket head capscrews and lockwashers, Items 77 and 78.

Insert two (2) capscrews in threaded holes in brake cylinder, Item 2, to provide means for pulling the brake cylinder assembly from the bearing support assembly. When this is done, the brake springs, Item 46, will probably fall out.

Turn brake cylinder assembly over and set on work surface.

Remove two (2) O-rings, Item 93, and discard.

Remove piston cylinder, Item 126. Remove O-ring, Item 71, from groove in piston cylinder and discard.

Remove brake release piston, Item 11.

Remove eight (8) each of brake discs, Item 63, and friction discs, Item 62.

Remove back-up plate, Item 58.

Remove O-ring, Item 71, and two (2) O-ring, Item 70, from grooves in brake cylinder, Item 2, and discard.

The bearing support assembly can now be disassembled.

Remove retaining ring, Item 106, from groove in bearing support, Item 1.

Remove, as an assembly, clutch back-up plate, Item 36, clutch pressure plate, Item 44, two (2) thrust bearing races, Item 87, thrust bearing, Item 68, and retaining ring, Item 138.

To take this assembly apart remove retaining ring, Item 138.

Remove primary planet carrier, Item 3, by inserting a hook puller in the splined hole, bringing with it the following parts: three (3) planet gear shaft, Item 4, three (3) planet cluster gear, Item 8, six (6) low speed clutch disc, Item 37, five (5) low speed friction disc, Item 38, one (1) ring gear, Item 40, one (1) high speed clutch hub, Item 42, one (1) retaining ring, Item 66, three (3) rollpin, Item 97, nine (9) high speed clutch disc, Item 110, and eight (8) high speed friction disc, Item 111.

Remove ring gear spacer, Item 43.

Remove two (2) thrust bearing races, Item 87, and thrust bearing, Item 68.

Remove thrust bearing support, Item 41.

Remove retaining ring, Item 106.

Remove piston guide, Item 47. Remove O-ring Item 71, from groove in piston guide and discard.

Remove clutch piston, Item 39. This may require the use of a length of hardwood and a hammer.

Remove O-ring, Item 71, and two (2) O-rings, Item 94, from grooves in bearing support, Item 1, and discard.

Remove retaining ring, Item 66, from groove in primary planet carrier, Item 3. Remove high speed clutch hub, Item 42.

Refer to page 22 for disassembly and reassembly of primary planet carrier assembly.

PROCEDURE FOR REASSEMBLY OF BRADEN CONSTRUCTION HOISTS

MODELS C2H16 and C2H16D

Assemble brake clutch assembly per instructions on page 22.

Assemble final planet carrier assembly per instructions on page 23.

Assemble secondary planet carrier assembly per instructions on page 23.

Assemble primary planet carrier assembly per instructions on page 22.

Stand bearing support, Item 1, on work surface with large end down.

It is recommended that a light lubricating grease be used on O-rings and the surfaces to be sealed.

Install O-ring, Item 71, and two (2) O-rings, Item 94, in grooves in bearing support.

Install the clutch piston, Item 39, using a plastic or rubber hammer, if necessary. Be sure to insert this piston with the short shoulder up.

Install O-ring, Item 71, in groove in piston guide, Item 47.

Install piston guide, Item 47, by engaging splines and sliding it into bearing support, Item 1, as far as it will go.

Install retaining ring, Item 106.

Install thrust bearing support, Item 41.

Install ring gear spacer, Item 43.

Install two (2) thrust bearing race, Item 87, with thrust bearing, Item 68.

Slide high speed clutch hub, Item 42, onto spline on primary planet carrier, Item 3, and secure in place with retaining ring, Item 66.

Install primary planet carrier assembly being sure it seats on the thrust bearing race, Item 87.

Install ring gear, Item 40, engaging spline with teeth of planet cluster gears, Item 8.

Insert high speed friction disc, Item 111, and high speed clutch disc, Item 110. Continue to alternate discs until eight (8) of Item 111 and nine (9) of Item 110 are in place (the last two discs will be Item 110).

NOTE: Be sure to start with friction disc, Item 111, next to primary planet carrier, Item 3.

Insert low speed clutch disc, Item 37, and low speed friction disc, Item 38. Continue to alternate until six (6) of Item 37 and five (5) of Item 38 are in place.

Install two (2) thrust bearing race, Item 87, with thrust bearing, Item 68, onto high speed clutch pressure plate, Item 44. Slip clutch back-up plate, Item 36, onto hub of pressure plate, Item 44, securing with retaining ring, Item 138.

Install this assembly into bearing support assembly engaging the teeth on the high speed clutch pressure plate, Item 44, into the teeth in ring gear, Item 40 and the teeth on back-up plate, Item 36, into teeth in bearing support, Item 1. Secure assembly in place by installing retaining ring, Item 106.

Install four (4) dowel pin, Item 76.

Set the brake cylinder, Item 2, down on the work surface with the external splines down.

Install O-ring, Item 71, and two (2) O-rings, Item 70, in grooves in brake cylinder.

Install back-up plate, Item 58.

Insert a friction disc, Item 62, and a brake disc, Item 63. Continue to alternate discs until eight (8) of each are in place.

Insert brake release piston, Item 11, into brake cylinder, being sure spring holes are up, using a plastic or rubber hammer.

Install O-ring, Item 71, in groove in piston cylinder, Item 126.

Install piston cylinder, Item 126, using a plastic or rubber hammer to seat in place.

Insert twenty four (24) brake springs, Item 46, into holes in brake cylinder, Item 2, using a small amount of grease on each spring to hold it in place during attachment to bearing support assembly.

Place two (2) O-ring, Item 93, in counterbores provided in brake cylinder.

It is recommended that the brake clutch assembly, Item 54, be inserted into the friction discs, Item 62, to align the teeth while the discs can be freely rotated.

Be sure that two (2) pipe plugs, Item 85, are installed in the holes in the outside of the brake cylinder, Item 2.

Turn the brake cylinder assembly over and install on bearing support, Item 2, using care to align brake control oil holes. A few taps with a hammer may be required to seat the brake cylinder on the dowel pins, Item 76. Be sure that O-rings, Item 93, are properly seated in the counterbores.

Install eight (8) socket head capscrews and lockwashers, Items 77 and 78, and tighten securely.

Install dowel pin, Iten 64, in hole in brake cylinder splines, seat until end of pin is flush with or below top of teeth.

Turn the bearing support and brake cylinder assembly over to install the end bracket.

At this point the brake cylinder and bearing support assembly should be tested for leakage. Attach the hose of a hydraulic hand pump, which is equipped with a dial guage that reads 600 P.S.I. or more, to the low speed port of the bearing support, Item 1. Apply 600 P.S.I. and hold for about five minutes. If pressure holds, detach the pump hose and connect it to the high speed port and, again, apply 600 P.S.I. Test the brake balancing input and brake release input in the same way.

If leaks occur during these tests, re-check all O-ring installations and re-test.

If the brake friction discs are not aligned and centered, this should be done when the brake release port is pressurized.

Insert greased O-ring, Item 74, in groove in face of right end bracket, Item 9.

Install right end bracket, Item 9, carefully aligning all holes. Be sure the four (4) $^{11}/_{16}$" diameter clearance holes are in alignment with the ⅛" pipe tapped holes in the bearing support. Install four (4) shoulder screw and lockwasher, Items 98 and 84. Install eight (8) capscrew and lockwasher, Items 101 and 78. Tighten all screws securely.

Turn the assembly over and rest on right end bracket, Item 9.

Insert secondary sun gear shaft, Item 5, into spline in primary planet carrier, Item 3.

Install retaining ring, Item 67, in groove on spacer, Item 12. Smear some grease on the short end of the spacer and place planet carrier spring, Item 45, on it.

Slip this assembly, spring down, over the secondary sun gear shaft, Item 5. Be sure the planet carrier spring remains in place on the spacer and does not become wedged between the spacer and primary planet carrier.

CAUTION — It is important to check the rotation of the brake clutch assembly, Item 54, when it is re-installed in the winch. Place the brake clutch in left hand and rotate the rotor in a counter-clockwise direction. If the rotor of the brake clutch assembly turns in this direction install it in place. If it will not turn in this direction, turn the brake clutch assembly over and test from the other side.

Install the secondary sun gear, Item 57.

If ball bearing, Item 89, oil seal, Item 90, and drum bushing, Item 26, were removed from cable drum assembly, Item 13, they should be replaced now.

Install pipe plug, Item 128, in cable drum.

Install cable drum assembly, Item 13, being careful to lower it straight to avoid damage to the ball bearing and oil seal.

Install secondary planet carrier, Item 55, and the components of the secondary planet carrier assembly.

Install retaining ring, Item 66, in groove in final sun gear, Item 61.

Insert small spline of final sun gear, Item 61, into spline in secondary planet carrier, Item 55.

Install ring gear, Item 60.

Reassembly procedures for hoists Model C2H16 and C2H16D are identical to this point. Continue reassembly from this point according to the following instructions applying to your particular winch.

REASSEMBLY OF DRUM SUPPORT END, MODEL C2H16

Install lightly greased O-ring, Item 130, in groove in final planet carrier, Item 27.

Install final planet carrier assembly consisting of: Items 27, 59, 115, 116, 117, 121, 130, 135, 136 and 137. All splines and gears must be aligned for this step. Planet carrier may require a few taps with a plastic or rubber hammer to be seated properly in the drum. Care should be taken to prevent damage to the O-ring seal.

If drum support end bracket assembly was torn down, reassemble as follows: Install new O-ring, Item 92, in groove on carrier bearing shaft, Item 20. Insert carrier bearing shaft, Item 20, into bearing shaft support, Item 21, aligning keyways and being careful not to damage the O-ring. Install bearing carrier shaft key, Item 22. Install bearing lockwasher, Item 104, and bearing locknut, Item 103. Tighten nut securely and bend down lockwasher tab. Place gasket, Item 129, on bearing shaft support, Item 21, and install this assembly in left end bracket, Item 10, and secure with six (6) capscrew and lockwasher, Items 79 and 80. Press oil seal, Item 131, into left end bracket.

Install end bracket assembly, carefully engaging shaft into roller bearing, Item 117, and seal onto wear sleeve, Item 135.

Attach two (2) tie plates, Item 31, using twenty (20) capscrews and lockwashers, Items 81 and 78. Install eight (8) dowel pins, Item 76. Tighten capscrews securely.

Install vent plug, Item 105.

This completes assembly of C2H16 winch except for motor and hydraulic lines. See section entitled "Procedure for Reassembling Motor and Hydraulic Lines on Models C2H16 and C2H16D" on page 21.

REASSEMBLY OF DRUM SUPPORT END, MODEL C2H16D

Screw fifteen (15) clutch spring studs, Item 29, into place to drop clutch hub, Item 14, as far as they will go and snug them up against the end of the threads.

Install drum bushing support, Item 15, on drop clutch hub and secure with fifteen (15) slotted nuts and cotter pins, Items 82 and 83.

Turn this assembly over with the spring studs up. Set on blocks high enough to clear final planet carrier assembly when it is installed.

Insert eight (8) spring retainers, Item 34, into holes in drop clutch hub. Place eight (8) clutch plate springs, Item 35, in spring retainers.

Install friction disc, Item 32, and drive disc, Item 33. Position drive disc so that holes for spring retainers are staggered between springs already in place. Alternate spring retainers, springs, friction discs and drive discs until six (6) of each disc are in place.

Install final planet carrier assembly, Items 27, 59, 115, 116 and 117.

Install thrust bearing support, Item 19, on hub of final planet carrier, Item 27.

Install two (2) thrust bearing race, Item 88, with thrust bearing, Item 69.

Install O-rings, Items 73 and 127, in external and internal grooves in drop clutch release piston, Item 17.

Install drop clutch release piston, Item 17.

Press four (4) rollpin, Item 112, into holes in drop clutch release cylinder, Item 18. Smear a little grease in spring pockets in release cylinder to hold springs during assembly. Insert four (4) face seal springs, Item 125, into spring pockets in release cylinder. Install O-ring, Item 127, in groove in cylinder.

Install drop clutch release cylinder, Item 18, onto drop clutch release piston, being careful not to damage O-ring in piston and being sure that rollpins, Item 112, in cylinder go into holes in piston.

Install thrust bearing race, Item 88.

Install pressure plate, Item 16.

Install fifteen (15) clutch springs, adjustment nuts and jam nuts, Items 30, 28 and 102. Adjust spring pressure as follows: If old friction and clutch plates are used position top of adjustment nuts 2½ inches from spring seating surface; If new friction and clutch plates are installed position top of adjustment nuts $2\frac{17}{32}$" inches from spring seating surface. Tighten jam nuts, Item 102, securely.

Install drop clutch and final planet carrier assembly into winch. All splines and gears must be aligned for this step. A coating of gear oil on the drum bushing support, Item 15, will be helpful. A few taps on the pressure plate with a plastic or rubber hammer may be required to seat this assembly in the drum.

Install O-ring, Item 95, in groove in clutch cover, Item 23.

Install clutch cover, Item 23, and secure with six (6) flathead capscrews, Item 100.

Attach clutch cover plate, Item 24, and gasket, Item 25, with four (4) flathead capscrews, Item 80.

Press two (2) rollpins, Item 75, into holes in face seal plate, Item 113. Install O-ring, Item 91, in groove in face seal plate. Smear a little grease in the eight (8) spring pockets in the face seal plate and insert eight (8) face seal springs, Item 125.

Install face seal plate assembly in recess provided for it in the drop clutch cover, Item 23.

Lay face seal washer, Item 119, on top of face seal plate.

If drum support end bracket assembly was torn down, reassemble as follows: Install new O-ring, Item 92, in groove on bearing shaft, Item 20. Insert bearing shaft, Item 20, into bearing shaft support, Item 21, aligning keyways and being careful not to damage the O-ring. Install bearing shaft support key, Item 22. Install bearing lockwasher, Item 104, and bearing locknut, Item 103. Tighten nut securely and bend down lockwasher tab. Place gasket, Item 129, on hub of bearing shaft support, Item 21. Use whatever number of gaskets were removed from your winch when it was disassembled. Install the assembly just completed into the left

end bracket, Item 10, securing with six (6) capscrews and lockwashers, Items 79 and 78. Install street elbow, Item 52, and vent plug, Item 105. Be sure vent plug is turned up. Install O-ring, Item 114, in groove in bearing shaft support. Item 21.

Install end bracket assembly, carefully engaging shaft into roller bearing, Item 117, and bores of drop clutch release cylinder and drop clutch release piston, Items 18 and 17.

Attach two (2) tie plates, Item 31, using twenty (20) capscrews and lockwashers, Items 81 and 78. Install eight (8) dowel pins, Item 76. Tighten capscrews securely.

This completes assembly of C2H16D winch except for motor and hydraulic lines. See following section entitled "Procedure for Reassembling Motor and Hydraulic Lines on Models C2H16 and C2H16D."

PROCEDURE FOR REASSEMBLING MOTOR AND HYDRAULIC LINES ON MODELS C2H16 and C2H16D

Stand winch in a vertical position resting on left end bracket, Item 10.

Install four (4) nipple, Item 49, in ports in bearing support, Item 1. Use a good grade of thread compound with Teflon on all fittings.

Install street elbow, Item 52, and tee, Item 124.

Install thrust bearing race, Item 96, on end of input sun gear shaft, Item 5.

Press motor gear bushing, Item 7, into motor gear, Item 6.

Install motor gear, Item 6, engaging primary planet gear teeth and stopping against thrust bearing race, Item 96.

Insert O-ring, Item 72, in counterbore of right end bracket, Item 9.

Install hydraulic motor, Item 48, in place on the end bracket. Secure with two (2) capscrew and lockwasher, Items 99 and 84.

Insert O-ring, Item 121, in counterbore of counterbalance valve, Item 56. Secure this assembly to motor with four (4) capscrews, Item 122.

Insert O-ring, Item 108, in counterbore of manifold, Item 65. Secure manifold to motor with four (4) capscrew, Item 107.

Install two (2) 45° tubing elbow, Item 120 (one in top of counterbalance valve, Item 56, and one in top of manifold, Item 65).

Install tubing elbow, Item 132, in drain on bottom of hydraulic motor, Item 48.

Install check valve assembly, Item 123, in front of counterbalance valve, and male elbow, Item 53, in check valve.

Install 14″ hose assembly, Item 50, from tee to top of manifold.

Install 16″ hose assembly, Item 51, from street elbow, Item 52, to elbow in check valve.

