SPX®
WHERE IDEAS MEET INDUSTRY

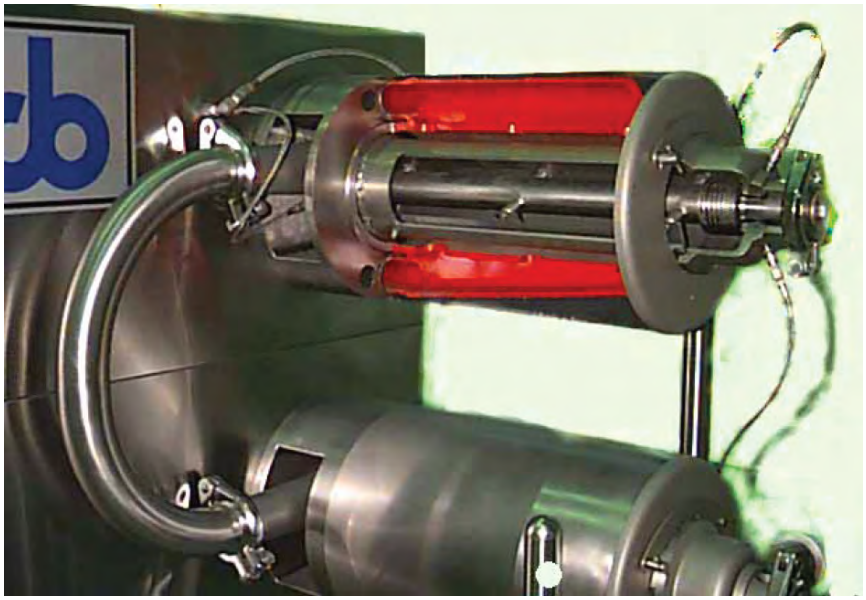
INSTRUCTION MANUAL

Thermutator

SCRAPED SURFACE HEAT EXCHANGER

FORM NO.: 5605-R89 REVISION: 1998

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.



Waukesha Cherry-Burrell®

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Table of Contents

INTRODUCTION ..... Pages 1-10

INSTALLATION ..... Pages 11-30

OPERATION ..... Pages 31-38

MAINTENANCE ..... Pages 39-64

LUBRICATION ..... Pages 65-67

PARTS LIST INDEX ..... Pages 68-138

ADDENDUM ..... Pages 139-142

Warranty

Seller warrants its products to be free from defect in materials and workmanship for a period of one (1) year from the date of shipment. This warranty shall not apply to products which require repair or replacement due to normal wear and tear or to products which are subjected to accident, misuse or improper maintenance. This warranty extends only to the original Buyer. Products manufactured by others but furnished by Seller are exempted from this warranty and are limited to the original manufacturer's warranty.

Seller's sole obligation under this warranty shall be to repair or replace any products that Seller determines, in its discretion, to be defective. Seller reserves the right either to inspect the products in the field or to request their prepaid return to Seller. Seller shall not be responsible for any transportation charges, duty, taxes, freight, labor or other costs. The cost of removing and/or installing products which have been repaired or replaced shall be at Buyer's expense.

Seller expressly disclaims all other warranties, express or implied, including without limitation any warranty of merchantability of fitness for a particular purpose. The foregoing sets forth Seller's entire and exclusive liability, and Buyer's exclusive and sole remedy, for any claim of damages in connection with the sale of products. In no event shall Seller be liable for any special consequential incidental or indirect damages (including without limitation attorney's fees and expenses), nor shall Seller be liable for any loss of profit or material arising out of or relating to the sale or operation of the products based on contract, tort (including negligence), strict liability or otherwise.

Shipping Damage or Loss

If equipment is damaged or lost in transit, file a claim at once with the delivering carrier. The carrier has signed the Bill of Lading acknowledging that the shipment has been received from SPX FLOW in good condition. SPX FLOW is not responsible for the collection of claims or replacement of materials due to transit shortages or damages.

Warranty Claim

Warranty claims must have a **Returned Goods Authorization (RGA)** from the Seller before returns will be accepted.

Claims for shortages or other errors, exclusive of transit shortages or damages, must be made in writing to Seller within ten (10) days after delivery. Failure to give such notice shall constitute acceptance and waiver of all such claims by Buyer.

INTRODUCTION

SCRAPED SURFACE HEAT EXCHANGER

The scraped surface heat exchanger consists of concentric product and media tubes, a rotating scraper and a suitable scraper drive. The product tube contains the product, provides a heat exchange surface and an enclosure for the rotating scraper. The media tube contains the heating or cooling media.

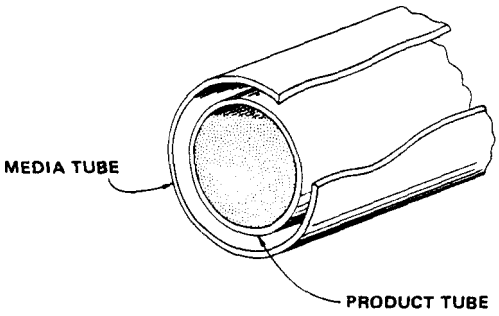


Figure 2-1. Concentric Product and Media Tubes

The rotating scraper or mutator continuously changes the product on the heat exchange surface of the product tube. By continuously changing the product, the scraped surface heat exchanger assures very rapid heat transfer to a relatively small product volume.

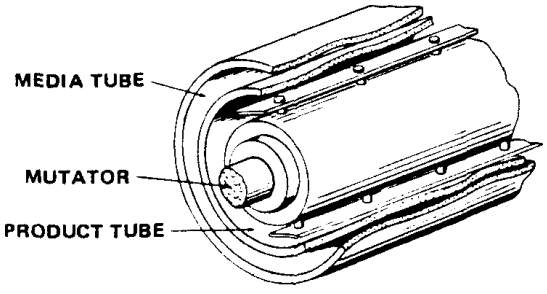


Figure 2-2. The Rotating Scraper

THE THERMUTATOR

The Thermutator is a scraped surface heat exchanger. It is used to heat or cool products that cannot be continuously processed by other types of heat exchangers.

Included are products that:

1. are very heat sensitive.

2. form film on the heat exchange surface.

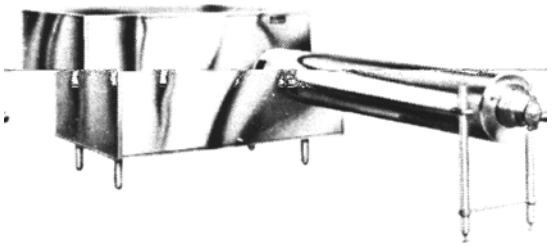


Figure 2-3. The Thermutator - A Scraped Surface Heat Exchanger

3. are highly viscous or become highly viscous during process.

4. have a particle size or delicacy that cannot be accommodated by other heat exchangers.

THREE BASIC MODELS

Three basic models of Thermutators are available from Waukesha Cherry-Burrell. These are the “624,” the “648" and the “672.”

Model Number Designation

The first number in the model designation indicates the diameter of the product tube. The second two numbers indicate the length of the tube. For example, the product tube in the model “648” has a 6" inside diameter and a length of 48".

The number designation is always followed by a letter suffix which indicates the type of media used for heating or cooling. The three letter suffixes used are:

DE For Direct Expansion media. (Such as ammonia or freon)

S - For Steam.

L - For Liquid. (In the form of city, well, icewater, Brine or Glycol.)

CABINETS

The Thermutator tubes, of all lengths and media types, can be mounted in a Model V cabinet, a Model H cabinet or an oversize Model H cabinet. The Model V is a narrow vertical cabinet for side by side mounting. The Model H is a horizontal cabinet and the oversize Model H is a horizontal cabinet which is used to accommodate a mechanical variable speed mutator drive.

In installations where space is at a premium Model H cabinets may be stacked three high and oversize Model H cabinets may be stacked two high. See figures 2-4 and 2-5.

This “unistack” arrangement is a Waukesha Cherry-Burrell exclusive that allows customers to add on equipment without taking extra floor space.

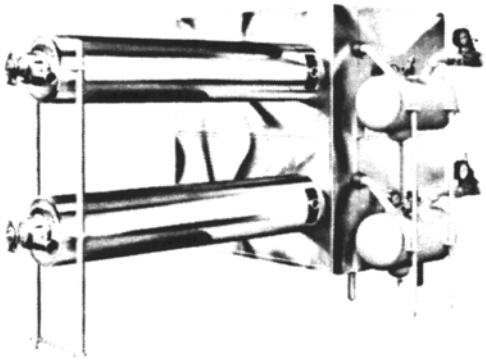


Figure 2-4. Thermutators In Stacked Oversize Model ‘H’ Cabinets.

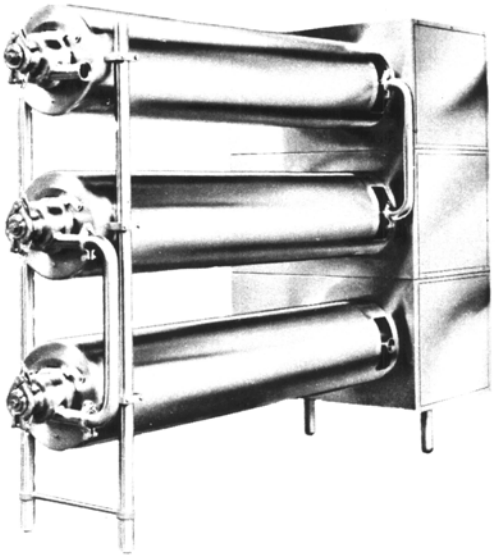


Figure 2-5. Thermutators In Stacked Standard Model ‘H’ Cabinets.

PRODUCT TUBE MATERIALS

A choice of five different tube materials is available for use in Thermutators. The characteristics of the product, the temperature requirements and the cleaning compounds used generally are the factors involved in selecting the proper tube material.

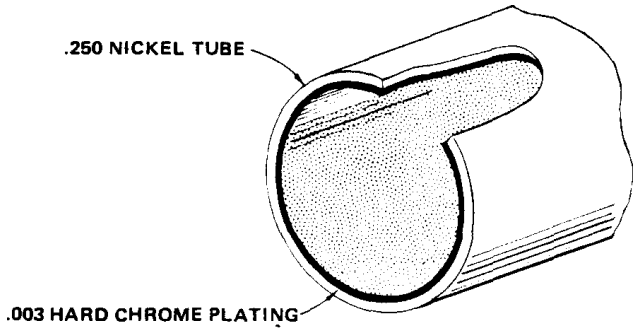


Figure 2-6. Nickel/Chrome Product Tube

Chrome Plated Nickel
Highest thermal conductivity, for use with stainless steel blades. Use with acid products or acid cleaners causes pitting and/or loss of chrome plating.

Nickel (Less Chrome Plating)
Highest thermal conductivity, plastic blades must be used. Can be used with acid products but low PH and elevated temperatures may cause general etching.

Stainless Steel
Lowest thermal conductivity, plastic blades must be used. Suitable for use with acid products.

Stainless Steel Chrome Plated
Lowest thermal conductivity, for use with stainless steel blades. Suitable for use with acid products.

Mild Steel CR3000 Lined
Medium thermal conductivity, for use with stainless steel blades. High corrosion resistance and abrasion resistance. Suitable for use with acid products.

OPERATING PRESSURE

The maximum operating pressure for Thermutator product tube is 400 psi. The maximum operating temperature is 400°F. All Thermutator media tubes are built to the A.S.M.E. code for unfired pressure vessels and have “U.M.” Certification. “U” Certification is available as an extra cost option.

MUTATORS

Operation and Design

In operation, the mutator blades constantly scrape the wall of the product tube. The blades are mounted on pins attached to the mutator tube and are allowed to pivot to contact the heat exchange surface. See figure 2-7. Because of the continuous blade/wall contact the mutator blades constantly change the product on the heat exchange surface.

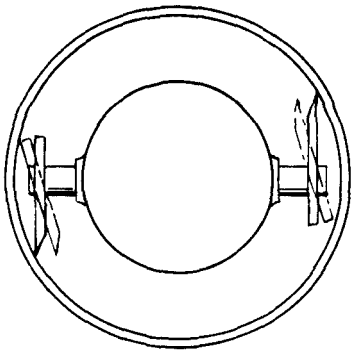


Figure 2-7. Typical Mutator Blade Movement

The mutator blades are designed much the same way as an airplane wing. They rely on positive pressures on the leading side, and negative pressure on the tracking side to insure blade to wall contact and product deposit and removal. See figure 2-8.

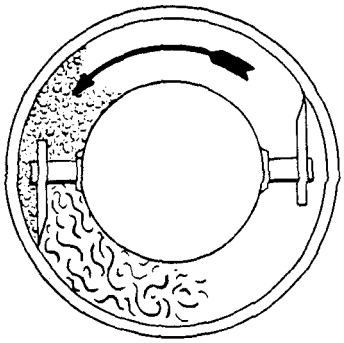


Figure 2-8. Blade Action Caused By Blade Speed And Product Viscosity

Product is removed by the rotation blades scraping the wall. The mixing caused by the blade makes it important that the mutator shape and size is compatible with the product. The scraping action makes it important that the blade is compatible with the heat exchange tube.

HOLDBACK VALVE

A product hold back valve is frequently used on the Thermutator discharge to insure proper mutator blade functioning by assuring the tube is completely full of product. The amount of effective blade to wall pressure varies with the product viscosity, the more viscous the product the higher the blade pressure.

When a product is heated above the boiling point, a hold back valve is required to maintain product pressure high enough to prevent flashing.

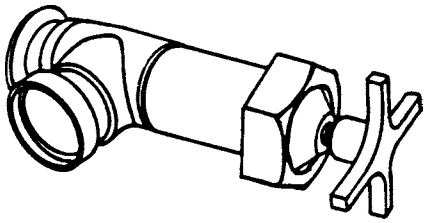


Figure 2-9. Product Holdback Valve

Mutator Sizes and Applications

4-1/2" MUTATOR

The most common mutator uses two rows of blades and is 4-1/2" in diameter. See figure 2-10.

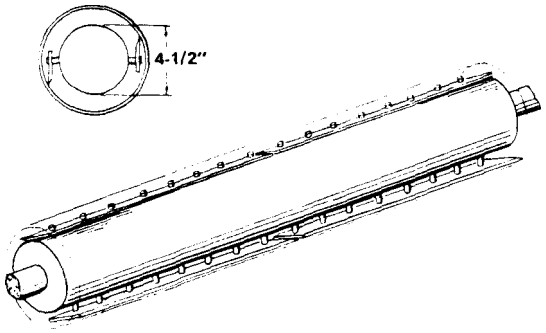


Figure 2-10. Common 4-1/2" Mutator With 2 Rows Of Blades

5-1/2" MUTATOR

The 5-1/2" diameter narrow clearance mutator with two rows of blades is used to process heat sensitive products at very high temperatures. A typical application is aseptically processed puddings.

The small volume in the Thermutator with a narrow clearance mutator improves the quality of the finished product by reducing the time spent at processing temperature and by decreasing the gradient range between cooked, under cooked and over cooked. See figure 2-11.

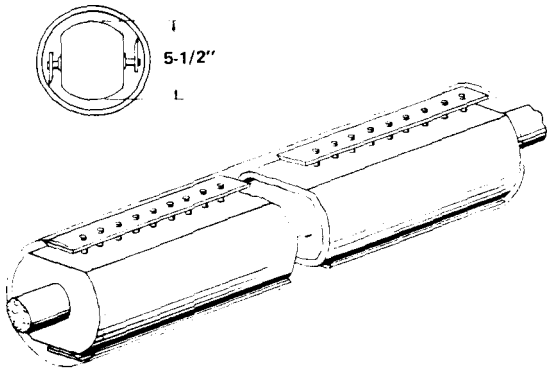


Figure 2-11. Typical 5-1/2" Narrow Clearance Mutator

3-1/2" MUTATOR

The 3-1/2" mutator has staggered rows of blades. It is used for products containing moderate size particulates and some very viscous products.

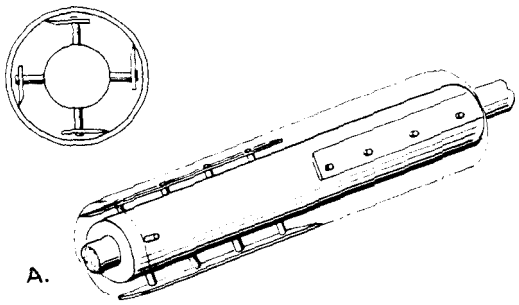


Figure 2-12.Typical 3-1/2" Mutator
A. With Staggered Blades

2-1/4" MUTATOR

A 2-1/4" mutator is used when processing products with large particulates such as dog food, beef stew, or chop suey. The product particles won't be damaged in the large space between the mutator tube and the heat exchange surface. See figure 2-13.

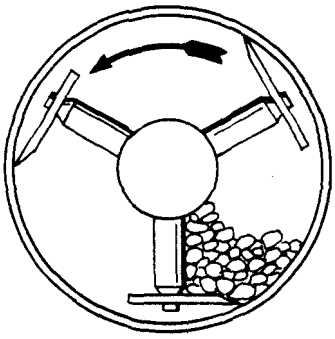


Figure 2-13. 2-1/4" Mutator Used With Products That Have Large Particulates

HOLLOW MUTATORS

With the exception of the 2-1/4" mutator all of the units are hollow and can be flooded with hot water or low pressure steam.

Flooding the mutator tube prevents the build-up of coatings on the mutator and assures an even product texture. This feature is often employed when cooling margarine.

The heated mutator does, however, reduce the capacity of the Thermutator when it is used with a product that is being cooled. The heat from the mutator must be dissipated along with the heat from the product. Compensation for this capacity loss is provided, however, since static coatings on the mutator impede heat transfer and product mixing. See figure 2-15. The coatings also increase rotating mass and cause considerable drag and power loss. See figure 2-14.

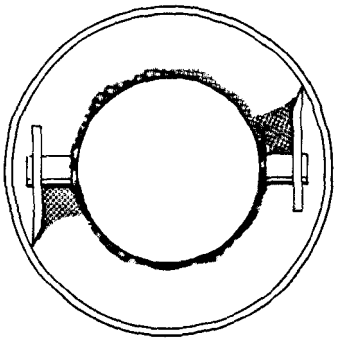


Figure 2-14. Static Coatings On Mutator Reduce Capacity And Cause Drag

Offset Cylinder

An offset cylinder is used to process exceptionally viscous products. The cylinder is offset about 1/8" from the mutator center line of rotation. As the mutator turns, the blades must rock slightly to maintain contact with the heat exchange surface. The rocking action of the blades prevents product build-up on the mutator. The rocking action insures a thoroughly mixed product, efficient heat transfer and low power loss from drag caused by static coatings. The offset cylinder is typically employed with products with a high percentage of insoluble solids such as peanut butter.

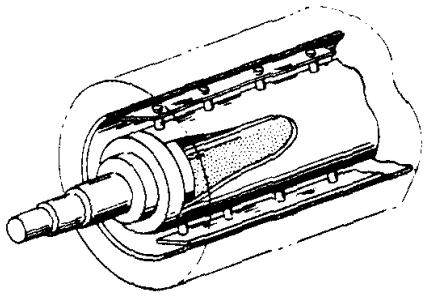


Figure 2-15. Typical Hollow Mutator All Models Except 2"

Mutator Blades

The mutator in figure 2-16 is a standard “648” mutator. There are two rows of two blades.

Many Thermutator processed products require the scraping frequency and product turbulence of only two rows of mutator blades.

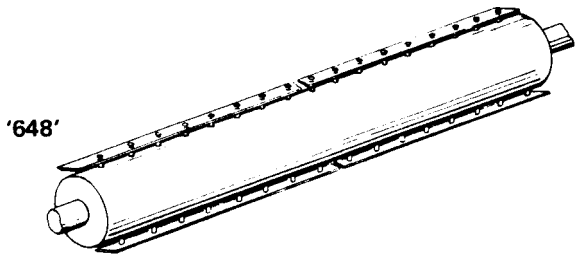


Figure 2-16. Most Common Mutator With 2 Rows of 24" Blades.

Because of product viscosity, four rows of blades are employed on many mutators. Very viscous products cause excessive blade to wall pressures. With, four rows of blades instead of two, the mutator speed can be reduced to reduce the blade to wall pressure and still maintain scraping frequency. The reduced blade pressure means a reduced possibility of scoring the plating on the heat transfer surface. The additional rows of blades maintain the scraping frequency and product turbulence of two rows of blades operating at twice the speed. See figure 2-17.

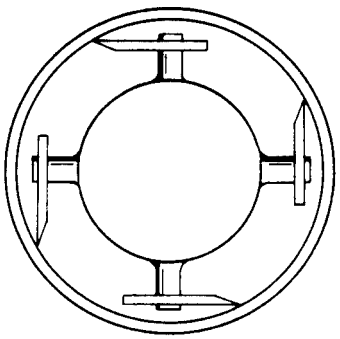


Figure 2-17. 4 Rows of Blades Maintain Scraping Frequency With Reduced Mutator Speed

Mutators with staggered blades are used to process products that require high turbulence, such as pseudoplastic materials like margarine or butter. The “648” mutator in figure 2-18 uses four rows of staggered 12" blades to achieve high turbulence and scraping frequency.

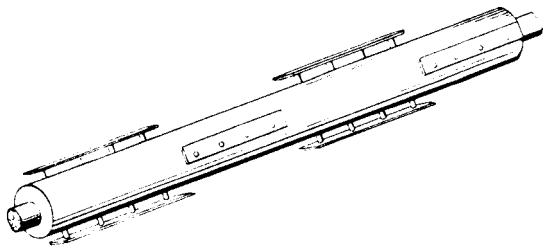


Figure 2-18. A ‘648’ Mutator With Staggered Blades

MEDIA SYSTEMS

Steam media systems feed into the top header of the media tube. The entire area around the product tube is filled with media. Condensate, which naturally forms on the product tube falls away from the tube into the lower header. See figure 2-19. Condensate is prohibited from collecting and flooding the bottom of the media tube, which would cause uneven heating of the product tube.

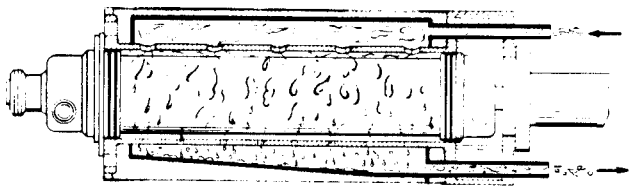


Figure 2-19. Condensate Forms On The Product Tube And Falls Through Holes in The Media Tube Into Lower Header To Prevent Tube Flooding.

Liquid

Liquid media systems feed into either the upper or lower header and follow a spiraling baffle or helix around the exterior of the product tube. This helix guides the liquid at high velocity and turbulence to promote reduction in film resistance. The product enters the processing zone at the end opposite the media entry. This counter-flow design insures heat exchange efficiency.