Install 14″ hose assembly, Item 50, from tee to top of counterbalance valve.

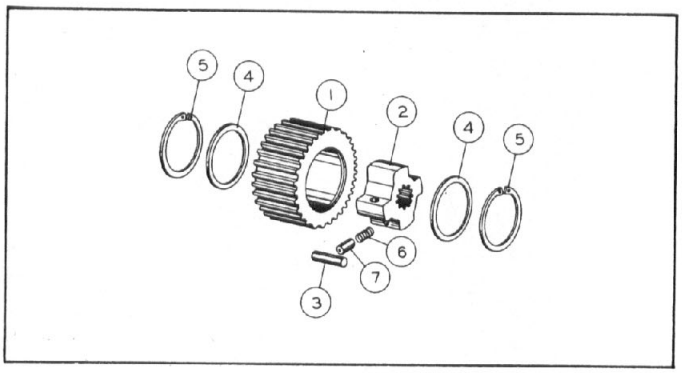
Install 14″ hose assembly, Item 50, from side of check valve to elbow in motor drain.

Set winch on base and rotate cable drum until filler hole in flange opposite motor is at the top. Refill with a good grade of 90 weight all-purpose gear oil according to capacities shown on page 25.

Before running winch, wait until some oil flows from the ½ inch diameter hold in the right end bracket, Item 9, just below the hydraulic motor, Item 48. This assures that oil has flowed into the two-speed assembly thus avoiding any damage which would result if this were run dry.

Install pipe plug, Item 85, under motor, and pipe plug, Item 86, at opposite end of cable drum.

BRAKE CLUTCH ASSEMBLY, PART NO. 81324 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	21094	850690	Brake Race
2	1	21093	850670	Brake Cam
3	4	21097	850730	Brake Roller
4	2	12592	630300	Brake Roller Retainer
5	2	12913	MU7-121	Retaining Ring
6	4	12050	238-148-5	Spring
7	4	12049	238-148-4	Plunger

DISASSEMBLY PROCEDURE

Remove retaining rings, Item 5.

Remove brake roller retainers, Item 4.

This will release the brake cam, Item 2, brake rollers, Item 3, plungers, Item 7, and springs, Item 6, from the brake race, Item 1.

Check for wear on race and rollers.

REASSEMBLY PROCEDURE

Insert brake cam, Item 2, into brake race, Item 1, just far enough to insert springs, Item 6, plungers, Item 7, and rollers, Item 3.

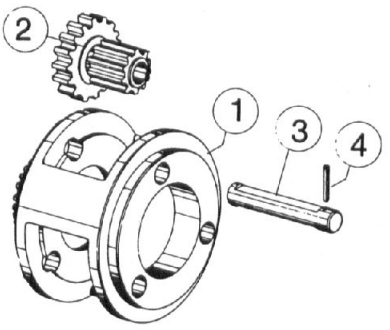
By using the secondary sun gear shaft (Item 5 on Material Lists, pages 12 and 13) to hold the cam, the springs, plungers and rollers can be inserted with the aid of a small screwdriver.

After the springs, plungers and rollers are installed and the cam is in place, install the brake roller retainers, Item 4, and secure with retaining rings, Item 5.

After all parts have been installed, rotate the brake cam with the aid of the secondary sun gear shaft. It should turn in one direction.

PRIMARY PLANET CARRIER ASSEMBLY, MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	22302	22302	Primary Planet Carrier
2	3	22307	22307	Planet Cluster Gear
3	3	22303	22303	Planet Gear Shaft
4	3	22375	R12-112	Rollpin



DISASSEMBLY PROCEDURE

Remove rollpin, Item 4, by inserting a ⅛" punch into hole provided in planet carrier, Item 1. A few taps on the punch will drive the rollpin completely through the shaft, Item 3. The shaft, Item 3, and planet cluster gear Item 2, can now be removed for inspection.

Drive old rollpin completely from the planet carrier and use new rollpin, ⅛" x 1⅛", for reassembly.

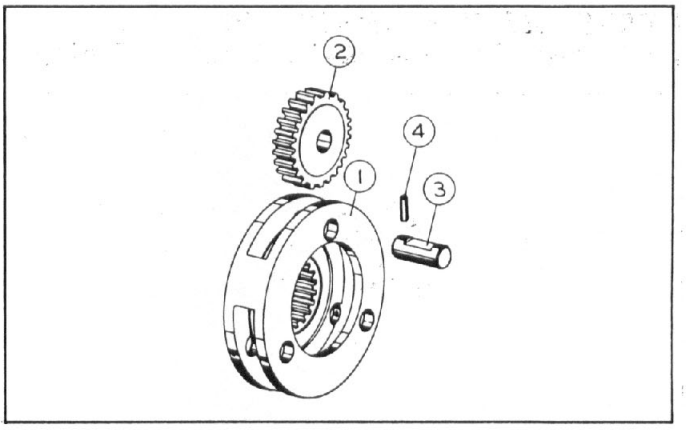
REASSEMBLY PROCEDURE

Install planet cluster gear, Item 2, into planet carrier, Item 1. Insert planet gear shaft, Item 3, into planet carrier through hole provided, passing it through planet cluster gear and into planet carrier. Align rollpin holes. Install new rollpin, Item 4, so that it is flush with planet carrier, both top and bottom.

Install remainder of gears, shafts and pins in the manner described.

SECONDARY PLANET CARRIER ASSEMBLY, MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	22652	22652	Planet Carrier
2	3	22653	22653	Planet Gear
3	3	22654	22654	Planet Gear Shaft
4	3	21049	R18-075	Rollpin



DISASSEMBLY PROCEDURE

Remove rollpin, Item 4, by inserting a 3/16" punch into hole provided in planet carrier, Item 1. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 3, thus allowing removal of the shaft and planet gear, Item 2, for inspection.

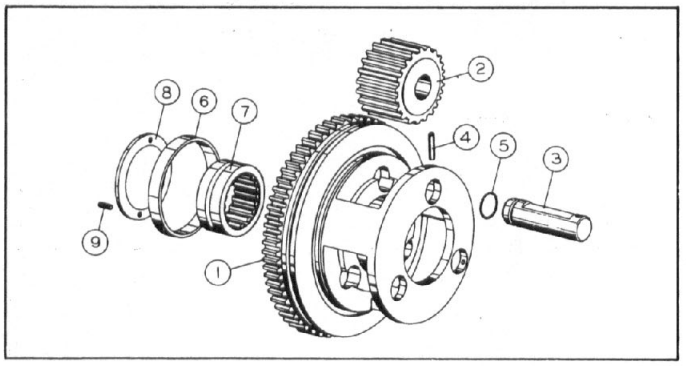
Drive old rollpin completely from the shaft and use new rollpin, 3/16" x 3/4", for reassembly.

REASSEMBLY PROCEDURE

Install planet gear, Item 2, into planet carrier, Item 1. Insert planet gear shaft, Item 3, into planet carrier through hole provided, passing it through planet gear and into planet carrier. Align rollpin holes. Install new rollpin, Item 4. This pin should be countersunk to 3/16" below the surface of the planet carrier. With a centerpunch, dimple the edge of the rollpin hole to keep the pin from backing out.

Install remainder of gears, shafts and pins in the manner prescribed.

FINAL PLANET CARRIER ASSEMBLY, MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	DESCRIPTION	C2H16			C2H16D		
		QTY.	5-DIGIT NO.	CATALOG NO.	QTY.	5-DIGIT NO.	CATALOG NO.
1	Final Planet Carrier	1	22649	22649	1	22649	22649
2	Final Planet Gear	3	22657	22657	3	22657	22657
3	Planet Gear Shaft	3	22664	22664	3	22664	22664
4	Rollpin	3	18055	R25-150	3	18055	R25-150
5	O-Ring	3	13542	1875012	—	—	—
6	Wear Sleeve	1	22667	22667	—	—	—
7	Roller Bearing	1	22665	22665	1	22665	22665
8	Thrust Washer	1	22668	22668	—	—	—
9	Pin	2	21060	850460	—	—	—

DISASSEMBLY PROCEDURE

Remove rollpin, Item 4, by inserting a 1/4" punch into hole provided in planet carrier, Item 1. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 3, thus allowing removal of the shaft and planet gear, Item 2. Remove all shafts, gears and rollpins. On Model C2H16, the removal of O-ring, Item 5, occurs at this time.

Drive old rollpins out of shafts and discard.

On Model C2H16, remove roller bearing, Item 7, thrust washer, Item 8, and two (2) pins, Item 9.

For best performance, the O-ring seals and rollpins should be replaced with new parts prior to reassembly of the planet carrier.

REASSEMBLY PROCEDURE

Insert planet gear, Item 2, into planet carrier, Item 1.

On Model C2H16, install O-ring, Item 5, in groove of planet gear shaft, Item 3, and coat lightly with all-purpose grease.

Insert rollpin end of planet gear shaft, Item 3, into hole in planet carrier on hub side, pass through gear. Press or tap lightly until pin end of shaft is aligned will rollpin hole in planet carrier.

Install new rollpin, Item 4, to lock shaft in place and prevent rotation. Counter sink rollpin to 3/16" below surface of planet carrier. Dimple edge of hole with centerpunch to prevent pin from backing out.

Install remainder of gears, shafts, O-rings and rollpins in the manner described.

Insert roller bearing, Item 7, into hole provided.

On Model C2H16 only: Install wear sleeve, Item 6, by using a hand press; Install thrust washer, Item 8, secured by pins, Item 9.

BRAKE VALVE INFORMATION

The brake valve assembly, Item 56, is a purchased component, manufactured to exacting Braden specifications. Should a failure occur, or repairs be needed in this assembly, it is suggested that the entire part be removed from the winch and forwarded to the Braden factory for inspection and replacement.

BRAKE VALVE ADJUSTMENT

The brake valve contains an adjusting screw and lock nut which allow pressure adjustments to be made.

If the winch oscillates when lowering a load, turn the adjusting screw one-half (½) turn in a clockwise direction. If oscillation continues, again turn adjusting screw one-half (½) turn in a clockwise direction.

Use caution in this adjustment and be certain that pressure does not exceed 1500 p.s.i. A good working pressure is approximately 800 p.s.i. Excessive pressure could damage the O-ring seal located inside the brake cylinder.

BRAKE VALVE INSPECTION

If down pressure is erratic, and cannot be controlled by the adjusting screw, a defect might exist in the O-ring or backup rings inside the brake valve.

To gain entry to the valve, remove the large nut, being careful of the springs and spring retainers.

Grasp the spool with a pair of long nosed pliers, or similar device, and pull straight out of the brake valve housing. The O-ring and backup rings can now be inspected.

Replace the spool, springs and retainers and replace nut.

DROP CLUTCH ADJUSTMENT, MODEL C2H16D

If the drop clutch slips during the hoisting of a load, it may be due to wear on the friction discs.

The drop clutch can be easily adjusted with the winch mounted on equipment and cable on the drum.

Disconnect the drop clutch control line from the winch. Connect a hydraulic pumping unit (Porta-power, Enerpac, etc.) to the port which releases the drop clutch for free-fall and apply approximately 500 P.S.I. This will release the cable drum so that it may be turned by hand or by power.

Turn cable drum until square clutch cover plate, Item 24, appears at the large hole in the top web of left end bracket, Item 10. At this point you may wish to place a wood block, or similar object, under the flange of the cable drum to prevent its rotation during the adjustment procedure.

Remove four (4) flathead capscrews, Item 80, clutch cover plate, Item 24, and gasket, Item 25.

With power, center one of the adjustment nuts in the round hole in the aluminum clutch cover, Item 23. Loosen the jam nut, Item 102, and tighten adjustment nut, Item 28, one-quarter turn using a 1⅝" socket or other suitable tool which will go through the hole in the cover. Tighten jam nut, Item 102. If adjustment nut starts to turn while tightening the jam nut, it should be held with a flat bar.

It is suggested that a centerpunch mark be made on the end of the first clutch spring stud, Item 29, which is adjusted. There are fifteen spring adjustments to be made and this marking will help eliminate the possibility of making a second adjustment to the same nut. If your winch has been previously marked in this manner, begin adjustment at that point.

Repeat the adjustment procedure for each of the fifteen (15) clutch springs.

Replace gasket and cover and secure with flathead capscrews. Release pressure on hydraulic pump and disconnect pump from drop clutch release port. Remove wood block from cable drum flange.

The winch is now ready for slip testing. If slipping continues to occur, repeat the drop clutch adjustment procedure.

CAUTION - If, after numerous adjustments, slipping of the clutch continues to occur, replacement of the friction discs, Item 32, will probably be required.

INSTALLATION SUGGESTIONS

1. The winch should be mounted with the centerline of the cable drum in a horizontal position. The base can be mounted in any position around this horizontal centerline.
2. It is important that the winch is mounted on a surface that will not flex when the winch is used, since this would bind working parts of the winch. Be sure that the winch is not mounted on an uneven surface. If necessary, use shim stocks to insure even mounting.
3. Hydraulic lines that operate the winch should be of sufficient diameter to assure that back pressure at the winch will not exceed 150 P.S.I.
4. The winch directional control valve must be 4-way, 3 position, parallel circuit with motor type spool. Work ports must open directly into tank in neutral position.
5. Hydraulic oil filter should have 10 micron nominal rating and be a full flow type.

MAINTENANCE SUGGESTIONS

I. CHECKING OIL LEVEL

1. Model C2H16 - Turn cable drum until ¾" pipe plug in drum flange away from motor is seen through hole in top web of left end bracket. Remove ¼" pipe plug through hole in side web of right end bracket at motor end of winch. Oil should be level with this plug. Add a good grade of 90 weight worm gear oil through ¾" opening, if necessary.
2. Model C2H16D - Turn cable drum until ¾" pipe plug in drum flange over drop clutch is at the top. Remove ¼" pipe plug through hole in side web of right end bracket at motor end of winch. Oil should be level with this plug. Add a good grade of 90 weight worm gear oil through ¾" opening, if necessary.

II. OIL CHANGE INFORMATION

1. Oil should be drained after the first two (2) months operating time.
2. Fill winch with clean kerosene and run for 15 minutes in each direction. Drain kerosene and add proper amount of a good grade 90 weight worm gear oil. Oil should then be changed every six (6) months.

III. OIL CAPACITY RECOMMENDATIONS

1. Model C2H16 oil capacity is 34 pints.
2. Model C2H16D oil capacity is 45 pints.

A regular program of preventive maintenance will tend to eliminate the need for much emergency servicing and insure a long life and trouble-free service from your planetary winch.

SOME THINGS TO REMEMBER IN YOUR SERVICING OPERATIONS:

- Work in a clean, dust free area as cleanliness is of utmost importance when servicing any hydraulic equipment.
- Inspect all replacement parts, prior to installation, to detect any damage which might have occurred in shipment.
- Use only factory certified replacement parts for optimum results. Never re-use expendable parts such as oil seals, backup washers and O-rings. Although they may appear to be in good condition, many times they are not.
- Clean all parts and inspect all machined surfaces for excessive wear or damage . . . before reassembly operations are begun.
- Lubricate all O-rings and oil seals with grease prior to installation.

SUGGESTIONS FOR TROUBLE SHOOTING

A. Winch will not lower load.

1. This is probably caused by stoppage of the orifice plug in the brake valve or jamming of the brake release piston.
2. To check orifice plug, remove hose, Item 50, and tubing elbow, Item 120, from top of brake valve, Item 56. Remove the plug, using a screwdriver with a ⅛" wide blade. Check the hole in the plug with a wire of less than .020" diameter. If the hole is open, the fault is probably not in the brake valve.
3. Disassemble the winch brake cylinder and release piston to determine cause of non-release of brake.

B. Winch leaks a large volume of oil through the vent plug.

1. This caused by hydraulic oil leaking into the winch from one or a combination of the following; damaged or worn hydraulic motor shaft seal, damaged O-ring in the winch brake mechanism, damaged O-ring in the winch two speed assembly, damaged O-ring in the drop clutch release cylinder (C2H16D only).
2. Disconnect the hoses, Item 50, and tee, Item 124, from the brake release port. Attach the hose of a hydraulic hand pump, which is equipped with a dial guage that reads 600 P.S.I. or more, to the nipple just exposed. Apply 600 P.S.I. to the brake. The brake should hold this pressure for ten minutes. If pressure holds, detach the pump hose and connect it to the brake balancing input, and repeat the pressure test.
3. The two speed assembly is checked in the same manner. Disconnect the line to the low speed nipple and attach the hand pump hose. Test at 600 P.S.I. for ten minutes. If the pressure holds, detach the pump hose and connect it to the high speed nipple, and repeat the pressure test.
4. Disconnect the drop clutch control line. Attach the hand pump hose to the drop clutch release port. Test at 600 P.S.I. for ten minutes. (C2H16D only)
5. If any of the preceding tests fail, the winch should be returned to the factory for repair.
6. If pressure holds on all of the preceding tests, then the hydraulic motor seal is leaking and should be replaced.

C. Winch will not hoist rated load.

1. Be certain that the winch has not been mounted on an uneven surface. If necessary, shim stock should be used.
2. Check for proper hydraulic pressure to the inlet port in the bottom of the brake valve. This pressure should be checked right at the valve for accurate readings.
3. Be certain that the hydraulic system which operates the winch is not running more than 180° F.
4. Remember that the winch ratings are established on the first layer of cable.
5. Be certain that any cable sheaves, used with the winch, are operating efficiently.

D. Winch runs hot (over 200°) or makes excessive noise.

1. Make certain that the winch has not been mounted on an uneven surface.
2. Be certain that the hydraulic system which operates the winch is not running more than 180°F.

E. Winch chatters while raising rated capacity load.

1. The relief valve in the hydraulic system may be trying to by-pass.
2. The flow of hydraulic fluid to the motor may be low.

F. Winch vibrates or chatters when lowering rated capacity load.

1. The orifice plug in the brake valve is probably loose. Remove hose, Item 50, and tubing elbow, Item 120, from top of brake valve, Item 56. Check orifice plug for tighness. This plug should be snug in the orifice hole. Use a screwdriver with a ⅛" wide blade to snug-up the orifice plug in the hole. Do not damage the part by over-tightening. Replace elbow and hose. Readjust brake valve pressure, per instructions on page 24, if required.

FOR ANY PROBLEM NOT COVERED ABOVE, CONSULT THE FACTORY FOR ASSISTANCE

PETTIBONE 200 R.R.C. RECOMMENDED SPARE PARTS LIST

ITEM	DESCRIPTION	PART NO	SUGGESTED FOR 1	STOCK FOR 3+
1	Engine Oil Filter (Cummins 290)	203709	1	2
	(GMC-671)	PF-132	1	2
	(GMC-8V-71)	PF-132	1	2
2	Transmission Oil Filter	102A32	1	2
3	Engine Fuel Strainer (Cummins)	154711	2	4
	(GMC-671)	TP-540	2	4
	(GMC-8V-71)	TP-552	2	4
4	Fan Belts (Cummins & GMC)	Order by Ser. No.	1 set	1 set/ machine
5	Alternator Belts (Cummins & GMC)	Order by Ser. No.	1 set	1 set/ machine
6	Steering Pump Cartridge Kit	923481	1	1
7	Steering-Outrigger Selector Valve Seal Kit	S-50 Kit	1	1
8	Outrigger Valve Seal Kit	15446-900	1	1
9	Outrigger Vertical Cylinder Seal Kit	4780-112012	1	2
10	Outrigger Vertical Cylinder Holding Valve	4801-012009	0	1
11	Outrigger Extension Cylinder Seal Kit (includes #12)	4790-040015	1	2
12	Extension Cylinder Port Tube Seal Kit	4773-012006	1	2
13	High Rail Cylinder Seal Kit	Order by Ser. No.	1	1/machine
14	High Rail Valve Seal Kit	F17717	1	1
15	High Rail Selector Valve Seal Kit	(See Item #7)	-	-
16	Two Pump Shifting Collar	100-180	1	1
17	Winch Pump Cartridge Kit 38 GPM (replaces	923266 923052)	1	1
18	Winch Pump Cartridge Kit 60 GPM	923034	1	1

ITEM	DESCRIPTION	PART NO.	SUGGESTED FOR 1	STOCK FOR 3+
19	Swing and Deck Winch Pump Cartridge Kit 60 GPM	(See Item 18)	-	-
20	Suction Strainer 150 GPM	100-919	2	2
21	Suction Strainer 50 GPM	100-172	1	1
22	Hydraulic Return Filter Cartridge (3 Pack Kit)	923118	1	2
23	Hydraulic Swivel Seal	100-043	2	2
24	Hydraulic Swivel Seal	100-044	1	1
25	Winch Valve Seal Kit	922927	1	1
26	Swing & Deck Winch Valve Seal Kit	922926	1	1
27	Swing & Deck Winch Valve Relief Valve (CM2) (2500 PSI)	318701	1	1
28	Winch Valve Relief Valve (CM3) (2500 PSI)	233017	1	1
29	Deck Winch Motor Seal Kit	6405 & 6406	1 1	1 1
30	Deck Winch Motor	100-821	0	1
31	Deck Winch Seal	A-249	1	1
32	Deck Winch Gasket Kit #7	Gasket Kit	1	1
33	Line Winch Seal Kit	61346	1	1
34	Line Winch Motor	23284	0	1
35	Line Winch Holding Valve	23290	0	1
36	Boom Winch Seal Kit	61303	1	1
37	Boom Winch Motor	22651	0	1
38	Boom Winch Holding Valve	22557	0	1
39	Gantry Lift Cylinder Seal Kit	6526-A	1	1
40	Slewing Brake Seal ("O" Ring)	6442	2	2
41	Slewing Brake Seal ("O"Ring)	6601	2	2

ITEM	DESCRIPTION	PART NO.	SUGGESTED FOR 1	STOCK FOR 3+
42	Slewing Brake Lining	6443	1	1
43	Slewing Motor Seal Kit	6405 & 6406	1 1	1 1
44	Slewing Motor	100-896	0	1
45	Slewing Brake Master Cylinder Kit	F8448	1	1
46	Cable (Line Winch)	100-788	1	2
47	Cable (Boom Lift)	100-789	1	2
48	Air Solenoid Valve	100-144	1	3
49	Air Cylinder	100-959	1	2
50	High Rail Wheel (16")	101487	1	2
51	High Rail Wheel Outer Bearing	101493	1	2
52	High Rail Wheel Inner Bearing	101494	1	2

2.00
Part No. 49451
Code No. 180

HUNTER®

FalconAire

HEATERS

Installation
Operation
Service

Model PH-20
20,000 BTU/HR.
PROPANE FUELED HEATER

HUNTER MANUFACTURING CO.
30525 Aurora Road Solon, Ohio 44139

WARNING

EXHAUST GASES

Do not operate heater in an enclosed area unless the exhaust gases are piped outside. Exhaust gases may contain carbon monoxide, a colorless and poisonous gas.

WARNING

FUEL USE

This heater is designed for use with propane (LP gas) only. Do not attempt to use gasoline as fuel since fire or explosions may result.

Use this heater only with gas regulator part number 88307 supplied with the heater. Operation with other regulators voids all warranties and may result in fire, explosion, or damage to the heater.

The propane gas bottle must be designed or modified for vapor take-off only. Use the regulator and excess flow valve supplied with the heater to conform to Department of Transportation (DOT) safety regulations.

WARNING

Heater must be grounded through ground screw supplied. Do not use the fuel line as an electrical conductor or ground connection. Use of the fuel line as electrical or ground conductor may result in fire or explosion.

Before performing maintenance or inspection (except operating tests), disconnect the power source. Do not operate the heater with the covers off.

The tilt switch is a safety device which stops heater operation in case the vehicle overturns. Do not remove this switch or defeat its purpose.

The heat exchanger must be inspected annually, or more frequently if heater usage is heavy. A damaged heat exchanger can allow poisonous gases to seep into the heated compartments causing illness or death.

CAUTION

Do not operate the heater at less than 11 volts for 12 volt models or 22 volts for 24 volt models. Propane flow to the burner head is constant, but blower motor speed and combustion air flow vary directly with voltage. Operation on low voltage will produce poor burning, smoke, and unburned fuel mixtures.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1
INTRODUCTION AND DESCRIPTION

INTRODUCTION

This manual contains installation, operation, maintenance, and repair instructions for Model PH-20 Heaters manufactured by Hunter Manufacturing Company, Solon, Ohio.

DESCRIPTION

The Model PH-20 Heater (figure 1) is a thermostatically controlled heater device. It is intended primarily to heat truck cabs and medium-sized truck bodies, but its compact design permits use wherever additional heat is required. The heater has a completely isolated combustion system which allows it to be operated within the compartment being heated without emitting dangerous or offensive fumes into the compartment.

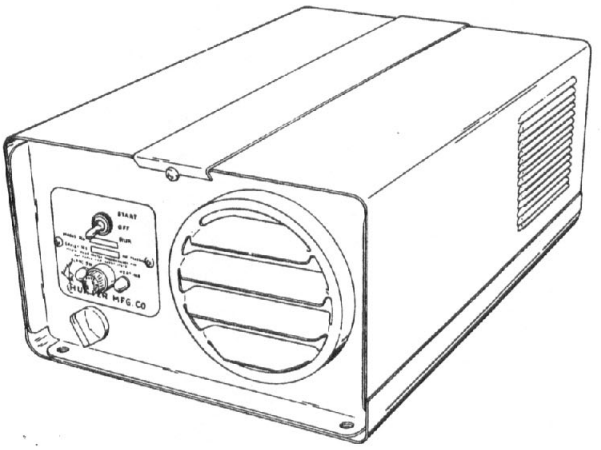


Figure 1. Heater, Model PH-20

Model PH-20 is designed for use solely with propane (LP gas) as fuel. Combustion air is supplied by a single-stage combustion air blower, and fuel flow to the burner head is controlled by a solenoid valve and a restrictor in the fuel line. Because the propane enters the burner head as a gas, no carburetor is required. Ignition of the propane is accomplished with a spark plug-like igniter, which is supplied with high voltage current from a vibrator-type ignition pack.

SPECIFICATIONS

Specifications for the heater are listed in Table 1.

Table 1. Specifications and Auxiliary Equipment

SPECIFICATIONS	
Heater case dimensions	16 in. long x 11 in. wide x 6-3/4 in. high
Weight	28 lbs
Shipping weight	30 lbs
Rating	20,000 BTU
Heated air outlet diameter	5 in.
Exhaust outlet	1 in. dia standard steel pipe
Combustion air inlet	1 in. OD tube
Fuel connection	5/8-18 UNF x 45° flare male fitting
Electrical requirements	12 volts DC
Current draw (average, start and run)	8 amps*
Fuel requirement	Propane (LP gas)
Fuel consumption	1 hour/pound on high thermostat setting
Burner	Low pressure type
Ignition	Mechanical vibrator ignition pack

*4 amps for 24-volt heaters

NOTE

All specifications are based on the use of a vapor-withdrawal gas bottle and gas regulator part number 88307. Operation under other fuel conditions voids all warranties. This regulator provides the mandatory pressure (11 inches H_2O) required by the calibrated burner head orifice.

Table 1. Specifications and Auxiliary Equipment (Cont)

AUXILIARY EQUIPMENT — TO BE ORDERED SEPARATELY	
Defroster adapter	Part No. 2-49100
Duct adapter for 4-inch tubing	Part No. 49097
Remote thermostat	Part No. 48286
Remote control kit	Part No. 1-49500

SECTION 2
INSTALLATION INSTRUCTIONS

PRE-INSTALLATION INSPECTION

WARNING

Read all warning tags supplied with the heater. Perform all duties indicated on the tags.

1. Inspect the heater for damage which may have occurred during shipment. Check against the packing list or invoice for lost parts.

2. Inspect the controls for loose or missing hardware.

3. Inspect all lines, tubing, and fittings to see that they are secure and free of breaks, kinks, or other damage.

NOTE

A warranty card is packed with each heater leaving the factory. Attached is a return postal card. It is the duty of the dealer to ensure that both the owner's copy and the registration card are completed and the registration card returned to Hunter Manufacturing Company. To be certain that you obtain the benefits of the above warranty, this card should be returned within 10 days from the date you purchased this equipment.

LOCATION AND MOUNTING

CAUTION

The heater is designed for use in the horizontal position with the heat exchanger exhaust outlet down. Other permissible positions are those which retain the motor shaft in the horizontal plane. Operation in any other attitude voids all warranties and may result in damage or rapid heater wear unless modified for such use by Hunter Manufacturing Company.

The heater is normally installed within the compartment being heated. It can be installed outside the compartment being heated by using a flexible heat duct to direct the heated air into the compartment. If this is done, the heater must be shielded against direct contact from rain and snow.

WARNING

The tilt switch is a safety device which stops heater operation in case the vehicle overturns. Do not remove this switch or defeat its purpose.

1. Mount the heater horizontally, as shown in figure 1. Choose a mounting location which will enable mounting the heater on a level surface, with adequate room around the heater for removal and service. Check that the tilt switch (21, fig. 11) is upright. Refer to figure 2 for mounting dimensions and clearances.

2. After selecting a location, remove all combustible material from area where the heater will be located. This includes carpeting, rubber mats, plywood flooring, etc.

3. Cut holes as required for air inlet and exhaust. Remove cross bar and covers. Set heater in place over inlet and exhaust holes and mark mounting holes. A reduced-size template is provided on the back cover. Remove heater and drill 5/16 inch diameter holes for mounting studs (7, fig. 10).

CAUTION

Use heat shield and exhaust insulator as described below to prevent damage to paint and furnishings of vehicle from excessive heat.

4. Position heat shield (6) around the hole for the exhaust connection, as shown in figure 10. The heater case becomes hot in this area during operation, and the heat shield is required to protect the vehicle from excessive heat. Set the heater over the mounting holes and secure with mounting studs (7, fig. 10) using the nuts and lock washers supplied with the heater.

WARNING

Exhaust gas must be piped to the outside of the heated compartment. Do not allow the exhaust gas to exit directly beneath the vehicle.

5. Direct the exhaust away from the compartment using elbow (5) and nipple (4), and additional 1-inch nipples as required. If the exhaust must pass through an additional vehicle body panel or floor, use exhaust insulator (3) to protect paint and/or trim. Cut a hole in the panel 2-7/8 to 3 inches in diameter to ensure adequate clearance between the hot pipe and the painted panel, and to provide access for later servicing. Cover the opening with exhaust insulator (3) and direct the exhaust pipe through the insulator.

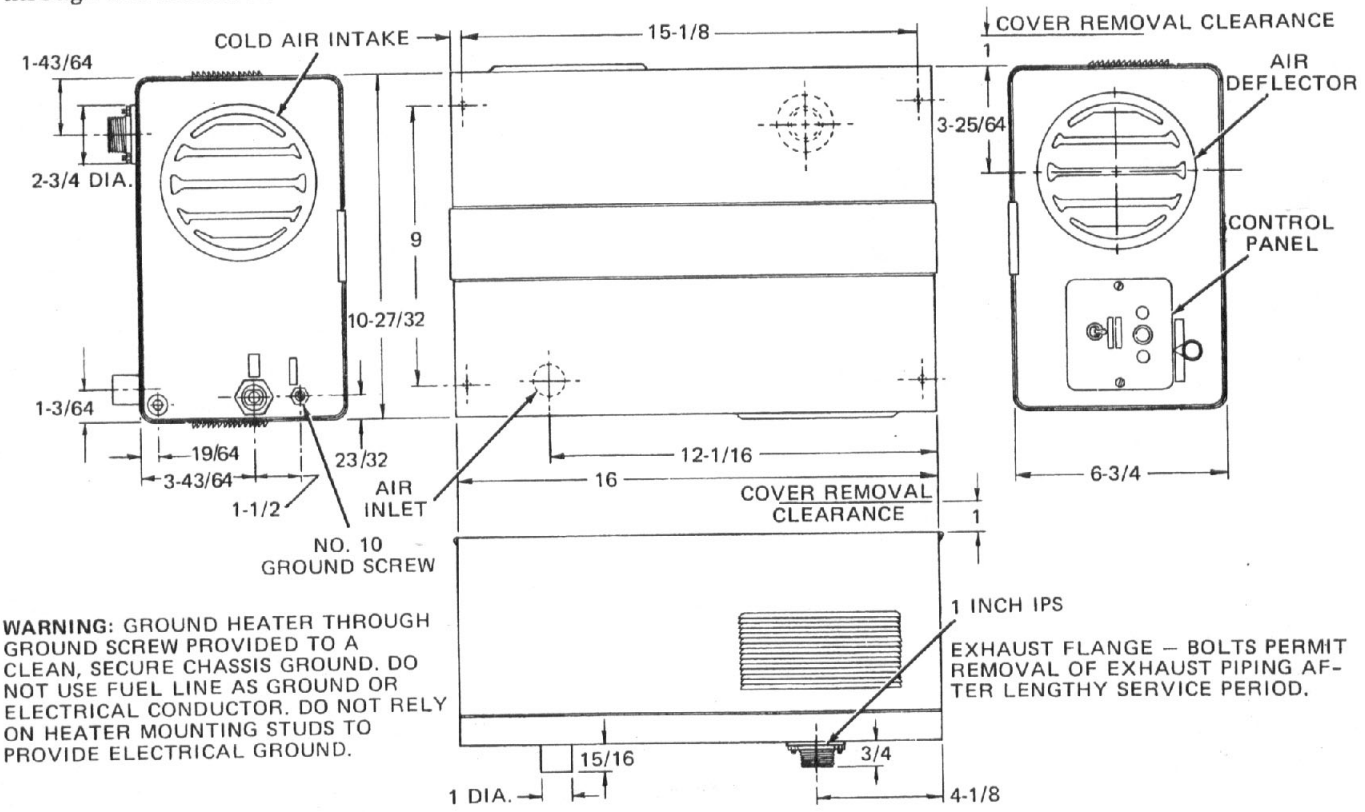


Figure 2. Heater Mounting Dimensions

6. If the heater is mounted entirely within the cab, connect a 1-inch rubber or plastic hose to the air inlet and run it outside the cab to provide fresh air for combustion.