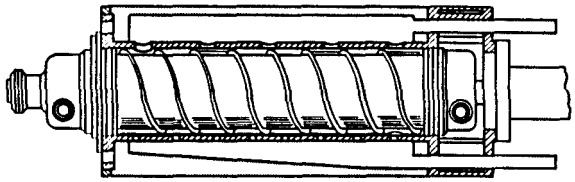


Figure 2-20. Typical Liquid System. Spiral On The Exterior Of The Product Tube Encourages High Liquid Velocity And Efficient Heat Transfer.

Direct Expansion

Direct expansion cooling systems use a vapor type tube equipped-with:

- An External Accumulator
- A Solenoid Valve
- A Pressure Reducing Valve
- An Injector Jet
- A Back Pressure Regulator Valve

Liquid refrigerant is admitted to the accumulator by a float valve and is maintained at a fixed level. Liquid refrigerant also passes through the solenoid valve, expansion valve and the injector jet on the way to the media tube.

The injector acts as a pump, pumping liquid from the accumulator to the cylinder. It is sized to pump slightly more liquid than is evaporated in the cylinder to assure complete flooding of the cylinder.

The back pressure regulator valve controls the evaporating pressure and, therefore, the temperature of the liquid refrigerant in the heat exchange tube.

INSTANT START - INSTANT STOP SYSTEM

Any DE Thermutator may be equipped with the "Automatic Instant Start - Instant Stop" feature.

The "I.S. - I.S." System applies hot gas from the high pressure side of the compressor to the refrigerant in the cylinder to raise the cylinder pressure to a point that prevents freeze-up. The I.S. - I.S. System is used whenever there is a malfunction or stoppage of product normally leaving the Thermutator.

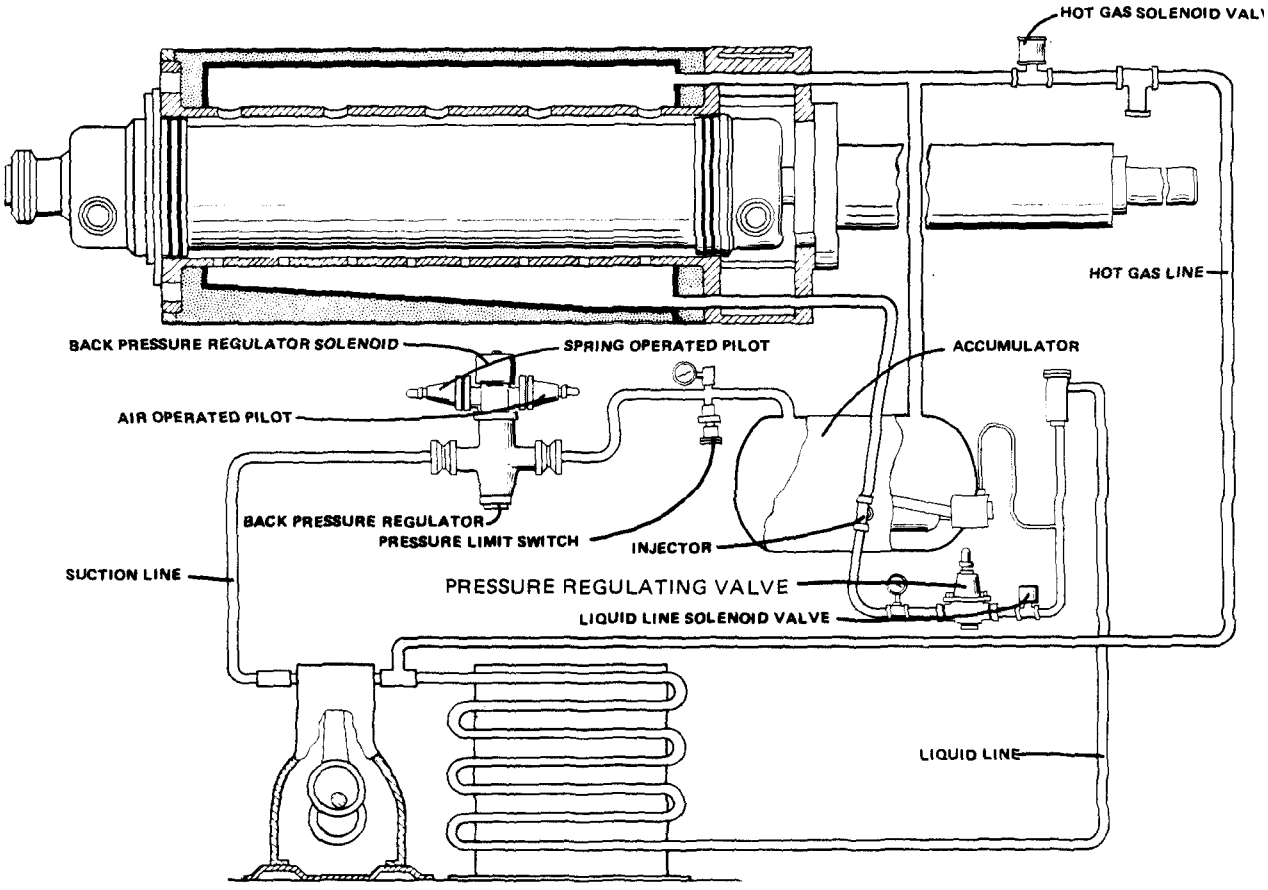


Figure 2-21. Direct Expansion Cooling System

MUTATOR DRIVES

With the Model V or Model H standard size cabinets, the mutator drive is an A.C. electric motor through V belts or V belts and a mutator shaft mounted gear reducer. (See table 2-2 for available drive speeds and HP.) If a variable speed drive is needed with the standard cabinet, a D.C. motor is used.

With Oversize Model H cabinets a mechanical variable speed drive is used with up to 30 HP motors. (See table 2-1 for available drive speeds and HP.)

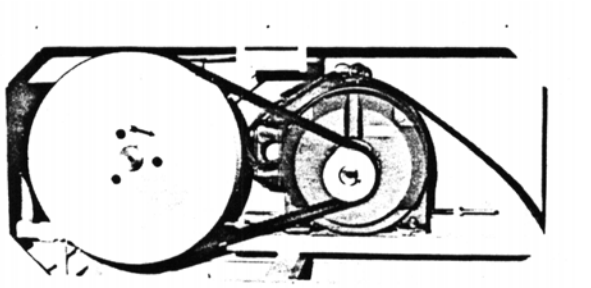


Figure 2-22. Standard V-Belt Drive.

Table 2-1. Available HP and RPM range of variable speed drives in oversize Model H cabinet.

HP	RPM RANGE
25	725 - 121 885 - 111
20	225 - 121 725 - 121
15	898 - 112
10	885 - 111 295 - 37

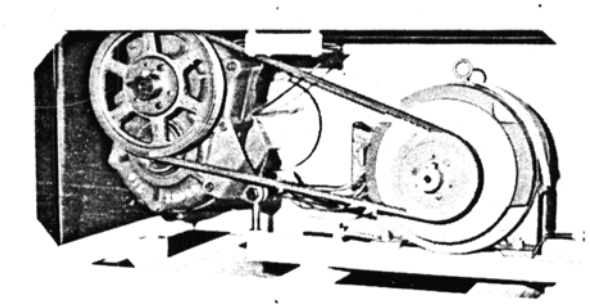


Figure 2-23. Shaft Mounted Gear Reducer Drive

Mutator Speed Limitations

Tables 2-1 and 2-2 indicate the maximum mutator RPM within a motor HP range.

The exceptions to the usual speed limitations are applications such as evaporating milk or concentrating fluids, when the mutator may run as fast as 800 RPM. The mutator, however, is turned backwards in these applications. The blades are used to spread the product rather than scrape the heat exchange surface. See figure 2-24.

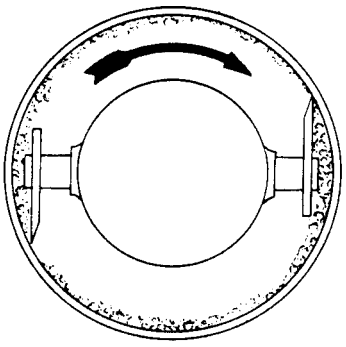


Figure 2-24. in Evaporation Or Concentration Applications, Mutator Rotation Is Clockwise

Table 2-2 Available HP/Drive speed in model V and H cabinets

HP	RPM
30	100* 150* 225* 325* 425*
20	100* 150*
15	100* 125*
15 or 20	225* 325* 425 610
10 or 7-1/2	100* 150* 225 325 425 610
5	325 425 610

*May require shaft mounted reducer or low speed motor.

INSTALLATION

INSPECTION UPON ARRIVAL

Immediately upon receipt of shipment (before the delivery driver leaves), inspect the equipment for damage. Check for a shortage by comparing the equipment received against the shipping papers. If damage has occurred or a shortage exists, record damage or shortage on freight bill and have driver attest by signing.

Unpack the equipment as soon as possible. If, during unpacking, you find concealed damage, hold all packaging material. Call the responsible carrier; have him inspect the damaged equipment and complete an inspection report (a form which is furnished by his company). Since the carrier is responsible for all damage incurred during shipment, file a damage or loss claim with the responsible carrier.

NOTE

We (Waukesha Cherry-Burrell) would appreciate your advising us of any damage or loss claims that you file so that we can assist you as needed.

LOCATING THE THERMUTATOR

The Thermutator should be located on a firm, level foundation. A minimum clearance of 46 inches should be allowed at the rear of the Thermutator for access to the drive mechanism. A minimum clearance must be allowed at the front of the Thermutator so that the mutator can be easily removed and replaced. This minimum clearance at the front should be as follows:

Model 624 Thermutators: 40 inches
Model 648 Thermutators: 65 inches
Model 672 Thermutators: 90 inches

Figures 3-1 through 3-6 give the outline dimensions for the various Thermutator models and cabinet styles. You can use these figures as a guide when selecting a location; however, in addition, you must also consider such factors as the product and media piping to the Thermutator(s), the location of the electrical cabinet, etc.

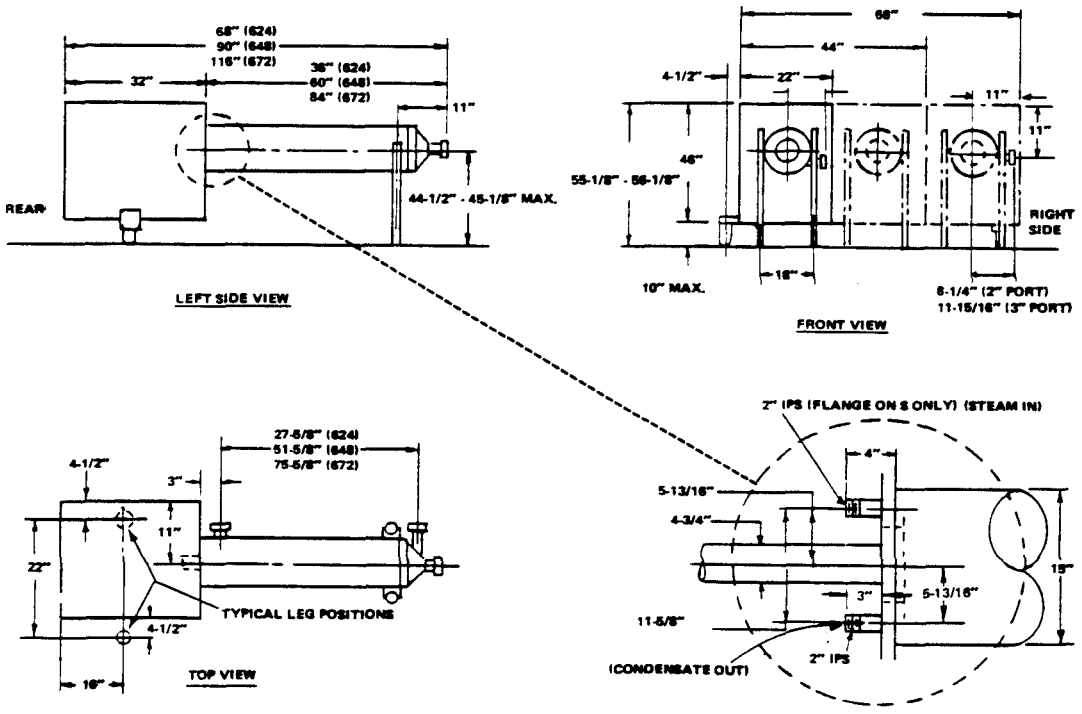


Figure 3-1. Dimensions - Model L and S Thermutators with Style V Cabinet

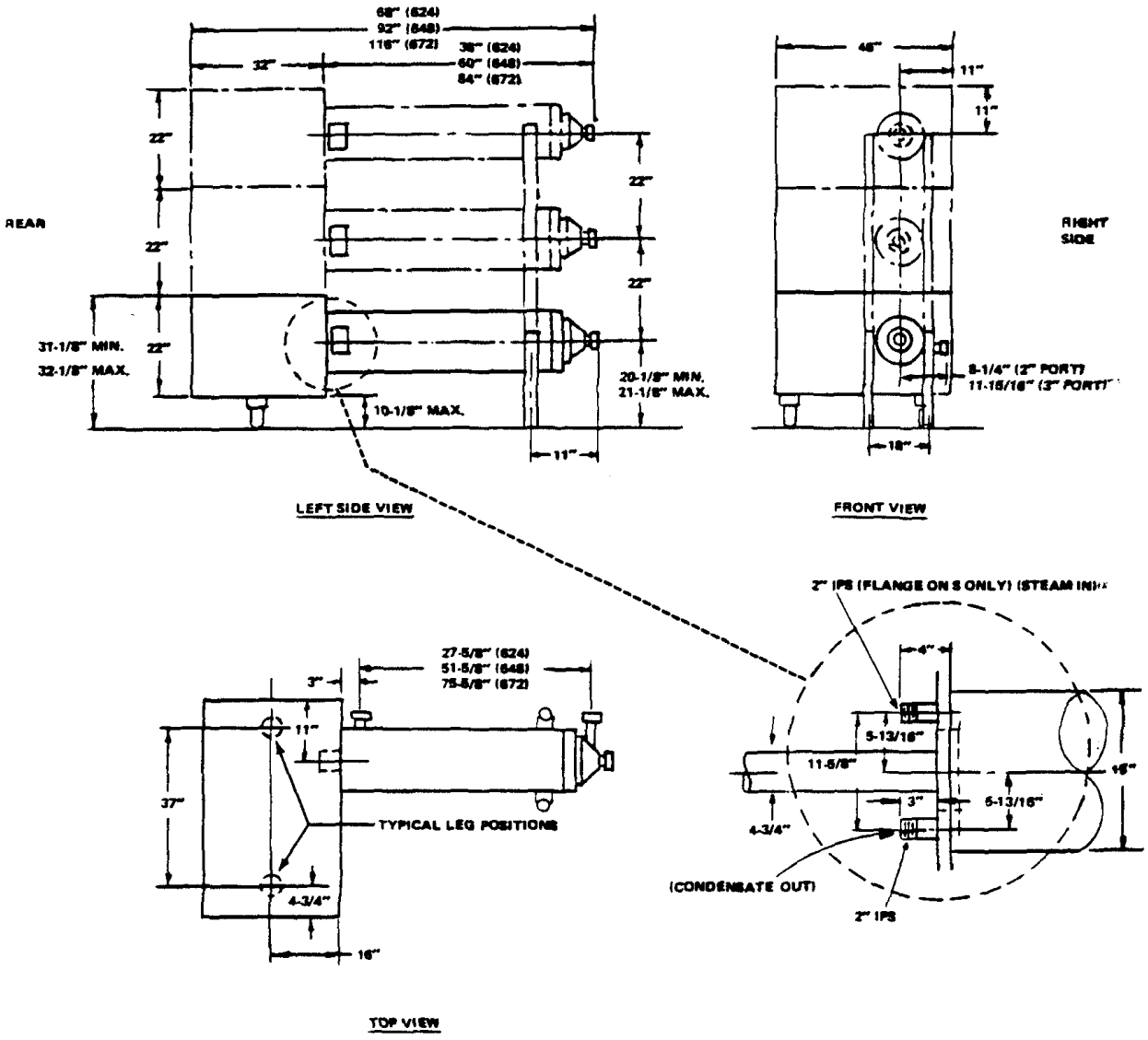


Figure 3-2. Dimensions - Model L and S Thermutators with Style H Cabinet

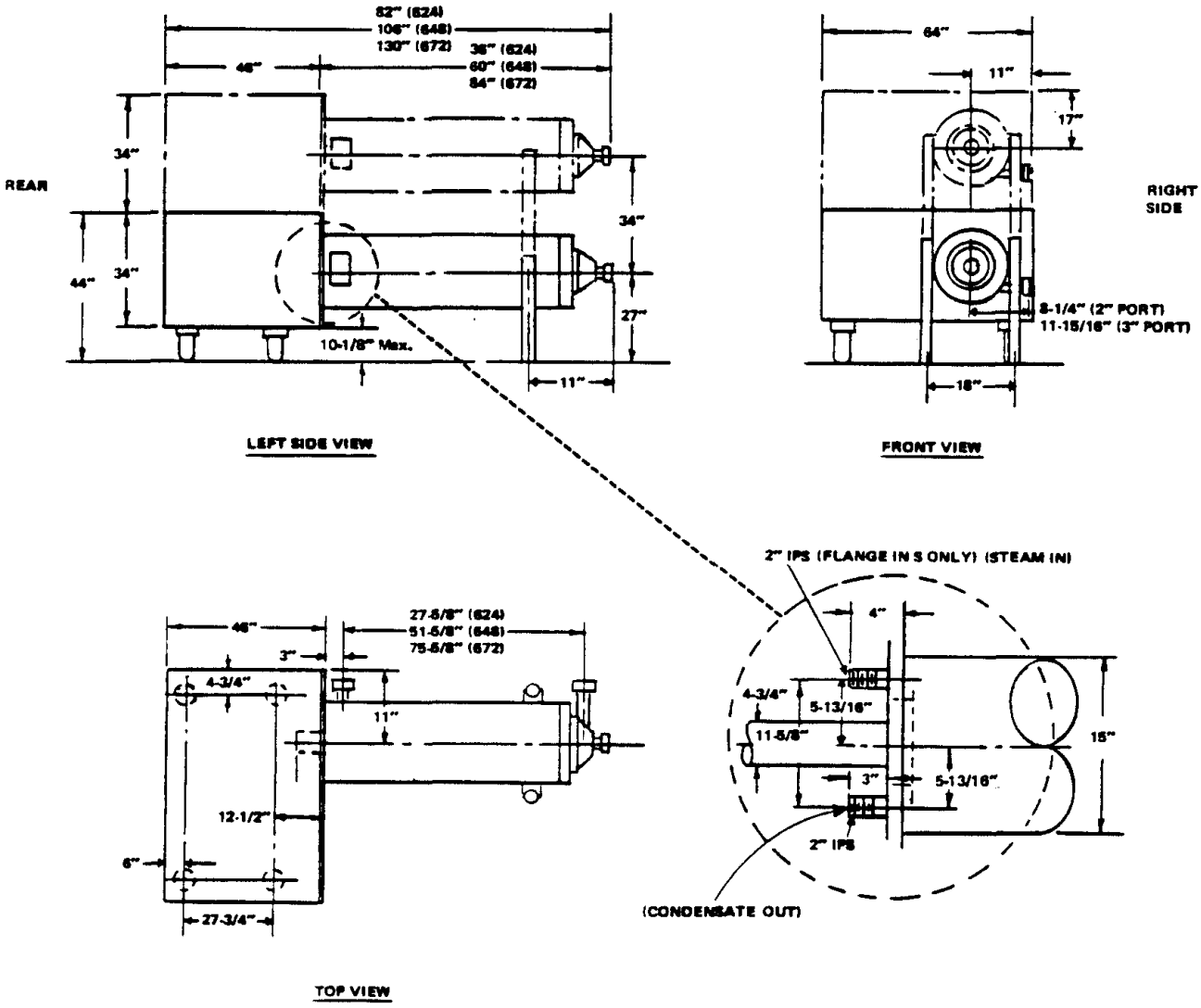


Figure 3-3. Dimensions - Model L and S Thermutators With Style H Oversize Cabinet