FUEL CONNECTIONS

WARNING

This heater is designed for use with propane (LP gas) only. Do not attempt to use gasoline as fuel since fire or explosion may result. Use this heater only with gas regulator part number 88307 and POL connector part number 88014 supplied with the heater. Operation with other regulators, or tampering with the regulator adjustment, voids all warranties, and may result in fire, explosion, or damage to the heater.

1. Locate and mount the propane tank (gas bottle) away from the engine and heater exhaust ports. The location should also protect the tank from accidental mechanical damage.

CAUTION

Use only propane tanks which are designed or modified for vapor withdrawal. Connect the heater to the VAPOR port on the tank. Damage to the heater and regulator will result if connections are not made properly.

2. The propane tank must be a gas bottle designed or modified for vapor takeoff only. Install POL connector (2, fig. 10) at the IN port on regulator (1), and install these assembled parts into the propane tank shutoff valve, as shown in figure 3.

NOTE

POL connector part number 88014 incorporates an excess flow valve. Use of an excess flow valve is a safety requirement of the Department of Transportation (DOT).

3. Fuel line from the regulator to the heater should be 3/8-inch diameter tube. If available, a short piece of flexible fuel line may be used at the regulator to make bottle changing more convenient. Flexible line must be approved 300 psi test neoprene hose, which can normally be obtained from the propane supplier.

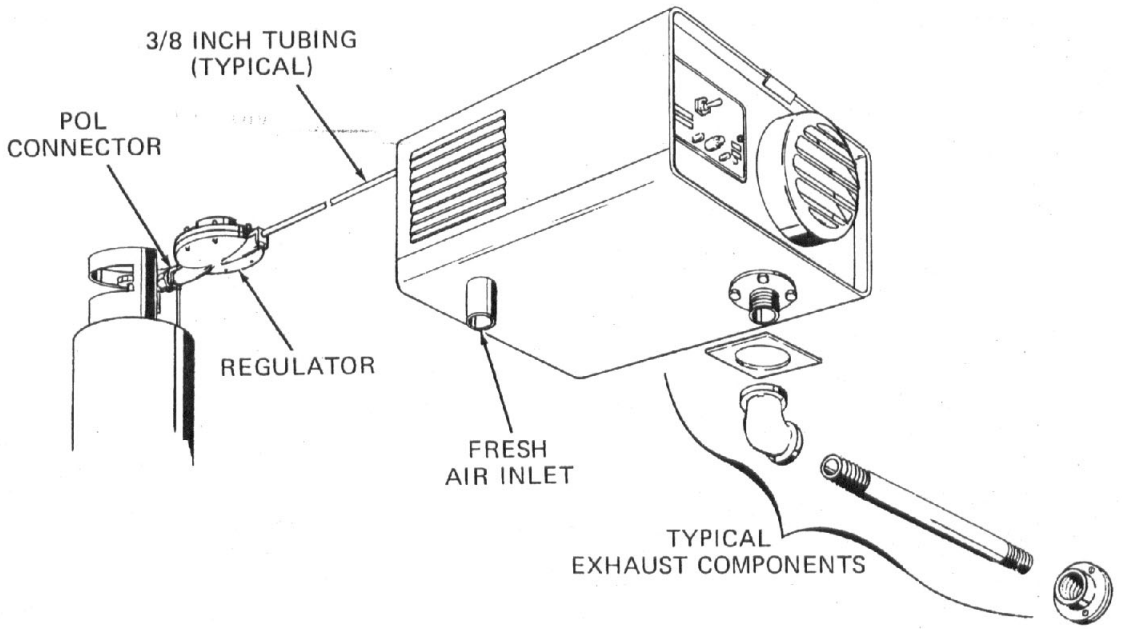


Figure 3. Typical Fuel and Exhaust Connections

WARNING

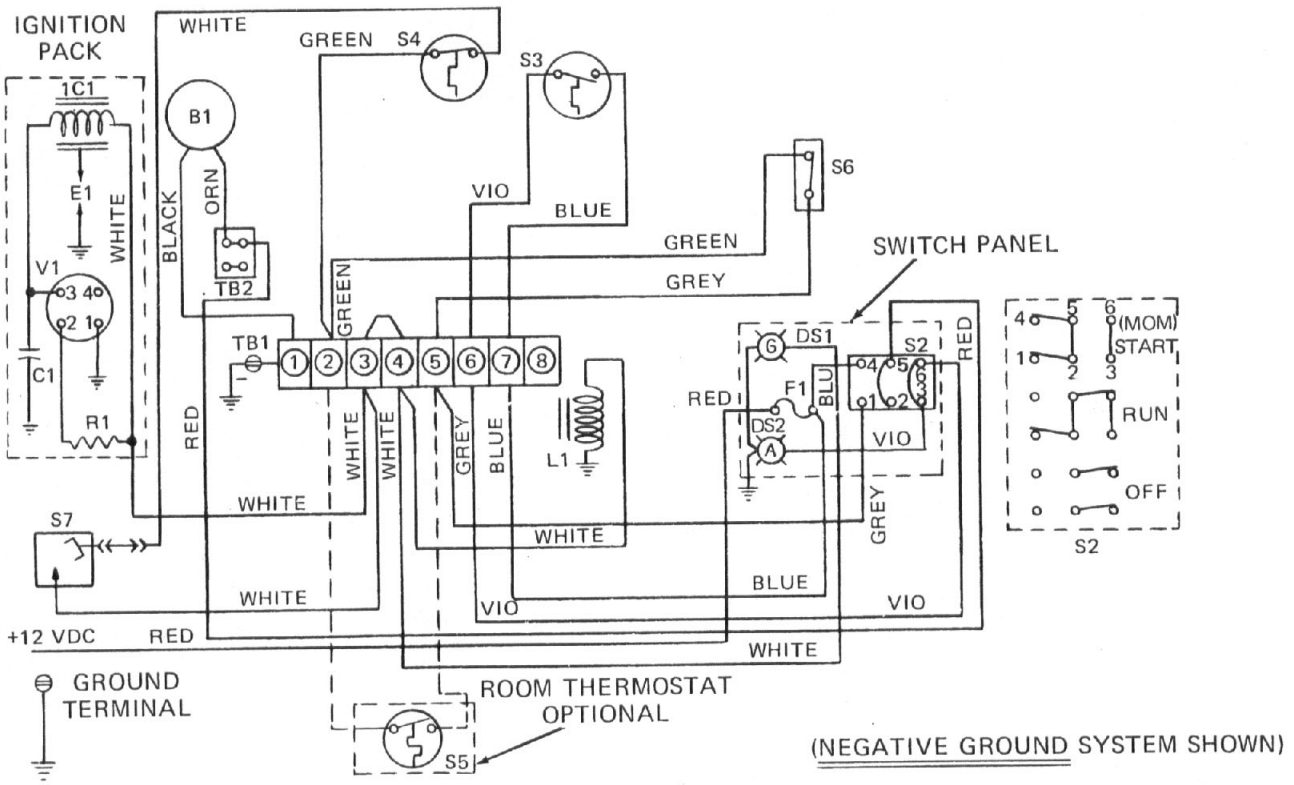
Ground the heater electrically through the ground screw provided on the heater case, and connect to a clean, secure chassis ground. Do not use the fuel line as a ground or electrical conductor. Use of the fuel line as an electrical or ground conductor can result in fire or explosion. Do not rely on heater mounting studs to provide electrical ground.

1. Refer to the wiring diagram in figure 4 and locate the power and ground connections on your heater. The ground terminal is located just above the fuel inlet. Connect this terminal to a good, clean chassis ground, using the wire size listed in Table 2.

NOTE

If you are using Remote Control Kit, part number 1-49500, refer to the instructions supplied with the kit, and install the remote control kit at this time. Skip step 2, below.

2. Refer to the wiring diagram and connect the red power lead from the heater fuse to the vehicle electrical system, using the wire size specified in Table 2. This line should be hot at all times so the heater can purge even if the vehicle ignition is off. Protect the vehicle with a circuit breaker or fuse in the feed line.



KEY TO DIAGRAM

B1	BLOWER MOTOR	2-49551	S3	FLAME SWITCH	49085
C1	CAPACITOR	49263	S4	THERMOSTAT (OVERHEAT)	4347
DS1	PANEL LIGHT (GREEN)	49217	S5	ROOM THERMO (AS REQ'D)	48286
E1	IGNITER (SPARK PLUG)	47182	S6	HI-LO SWITCH	2282
F1	FUSE (20 AMPS)	46273	S7	MERCURY TILT SWITCH	1-49433
IC1	IGNITION COIL (12 VOLT)	170760	TB1	TERMINAL BLOCK	49306
L1	SOLENOID (FUEL) (PRIMARY)	47396	V1	VIBRATOR	43215
R1	RESISTOR	43228	DS2	PANEL LIGHT (AMBER)	49516
S2	START-RUN SWITCH	2-49521	TB2	TERMINAL BOARD	49474

Figure 4. Wiring Diagram, 12-Volt Heater

Table 2. Wire Sizes

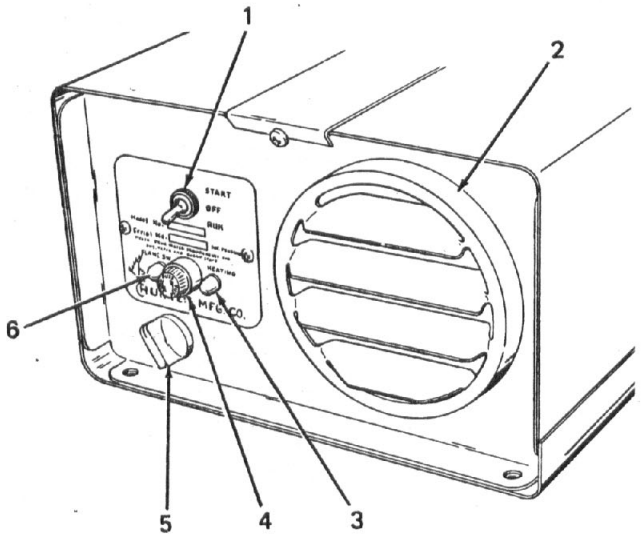
Length of Run (feet)	Wire Size
Less than 10	12 gauge
10 to 30	10 gauge
Over 30	8 gauge

3. If the optional room thermostat is used to control heater operation, wire it as shown in the wiring diagram. Connect either terminal on the thermostat to either of the two terminals shown.

SECTION 3
OPERATION

CONTROLS AND INDICATORS

Controls and indicators used during operation of the heater are listed in Table 3.



1. START RUN OFF switch
2. Air deflector
3. HEATING indicator
4. Fuseholder
5. HI-LO switch
6. FLAME SW indicator

Figure 5. Controls and Indicators

Table 3. Control and Indicator Functions

Fig. 5 Index No.	Name	Function
1	START RUN OFF switch	When held in the START position, this switch energizes the blower motor, fuel solenoid valve, and the ignition pack. After the amber FLAME SW indicator glows, this switch is moved to the RUN position. This transfers power to the flame switch, which maintains the fuel, ignition, and blower motor circuits so that the heater cycles under control of the HI-LO control or optional room thermostat.

Table 3. Control and Indicator Functions (Cont)

Fig. 5 Index No.	Name	Function
	START RUN OFF switch (cont)	When moved to the OFF position, this switch deenergizes the fuel and ignition circuits to stop spark and fuel flow, but it allows the blower motor to run until fuel remaining in the burner is consumed and the heat exchanger has cooled. The motor then shuts off under control of the flame switch.
2	Air deflector	Turn this to adjust the direction of warm air flow, or use to attach 5-inch flexible ducting. Second deflector at rear is the cold air intake or provides connection for return air ducting.
3	HEATING indicator (green)	Lights to indicate that electrical power is applied to heater circuits during starting and running. This light goes out when the burner is cycled off under control of the HI-LO microswitch or thermostat, and when the START RUN OFF switch is moved to OFF.
4	Fuseholder	Holds heater fuse F1 shown in the wiring diagram. Press in and rotate the cap counterclockwise to remove the fuse.
5	HI-LO control (manual)	Controls the temperature of the heated air delivered to the compartment. This control moves a lever which limits the travel of the bi-metal blade, thus determining the temperature at which the bi-metal blade actuates the HI-LO microswitch. Turning the knob toward HI increases the permissible bi-metal blade travel and raises the temperature of the heated air. When the microswitch is actuated, the blower continues to run, but fuel flow and ignition are stopped.
6	FLAME SW indicator (amber)	During starting, this indicator lights to show that the burner has ignited and is burning properly. After the heater is turned off, this light will remain on indicating that the heater is in the purge cycle.

STARTING

1. Turn the HI-LO control to HI. If the heater is equipped with the optional room thermostat, turn the HI-LO control to LO and rotate the thermostat knob to a setting several degrees or more above ambient temperature.

2. Hold the START RUN OFF switch in the START position. The green HEATING indicator must light immediately. If it does not, refer to troubleshooting.

WARNING

If the heater fails to produce heat within 30 seconds, turn off power immediately to prevent buildup of propane in the burner head. Refer to TROUBLESHOOTING to determine the cause of malfunction.

3. The amber FLAME SW indicator must light within 60 seconds after ignition. When it does, release the START RUN OFF switch to RUN. Both lights will remain on until the burner cycles off under control of the room thermostat or HI-LO control and microswitch.

HEATING

1. The heater will continue to run as long as fuel and power are provided to it.

2. If the heater is used without the optional room thermostat, the HI-LO microswitch controls heater cycling. A wishbone-shaped bi-metal blade senses the temperature of the heated air supplied by the heater, and opens the HI-LO microswitch which deenergizes the fuel and ignition circuits when the air temperature reaches a preset level. Moving the control toward HI raises the temperature at which this occurs by increasing the distance through which the bi-metal blade must move to open the microswitch. Moving the control toward LO lowers the temperature by decreasing the distance. When the microswitch opens, the blower will continue to run, supplying heated air to the heated compartment, but the burner is no longer operating. As the air temperature cools, the bi-metal blade contracts and closes the microswitch, restarting ignition in the burner head. The heater will cycle in this manner as long as fuel and power are available.

3. If the heater is equipped with the optional room thermostat, leave the HI-LO control in the LO position. The thermostat senses the air temperature within the compartment, rather than the temperature of the air delivered by the heater, but otherwise cycles the heater as described above.

STOPPING

1. Move the START RUN OFF switch to the OFF position. The green indicator should go out immediately.

2. The heater may not shut off immediately, since the heater incorporates circuits for a purge cycle. The blower will run until all fuel in the burner is consumed and the heat exchanger cools sufficiently to open the flame switch. When this occurs, the blower motor will stop and the amber FLAME SW indicator will go out.