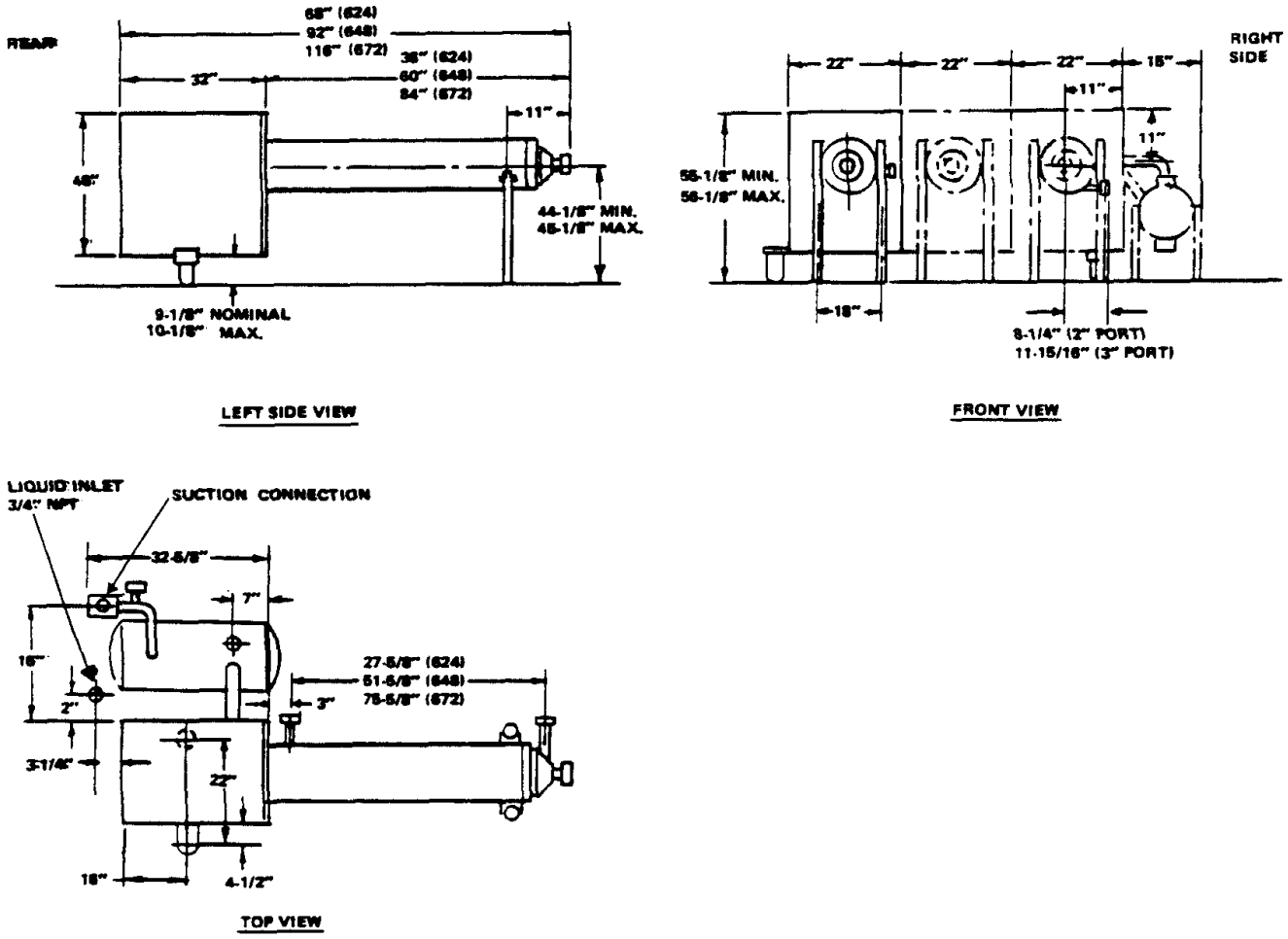


Figure 3-4. Dimensions - Model DE Thermutator with Style V Cabinet

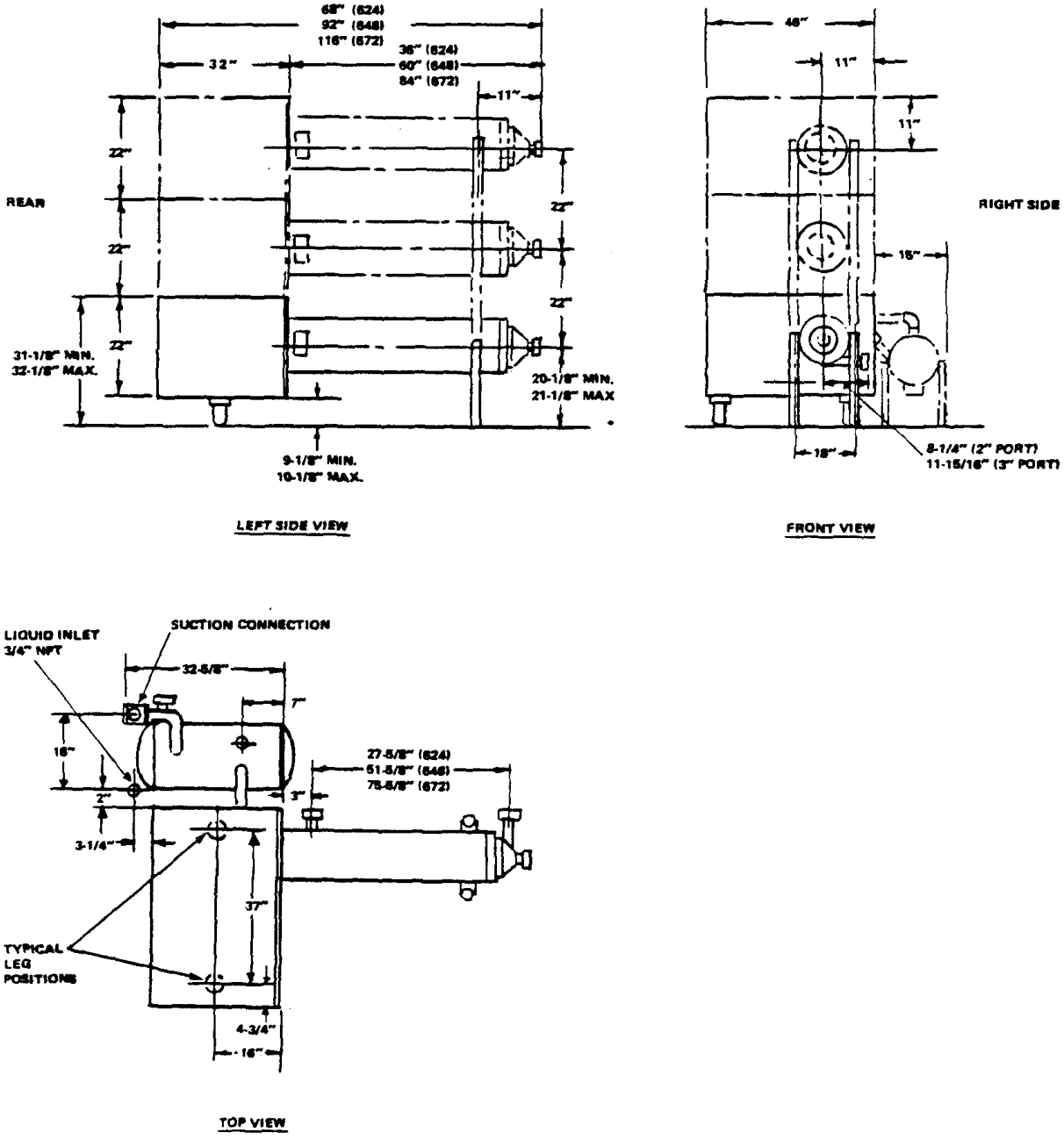


Figure 3-5. Dimensions - Model DE Thermutator with Style H Cabinet

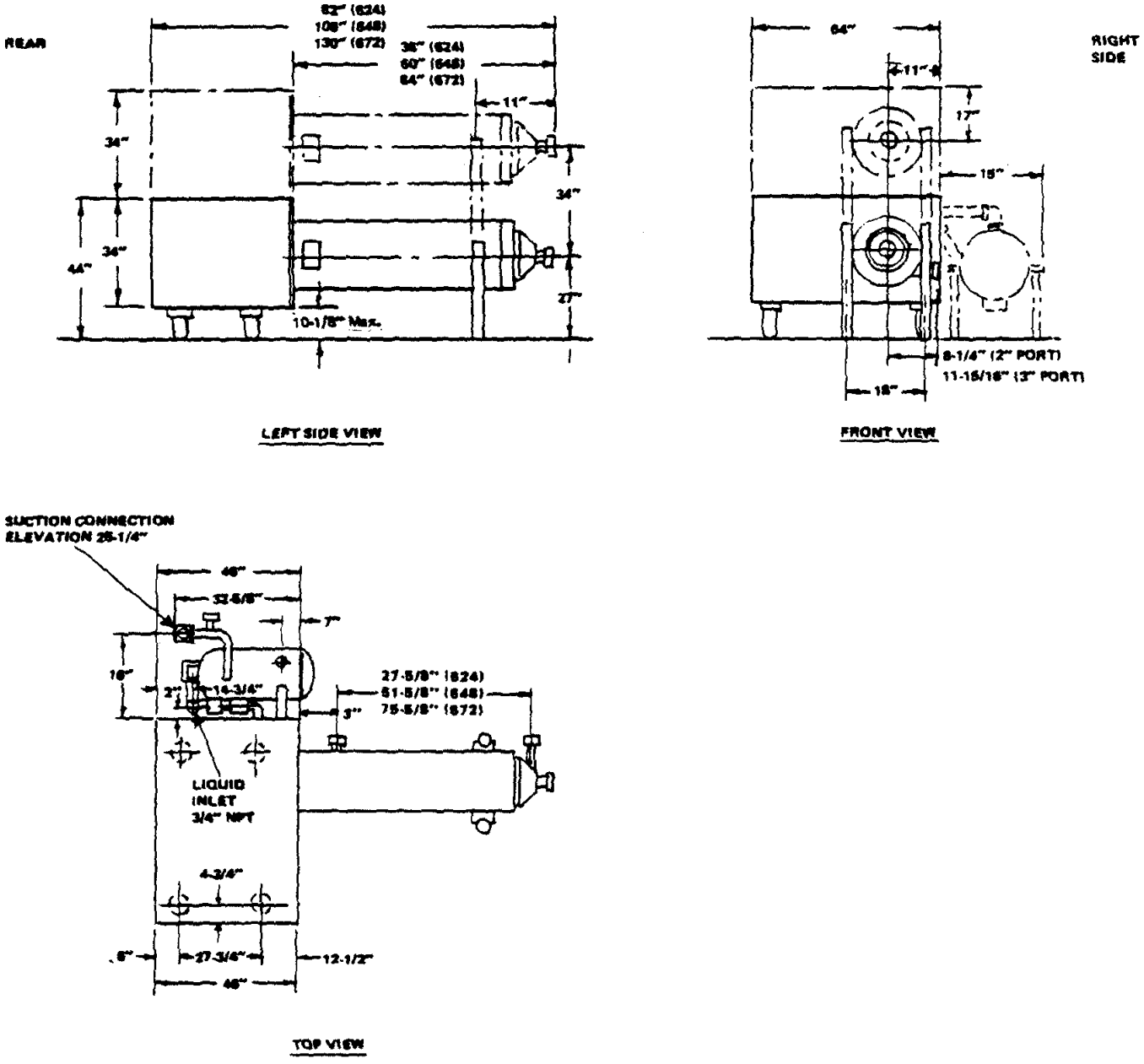


Figure 3-6. Dimensions - Model DE Thermutator with Style H Oversize Cabinet

LEVELING THE THERMUTATOR

The Thermutator should be leveled both lengthwise (along the length of the cylinder) and crosswise (across the width of the cabinet). If the unit is to be cleaned-in-place (CIP'd), the cylinder is not actually leveled; rather, it is set at a specified slope to ensure solution drainage. These instructions are covered under the lengthwise adjustment procedure.

Lengthwise Level

On units that will not be CIP'd:

1. Remove the mutator.
2. Place a level in the heat exchange tube.
3. Adjust the outboard legs to obtain level as indicated by the level in the tube.

On units that will be CIP'd:

1. Remove the mutator.
2. Place an engineers level in the heat exchange tube. The Level should be set for a forward pitch of 1/16-inch per foot.
3. Adjust the outboard legs to obtain level on the engineer's level which is preset to yield a slope of 1/16inch per foot.

Crosswise Level

To obtain crosswise level, place a standard level on a frame member across the top of the machine. Thread the cabinet legs in or out of the cabinet leg couplings until level is indicated. After crosswise level is obtained, recheck the lengthwise level.

ELECTRICAL CONNECTIONS

WARNING

The Thermutator operates off extremely dangerous voltage. All electrical work should be performed by a qualified electrician.

If your Thermutator is to be controlled from a Thermutator Remote Control Panel refer to figures 3-7 through 3-12 for the applicable schematic.

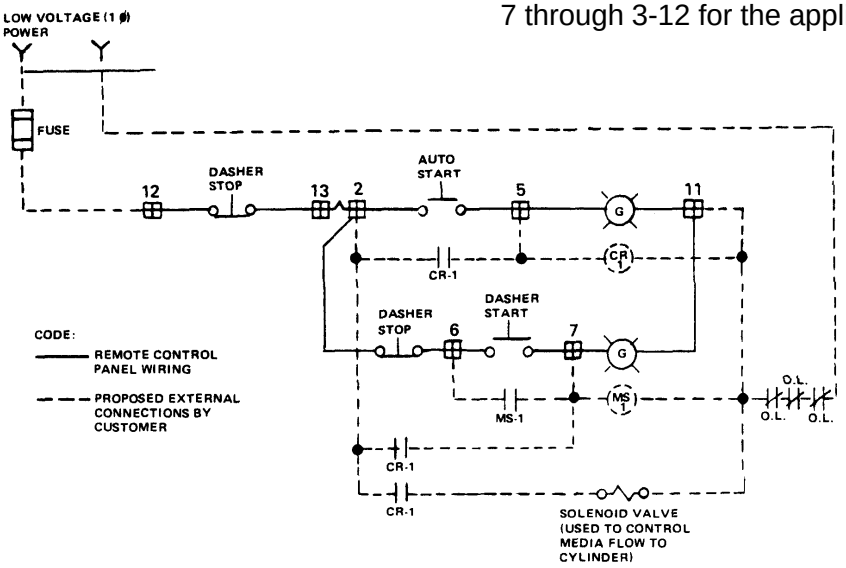


Figure 3-7. Wiring Diagram: Thermutator Control Panel, Steam Or Liquid
(See Figure 3-8 through 3-12 for Remote Control Panel Schematics)

INSTALLATION

In making electrical connections to the Thermutator, you must provide all needed electrical components (line switches, fuses, starters, overload protection, push-button stations, etc.). In selecting these components be certain that they meet the voltage and frequency requirements of your locale. Also, double check to be certain that the drive motor in the Thermutator meets the voltage and frequency requirements of your locale. As a rule of thumb, any motor should be operated at a voltage that is within ±10% of the values stamped on the motor nameplate.

Use figure 3-7 as a guide when making electrical connections to the Thermutator. On all units, it is often desirable to start and stop the product pump supplying the Thermutator with the same controls that start and stop the drive motor. On liquid and steam media Thermutators, you may wish to control media flow (through the use of a solenoid valve) with the Thermutator start/stop control. On aseptic Thermutators, you may wish to have similar control over the flow of liquid or steam to the Thermutator seals.

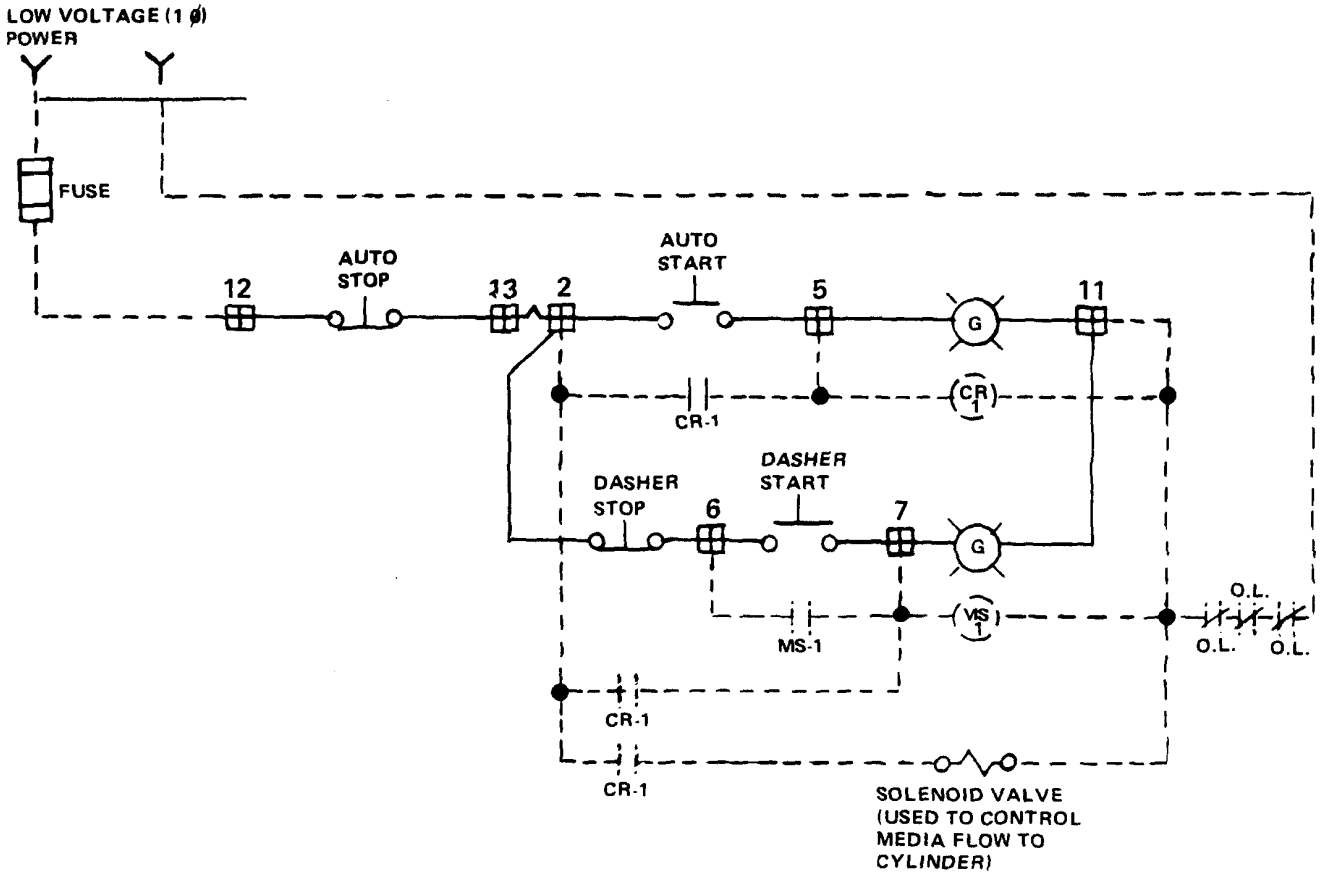


Figure 3 -8. Remote Control Panel For Liquid or Steam Media Thermutator, Schematic Diagram

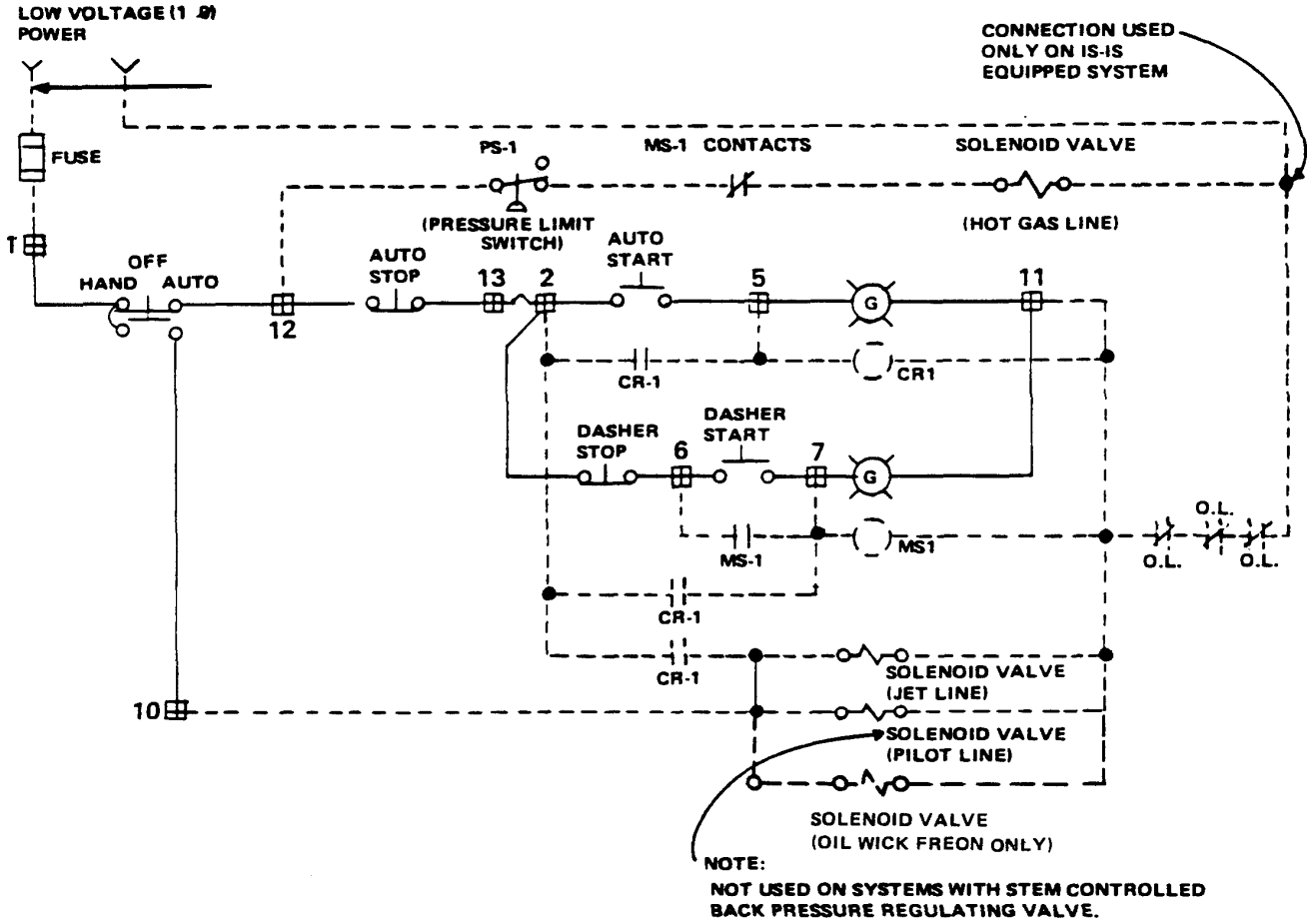


Figure 3-9. Remote Control Panel for Direct Expansion (with I.S.I.S.)
Media Thermutator, Schematic Diagram

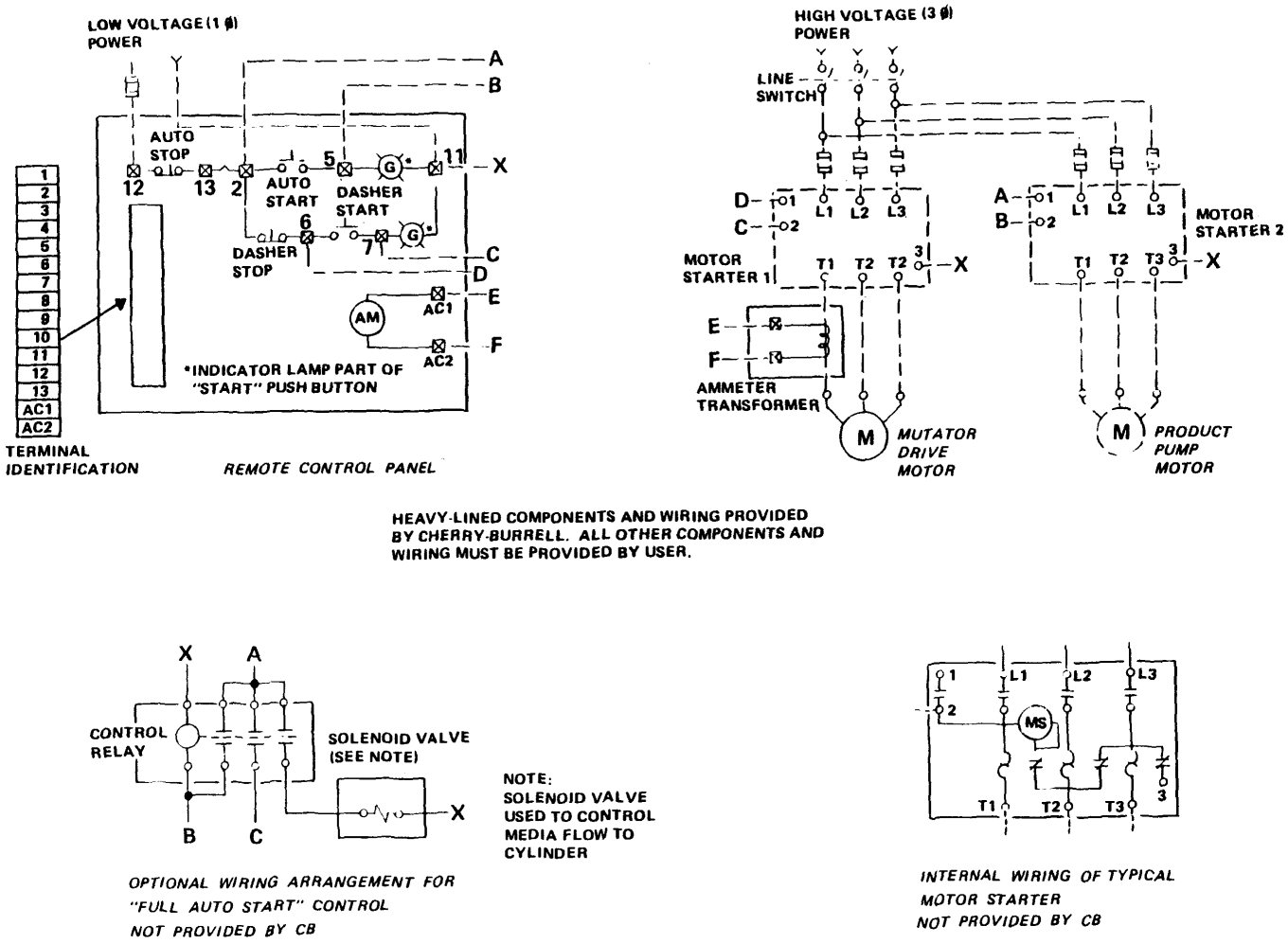


Figure 3-10. Remote Control Panel For Liquid or Steam Media Thermutator, Suggested System Wiring

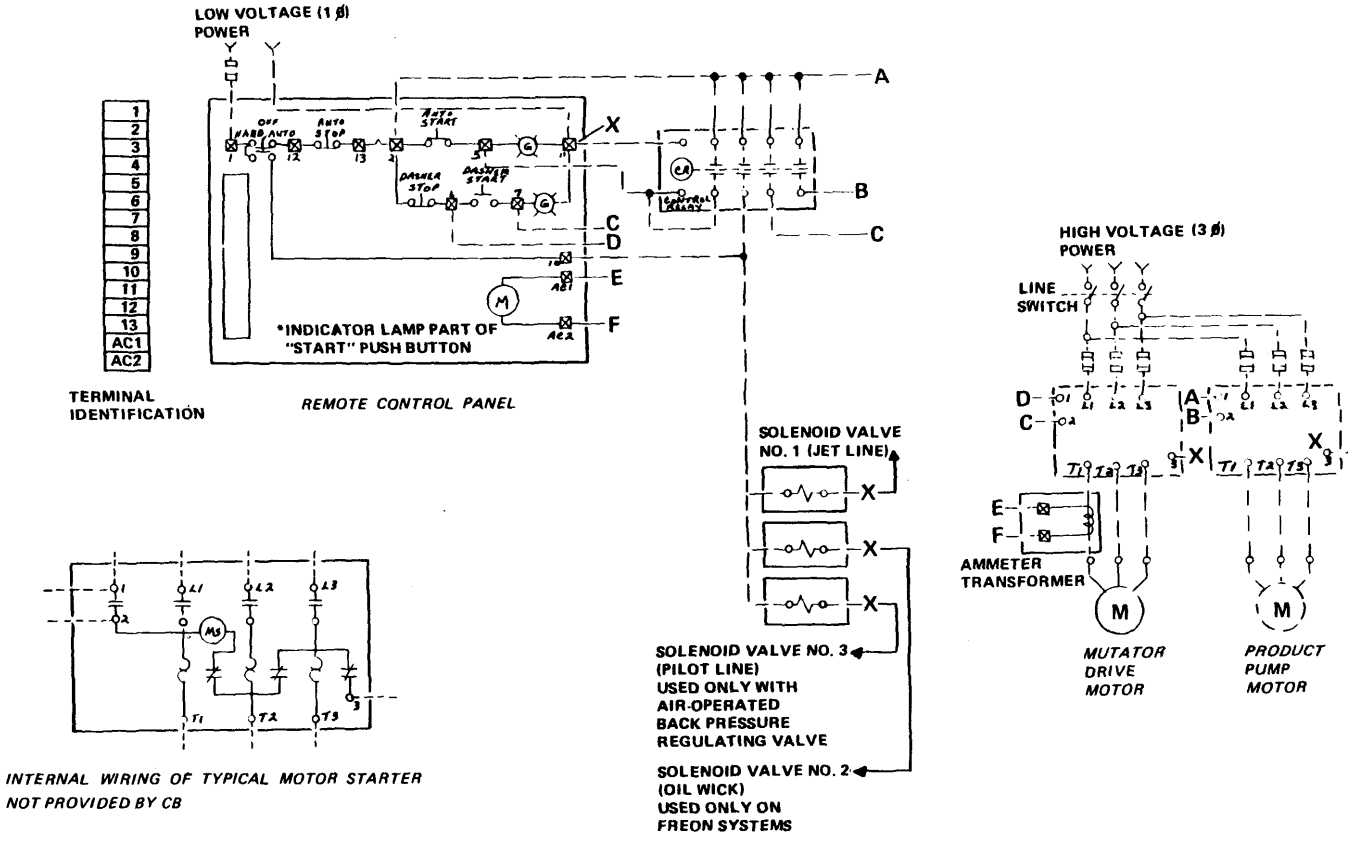


Figure 3-11. Remote Control Of Direct Expansion Media Thermutator, (Without I.S. - I.S.) Suggested System Wiring

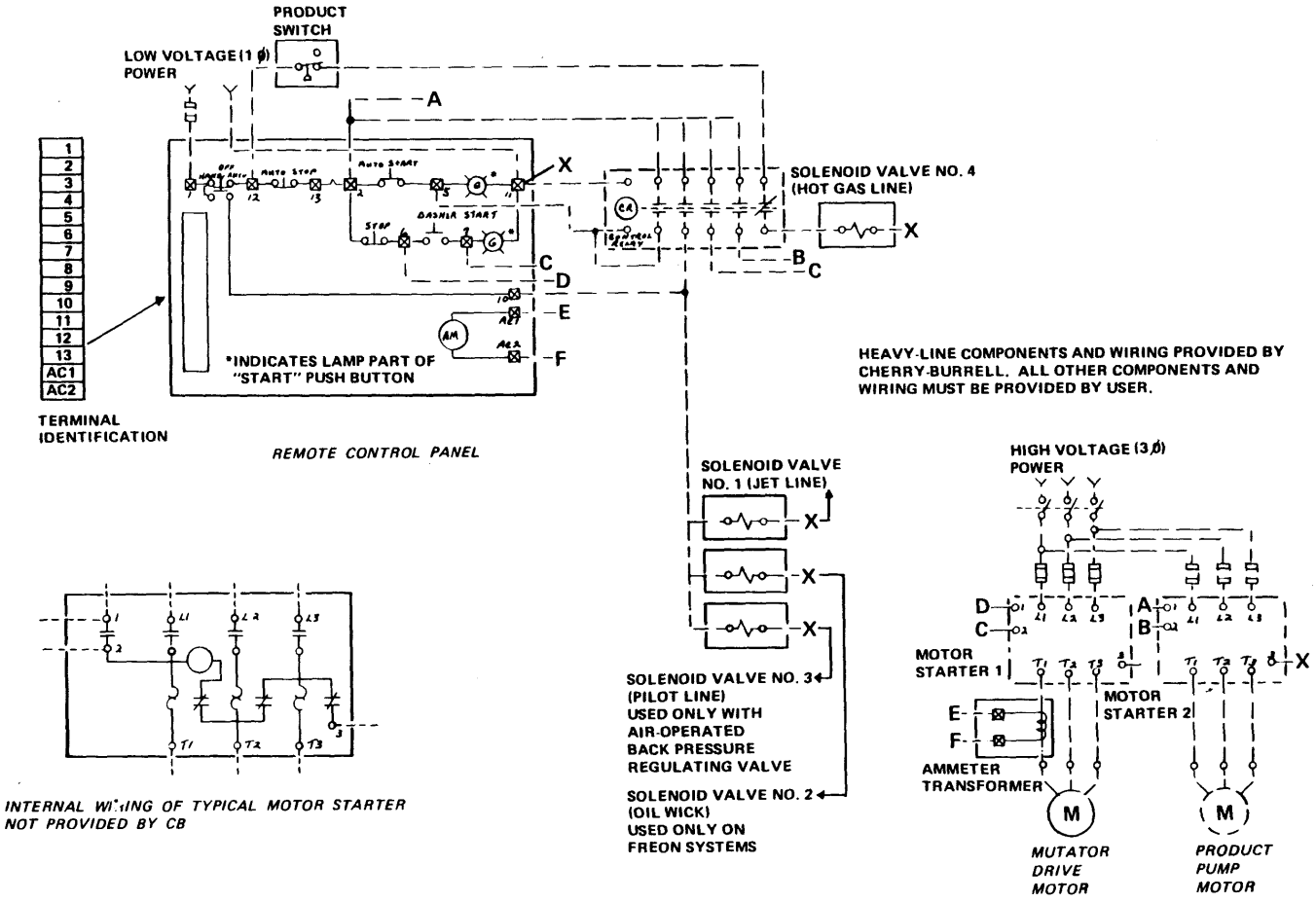


Figure 3-12. Remote Control Of Direct Expansion Thermutator, (With I.S. - I.S.) Suggested System Wiring

MEDIA PIPING

Model L Thermutators

Countercurrent flow of product and media yields the highest rate of heat transfer. If at all possible, countercurrent flow should be utilized. Figure 3-13 demonstrates countercurrent flow in a single Thermutator system. Figure 3-14 shows the use of countercurrent flow in a multi-Thermutator system.

The heat exchange cylinder water connections are 2-inch, threaded male pipes protruding from the rear end of the cylinder. The top connection runs to the front of the cylinder; the lower connection to the rear (see figure 3-13).

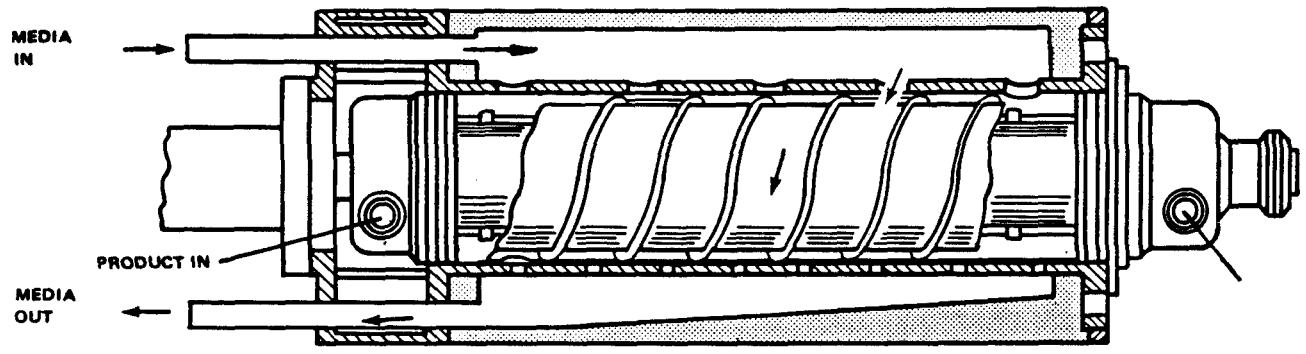
The water piping is usually brought into the cabinet from the bottom. The supply piping can be in either the front or rear of the cabinet, as desired. If it is in the rear, position all pipes so that you can later gain access to both the motor and drive components without moving pipes.

Shutoff valves should be installed where convenient to the operator.

Inside the cabinet use unions liberally so that piping can later be easily disassembled for servicing.

The pipe size will depend upon the volume of water required and is usually given in the machine specifications. On multiple cylinder installations, when so engineered, the same water is often used for more than one cylinder, by piping the cylinders in series.

Since the water passage is a closed system, the water may be returned to a chilling system or cooling tower without using a second pump.



NOTE: ENTIRE CYLINDER MAY BE TURNED 180° FOR CON-CURRENT FLOW.

Figure 3-13. Counter-Current Flow Through a Single Liquid Media Thermutator

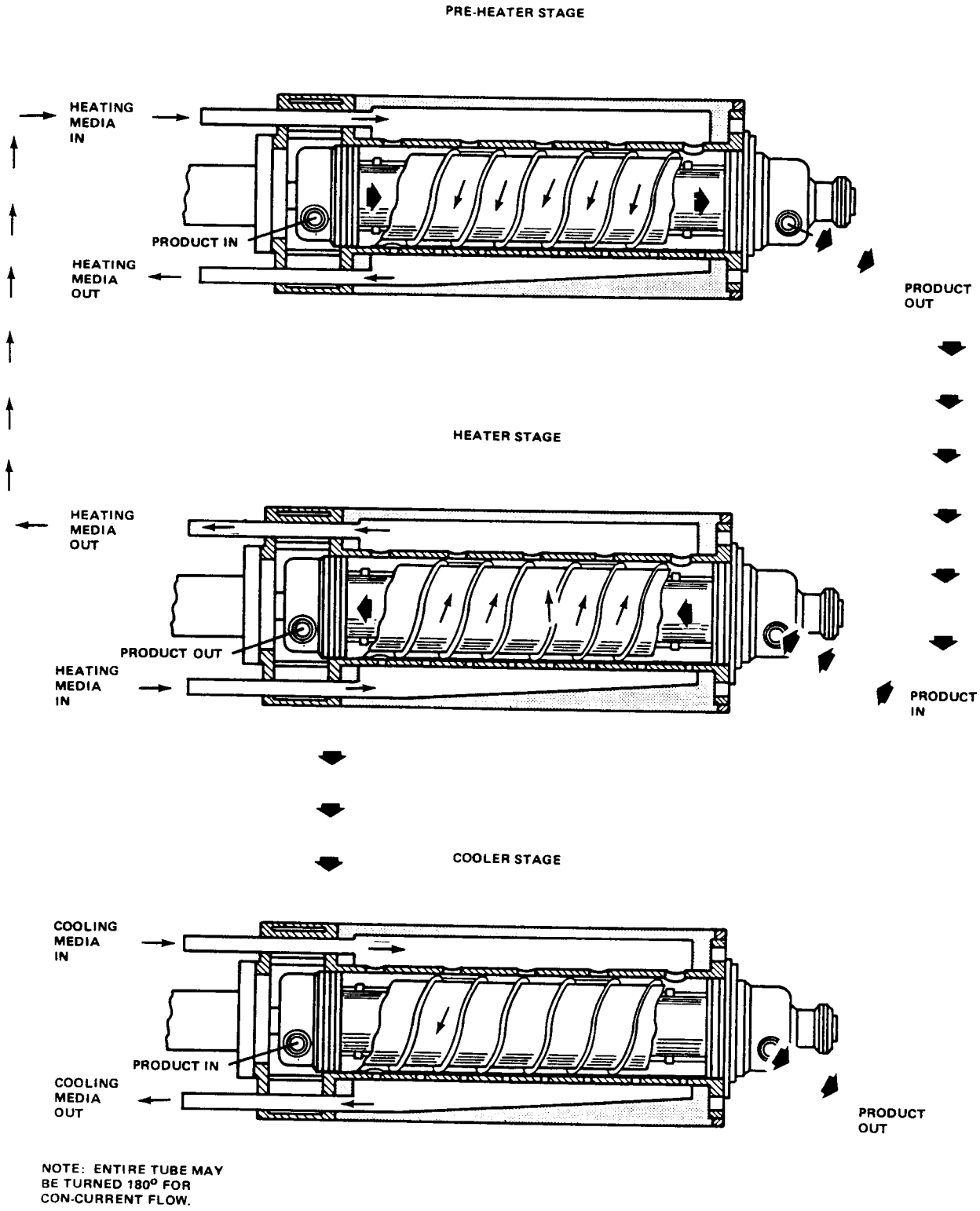


Figure 3-14. Counter-Current Flow through a Multi-Thermutator System (Model L Thermutators Illustrated).

Model “S” Thermutators

WARNING

The temperatures and pressures that exist within a steam system make this type of work dangerous. Only personnel qualified in steam system work should perform the following installation piping.

Connect the steam supply line to the upper pipe on each steam cylinder. This 2" IPS pipe extends from the rear of the cylinder inside the cabinet (see figure 3-1 thru 3-3).

This line should include all the necessary valves, strainers, pressure reducers, temperature controllers, etc., to permit accurate control and uniform operation of the system during high and low capacity product runs.

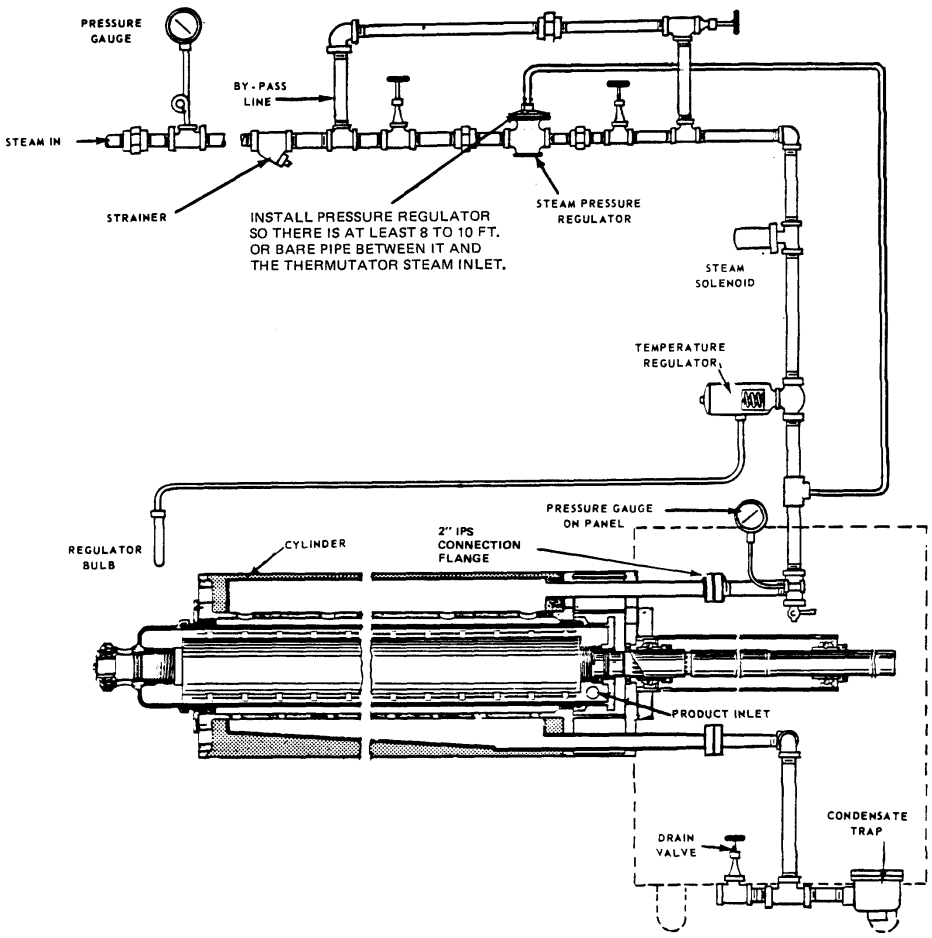


Figure 3-15. Typical Steam System

The steam line and accessories should be selected by someone experienced in similar installations. The proper size will depend upon the maximum steam load, the available steam line pressure and the rated operating pressure in the cylinder.

Following is a list of the details which must be given attention in order to avoid operating problems:

1. Improperly sized steam trap. A trap that is too small or rated for light duty may not be able to handle excess condensate at start-up. Condensate from steam lines may overload the trap causing build-up during the starting of the unit.

2. Improperly located steam trap. A trap which is set too high relative to the cylinder cannot provide complete condensate drainage. Traps must be located lower than the cylinder.

3. Sticking traps. A steam trap that momentarily sticks shut can cause condensate build-up. Protect all traps with scale separators and have regular inspection and maintenance schedules.

4. Always install and use condensate blow-off valves ahead of the steam traps to take care of excess condensate at start-up. Drain condensate before each start-up.

5. Improperly sized condensate piping. Small diameter piping to the steam trap may restrict free condensate drainage and allow build-up.

6. Restrictions in condensate discharge line from the trap. Restrictions caused by pipe size, elevation or condensate return systems can cause build-up in the cylinder.

Connect the condensate drain line to the lower fitting of each steam heated cylinder. Install the condensate trap as far below the lowest cylinder as possible to prevent surging. The trap should be outside the cabinet to prevent condensation of vapor inside the unit where damage to motors can result.

CAUTION

It is vitally important that the condensate system be arranged to assure continuous drainage from the heat exchange cylinder at all times during operation.

Any time that the condensate is allowed to accumulate in the cylinder to a level which partially covers the heat transfer tube surface, uneven heating of the tube will cause it to bow in the center until the blade retaining pins on the revolving mutator scrape the tube wall. The tube interior will be badly scored by the pins and other serious problems can develop. (See figure 3-16).

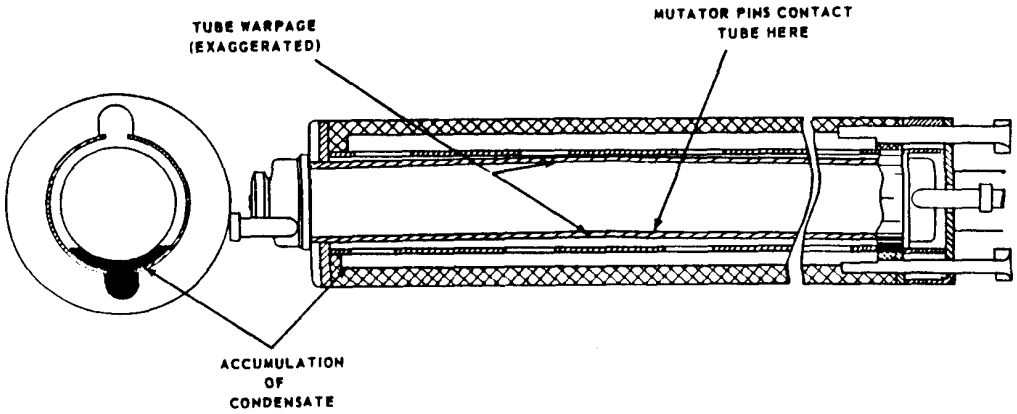


Figure 3-16. Example of Condensate Damage

Since the temperature at which the steam condenses will be determined by the pressure in the cylinder, some type of pressure control should be provided in most installations (see figure 3-15). (Table 3-1 shows equivalent steam temperatures at various pressures.) In installations where the product is sensitive to temperature, the steam line between the regulator and cylinder must be long enough to remove any superheat. Waukesha Cherry-Burrell has complete information on various types of controllers and can assist you in designing a system of steam piping that meets or exceeds the requirements of the Thermutator.