SECTION 4
TROUBLESHOOTING

TROUBLESHOOTING

1. Refer to Table 4 for assistance in determining the cause of heater malfunctions.

2. Refer to the wiring diagram in figure 4 for assistance in locating wires. Component locations are shown in figure 6.

3. Illustrations of active circuits follow the troubleshooting chart as a further aid to troubleshooting.

Table 4. Troubleshooting Chart

Trouble	Cause and/or Remedy
A. Heater fails to start - motor does not run.	1. Check fuse. 2. Check all electrical connections, including ground. 3. Check for power at the heater — at least 11 VDC with heater turned on (at least 22 VDC for 24-volt heaters). 4. Check motor. Replace if necessary.
B. Motor runs, but there is no combustion.	1. Check fuel supply by loosening the fitting on the outside of the heater and checking for propane odor. If propane odor is present, pull off igniter wire completely and remove igniter. Try to start heater and listen for solenoid click. Check for odor of propane in the burner. If propane odor is present at bulkhead fitting, but not

Table 4. Troubleshooting Chart (Cont)

Trouble	Cause and/or Remedy
B. Motor runs, but there is no combustion. (cont)	the burner head, the solenoid valve is defective or contaminated with some foreign object. The solenoid valve can become contaminated when a liquid take-off bottle is used instead of the required vapor take-off bottle. If the fuel system is contaminated, clean the lines and solenoid valve with a degreasing solvent. 2. Check HI-LO control and microswitch adjustment. Refer to Section 6, Adjustment and Repair. 3. Check for spark by holding an insulated-handle screwdriver with the shaft grounded and the tip approximately 1/8 inch away from the high tension lug of the ignition coil. There should be a continuous strong spark. If no spark is produced, check that there is voltage applied to the ignition pack. If input voltage is present and no spark or a weak spark is produced, replace or repair the ignition pack. 4. Check the igniter. To check, shut off the fuel at the tank and depress the start switch until the lines are purged of fuel. Remove the burner head and check the gap between the igniter and the burner tube. It should be 1/16 to 1/8 inch. With the burner head grounded, move the START RUN OFF switch to the START position and check the gap for spark. If no spark is produced, the igniter may be dirty or defective. Before removing igniter from burner head, check inside the burner head to determine if any carbon threads or chips are present which could short the plug. 5. Check tilt switch. The switch must be secure in its bracket and be in the vertical position with the electrical leads pointing down. Check leads on both sides of switch for power. Replace if defective. 6. Check with your propane supplier to be sure your fuel is suitable for the temperatures encountered. Around -10°F, propane may not produce enough pressure to pass through the regulator.
C. Excessive backfiring or popping.	1. Check ignition pack as described in B.3. 2. Using voltmeter, check to be sure full voltage is available for heater operation — 11 VDC minimum (22 VDC for 24-volt heaters) with heater turned on. 3. Check solenoid valve. When the START RUN OFF switch is in the RUN position, the solenoid valve should produce an audible click and remain open until heater cycles off. 4. In extremely cold weather, the regulator may become frosted. As it thaws and freezes, the heater will burn intermittently. 5. Check for clogged or restricted exhaust.
D. Heater remains on burner cycle after heat demands are met.	1. HI-LO control or microswitch out of adjustment. See Section 6. 2. Bi-metal blade broken or linkage out of adjustment. 3. Dirt on fuel solenoid valve lip.

Table 4. Troubleshooting Chart (Cont)

Trouble	Cause and/or Remedy
E. Excessive smoking at exhaust port and buildup of carbon in heat exchanger.	1. Check for plugged or blocked air inlet tube. 2. Check for low voltage — at least 11 VDC (22 VDC for 24-volt heaters). 3. Check for defective pressure regulator. There should be 11 inches water pressure in the propane supply line at the connector.

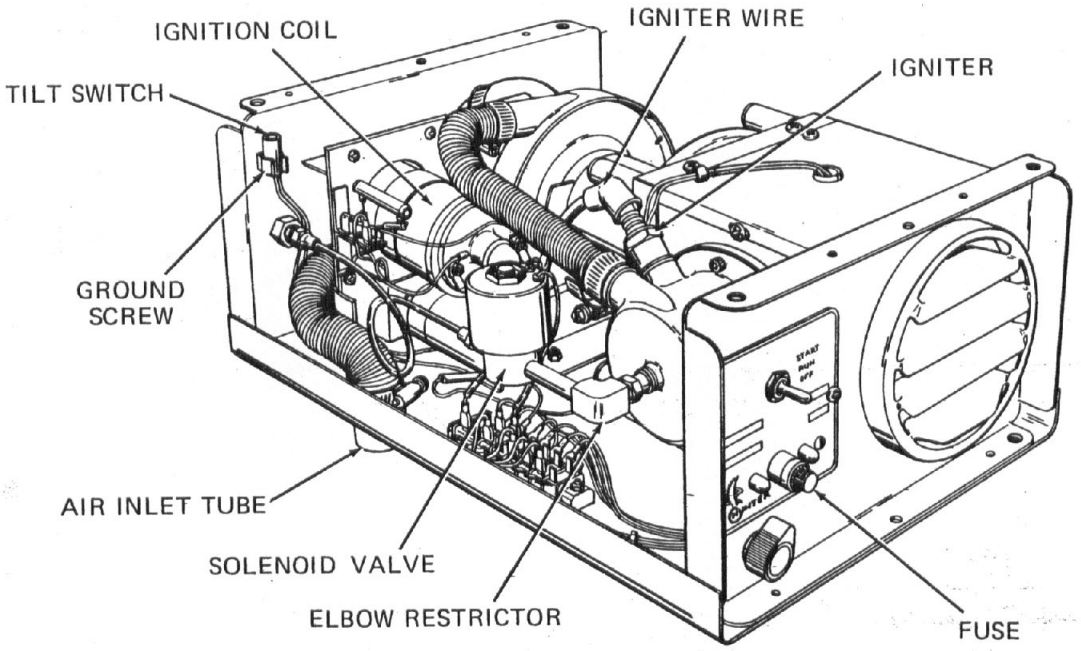
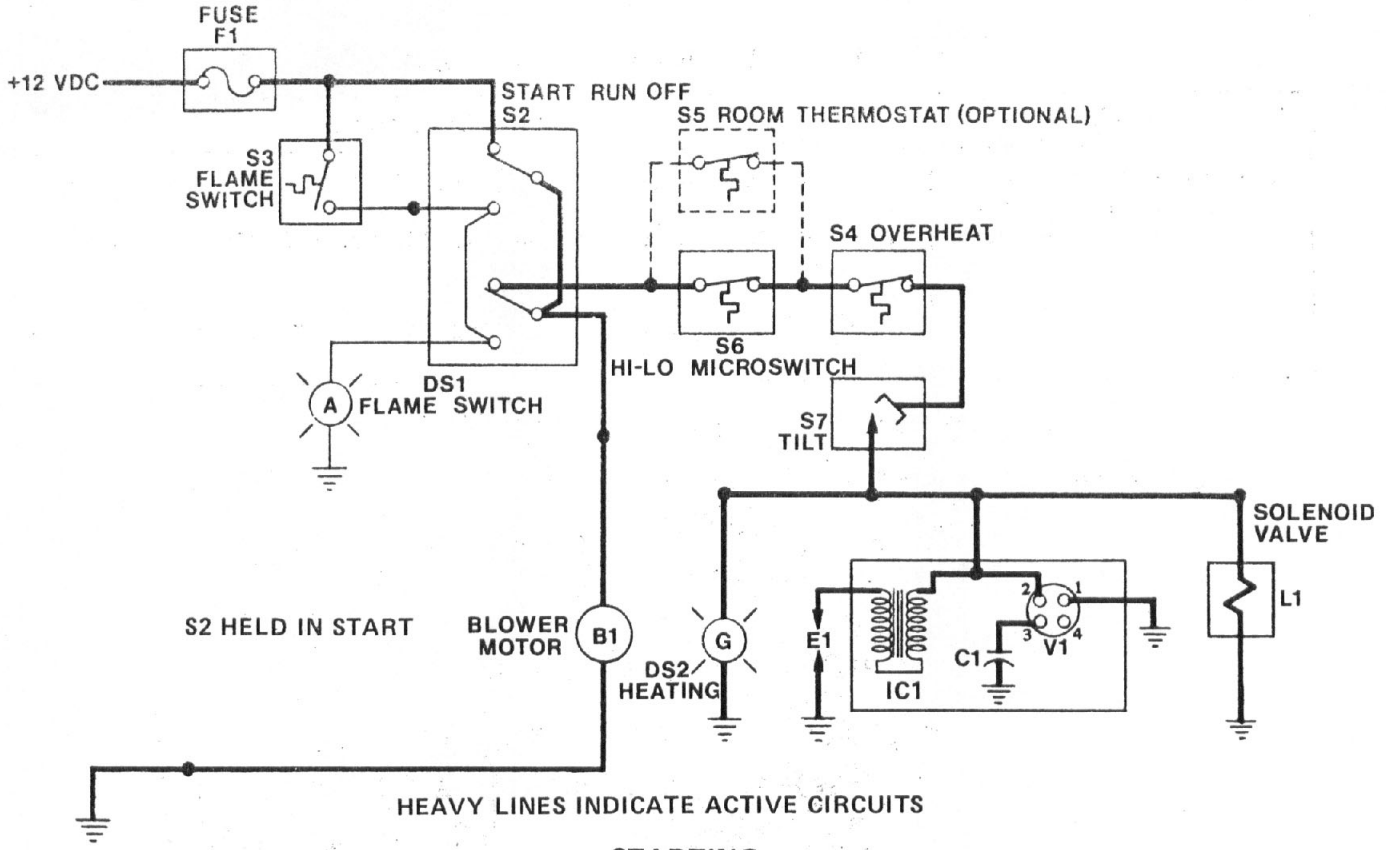


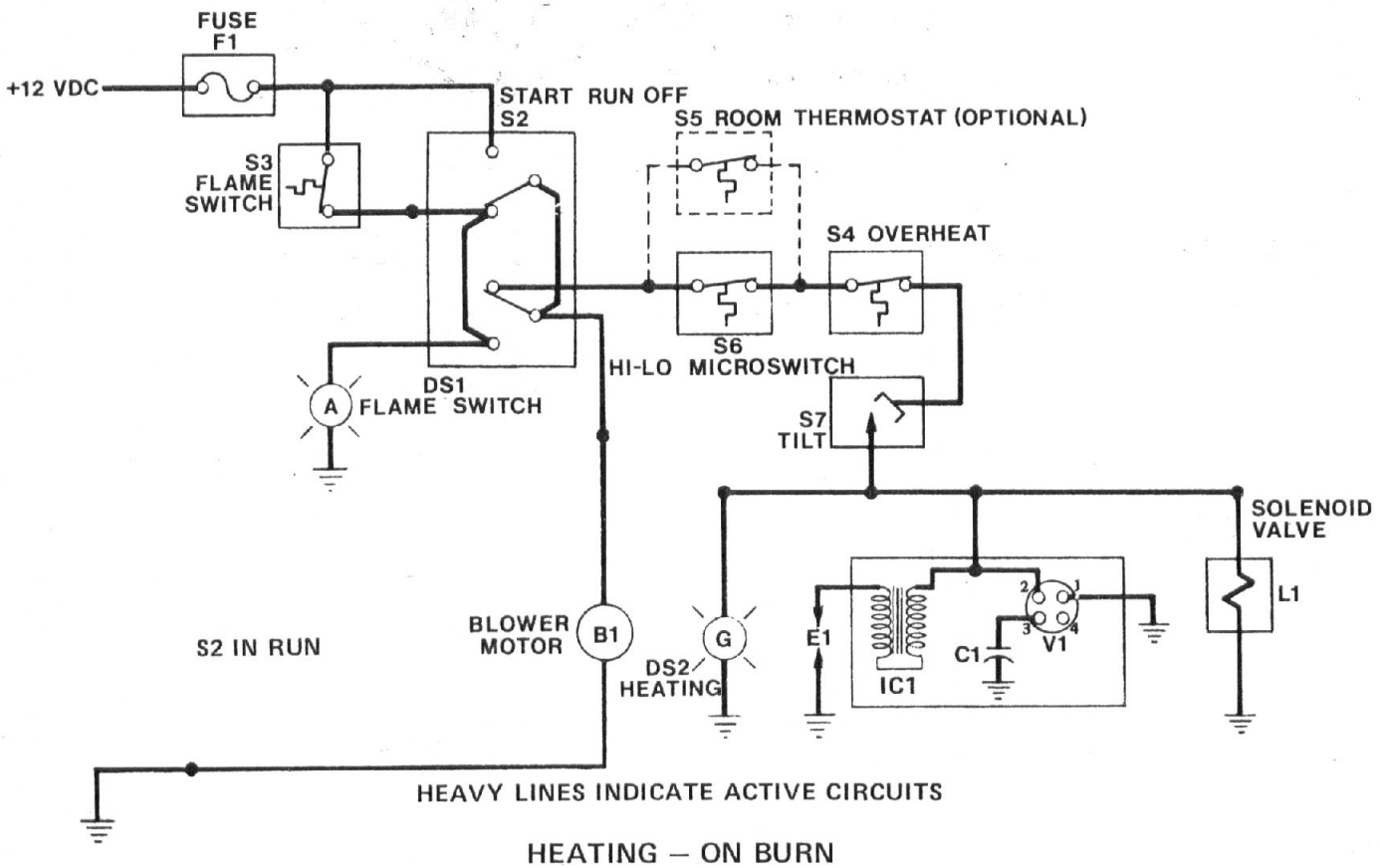
Figure 6. Component Locations

DESCRIPTION OF OPERATION

Refer to figure 7 and follow the circuits indicating heater electrical operation.