Table 3-1. - Steam Temperature/Pressure Relationships

Temp. *(°F)*	Pressure		Temp. *(°F)*	Pressure	
	Gauge	Absolute		Gauge	Absolute
212	0.0	14.696	255	17.83	32.53
214	0.59	15.29	260	20.73	35.43
216	1.20	15.90	265	23.83	38.53
218	1.84	16.53	270	27.15	41.85
220	2.49	17.19	275	30.68	45.38
222	3.17	17.86	280	34.50	49.20
224	3.86	18.56	285	38.55	53.25
226	4.58	19.28	290	42.85	57.55
228	5.32	20.02	295	47.43	62.13
230	6.08	20.78	300	52.31	67.01
232	6.87	21.57	310	62.98	77.68
234	7.68	22.38	320	74.95	89.65
236	8.52	23.22	330	88.33	103.03
238	9.38	24.08	340	103.29	117.99
240	10.27	24.97	350	119.92	134.62
242	11.15	25.88	360	138.31	153.01
244	12.13	26.83	370	158.63	173.33
246	13.10	27.80	380	181.0	195.70
248	14.09	28.79	390	205.6	220.30
250	15.12	29.82	400	232.55	247.25

Sizing Ammonia Suction Headers and Liquid Supply Lines

1. Determine the total refrigeration load which will be carried in the liquid header and the suction header. This is the sum of the rated capacities of each piece of equipment connected to the headers.

SUCTION HEADER SIZES

MAXIMUM TONS REFRIGERATION FOR AMMONIA MAINS 100' LONG

PIPE SIZE IN.	SUCTION PRESSURE PSIG AND TEMPERATURE DEGREE F							
	1.6" -30°	3.6# -20°	9.0# -10°	15.7# -0°	23.8# +10°	33.5# +20°	45# +30°	58.6# +40°
½				.9	1.2	1.5	2.0	2.2
¾	.9	1.0	1.4	1.8	2.3	3.0	4.1	4.4
1	1.5	2.0	2.6	3.4	4.5	5.7	7.5	8.1
1¼	3.0	3.9	5.2	6.7	9.1	11.5	15.0	16.3
1½	4.3	5.6	7.6	9.7	13.2	16.5	21.6	23.5
2	8.3	10.9	14.5	18.8	25.0	32.0	42.0	45.5
2½	12.8	17.0	22.4	28.0	35.0	50.0	65.0	70.0
3	21.7	28.5	38.0	50.0	66.0	83.0	108.0	118.0
3½	31.2	40.0	54.0	71.0	94.0	119.0	156.0	167.0
4	48.0	62.5	84.0	109.0	144.0	184.0	240.0	258.0
5	77.5	102.0	137.0	178.0	232.0	295.0	385.0	415.0
6	120.0	157.0	209.0	275.0	360.0	460.0	600.0	642.0
8	240.0	313.0	415.0	550.0	715.0	920.0	1200.0	1280.0
10	438.0	570.0	760.0	1020.0	1320.0	1680.0	2160.0	2350.0
12	710.0	925.0	1230.0	1630.0	2120.0	2700.0	2530.0	3750.0
14	1140.0	1500.0	2000.0	2650.0	3400.0	4370.0	5700.0	6050.0

LIQUID HEADER SIZES

MAXIMUM TONS PER 100' LENGH

PIPE SIZE IN.	MAXIMUM TONS
½	20.0
¾	75.0
1	137.0
1¼	245.0
1½	400.0
2	850.0
2½	1475.0
3	2400.0
3½	3500.0
4	
5	
6	
8	
10	
12	
14	

2. The equivalent length of the line is the sum of the pipe length plus the equivalent length of valves and fittings as given in the following table.

EQUIVALENT FEET OF PIPE FOR VALVES & FITTINGS

Line Size	½"	¾"	1"	1¼"	1½	2"	2½"	3"	3½"	4"	5"	6"	8"	10"	12"
Globe Valve (Open)	16	22	28	36	42	57	69	83	99	118	138	168	225	280	335
Angle Valve (Open)	9	12	15	18	21	28	34	42	49	57	70	83	117	140	165
Standard Elbow	2	2	3	4	4	5	7	8	10	12	14	16	20	26	31
Standard Tee	4	5	6	8	9	12	14	17	20	22	28	34	44	56	65

3. Where the equivalent length of suction and discharge lines are other than 100 feet, use the following factors to obtain the maximum tons refrigeration.

Equivalent Length	50'	100'	150'	200'	250'	300'	350'	400'	450'	500'
Factor	1.25	1	.84	.71	.62	.58	.53	.5	.48	.45

Example: A suction line having an equivalent length of 250 feet is desired for a 100 ton plant operating at 0°F and a saturated condition. From the table, a 5 inch line will have a capacity of 178 tons for a 100 foot length. For a 250 Feet line, the factor of .62 applies, this reducing the capacity to .62 or 110 tons.

Model "DE" Thermutators

WARNING

The nature of refrigerant gases and the pressures that exist within the refrigeration system make work on this system dangerous. Only qualified refrigeration personnel should perform Thermutator refrigeration system work.

CAUTION

Sub-Cooled Ammonia Operation is not recommended unless the machine was specially designed for such service and the injector jet and throat were so selected.

LIQUID AND SUCTION LINES

Size these lines according to the product cooling load. Manual shutoff valves should be installed in the liquid, hot gas and suction lines. A scale trap or line filter should be installed in the incoming liquid line.

The Thermutator suction line should not be connected into a suction line or other equipment with a widely or rapidly varying suction pressure. This would cause corresponding variations in product temperature from the Thermutator.

PRESSURE RELIEF VALVE

This valve, which is located on the accumulator, should be piped to atmosphere outside the building. The valve is factory set to relieve at 200 psi. If you want a relief line back to the suction line, it is suggested that a separate line be installed between the accumulator and suction line using a 125 or 150 psi relief valve. Never install a shutoff valve in a relief line.

Table 3-2. Temperature/Pressure Guide For Model DE Thermutators

TEMP. °F	EVAPORATOR PRESSURE-PSIG			TEMP. ° F.	EVAPORATOR PRESSURE-PSIG		
	AMMONIA R-717	FREON R-22	FREON R-502		AMMONIA R-717	FREON R-22	FREON R-502
-45	11.7*	2.7*	2.1	15	28.4	37.9	46.5
-42.1	10.01	0.5*	3.0	16	29.4	39.0	47.7
-40	8.7*	0.69	4.3	18	31.4	41.1	50.0
-37.3	7.0*	1.6	5.	20	33.5	43.3	52.4
-35	5.4*	2.6	6.7	22	35.7	45.5	54.9
-32	3.2*	3.9	8.3	24	37.9	47.8	57.4
-30	1.6*	4.9	9.4	25	39.0	49.0	58.7
-28	0.0#	5.9	10.5	26	40.2	50.2	60.0
-26	0.8	6.9	11.7	28	42.6	52.7	62.7
-24	1.7	8.0	13.0	30	45.0	55.2	65.4
-22	2.6	9.1	14.2	32	47.6	57.8	68.2
-20	3.6	10.2	15.5	35	51.6	61.9	72.6
-18	4.6	11.4	16.9	38	55.7	66.1	77.1
-16	5.6	12.6	18.3	40	58.6	69.0	80.2
-14	6.7	13.9	19.7	45	66.5	76.6	88.3
-12	7.9	15.2	21.2	50	74.5	84.7	96.9
-10	9.0	16.6	22.8	55	83.4	93.3	106.0
-8	10.3	18.0	24.4	60	92.9	102.4	115.6
.6	11.6	19.3	26.0	65	103.1	112.2	125.8
.4	12.9	20.9	27.7	70	114.1	122.5	136.6
- 2	14.3	22.5	29.4	75	125.8	133.4	148.0
0	15.7	24.1	31.2	80	138.3	145.0	159.9
2	17.2	25.7	33.0	85	151.7	157.2	172.5
4	18.8	27.5	35.0	90	165.9	170.0	185.8
6	20.4	29.2	37.0	95	181.1	183.6	199.7
8	22.1	31.0	39.0	100	197.2	197.9	214.4
10	23.8	32.9	41.1	105	214.2	212.9	229.7
12	25.6	34.9	43.2	110	232.3	228.6	245.8
14	27.5	36.9	45.4				

*Vacuum in Inches Mercury

OPERATION

The start-up, shutdown, and cleaning procedures outlined in this section should be considered as operating guides only. In some instances, these procedures can be used verbatim. In many instances, you will have to devise procedures that are tailored to the product that you are processing.

PRE-START-UP CHECK

Before starting the Thermutator, perform the following checks:

1. Check to insure that Thermutator is properly assembled and that all product line connections are tight.

2. Check media source to insure that media is at the correct pressure and temperature and that the supply will be adequate during operation.

3. Check to insure that an adequate supply of product is ready to be pumped to the Thermutator. If product must be supplied at specified temperature, check temperature for accuracy.

4. If Thermutator is equipped with steam or water flush seals, open supply valve to seals. Steam or water pressure not to exceed 15 psi.

5. On Model DE Thermutators only:
   (a) Be sure that main suction line valve is fully open.
   (b) Be sure that main liquid line valve is fully open and that the accumulator has filled to the float level.
   (c) Check to determine if compressor is operating at proper back pressure.
   (d) If an automatic back pressure valve is used, be sure compressed air supply to valve is open.

NOTE

Accumulator float valve stems are turned completely in, to limit vibration during shipping. The valve stem must be opened at start-up.

PRE-PRODUCTION RUN STERILIZATION

NOTE

The following information is not applicable to aseptic Thermutators. Special aseptic sterilization procedures should be used with aseptic units.

The interior of the Thermutator heat exchange tube, the mutator, the end caps, and the product piping leading to the Thermutator may be sterilized just prior to a production run.

CAUTION

Sterilization can be accomplished either by circulating 180°F hot water for 20 minutes or by using a bactericidal solution followed by a cold water rinse. If a chlorine solution is used, it should not be stronger than 50 PPM at 75ºF and should not be in contact with the Thermutator surfaces longer than 10 minutes.

CAUTION

After hot sterilization, the mutator should not be started until the heat exchange tube is completely drained or is completely filled with product or water. If part of the tube is hot and part cold, uneven expansion of the tube can result causing warping. If the mutator is operated with the tube warped, the interior of the tube will be badly damaged.

OPERATION

START-UP PROCEDURE

1. Start flow of product to Thermutator.

CAUTION

Do not perform step 2 until tube is completely filled with product and all surfaces of the tube are at the same temperature.

2. Start mutator drive motor.

3. On Model L Thermutators - after flow of product from Thermutator is steady, open media valve(s) and adjust flow rate to obtain desired product temperature.

   On Model S Thermutators - after flow of product from Thermutator is steady, open steam valve. Immediately open the bypass valve at the trap so that all condensate will be rapidly drained.

   On Model DE Thermutators - after flow of product from Thermutator is steady, open Liquid Line Solenoid Valve. Adjust Back Pressure Regulating Valve to obtain desired operating temperature (see table 3-2).

4. If product holdback valve is used, adjust valve to obtain desired pressure in the tube (internal pressure should not exceed 400 psi).

SHUTDOWN PROCEDURE

General

The procedure for shutting down a Thermutator (either during or after a production run) must be tailored to the product being processed. Special procedures should be constructed for emergency shut downs. Where product characteristics permit, it may be sufficient to simply stop the product pump, the mutator, and the flow of media. In other cases, especially where the product goes directly from the Thermutator to a filler, it may be necessary to provide a surge tank or a recirculation line. In some continuous operations (i.e. heating certain candies), it may be necessary to have a steam line connected into the product line so that steam may be used to soften and remove product in the tube at shut down. In many food operations, hot water is used to “chase” product from the tube at the end of a run.

Model “DE” Thermutator WITHOUT Instant Start-Instant Stop

The procedure to follow is shutting down a Model DE Thermutator either during or after a product run is dependent upon the characteristics of the product being processed; however, if the product holds its viscosity, the following suggested steps can be used:

1. Close the Liquid Line Solenoid Valve to stop refrigerant circulation.

2. Stop product flow to Thermutator (or proceed with follow-up solution rinse).

3. When product or rinse flow stops, stop mutator drive motor.

4. To prevent icing, increase refrigerant back pressure to above the product freezing point.

5. Close stop valve in liquid line to Thermutator.

OPERATION

Direct Expansion Media System Check

The following procedure checks for refrigerant leaks at the Thermutator cylinder and refrigeration system and at the media connections and piping to the Thermutator.

1. Close the shut-off valve in the main suction line.

2. Momentarily crack open main liquid line valve to allow pressure in system to build to 5 psig (as indicated on back pressure gauge). Close valve.

3. Check interior, front and back of Thermutator cylinder for leaks. Check all components and piping in Thermutator refrigeration system for leaks. Check all media piping and connection to Thermutator for leaks.

4. Open main liquid line valve and allow system pressure to build to 30 psig. Close valve.

5. Repeat all checks of step 3 with applicable refrigerant leak detector device.

6. Purge system of refrigerant used for leak test. It is desirable to purge the refrigerant used during the leak test into the atmosphere rather than pull the gas back into the system. By purging this gas, some of the air that's drawn into the system when the valve is first opened is removed from the system thus minimizing the amount of air trapped in the system. If the gas is purged into a bucket of water at the accumulator purge valve, the purging can be accomplished with a minimum of objectionable fumes. Be sure to close the accumulator purge valve after purging.

7. Open the shut-off valve in the main suction line.

GENERAL

If the Thermutator(s) is the only piece of equipment connected to a condensing unit and frequent shutdowns or changes in load are expected, provision for such load changes must be included in the condensing unit controls.

It is desirable to utilize a suction accumulator (or some type of liquid return system) with the condensing unit in order to minimize the possibility of liquid refrigerant returning directly to the compressor.

PRODUCT PIPING

Connect product infeed and discharge lines at front and rear inlet/outlet assemblies. Unless special fittings were ordered, all connections are Waukesha Cherry-Burrell I-type sanitary fittings. Use full or oversize pipe on lines leading to and from the Thermutator. The use of a product holdback valve is recommended. In addition, a sanitary pressure gauge should be installed at the inlet to the Thermutator to measure feed pressure to the unit. Other pressure gauges and temperature measuring devices should be used freely to provide the required degree of product monitoring.

The direction of product flow through the Thermutator is optional; however, it is normally most convenient to have the product enter at the rear of the tube and exit at the front.

INSTALLATION CHECK PROCEDURE

Scraper Blade Bevel Check

NOTE

On new machines, either (1) remove tapesecuring scraper blades to mutator; or, if blades not shipped installed, (2) install blades on mutator (installation instructions covered in later Par.).

Check to see that beveled edge of each scraper blade is correctly oriented as shown in figure 3-17.

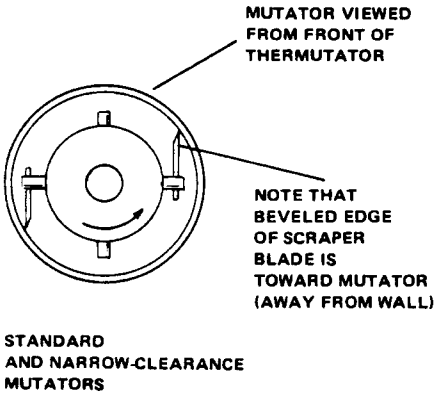


Figure 3-17. Correct Direction of Mutator Rotation

Mutator Rotation Check

Using “ON” or “START” button at pushbutton station (or “DASHER START” button on Remote Control Panel), momentarily start mutator and observe direction of rotation (as viewed from front of Thermutator). Direction of rotation should agree with that shown by arrows in figure 3-17. (If direction of rotation is opposite that shown, have qualified electrician reverse any two of the three leads connected to the mutator drive motor.)

Liquid or Steam Media System Check

The following procedure checks for media leaks at the Thermutator cylinder and the media connections and piping to the cylinder.

1. If a media pressure gauge is not already a part of the system, install one at the media inlet of the cylinder before proceeding.

2. Close off media return line from the Thermutator.

3. Crank open the media inlet valve and let the pressure in the system build to 5 lbs. Close the valve.

4. Check interior, front, and back of cylinder for leaks. Check all piping connections for leaks.

5. If leaks not detected in step 4, open inlet valve and let system pressure build to 40 or 50 lbs. Close valve.

6. Repeat checks of step 4.

7. On steam media Thermutators, drain condensate from cylinder.

Model "DE" Thermutator with Instant Start - Instant Stop

NOTE

Details on the Instant Start-Instant Stop System can be found in the introduction section of the manual.

1. Push the AUTO STOP button.

2. Push the stop button for the product pump. (On some installations, the controls may be wired so that the product pump stops when AUTO STOP button is pushed).

3. Push the DASHER START button.

4. Check BACK PRESSURE gauge for correct defrost back pressure indication.

5. When product or rinse flow stops, push DASHER STOP button. Close liquid and hot gas line stop valves.

MANUAL (Hand) CLEANING PROCEDURE

Rinsing

Remove all product piping (including product hold back valve, if used).

Place hose against fitting at either front or rear inlet/outlet assembly, and rinse out remaining product by running water (or appropriate solutions) through the heat exchange tube. Rinse first with warm (90° to 125°F) water or solution. (It may be desirable to allow the mutator to run for a few seconds during the warm water rinse to help loosen particles that might be adhering to the unit.) Follow-up with a cold water rinse.

Dismantling and Washing

1. Remove front product inlet/outlet assembly and mutator as described in the Maintenance Section of this manual.

2. Remove scraper blades from mutator. Thoroughly wash each blade. Allow to air dry.

NOTE

Place mutator on mutator wash rack while performing step 3.

3. On mutators with mechanical rotary seals, disassemble seals.

   On mutators with O-ring seals, remove O-rings from mutator.

   Thoroughly scrub mutator. Be sure to remove all particules from pin grooves, O-ring seal grooves, etc.

   Rinse all traces of cleaning solution from mutator. Allow mutator to air dry (do not wipe dry).

4. Clean the front product inlet/outlet assembly.

5. Wipe the front mutator bearing assembly and its housing with a dry cloth.

6. Remove the rear product inlet/outlet assembly. Wash, rinse and allow to dry.

7. Thoroughly brush the interior of the heat exchange tube. Rinse and allow to dry.

NOTE

It is recommended that a shield be improvised to cover the mutator drive spindle. This shield should prevent water entering the spindle while the tube is being cleaned and rinsed.

IMPORTANT NOTE

Do not assemble Thermutator parts immediately after washing and rinsing . Allow disassembled parts to dry overnight. This eliminates the possibility of electrolytic corrosion and allows the stainless steel to renew its corrosion resistant protective surface film.

CIP CLEANING

Thermutators in a system can be cleaned by CIP methods if proper procedures are followed. The procedures must include consideration of:

- Solution flow rate
- Mutator operation
- Cleaning compounds
- Direction of flow
- Draining and drying
- Inspection procedures

Failure to consider the above may result in inadequate cleaning and/or damage to the heat transfer tubes from chemical attack.

Use the following guidelines in establishing your own CIP program.

FLOW RATE

The rates of flow of CIP solutions and rinse water should be established based on the minimum flow rates required to clean the pipelines in the system but in no case be less than 65 GPM. See Table #1.

Table 1 - Flow Rate Required for 5 Ft./Sec. Velocity in Sanitary Tubing.

Sanitary Pipe Size	Flow Rate Required
2”	45 GPM*
2½”	69 GPM
3”	100 GPM
4”	180 GPM

*Insufficient velocity to clean Thermutator.

Mutator Operation

The flow rates noted in the table will produce an average velocity of 5 Ft./Second in the indicated tube size. The average velocity inside the Thermutator is dependent upon the flow rate and mutator’s size. The velocity and turbulence necessary to clean the Thermutator is obtained by running the mutator in reverse during all wash and rinse cycles.

Use Table 2 to determine the % of time that the mutator should be in operation to achieve through cleaning.

Running the mutator promotes cleaning. Running it in reverse avoids excessive wear on the blade and the product tube.

TABLE 2 - percent of time mutator should operate in reverse during CIP.

Mutator Diameter	Minimum % of Time Mutator Should Run
2¼”	100%
3½”	75%
4½”	50%
5½”	25%

Cleaning Compounds

The selection of cleaning compounds and CIP procedures should be done with the assistance of your cleaning compound representative. Your CIP program should be capable of completely removing all soil without causing corrosion damage to the system.

Complete removal of all soil is important. Residual soil on the metal surfaces can trap cleaning chemicals where they may cause pitting in the metal surface.

The product contact surfaces in Thermutators are eight 304 and 316 stainless steel except the Heat Exchange Tube. Tube materials are dependent upon the application and must be considered when selecting cleaning compounds. Use the following guidelines:

Chrome plated nickel tubes may be cleaned using normal dairy cleaning compounds and procedures. Never use acid cleaning solutions! Acid cleaners and acid products will attack the base nickel and cause the plating to flake off.

Unplated nickel and Waukesha Cherry-Burrell Dimetallic tubes may be cleaned using normal dairy cleaning compounds and procedures. Use acid cleaners only when necessary. When acid cleaners are necessary, use only phosphoric base materials. Minimize concentration, temperature and exposure time. Acid products and cleaners will produce an etched surface in unplated nickel tubes and Waukesha Cherry-Burrell Bimetallic tubes. Occasional rehoning will restore the smooth surface.

Stainless steel tubes may be cleaned using normal dairy cleaning compounds and procedures. This material is unaffected by normal dairy acid or caustic cleaning solutions.

CAUTION

Never use strong acids such as nitric, sulfuric or hydrochloric in any Thermutator regardless of tube material.

Direction of Flow

Cleaning solutions must enter the system at the lowest point and exit from the highest point. The system must be totally flooded and free of air pockets. Use a holdback valve to maintain a positive pressure in the Thermutator during CIP.

CAUTION

Never use the Thermutators in the system to heat CIP solution.

Draining and Drying

Drain the Thermutators completely at the end of the final rinse cycle. Expose all surfaces to the air for drying. Failure to drain and air dry the Thermutator will result in tube damage.

Inspection

Open and inspect each Thermutator weekly. Remove the mutators and inspect the blades, shaft seals and O-rings. Inspect all surfaces to ensure that soil has been completely removed and that there is no corrosion damage. If corrosion damage is noticed, take corrective action at once.

CORRECTING OPERATIONAL PROBLEMS
Poor Heat Transfer

First, check to insure that the product entry temperature, media entry temperature, and product and media flow rates are all in agreement with the specifications set forth in the processing program.

Second, check the mutator scraper blades for wear. (These blades should be examined weekly or after each 40 hours of operation.) If the blades are worn, they will not effectively scrape the tube interior and poor heat transfer will result. Replace or renew the scraper blades as needed.

Third, check the tube interior for baked-on or frozen on product. If such a condition exists, it may have been caused by worn blades or possibly by operators error (i.e. steam or refrigerant applied before the mutator was turned on). Clean the tube interior, replace or renew worn blades if necessary, and/or correct operating procedure.

Fourth, check the exterior of the heat exchange tube for accumulations of dirt or mineral scale deposits. (Tube removal and cleaning instructions can be found in the maintenance section of this manual.)

Motor Overload

Drive motor overloads may be worn scraper blades (failure of the blades to scrape properly) or to the stopping or starting of the machine on products that become more viscous when permitted to remain stationary. (See above paragraphs for information related to worn blades.) To prevent motor overload with viscous products, it may be necessary to pump relatively warm product through the Thermutator before starting the mutator and flow of media after the product pump and mutator have been temporarily stopped.

Regardless of the cause of a motor overload, do not run the mutator if the V-belts are slipping or squealing. If the mutator would completely stall, the V-belts would be ruined in seconds.

HOW TO PREVENT TUBE SCORING

Thermutator operators have scored the center area of heat exchange tubes by allowing sudden temperature changes affecting only one side of the tube to occur. An example is the pumping of cold product into a tube that is still hot following cleaning or sterilization. The top half of the tube is hot (expanded) while the bottom half is cool (contracted). As a result, the tube bows in the middle allowing the mutator pins to touch the tube walls. If the mutator is started while the tube is bowed, the mutator pins will badly score the tube interior.

Several of the more common causes of tube warpage are:

1. Sterilizing water or solution left in the tube. After sterilization is complete, the tube must be completely drained or completely filled with product before the mutator is started.
2. Poor condensate drainage on steam media cylinders. The steam trap must be large enough to carry away all condensate from the tube, as the condensate line should be opened during initial start-up.
3. Turning on the media when the tube is only partially filled with product. This problem can be overcome by recirculating product through the tube until all parts of the tube are at a uniform temperature. The product should be recirculated for several minutes so that the top portion of the tube, which is kept clear by entrapped air (see figure 4-2), can reach the temperature of the remainder of the tube before the mutator is started.

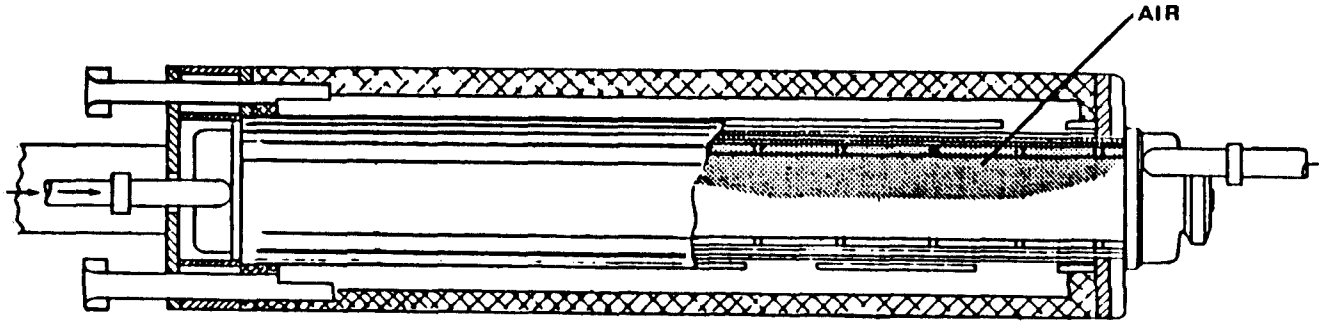


Figure 4-1. Example of Entrapped Air in the Heat Exchange Tube

MUTATOR REMOVAL AND REPLACEMENT

The mutator must be removed to perform some of the procedures that follow as well as when the unit is hand cleaned or the scraper blades checked for wear. Each time reference is made to mutator removal or replacement, perform the applicable procedure of the two that follow:

CAUTION

Never attempt to remove or replace a mutator without using the specially provided mutator removal trough. This trough protects both your and the inner wall of the heat exchange tube from the knife edges of the scraper blades.

CAUTION

On Model 672 Thermutators, never attempt to remove or replace the mutator alone. Two people are needed to support the mutator as it is pulled from or inserted into the heat exchange tube.

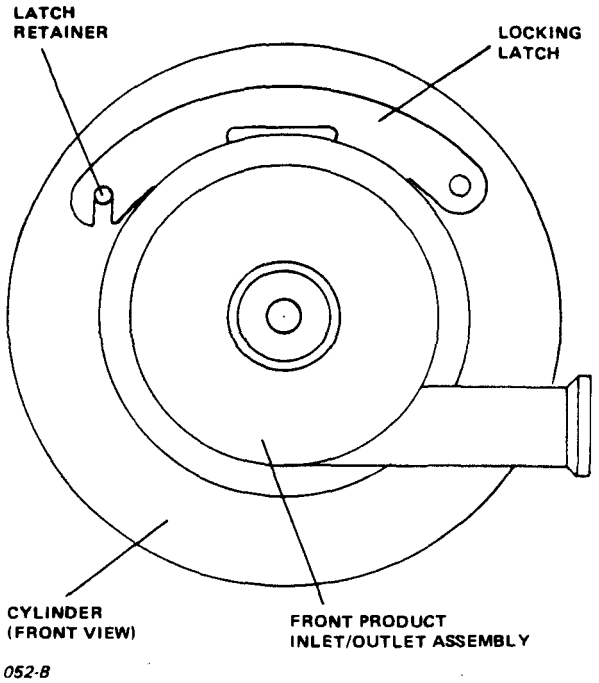


Figure 5-1. Front Product Inlet/Outlet Assembly Removal

Removal

1. Remove the front product inlet/outlet assembly by:
   (a) Removing the bearing end cap (item 9 of figure 7-2)
   (b) Removing the clamp (item 4 of figure 7-2)
   (c) Removing the front mutator bearing assembly (item 5 of figure 7-2)
   (d) Loosening the latch retainer (see figure 5-1)
   (e) Lifting the locking latch (see figure 5-1)
   (f) Turning the front product inlet/outlet assembly until it disengages, and
   (g) Pulling the assembly away from the Thermutator.

2. Turn the front of the mutator so that front support pins are vertical (see figure 5-2).

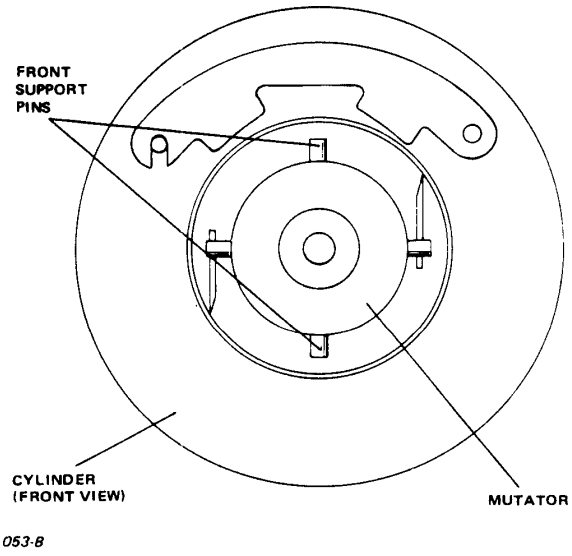


Figure 5-2. Front View of Thermutator with Front Product Inlet/Outlet Assembly Removal

3. Lift the front of the mutator, and slide the mutator removal trough under the mutator.

NOTE

With staggered-blade mutators (or when a viscous product has been processed through the unit), it may require two people to insert the trough - one to lift the mutator and one to insert the trough.

4. Using the special mutator removal hook provided (see figure 5-3), pull both the mutator and trough from the Thermutator.

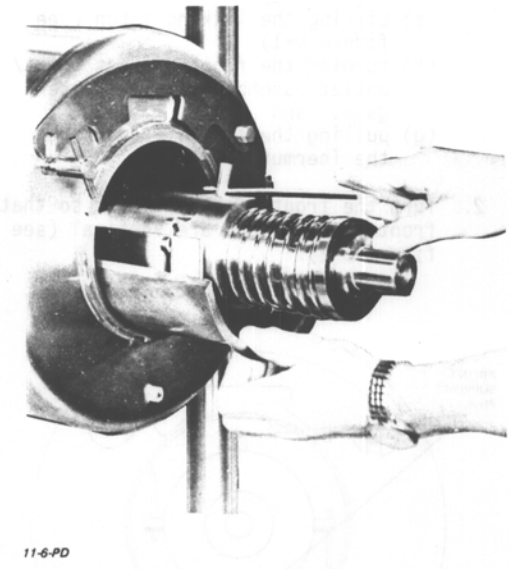


Figure 5-3. Pulling the Mutator and Trough from the Thermutator

Replacement

1. Check mutator to insure that all scraper blades and both mechanical rotary seals are properly attached.

2. Position the mutator on the mutator removal trough. Note that the trough has a lip at its forward end. Be sure that the forward end of the mutator is at the forward end of the trough. (The forward end of the mutator is the end without the geared spline.)

3. Check to see that the rear product inlet/outlet assembly is securely in place.

4. Push the mutator and trough, together, into the heat exchange tube.

5. Rotate the mutator so that the front support points are vertical (see figure 5-2).

NOTE

Positioning the support pins to vertical aligns the mutator spline to the drive sleeve.

6. Push the mutator spline into the drive sleeve.

7. Install the front product inlet/outlet assembly (with o-ring) (see figure 5-4) making sure it is fully engaged.

NOTE

The assembly can be installed with the fittings pointing right at the bottom or left at the top.

8. Close the locking latch (see figure 5-4) and secure by tightening latch retainer.

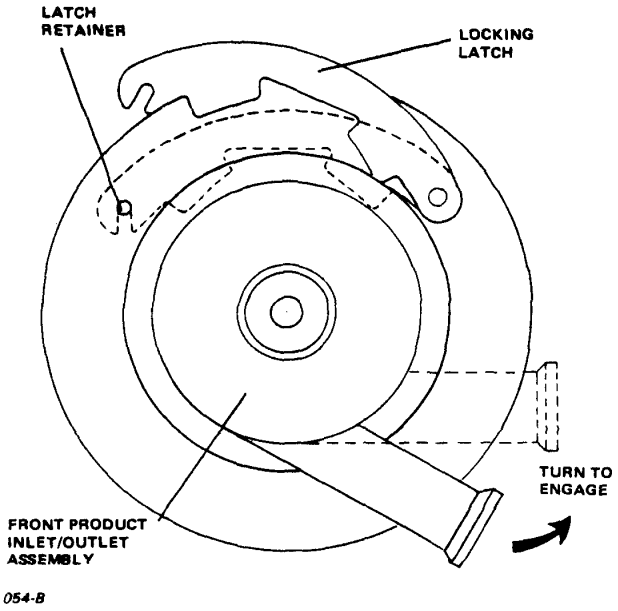
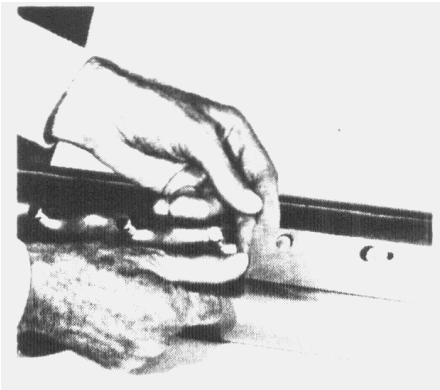


Figure 5-4. Front Product Inlet/Outlet Assembly Placement

9. Check the position of the end of the mutator shaft. It should be not less than 1/16 inch back from the face of the inner race of the front bearing. This insures that sufficient expansion clearance is provided.

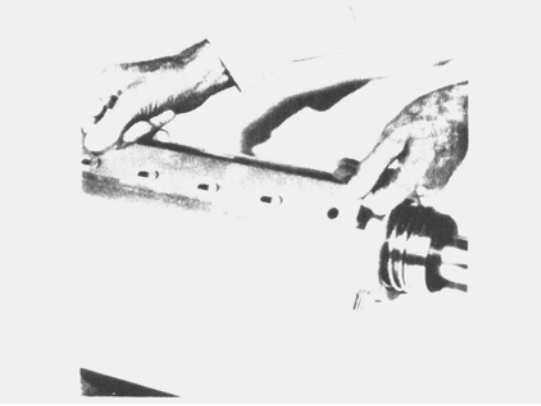
10. Replace the front mutator bearing assembly (item 5 of figure 7-2), the clamp (item 4 of figure 7-2 and the bearing end cap (item 9 of figure 7-2).

REMOVAL



1. Lift back edge of front blade so it clears the locking pin.

INSTALLATION



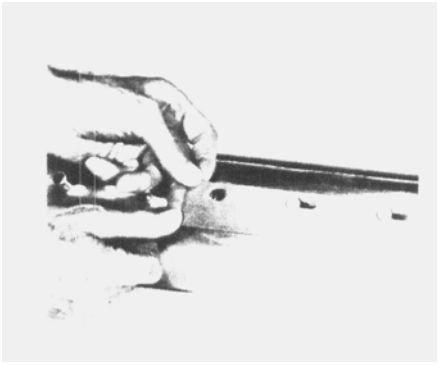
1. Set blade over pins. Spring the blade so it lines up with the slots in the pins.

SCRAPER BLADE REMOVAL AND REPLACEMENT

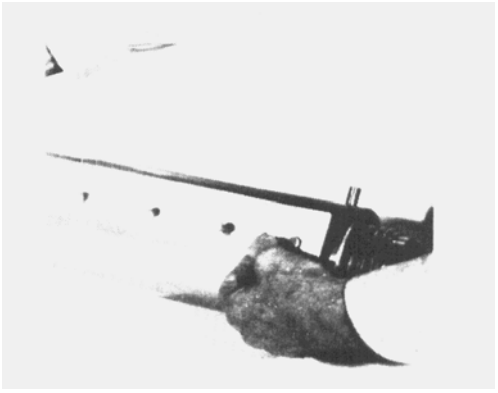
NOTE

On Model 648 and 672 Thermutators with standard mutators, the rear blade in each row must be installed first and removed last.

Figure 5-5 shows the correct method of removing and replacing the scraper blade. Remember that the beveled edge of the blade should always face the mutator (see figure 3-17).



2. Slide the blade forward until pins are in line with the holes and blade can be lifted off.



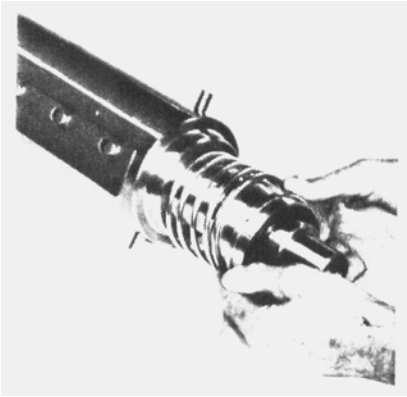
3. Slide the blade back until it is in place and the end snaps over the locking pin.

Figure 5-5. Scraper Blade Removal and Replacement

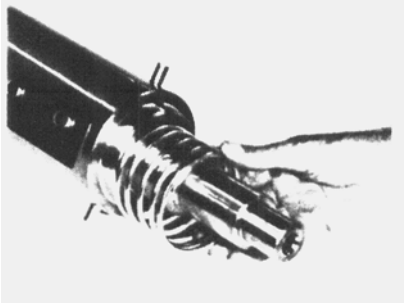
MECHANICAL ROTARY SEAL DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

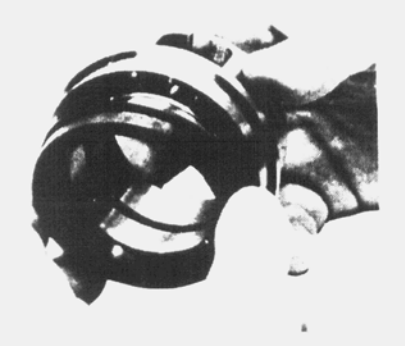
1. Unlock rotary seal shell by pushing it in and turning so that the pin is in line with slot.



2. Remove rotary seal shell.



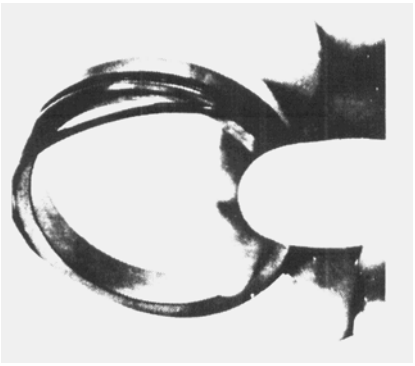
3. Remove rotary seal spring. Remove rear rotary seal assembly in same manner.



4. Remove rotary seal ring from seal shell.

NOTE

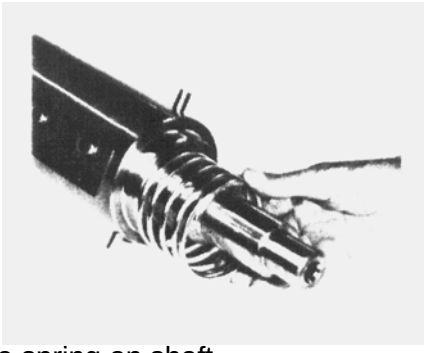
While the seal is disassembled, check the carbon sealing ring for wear. Replace parts as needed before assembly.



5. Check O-ring on rotary seal ring. Replace as necessary.

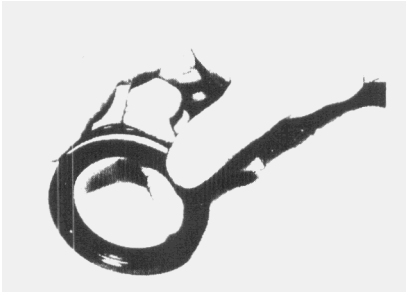
Figure 5-6. Mechanical Rotary Seal Disassembly/Assembly (continued on next page).

ASSEMBLY

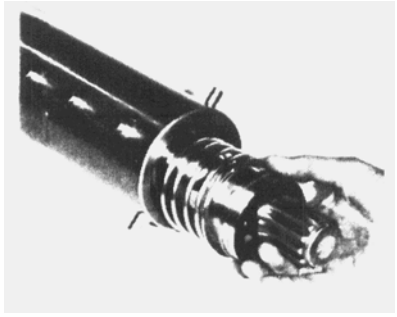


1. Place spring on shaft.

4. Place carbon ring into head with beveled edge inward!



2. Place a good O-ring in the carbon seal ring groove and lubricate.



5. Place seal shell assembly on mutator shaft.

3. Place a good O-ring in the rotary seal head groove and lubricate.

6. Depress spring and engage shell bayonet slot with pin on journal. Install rotary seal on the other end of mutator in the same manner.

Figure 5-6. Mechanical Rotary Seal Disassembly/Assembly

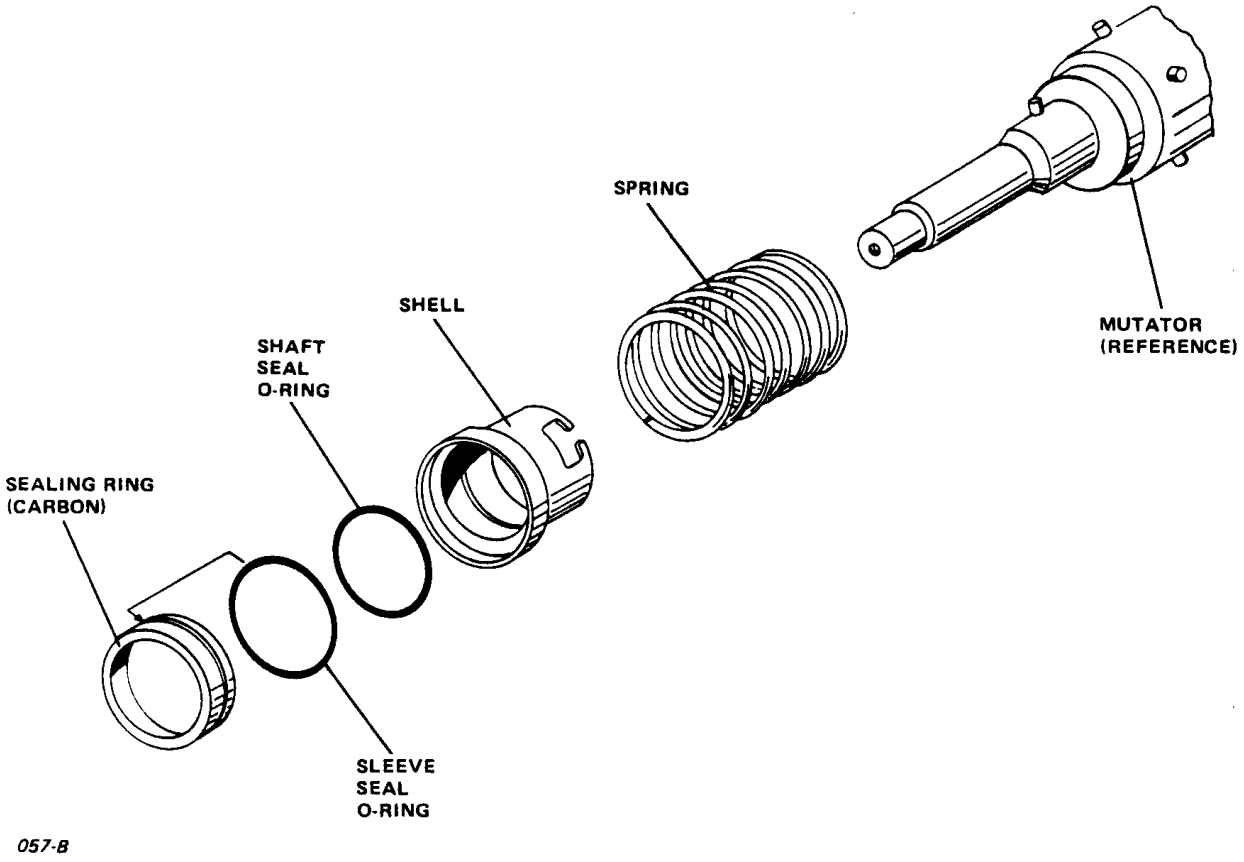


Figure 5-6. Mechanical Rotary Seal-Parts Identification

SCRAPER BLADE MAINTENANCE

Scraper Blade Wear

As the scraper blades scrape across the interior of the heat exchange tube, they wear in to the contour of the tube. A flat surface called a heel develops at the contact area on the side of the blade that is against the tube wall (see Figure 5-8B). The leading edge of the heel turns away from the tube wall forming a burr or feathered edge.

When a new blade, such as that shown in figure 5-3A, is first used, the heel forms unevenly across the length of the blade. This is due to slight irregularities in the surface of the tube. After a short period of time, the heel will run evenly across the length of the blade (see Figure 5-8B). When this conditions exists, the blade is said to be "worn-in-to" the tube and maximum scraping efficient is realized. For this reason, blades should be marked and kept in the same position on the same mutator in the same tube.