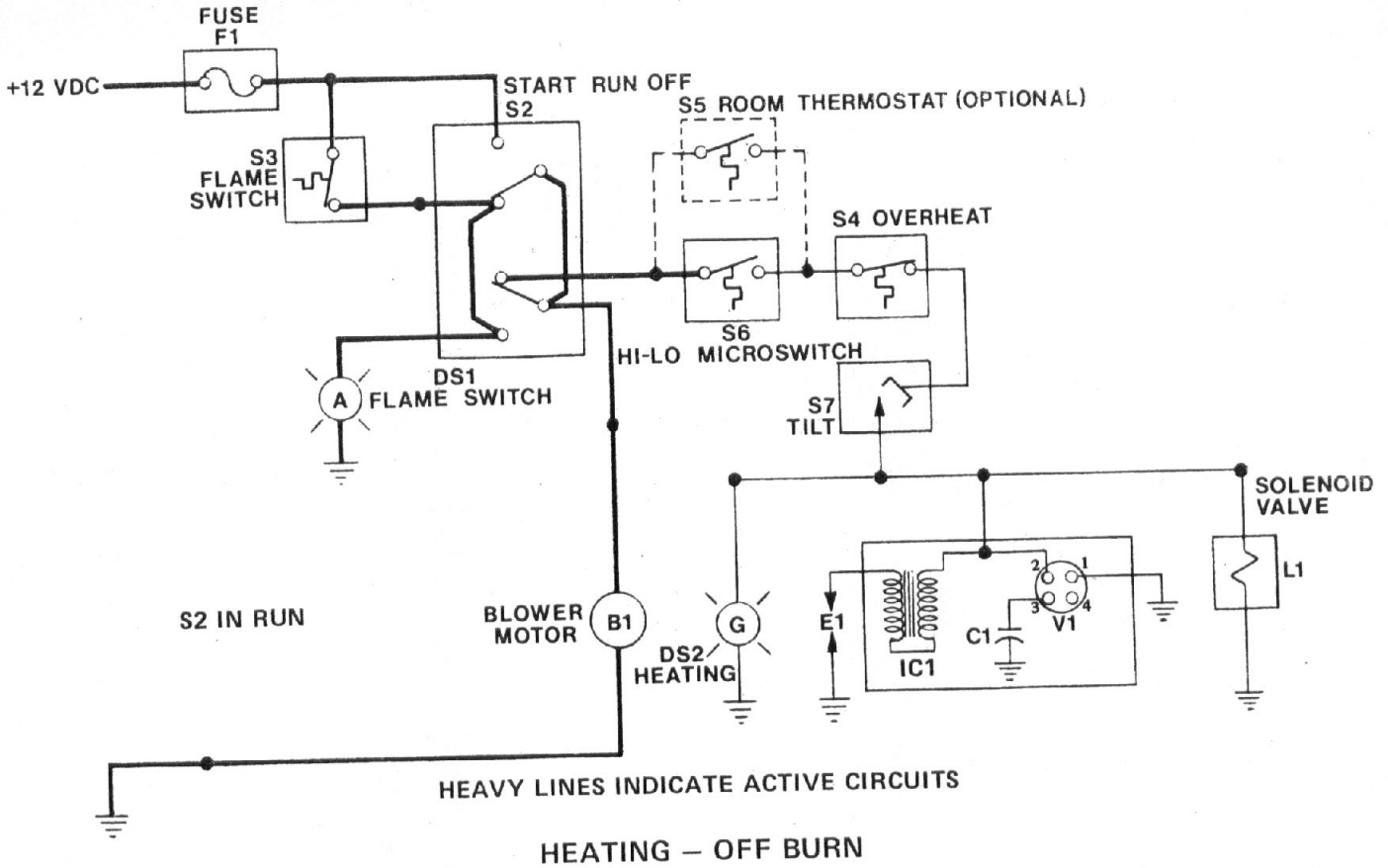


STARTING

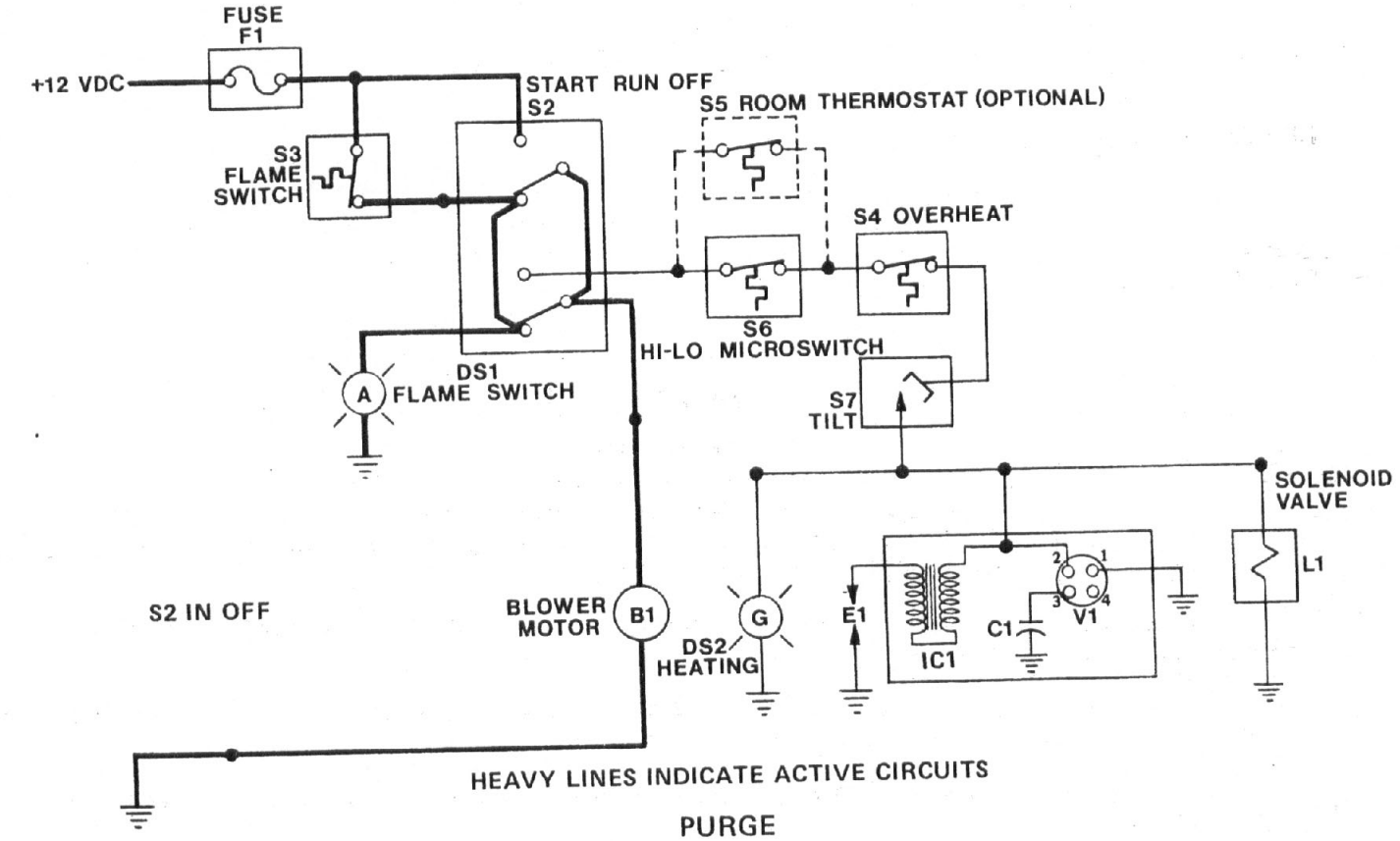


HEATING – ON BURN

Figure 7. Active Electrical Circuits (Sheet 1 of 2)



HEATING – OFF BURN



PURGE

Figure 7. Active Electrical Circuits (Sheet 2 of 2)

SECTION 5
ANNUAL SERVICE INSTRUCTIONS

The following service procedures, if performed each year, will help ensure proper operation and extend the life of the heater. Refer to Section 6 for disassembly instructions.

1. Inspect the propane tank, regulator, and excess flow valve.

2. Remove the igniter; clean and inspect. The electrode should be positioned in the burner so there is a 1/16-inch gap between the tip of the electrode and the burner nozzle.

3. Remove the burner head and remove excessive carbon deposits.

NOTE

Use new gasket when refitting burner head.

4. Disconnect the air hose at the burner head, and clean the blower and motor by using compressed air on combustion air inlet.

CAUTION

Do not use a drill to clean the restrictor orifice. Even very small changes in orifice size can cause poor combustion and carbon buildup.

5. Remove the elbow restrictor (7, fig. 12) and clean it carefully with solvent and compressed air. Do not force a drill or other hard, sharp object through the hole.

SECTION 6
ADJUSTMENT AND REPAIR

HEATER HOUSING

1. The heater is designed for easy service. Disconnect fuel lines, electric wires, and exhaust connections. Remove the mounting bolts and remove the heater. If the heater has been in service for a long time, it may be easier to remove exhaust connector (13, fig. 11) than to disconnect the exhaust piping from the connector.

WARNING

Disconnect electrical power from the heater before removing the covers. Do not run the heater with covers removed except for troubleshooting or adjustment. The ignition pack generates a voltage that is high enough to cause severe injury.

2. The covers (2, fig. 11) are a slide fit. From the sides of the heater, pull outward on the covers to disengage them from the cross bar (1) at top center of the heater.

3. Three clips hold each of the air deflectors (10) to the case. To remove them, squeeze the ring of the deflector at one of the clips to disengage it from the case.

4. When reinstalling the heater, the use of Exhaust Seal Kit, part number 1-49530, will facilitate heater installation.

SOLENOID VALVE (Refer to figure 12)

1. Removal.

a. Turn off the fuel supply to the heater at the propane tank.

b. Disconnect the fuel line (11) from solenoid valve (9).

c. Tag and disconnect the electrical lead, then unscrew and remove the solenoid valve from nipple (8).

d. No service to the solenoid valve is authorized. Replace if defective.

2. Installation. Installation of the solenoid valve is the reverse of removal. Check that all lines are tight before restarting the heater.

BURNER HEAD (Refer to figure 12)

1. Removal and Disassembly.

a. Remove the solenoid valve and disconnect the igniter wire and combustion air hose.

b. Remove five screws around the burner head and remove the burner head and gasket (3).

c. Remove the igniter from the burner head.

2. Cleaning and Inspection.

a. Clean the igniter with cleaning solvent or diesel fuel.

b. Clean the carbon from the burner head.

c. Inspect the burner head for cracks, dents, damaged threads, or other damage.

d. Inspect the igniter for an eroded or damaged electrode, cracked porcelain, and damaged threads.

3. Reassembly and Installation. Reassembly and installation are the reverse of removal and disassembly. Refer to figure 12 and note the following:

a. Install the igniter in the burner head before installing the burner head on the heat exchanger. Check that there is a 1/16- to 1/8-inch gap between the tip of the igniter electrode and the burner tube. The electrode can usually be bent carefully to obtain this gap, but if it cannot, replace the igniter.

b. Install the burner head on the heat exchanger. Make sure the gasket (3) is in place before positioning the burner head.

IGNITION PACK

1. Testing. Test the igniter and the ignition pack as described in the troubleshooting chart, Table 4.

2. Removal.

a. Disconnect the igniter wire (2, fig. 12) from the igniter and the top of the ignition coil. Tag and disconnect the other electrical leads.

b. Loosen the clamps and pull out ignition coil (1, fig. 14).

c. Remove the two screws and lock washers which secure the top of the ignition pack to the case assembly. Tilt the ignition pack and lift it from the case.

3. Disassembly (figure 14).

NOTE

12-volt heaters with serial numbers up to 600 used a 6-volt coil (1) and a resistor board (12). Later model heaters use a 12-volt coil and no resistor board.

a. Loosen the vibrator clamp screw. Wiggle the vibrator and pull it out.

b. Capacitor (2) and resistor (8) are accessible after removing vibrator bracket (3). If either part is defective, note the position of the leads, then unsolder and remove the part.

NOTE

For 12-volt heaters supplied with 6-volt coils and resistor boards, if coil is defective, replace with 12-volt coil and discard resistor board.

MOTOR AND BLOWER ASSEMBLY (Refer to figure 15)

1. Removal.

a. Carefully note the connection of the motor leads.

b. Remove the ignition pack.

c. Pull off air hoses (14 and 16). Be careful not to lose restrictor (15). On some heaters, this restrictor is welded to the burner head and cannot be removed.

d. Remove spacers (10) and well nuts (11).

e. Remove nuts securing mounting plate (6) to case assembly. Lift out assembled blower and motor.

2. Disassembly.

a. Remove the tape that seals the blower housing (1). Remove the attaching screws and pry off the blower housing.

b. Loosen setscrew (2) in blower wheel (3), and pull off the blower wheel.

c. Remove back plate (4), gasket (5), and mounting plate (6) from the end of motor (7).

d. Loosen setscrew in propeller (9) and pull off propeller.

e. Remove spider arm (8) from the end of the motor.

3. Cleaning and Inspection.

a. Clean the parts with a cloth lightly dampened with diesel fuel. Blow off dirt with compressed air.

b. Inspect the motor for signs of overheating and for rough, catching, or binding operation of the motor shaft. Check the motor using a 12-volt or 24-volt battery. Connect the black lead to battery negative. When the orange lead is connected to battery positive, the motor will run at high speed. The red lead is not used.

c. Inspect the propeller and blower wheel for cracks, distortion, broken vanes, and other damage.

d. Inspect the blower housing for distortion, cracks, and dents.

e. Check all non-metallic parts for brittleness, deterioration, and damage.

f. Replace all defective parts.

4. Reassembly and Installation.

a. Reassembly is the reverse of disassembly. Make sure that all setscrews that secure the propeller and blower wheel to the motor shaft are tightened against the flats of the motor shaft. Be sure to seal the blower housing to the back plate with tape.

b. Installation is the reverse of removal. If necessary, refer to the wiring diagram in figure 4 for wire connection information.

HI-LO CONTROL AND MICROSWITCH

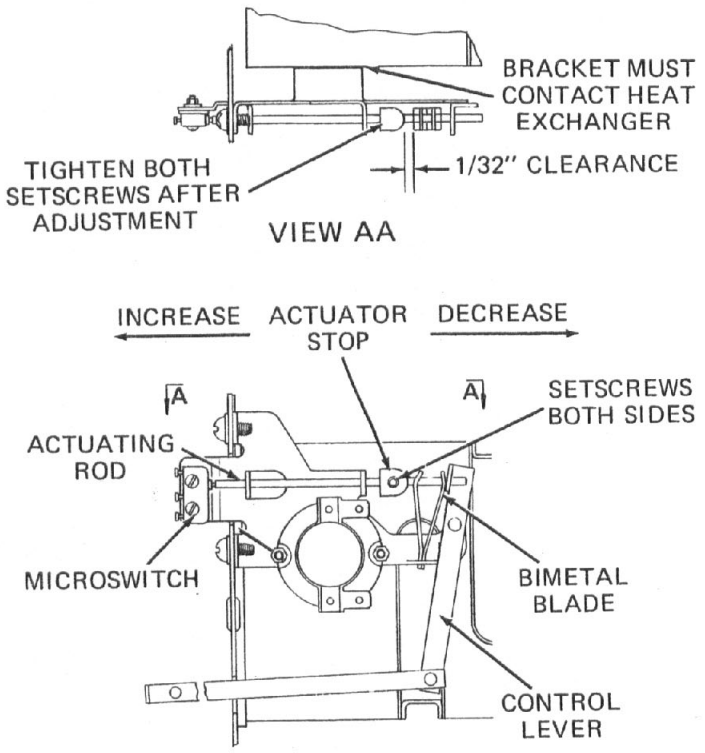


Figure 8. HI-LO Control and Microswitch Adjustment

1. Adjustment. These parts constitute a thermostat assembly which is adjustable to provide the desired heat level for the cab. Adjust as follows:

a. Remove the air deflector adjacent to the control panel. Squeeze the outside diameter of the deflector at one of the clips, and disengage the deflector from the heater case.

b. The V-shaped bi-metal blade (figure 8) expands to widen the gap at the top of the V when heated. As the bi-metal blade expands, it strokes the actuator stop and pushes the actuating rod against the microswitch. This causes the heating circuits to deenergize.

c. Adjustment is made by changing the position of the actuator stop on the actuating rod. Loosen the two setscrews in the stop to permit adjustment. Hold the rod and shift the stop toward the microswitch to increase the temperature within the control range. Shift the stop toward the bi-metal blade to decrease the temperature within the control range. Tighten the setscrews.

NOTE

After adjustment there must be a minimum gap of 1/32 inch between the bi-metal blade and the actuator stop when the control knob is in the LO position. Insufficient clearance will result in incorrect operation.

d. Install the air deflector and operate the heater to determine if it provides the required temperature. Readjust if necessary.

2. Removal and Disassembly (figure 13).

a. Remove the deflector from the heater outlet.

b. Remove the stop nut (23) and disengage pivot arm (22) from the lever on bracket (5).

c. Disconnect the leads from flame switch (7) and remove the switch.

d. Remove bracket (5), if necessary, and pull out the assembly through the heater outlet.

e. Loosen the setscrews (2) in actuator stop (3). Pull out the actuating rod (1) to release the stop and bi-metal blade (4).

f. Remove two screws through microswitch (24). Pull off the microswitch and insulator (25). These two parts are kitted as shown in the parts list.

WARNING

The heat exchanger must be inspected annually, or more frequently if heater usage is heavy. A damaged heat exchanger can allow poisonous gases to seep into the heated enclosure causing illness or death to occupants.

1. Removal (figure 11).

   a. Remove the two screws that secure the cross bar (1) to the case.

   b. Disconnect the fuel line at the solenoid. Remove the burner head and elbow restrictor.

   c. Remove the heat exchanger top cover (5).

   d. Remove the screw that secures the end of heat exchanger (16) to mounting bracket (14). Pull straight up to remove the heat exchanger.

2. Cleaning and Inspection.

   a. Clean the exterior of the heat exchanger with a wire brush to remove all dust and dirt.

   b. Inspect the heat exchanger for cracks, holes, broken weldments, and other damage. Replace if defective or install Heat Exchanger and Control Subassembly service kit, part number 1-49477.

CAUTION

Heat exchanger must be installed as shown to prevent exhaust gases from leaking around the burner head.

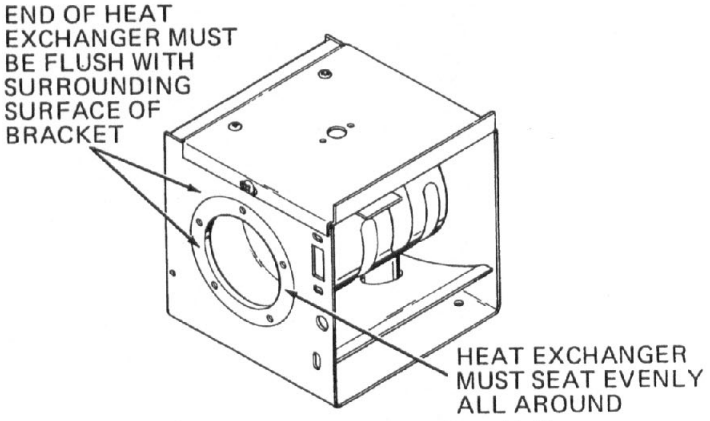


Figure 9. Heat Exchanger Installation

3. Installation. Installation is essentially the reverse of removal. Alignment between the heat exchanger and the bracket is critical to correct sealing of the burner head. Install the heat exchanger in the bracket and carefully align the open end of the heat exchanger with the hole in the bracket as shown in figure 9. At the same time, the exhaust outlet must be aligned with the hole in the bottom of the bracket, and the tapped hole in the back of the heat exchanger must be aligned with the hole for the attaching screw. Make sure all parts are aligned before installing the burner head.