Resharpening

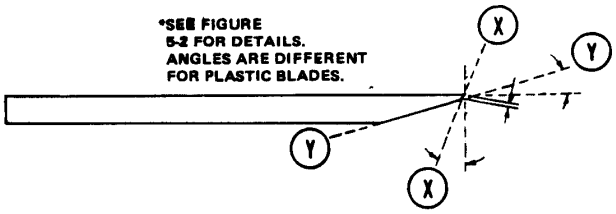
When the width of the heel on a scraper blade exceeds 1/32 inch (see Figure 5-8C), the blade should be resharpened. To resharpen, either send blades to Waukesha Cherry-Burrell for resharpening (contact Waukesha Cherry-Burrell Sales Representatives for procedure to be followed); or, perform the following resharpening procedure:

1. Clamp blade securely in vise.

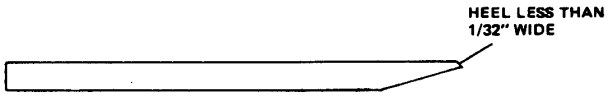
NOTE

Vise must have soft metal jaw covers or inserts.

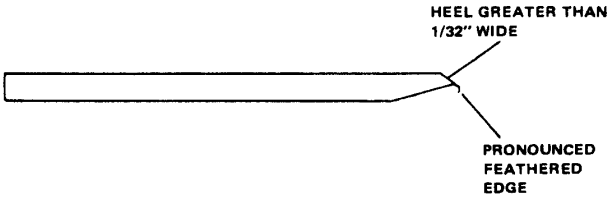
2. Using a fine toothed file or flat sharpening stone held at the angle shown by line X-X (see figure 5-8A), remove the feathered edge (see Figure 5-8D). Continue to remove metal at this angle until the heel is reduced to a barely visible line running the length of the blade. (Leaving a slight bit of heel retains the blade wear-pattern. As a result, the blade does not require another wear-in period.)



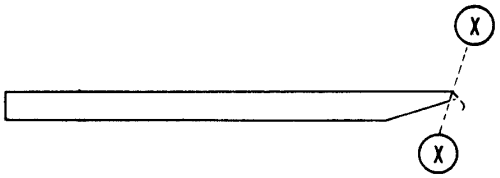
A – CROSS-SECTION OF UNUSED SCRAPER BLADE



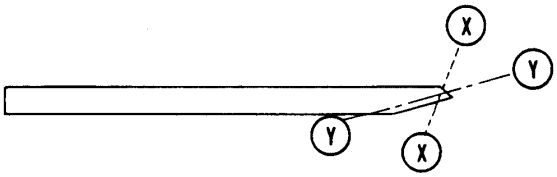
B – CROSS-SECTION OF "WORN-IN" SCRAPER BLADE



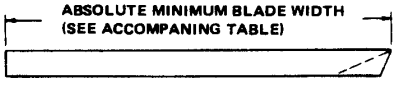
C – CROSS-SECTION OF EXCESSIVELY WORN SCRAPER BLADE



D – REMOVING FEATHERED EDGE DURING RESHARPENING



E – RESTORING BEVELED EDGE (IF DESIRABLE)



F – BLADE WORN BEYOND USABLE MINIMUM WIDTH

Minimum Blade Width		
Blade Type	Original Width	Minimum Width
Stainless Plastic	1-9/16	1-3/8"

5367-061-B

Figure 5-8. Scraper Blade Wear and Resharpening

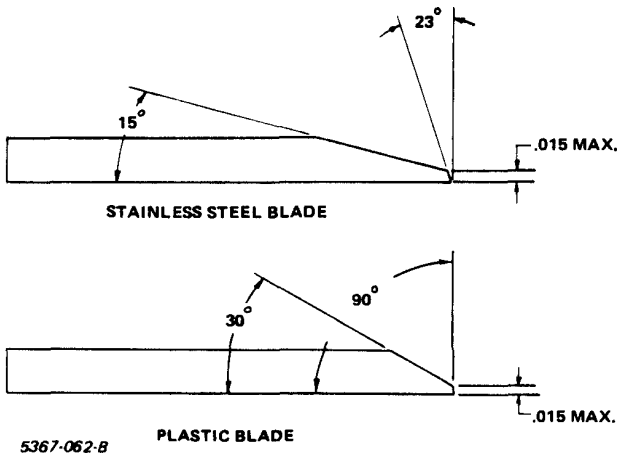


Figure 5-9. Comparison of Stainless And Plastic Blade Sharpening Angles

3. If facilities exist for extensively accurate grinding, the original bevel can be restored by removing metal at the angle shown by line Y-Y (see Figure 5-8A and E). This procedure should be performed where the blade is at the midpoint of its width limitation (see table following illustration 5-8F). A blade will scrape satisfactorily without restoration of the original bevel if the blade is kept sharp.

MUTATORS

Waukesha Cherry-Burrell makes available several mutators that are designed for use in special applications. This subsection covers these specialized mutators.

Whipping Dasher (For Model 624 and 648 Thermutators only).

In Model 624 and 648 Thermutators, a whipping dasher can be substituted for the standard solid mutator when the application warrants. A whipping dasher is normally used when oil, or a gas, must be uniformly dispersed in the product being processed.

When a Thermutator mutator is replaced with a whipping dasher, the front product inlet/outlet assembly must also be changed. You'll note in the parts listing that a special inlet/outlet is used with the whipping dasher.

WHIPPING DASHER DISASSEMBLY

Figure 5-10 illustrates the disassembly sequence for a whipping dasher. The dasher must be disassembled as shown for cleaning and blade replacement.

DASHER BEARING

The sleeve type bearing which supports the front end of the displacement beater and the flanged bearing that supports the rear, must be periodically checked for wear. (If wear becomes excessive, the pins on the dasher tube will score the inner wall of the heat exchange tube.) A new sleeve bearing has an inner diameter of 1.501 inch. A new flanged bearing has an inner diameter of 1.001 inch. When either of these dimensions is exceeded by 0.015 inch at any diametric point, replace the worn bearing.

To replace a bearing, carefully press out old bearing. Cool replacement bearing on dry ice for 30 minutes. Carefully press in new bearing.

After a new front sleeve bearing is replaced, face both ends of the bearing flush with the housing. Chamfer the inner edges 1/32 inch at 45°. If necessary, ream inner diameter to 1.50 inch.

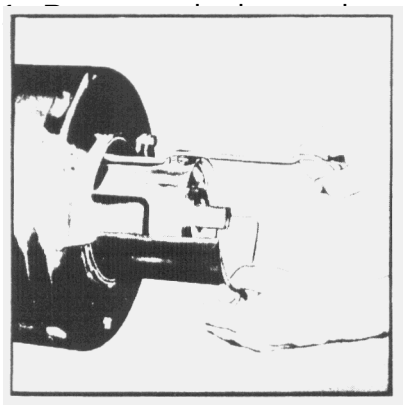
WHIPPING DASHER ASSEMBLY

Follow the sequential steps shown in Figure 5-11 to assemble a whipping dasher.

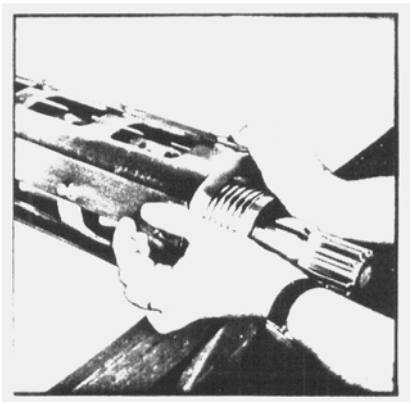
PARTS LIST

Refer to page 7-10 for a listing of parts for both the 24 and 48 inch whipping dashers.

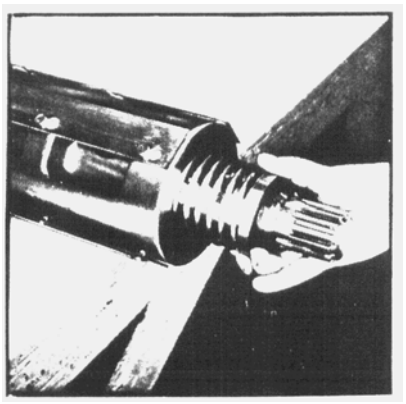
REMOVING DASHER



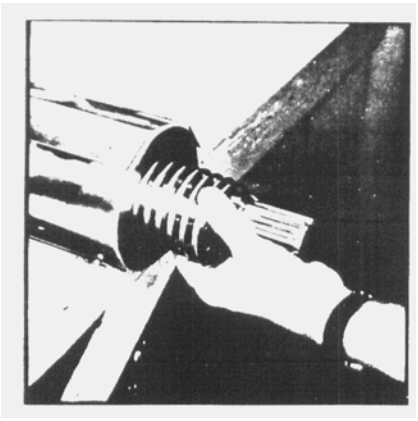
trough and hook.



2. Unlock rotary seal assembly.

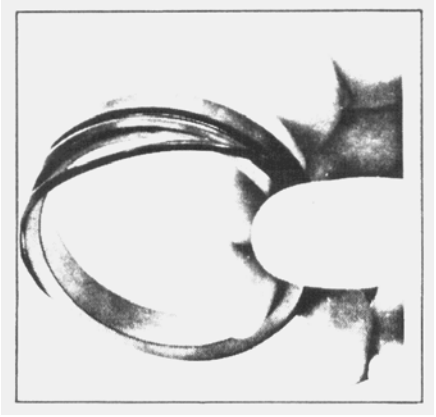


3. Remove rotary seal head assembly.

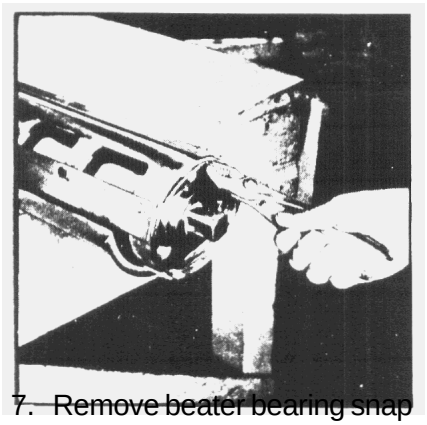


4. Remove rotary seal spring.

5. Remove rotary seal ring from seal head.



6. Check O-ring on rotary seal ring.



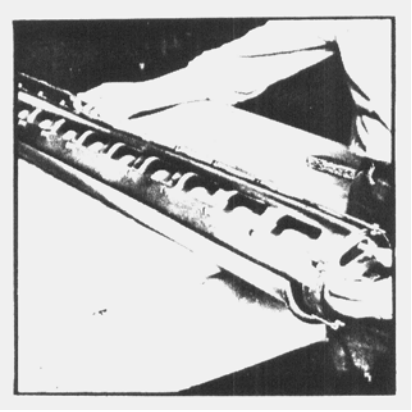
7. Remove beater bearing snap ring.

8. Pull beater bearing outward enough to permit blade release.

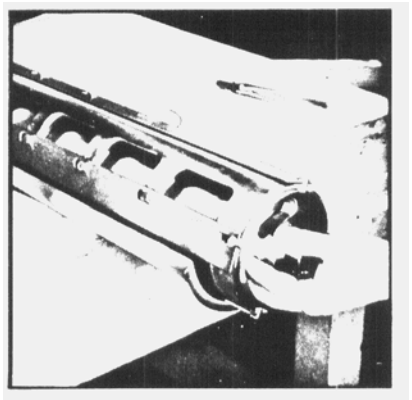
9. Slide blades to release from pins and lift off.

Figure 5-10.

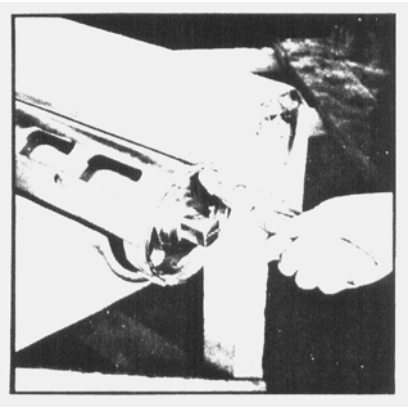
ASSEMBLING DASHER



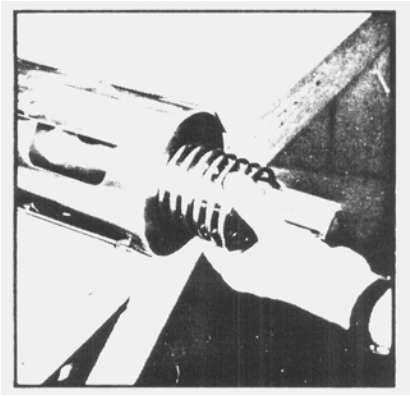
1. Place blades on dasher and engage with pin slots.



2. Install beater bearing to lock blades in place.



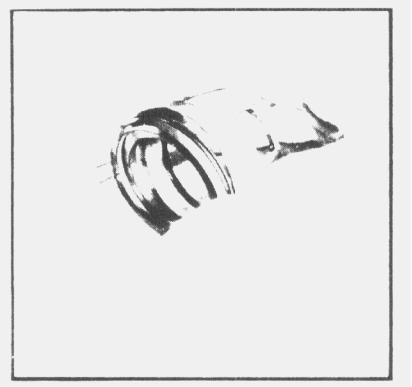
3. Install snap ring to retain beater bearing. Be certain it seats in groove.



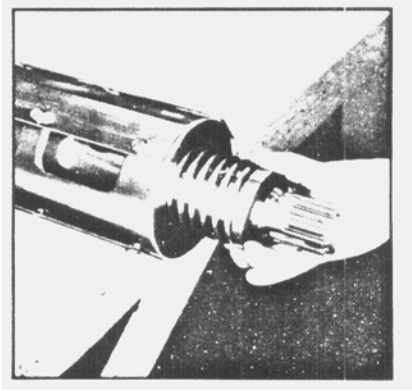
4. Place spring on dasher shaft.

5. Place a good O-ring in the carbon seal ring groove and lubricate.

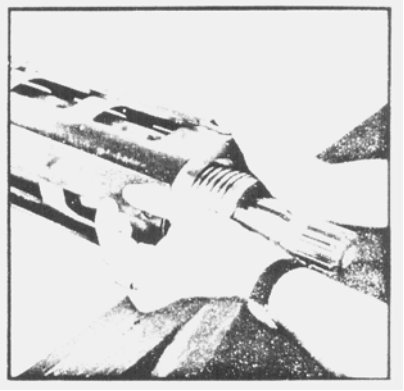
6. Place a good O-ring in the rotary seal head groove and lubricate.



7. Place carbon ring into head with beveled edge inward!



8. Place seal head assembly on dasher shaft.



9. Depress spring and engage head bayonet slot to pin in shaft.

Figure 5-11.

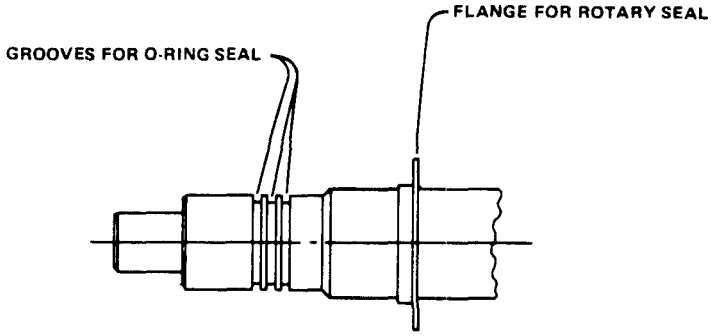
ULTRA-WIDE CLEARANCE MUTATOR

The ultra-wide clearance mutator has a shaft diameter of 2¼". The mutator is available with either three rows of 24" blades or two rows of 24" blades on the "672" model. On the "624" model and the "648" model, the 2¼" mutator is available with two rows of 24" blades.

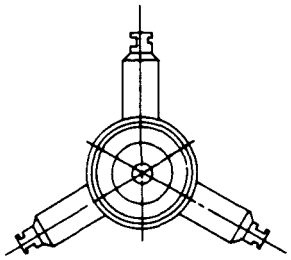
Most applications of the 2¼" mutator are in meat processing; however, the mutator can be used in any application where large chunks of product must be processed.

NOTE

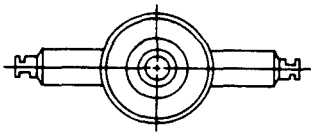
A special product inlet/outlet assembly must be used in conjunction with the ultra-wide clearance mutator. The part numbers for these assemblies are given in the parts listing on page 77.



O-RINGS AND ROTARY SEAL ARE USED FOR ASEPTIC SEAL



3 ROW MUTATOR



2 ROW MUTATOR

HEAT EXCHANGE TUBE REMOVAL

Preparation For Tube Removal

On Model L Thermutators, close incoming media line and make sure media cannot drain back through the return line. Open lower media line and drain all media from cylinder.

On Model S Thermutators, close incoming steam line. Completely drain all steam condensate from cylinder.

On Model DE Thermutators:

1. Check to insure that liquid line stop valve (and hot gas line stop valve) is tightly closed. Tag closed valve(s) to prevent premature opening.

2. Pump all liquid refrigerant from system. Open injection line solenoid valve to remove all liquid refrigerant trapped between it and the expansion valve. Screw in (turn clockwise) manual opening stem on back pressure regulating valve.

3. After all system gauges read zero, close suction line shut-off valve.

CAUTION

When withdrawing tubes, DO NOT allow the drip strip to contact the O-ring sealing surfaces of the cylinders. Nicks or scratches will result in leakage.

Removal Procedure

1. Remove front and rear product inlet/outlet assemblies and mutator (refer to instructions on pages 39 and 40).

2. Remove the cylinder head by removing the backing latch shoulder pivot screw, latch stud, and one capscrews (see Page 78).

3. Measure and record the distance between the rear flange on the heat exchange tube and the rear surface of the cylinder as shown in figure 5-12).

4. Remove the four adjusting setscrews from the tube flange (B on figure 5-13).

5. Remove the six hex-head bolts that secure the heat exchange tube flange to the cylinder (A on Figure 5-13).

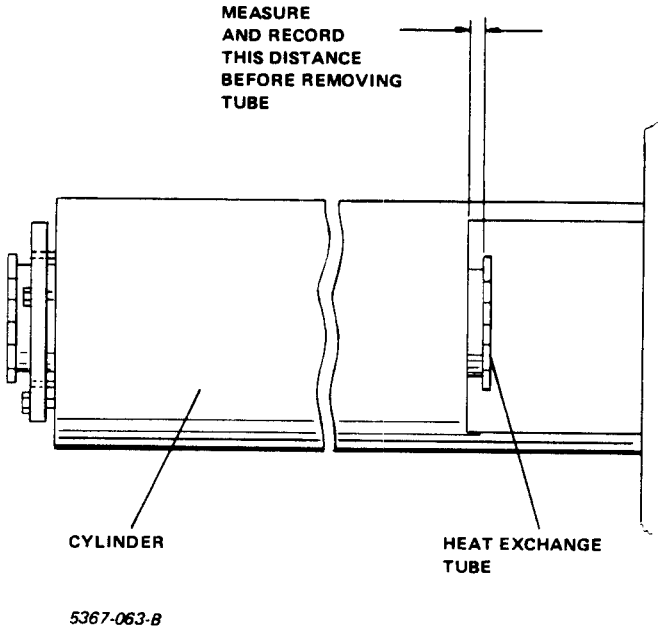


Figure 5-12. Heat Exchange Tube Rear Extension

6. Take four of the hex-head bolts removed in step 5 and thread them into the “B” holes (see Figure 5-13). Thread each bolt against the cylinder surface but do not tighten.

7. Using an X pattern, gradually tighten the bolts to withdraw the tube from the cylinder. Considerable effort is needed to overcome the tight seal of the O-rings.

CAUTION

If the tube does not start to pull away from the cylinder as the bolts are tightened, do not continue. Continuing may disturb and ruin the heat exchange tube flange. Place a block of wood across the rear end of the tube and apply pressure to force the tube forward. When the O-rings break loose, use bolts to complete removal.

8. Pull tube straight out of cylinder. Do not allow fins or drip strip to contact the O-ring sealing areas in the cylinder. Mark the tube and cylinder so that the tube can be replaced in the same cylinder.

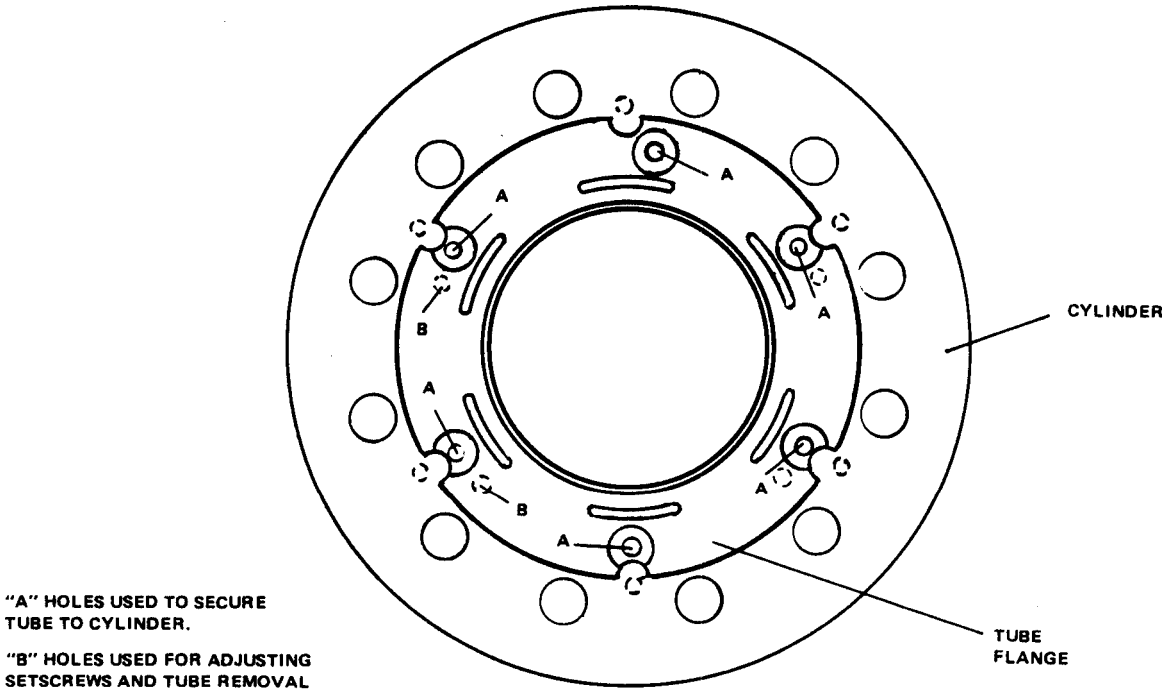


Figure 5-13. Front of Heat Exchange Tube and Cylinder

CLEANING HEAT EXCHANGE TUBE EXTERIOR

Wash outer surface of tube with effective cleaning solvent. If corrosion or rough areas are found on the tube exterior, polish these areas smooth with emery cloth.