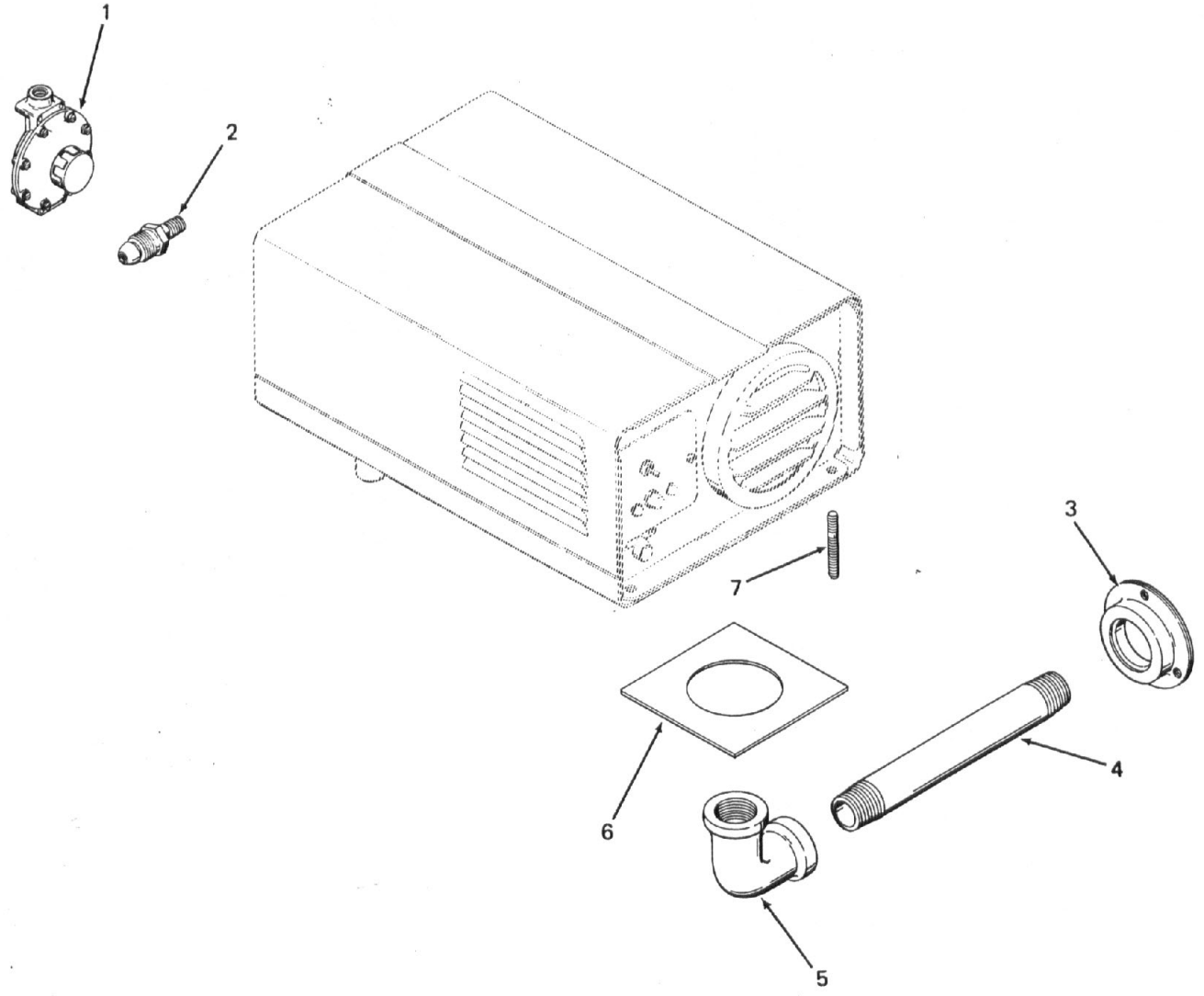
SECTION 7
PARTS LISTS

GENERAL

This section lists and illustrates the major parts of Model PH-20 Heaters. In general, attaching parts such as screws, nuts, and lock washers have not been listed or illustrated since their application is obvious. If a part has not been assigned a part number, or the abbreviation COML appears, the part can be replaced with a commercially available equivalent.

All available service kits are listed. In most cases, if a part has not been assigned a part number, it is available only as part of a service kit.

Index Number	Part Number	Description
* 1	88307	Regulator
* 2	88014	POL Connector (includes excess flow valve)
3	1-47023	Exhaust Insulator
4	49109	Exhaust Nipple
5	49108	Exhaust Elbow
6	49091	Heat Shield
7	49084	Mounting Stud



WARNING

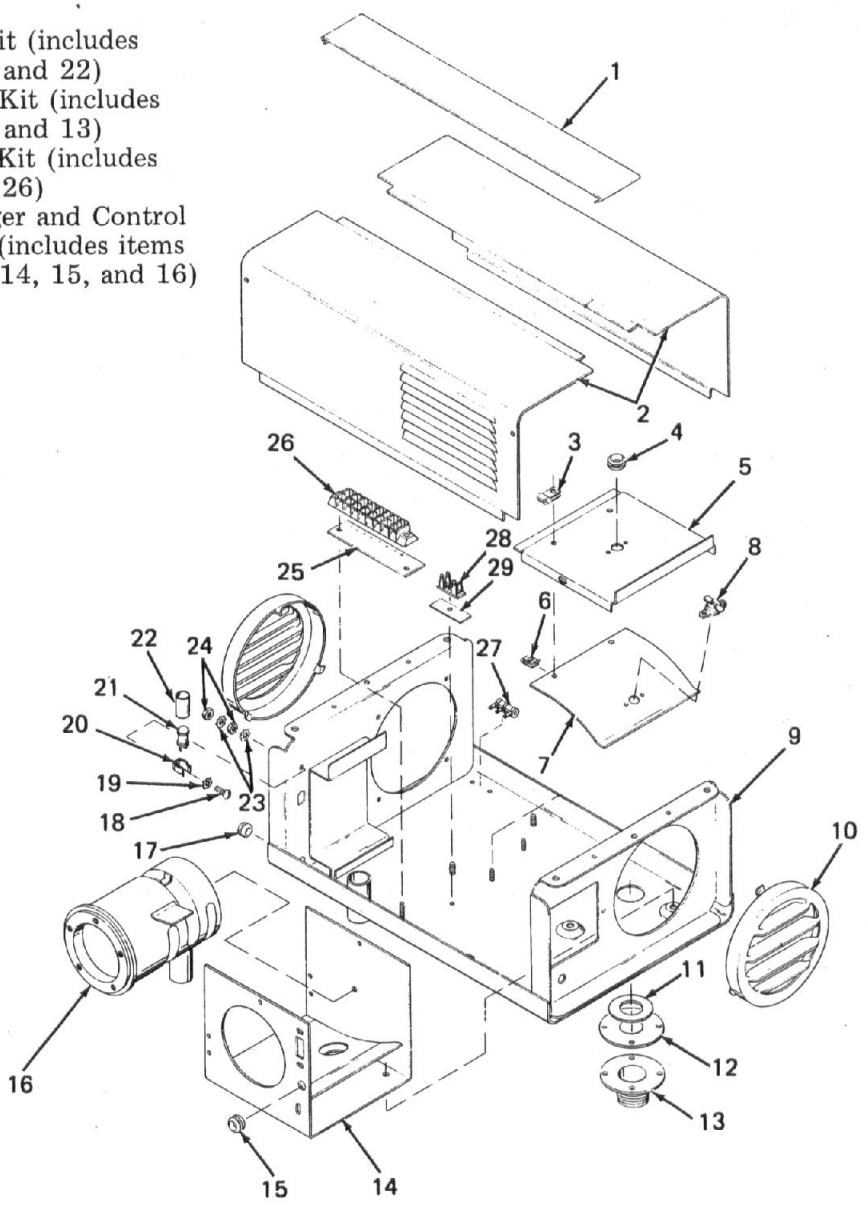
USE OF THE HEATER WITH A REGULATOR OTHER THAN THAT SHIPPED WITH THE HEATER, OR TAMPERING WITH THE REGULATOR ADJUSTMENT, VOIDS ALL WARRANTIES AND MAY RESULT IN FIRE, EXPLOSION, OR EQUIPMENT DAMAGE.

* NOTE 1: SOLD ONLY AS REGULATOR ASSEMBLY PART NO. 1-88301

Figure 10. Heater Installation

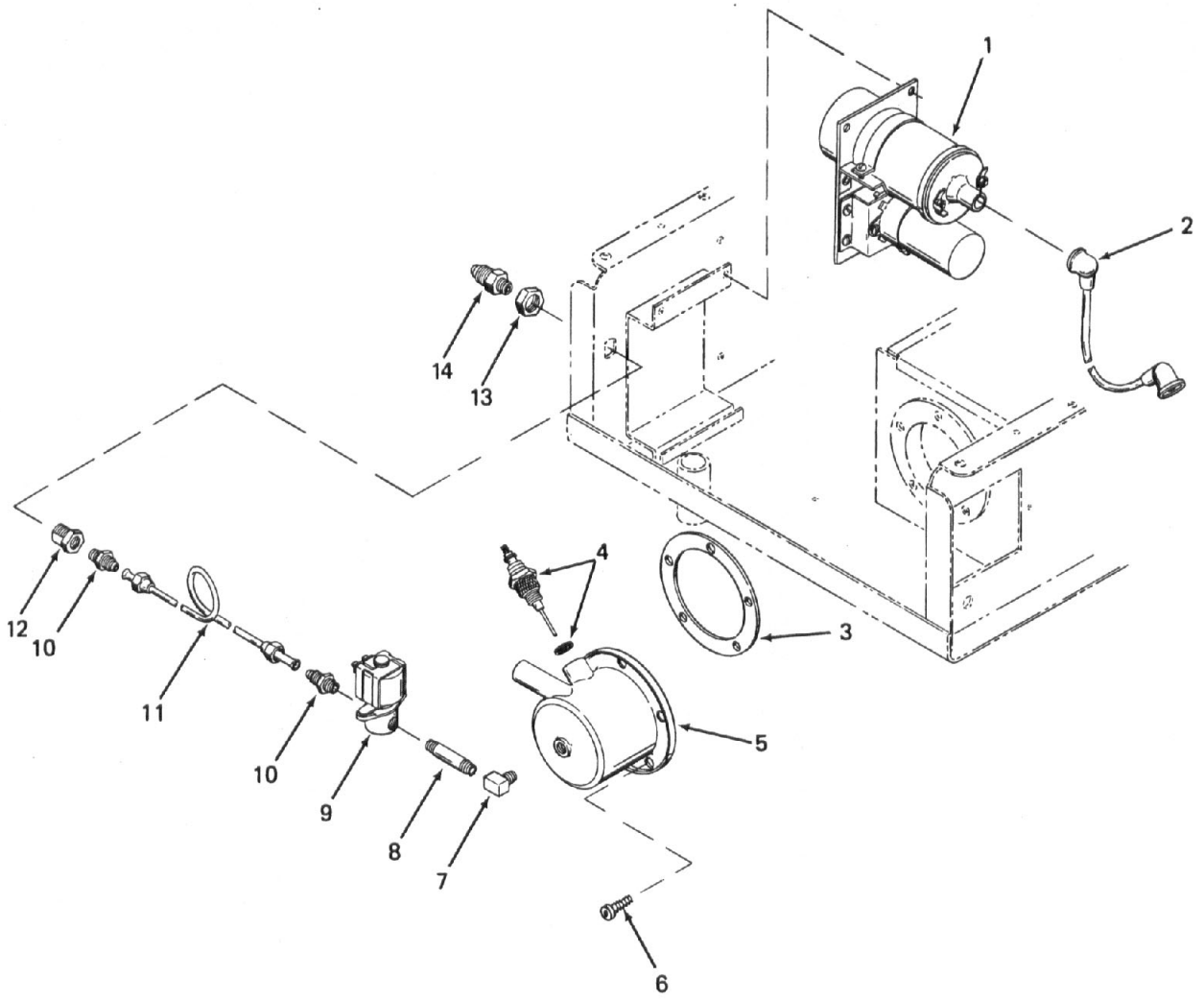
SERVICE KITS

1-49433	Tilt Switch Kit (includes items 20, 21, and 22)
1-49530	Exhaust Seal Kit (includes items 11, 12, and 13)
1-49531	Marker Strip Kit (includes items 25 and 26)
1-49477	Heat Exchanger and Control Subassembly (includes items 4, 5, 6, 7, 8, 14, 15, and 16)



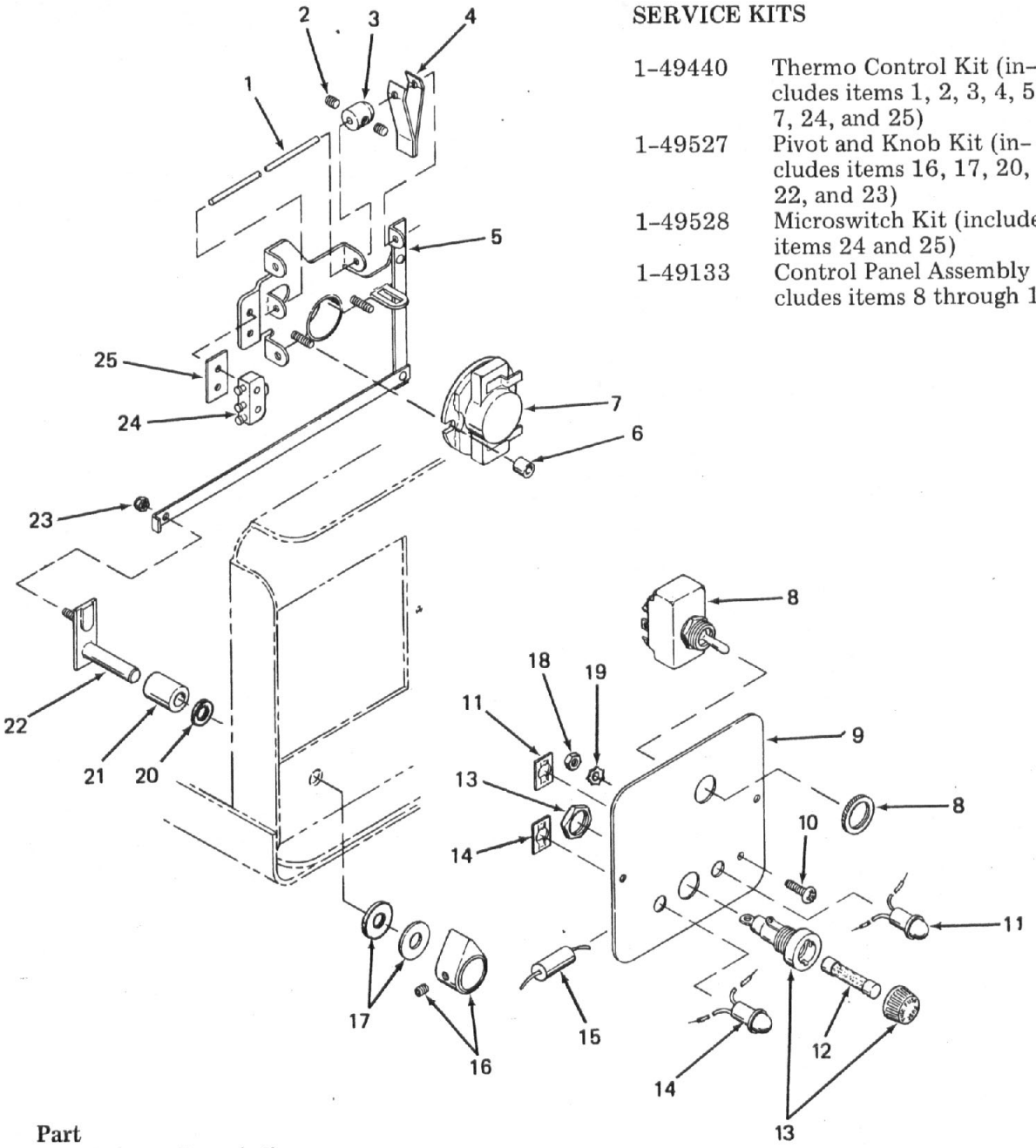
Index Number	Part Number	Description
1	49131	Cross Bar
2	49196	Cover
3	3634	Clamp
4		Grommet
5		Top Cover
6		Speed Nut
7		Upper Baffle
8	4347	Thermostat (overheat switch)
9	2-49218	Case Assembly
10	2-49188	Air Deflector
11		Washer
12		Exhaust Gasket
13		Exhaust Connector
14		Bracket
15		Grommet
16	2-49420	Heat Exchanger
17		Grommet
18	COML	Ground Screw, No. 10-24 x 1/2 inch
19	COML	Lock Washer, No. 10 int-ext tooth
20		Clip
21		Mercury Switch
22		Insulator
23	COML	Lock Washer, No. 10 ext tooth
24	COML	Nut, No. 10-24
25	49386	Marker Strip
26	49306	Terminal Block
27	49203	Resistor (24 volts only)
28	49474	Terminal Board
29	49473	Insulator

Figure 11. Case and Heat Exchanger



Index Number	Part Number	Description
1	1-49122	Ignition Pack Assembly
	1-49122-01	Ignition Pack Assembly (used on serial numbers 10001 thru 10600 - can be replaced by 1-49122)
2	2-49421	Igniter Wire
3	58111	Gasket
4	47182	Igniter
5	2-49445	Burner Head
6	7520	Screw
7	2-49501	Elbow Restrictor
8	1321	Nipple
9	47396	Solenoid Valve (12 volts)
	86347	Solenoid Valve (24 volts)
10	3546	Connector
11	2-49515	Fuel Line Assembly
12	47632	Connector
13	5697	Lock Nut
14	3629	Male Connector

Figure 12. Fuel and Ignition Systems



SERVICE KITS

1-49440	Thermo Control Kit (includes items 1, 2, 3, 4, 5, 6, 7, 24, and 25)
1-49527	Pivot and Knob Kit (includes items 16, 17, 20, 21, 22, and 23)
1-49528	Microswitch Kit (includes items 24 and 25)
1-49133	Control Panel Assembly (includes items 8 through 15)

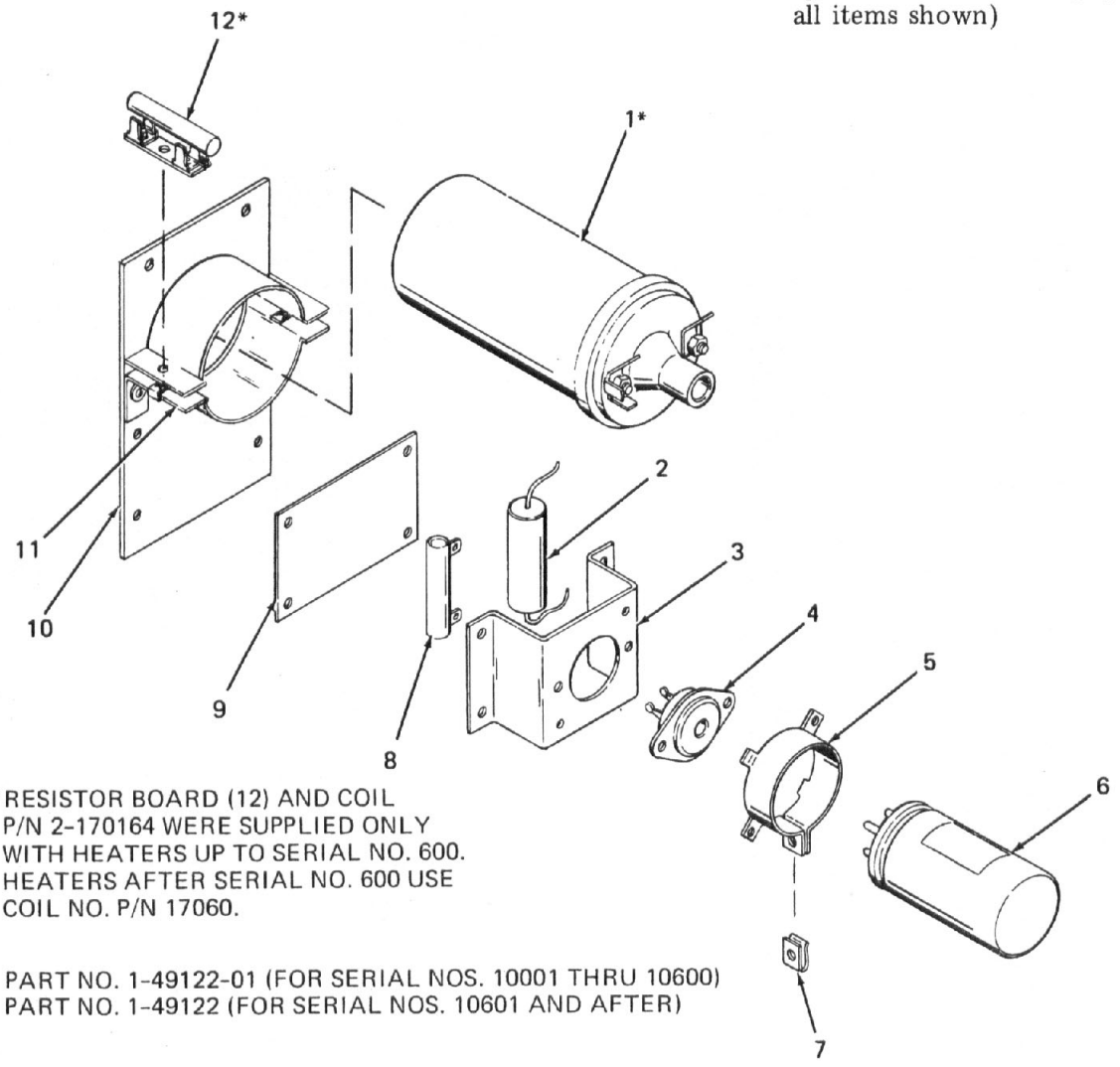
Index Number	Part Number	Description
1		Actuating Rod
2		Setscrew
3		Actuator Stop
4	2-47741-01	Bi-metal Blade
5		Bracket
6		Spacer
7	49085	Flame Switch
8	2-49521	Toggle Switch (2-pole) (with jumpers)
9	49484	Plate
10	COML	Ground Screw, No. 6-32 x 3/8 inch
11	49217	Pilot Light (green)
12	COML	Fuse, 20 amp (10 amp for 24-volt heaters)
13	73270	Fuseholder

Index Number	Part Number	Description
14	49516	Pilot Light (amber)
15	49599	Resistor (24 volts only)
16		Knob
17		Washer
18		Nut
19		Lock Washer
20		Spring Washer
21		Spacer
22		Pivot Arm
23		Stop Nut
24		Microswitch
25		Insulator

Figure 13. Control Panel

SERVICE KIT

1-49122 Ignition Pack Assembly (includes all items shown)



*RESISTOR BOARD (12) AND COIL P/N 2-170164 WERE SUPPLIED ONLY WITH HEATERS UP TO SERIAL NO. 600. HEATERS AFTER SERIAL NO. 600 USE COIL NO. P/N 17060.

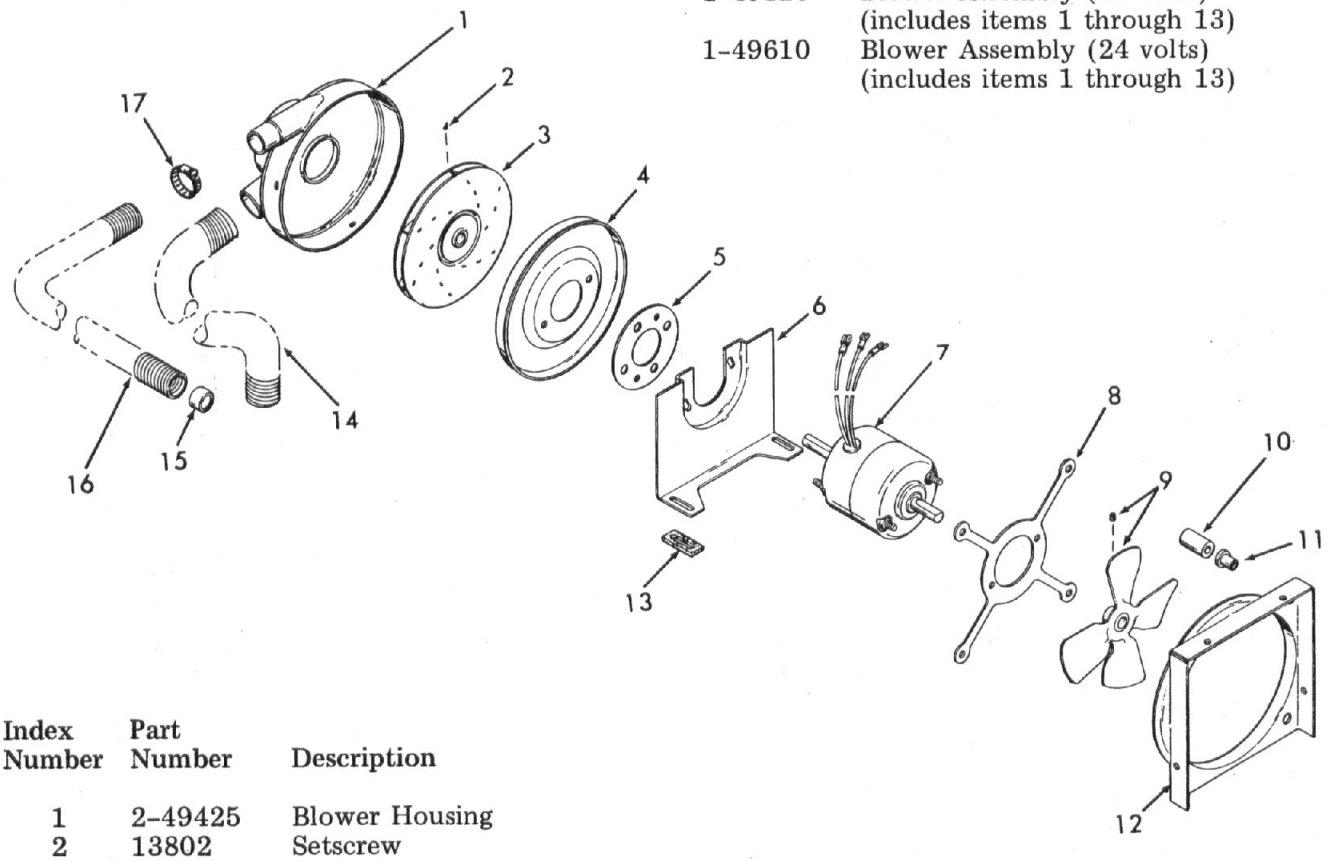
PART NO. 1-49122-01 (FOR SERIAL NOS. 10001 THRU 10600)
PART NO. 1-49122 (FOR SERIAL NOS. 10601 AND AFTER)

Index Number	Part Number	Description
1	170760	Coil, 12-volt (heaters after serial number 600)
	2-170164*	Coil, 6-volt (heaters up to serial number 600 only)
2	49263	Capacitor, 0.33 μF Mylar
3		Vibrator Bracket
4	46236	Vibrator Socket
5		Clamp
6	43215	Vibrator
7		Tinnerman Nut
8	43228	Resistor, 15 ohm, 12 watt
9	49247	Insulator
10		Mounting Plate
11		Clamp,
12	2-49494*	Resistor Board (heaters up to serial number 600 only)

Figure 14. Ignition Pack

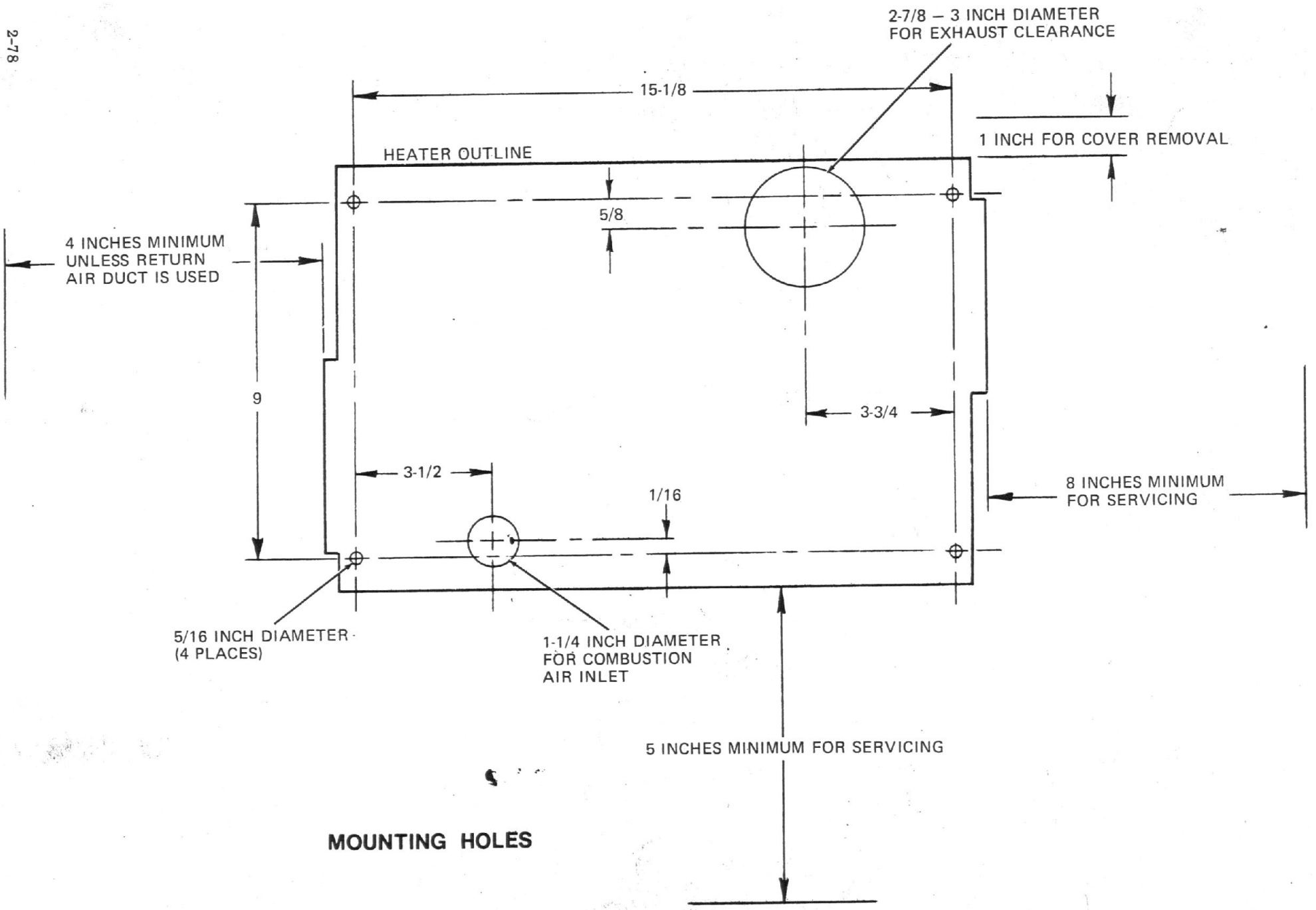
SERVICE KITS

1-49123	Blower Assembly (12 volts) (includes items 1 through 13)
1-49610	Blower Assembly (24 volts) (includes items 1 through 13)



Index Number	Part Number	Description
1	2-49425	Blower Housing
2	13802	Setscrew
3	2-49285	Blower Wheel
4	47417	Back Plate
5	170039	Gasket
6	49227	Mounting Plate
7	2-49551	Motor, 12-volt
	49601	Motor, 24-volt
8	49345	Spider Arm
9	49364	Propeller
10	49428	Spacer
11	49374	Well Nut
12	49399	Mounting Plate
13	49228	Pad
14	49351-01	Air Hose (incoming)
15	49455	Air Restrictor (may be welded to burner head in some heaters)
16	49342-02	Air Hose (outgoing)
17	49602	Hose Clamp

Figure 15. Motor and Blower



MOUNTING HOLES

C/ Rail Ofer Chapman 297-3109

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