NOTE

The tube exterior should be periodically checked and, if necessary, cleaned. Since oil or corrosion build up occurs slowly, periodic checks and cleaning will prevent emergency shutdowns for cleaning.

HEAT EXCHANGE TUBE INSTALLATION AND ADJUSTMENT

Preparation For Tube Installation

1. Inspect the cylinder interior and wipe out all dirt or impurities.

2. Inspect O-rings for damage or wear. Replace O-rings as necessary.

3. Apply a light coat of grease to each O-ring and a thin film of grease in the cylinder interior where the O-rings seal.

INSTALLATION

1. Insert tube in cylinder and push straight in toward rear of cylinder.

2. Push tube on into cylinder until dimension shown in figure 5-12 is reached (this dimensions was recorded before removal).

3. Insert four setscrews in “B” holes (see figure 5-13 and tighten set-screws until they contact cylinder surface.

4. Insert six hex-head bolts in “A” holes (see figure 5-13) and start tightening in an even pattern. When bolt heads reach flange, continually check rear tube extension and adjust setscrews to maintain dimension as you tighten down flange bolts.

5. Replace cylinder head and latch parts (see Figure on Page 78).

6. Leak test as instructed in next paragraph.

LEAK TEST PROCEDURES

Perform the applicable “Liquid or Steam Media System Check” or “Direct Expansion Media System Check” of the Operation Section.

DRIVE SYSTEM MAINTENANCE

V-Belt Tension Adjustment

The V-belts which drive the mutator should be checked for proper tension after the first week of operation and at regular intervals thereafter. Loose belts will allow slippage under load with resulting interruption of operation and possible damage to belt sets.

Belts should be tight enough to vibrate rapidly when struck with the hand. Loose belts will vibrate only slightly or not at all. This tension test is easy to make and should be a weekly procedure.

CAUTION

Do not overtighten V-belts. Excessive belt tension decreases the lift of the mutator drive shaft and motor bearings.

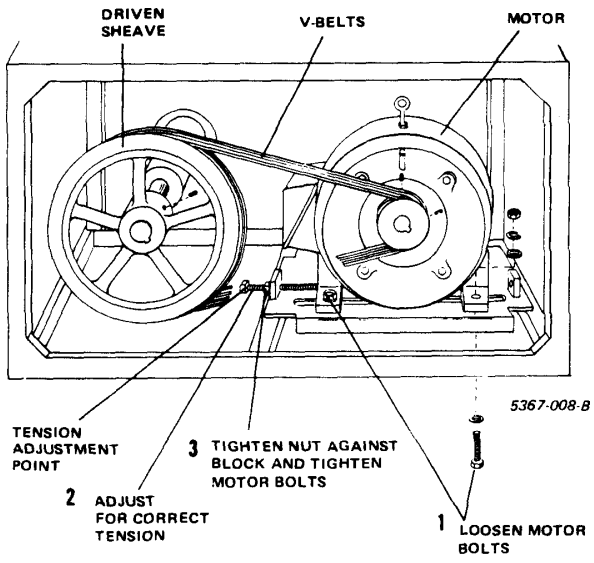


Figure 5-14. V-Belt Tension Adjustment

Drive Shaft Bearing Replacement

The mutator drive shaft and the bearings can be removed and replaced without disturbing the cylinder or media piping.

1. Remove the mutator and rear product inlet/out assembly (refer to instructions in this section).

2. Check the position of the drive shaft spline relative to the front of the cabinet as shown in figure 5-15. On most machines, the front surface of the spine will be flush with the cabinet front surface. If it is not, record the distance between the front surface of the spline and the front surface of the cabinet. The drive shaft must be replaced in the exact position before removal.

3. Loosen the motor mounting bolts and V-belt tightening screws (see Figure 5-14). Remove the V-belts.

4. Remove the driven sheave.

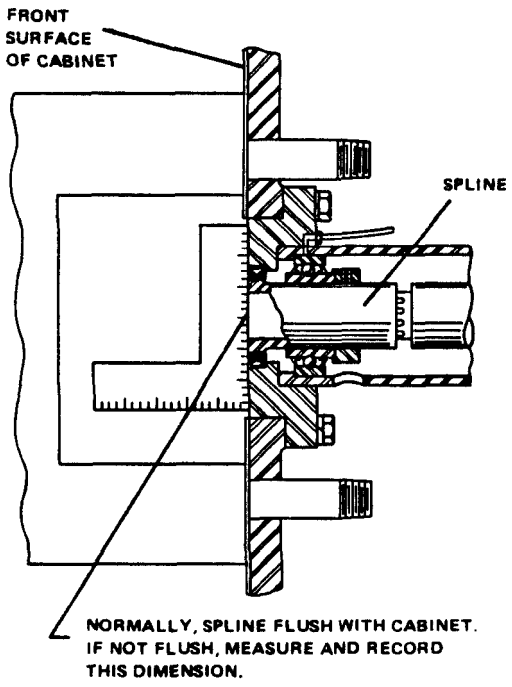


Figure 5-15. Checking Drive Shaft Spline Position

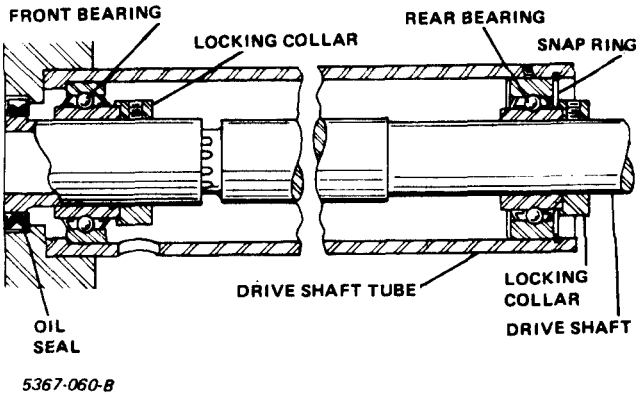


Figure 5-16. Drive Shaft Assembly and Tube

5. Remove the snap ring at the rear end of the drive shaft tube (see figure 5-16) and pull the drive assembly from the tube.

6. Check the condition of the oil seal at the front end of the drive shaft tube (see Figure 5-16). Replace seal if condition warrants.

7. Replace front and rear bearings (see Figure 5-16).
   (a) Remove rear backing collar and press off rear bearing.
   (b) Mark position of front bearing on spline.
   (c) Remove front backing collar and press off front bearing.
   (d) Press on new front bearing.

NOTE
When pressing on bearings, press with sleeve pushing against inner race.

IMPORTANT NOTE
New bearing must occupy same position on spline as old bearing.

   (e) Replace front backing collar.

8. Install shaft assembly in tube.

NOTE
Insure that front bearing is properly seated.

9. Check position of front service of spline relative to front surface of cabinet. If position is not the same as noted in step 2, change bearing position on spline until spline is in same position as noted in step 2.

10. Install and position rear bearing and backing collar (see Figure 5-16).

11. Replace snap ring (see Figure 5-16).

12. Replace driven sheave and V-belts.

13. Tighten belts per "V-Belt Tension Adjustment" procedures.

14. Replace the mutator and product inlet/outlet assemblies.

REFRIGERATION SYSTEM

Impurities - Oil in the Refrigeration System

Oil in the system is probably the most common cause of heat transfer difficulties. It is a very effective insulator and when deposited on the heat transfer surface will reduce heat transfer rate and cooling difficulties may be encountered.

To avoid oil difficulties as much as possible, the following is recommended.

1. Use a compressor oil that has a high flash point (over 300°F), a low pour point (minus 25°), and a wax free base. Oils which contain additives to reduce their surface tension and make them more free flowing are recommended.

2. Check each lot of oil received by placing a small sample in a deep freezer and allowing it to cool to -25°F. Make sure the oil will flow at this temperature. Oil which congeals and will not flow at temperatures higher than minus 25°F will not drain from refrigerating surfaces. Make this test on each lot of oil received regardless of label on container.

3. Periodically take a sample of oil drained from the Thermutator accumulator and place it in a deep freezer. If new oil added to compressor will flow at -25°F but oil drained from freezer accumulator will not, it indicates other impurities in the system are affecting the pour point of the oil. Steps should then be taken to clean up system to remove these impurities.

4. Check and drain oil regularly from oil separators and oil legs or pots.

5. Maintain proper oil level in compressor if mechanical feeders are used, check that they are feeding properly.

6. Keep sufficient water flowing through condensers to maintain lower head pressures.

7. Keep condensers clean.

8. Check general condition of refrigeration equipment regularly to keep it in best operating condition.

Impurities - Water Or Air In The Refrigeration System

Water and ammonia will form ammonium hydroxide which will combine with oil to form a sludge. In extreme cases, this sludge can be similar to asphalt and is extremely difficult to remove. As water does not vaporize at the pressure and temperature in the accumulator, it will be distilled off and remain to dilute the liquid ammonia. The ammonia diluted with water has a higher boiling point which means that a lower back pressure must be used to get the required refrigerant temperature and refrigerating affect. Air in the ammonia increases the compressor head pressure which, in turn, increases the gas discharge temperature and the possibility of carbonizing or vaporizing oil. In addition, air in the system, because of higher head pressure, increases motor horsepower used. Air also contains moisture which will be picked up by the ammonia refrigerant.

To avoid difficulties with water and air, the following are recommended:

1. Regularly purge refrigeration system of air and non-condensable gases. It is desirable to have an automatic air purger in the system.

2. Keep all valve stems greased so that packing remains soft. This will prevent the leakage of air past the stems if the system should be operated on a vacuum.

3. Keep all stuffing boxes pulled up tight to prevent the entrance of air and moisture.

4. Avoid operating system on a high vacuum.

Injector Assembly (See Figure 5-17).

The injector nozzle is protected from scale by a strainer ahead of the liquid line solenoid valve, and, under normal operating conditions, the nozzle will seldom have to be serviced. If, by chance, scale should get in the nozzle, it can be cleared as follows:

1. Pump down the entire system.

2. Loosen the nuts on the ends of the feed line to the tee in which the nozzle is mounted. Remove the line.

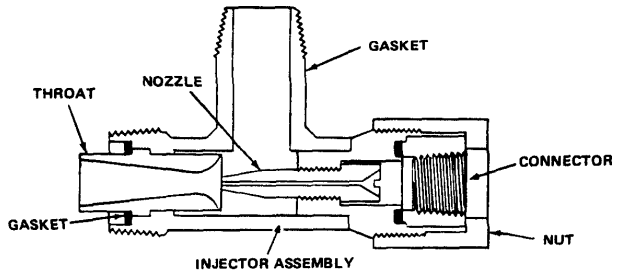
3. Using a screwdriver, unscrew the nozzle from the tee.

4. Clean the nozzle by blowing it out with air and/or submerging it in a cleaning solvent.

5. Check the tee for scale or chips.

6. Blow out the connecting line with air.

7. Screw the nozzle back in position and reassemble the piping.



5367-001-A Figure 5-17. Injector Assembly

Float Valve

The float valve supplied is based upon the specification of each Thermutator. All are serviced according to the following general instructions.

Periodic cleaning of the filter-screen portion of the cartridge is necessary. When performance indicates that the needle and seat of the cartridge are worn, a new cartridge should be installed. Remove the cartridge in the following way:

1. Pump down the refrigerant systems to zero pressure and close off the refrigerant lines.

2. Unscrew the access plug.

3. With the aid of a 3/8” hex socket wrench, unscrew the cartridge and remove it from the valve.

4. Install the new cartridge. Good procedure is to snug up, then loosen cartridge several times before final tightening to insure good seating.

5. Check the access plug gasket to make certain it is in good condition and will seal properly.

6. Install the access plug and tighten securely.

7. Admit a small amount of ammonia to the system and test the float valve plug for leakage. (Approx. 5) If no leakage occurs, test again at 60.

8. Open the suction line valves and then the liquid line valve to check the operation of the float valve. A frost line will show approximate liquid level in the accumulator.

In the event the float or pusher need to be replaced, proceed as follows:

1. Pump down the refrigerant system to zero pressure and close off refrigerant lines.

2. Remove the six socket head capscrews from the valve body.

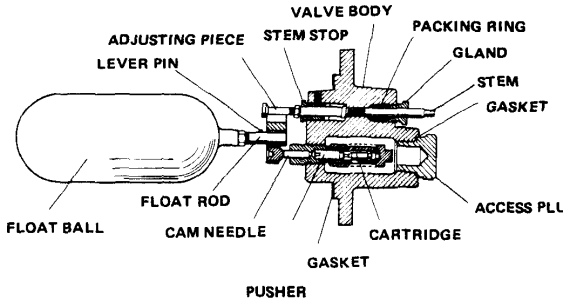
3. Pull out the entire body and float assembly.

NOTE

If extensive repairs to the assembly are necessary, it is recommended that a spare unit be purchased and the inoperative one returned to the factory for precision overhaul and testing.

4. Before reinstalling the assembly, carefully inspect the valve gasket on the body. If there is any doubt regarding sealing ability, replace the gasket.

5. After installing the assembly and tightening the six attaching screws, check for gasket leakage by building a small amount of ammonia pressure (approx. 5) in the system. If no leakage occurs, test again at 60.



5367-015-B

Figure 5-18. Float Valve

Liquid Line Solenoid Valve

OPERATION (See Figure 5-19)

The liquid line solenoid valve opens the liquid line to allow refrigerant flow to the injector. When the coil is energized the drawbar assembly is raised, lifting the drawbar off the seat to open the valve. If the coil is de-energized, the drawbar assembly drops, closing the valve.

Since it is an on-off device, valve operation is easy to check. When energized, the plunger opens with a sharp click. The liquid pressure gauge in the injector line should immediately rise to the set pressure.

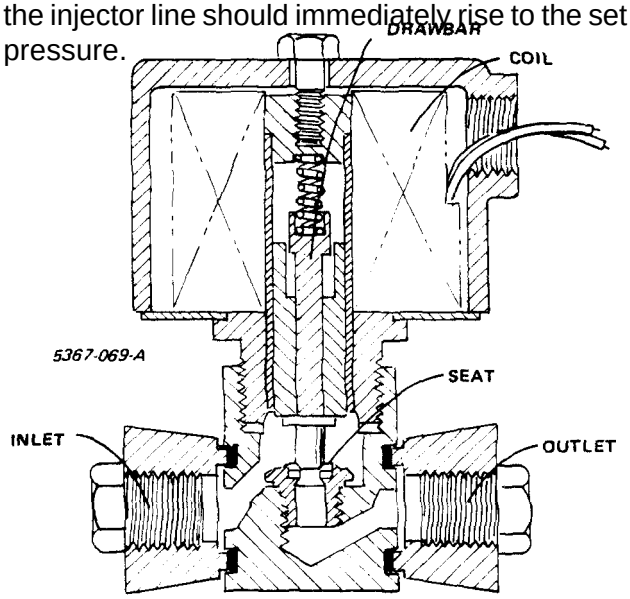


Figure 5-19. Liquid Line Solenoid Valve

Erratic solenoid valve operation is usually due to under voltage or faulty switch contacts. Leakage by the valve may be caused by dirt or chips between the drawbar and seat.

To examine the drawbar seat, close the liquid line valve. Pump down the accumulator and close the suction valve. Be sure that the solenoid valve was open during the pump down, or liquid may be trapped in the liquid line (theoretically, the float valve should open and prevent trapping).

REPAIR

Remove the coil assembly by unscrewing it from the valve body (use the hex under the cod] platform. Do not use a wrench or pliers on the coil cover).

The drawbar and seat are exposed when the coil and valve body are separated. The seat is threaded into the body and may be removed for inspection or replacement. The drawbar assembly may be slipped out of the coil for inspection or replacement.

When reassembling the valve, replace the body gasket with a new one. Be sure that all parts are assembled in the proper position.

Automatic Pressure Regulating Valve

(See Figure 5-20)

ADJUSTMENT

To increase the injector pressure, turn the adjusting stem clockwise. To decrease the injector pressure, turn the stem counterclockwise.

OPERATION

The automatic pressure regulating valve controls the liquid refrigerant pressure to the injector nozzle.

Liquid refrigerant from the plant DE system passes into the valve, past the inlet check ball, and out of the valve through an orifice tube.

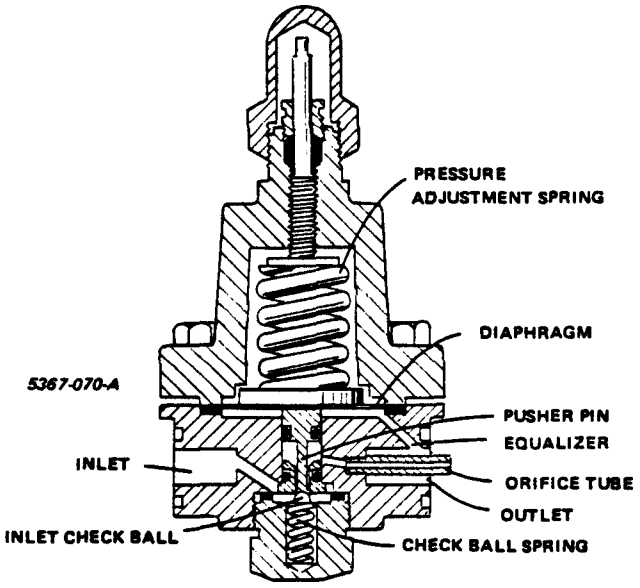


Figure 5-20. Pressure Regulating Valve.

A diaphragm controls a pusher pin, which in turn controls the movement of the spring-closed inlet check ball. The position of the diaphragm (and thus the inlet check ball) is determined by a pressure adjustment spring and opposing liquid refrigerant pressure. Liquid refrigerant pressure is applied to the diaphragm through an equalizer port on the outlet side of the valve.

The valve is normally in an open position (the pressure adjustment spring pushes the diaphragm down, which moves the pusher pin to unseat the check ball). As liquid refrigerant flows through the expansion valve to the injector, the liquid pressure is applied to the under side of the diaphragm through the equalizer port. The liquid pressure and the check ball spring act together to overcome the pressure adjustment spring, to move the pusher pin out of the check ball seat. This allows the ball to seat and block liquid refrigerant flow.

As the liquid pressure on the outlet side of the valve drops, the pressure adjusting spring causes the check ball to be pushed off seat, allowing liquid refrigerant to pass through the valve. The additional pressure through the equalizer port acts on the diaphragm to overcome the pressure adjusting spring and allow the check ball to move back on seat.

The action of liquid pressure versus spring pressure is continuous and effectively modulates the liquid refrigerant pressure at the injector jet.

The actual liquid refrigerant pressure applied to the injector is determined by the pressure adjustment spring pressure, which is manually preset with the pressure adjustment stem.

The volume of liquid refrigerant which passes through the automatic pressure regulating valve is controlled by a removable orifice at the valve outlet.

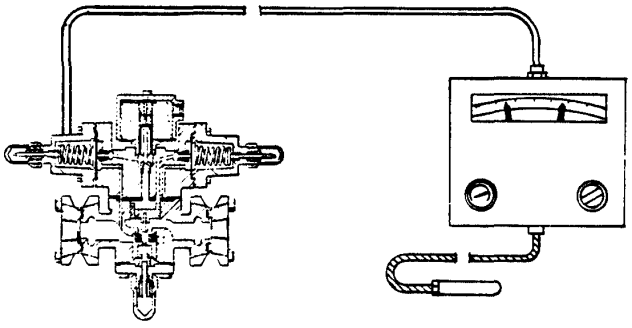


Figure 5-21. Typical PA Type Back Pressure Regulating Valve

If pressure regulating valve action is erratic or if the valve leaks, it can be completely disassembled for cleaning, repair and/or replacement of components. Replaceable components with limited life include: the check ball, check ball spring, check ball seat, the pusher pin and o-rings, the diaphragm and diaphragm gasket, and the spring plug gasket.

To replace the discharge tube, disconnect the evaporator line by removing the capscrews from the outlet flange, then unscrew the old discharge tube with pliers.

Back Pressure Regulating Valve

(See Figure 5-21 and 5-22).

The back-pressure regulating valve gives the desired final product temperature by controlling the pressure in the evaporator. This pressure in turn sets the temperature at which the refrigerant evaporates, which is the same as the liquid temperature in the cooling passage of the cylinder.

The same basic type of valve is used on all Model DE Thermutators although the means of adjusting the desired back pressure is slightly different on manual and I.S. - I.S. Systems. The valve is sized to the normal refrigeration load. Since it must function as a modulating control, not an on-off type, the size is determined by pressure drop as well as tonnage.

Where greatly varying loads (i.e. as 2 or 12 tons) must be handled, it may be desirable to provide two valves.

In operation, the position of the piston (and the opening between the valve seat and disc) is determined by the pressure of the gas admitted to the space above the piston.

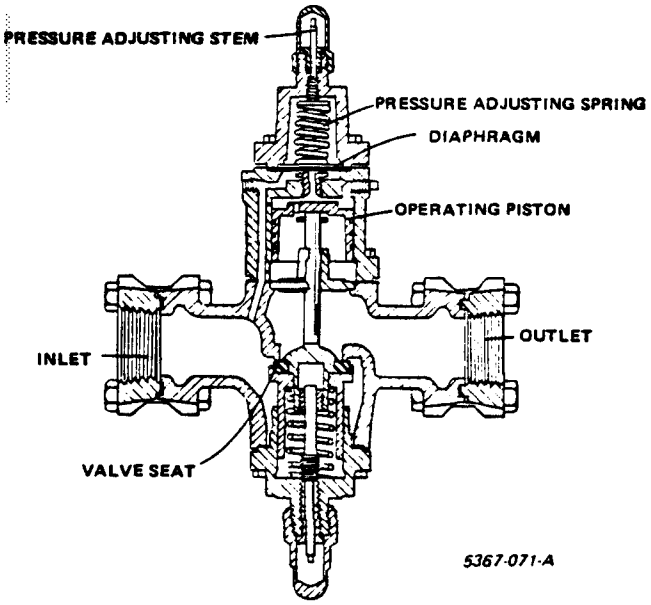


Figure 5-22. Back Pressure Regulating Valve

REPAIR - OPERATOR

The entire pilot assembly is removable from the upper body by removing the attaching bolts. If the diaphragm and the pilot seat become dirty, clean them with a soft, clean cloth. If necessary, the seat can be removed from the housing by the use of a socket wrench.

REPAIR - MAIN VALVE

The cylinder and bonnet may be removed from the lower body by removing the capscrews. (With the capscrews removed, the cylinder and bonnet can be lifted off of the lower body.) The main piston slides freely in the cylinder, and care should be taken to prevent the piston from dropping out of the cylinder when disassembling the regulator. To inspect the disc and seat, compress the disc piston spring. If the disc shows signs of wear or erosion, or if the seat is cut or eroded, both the disc and seat must be replaced.

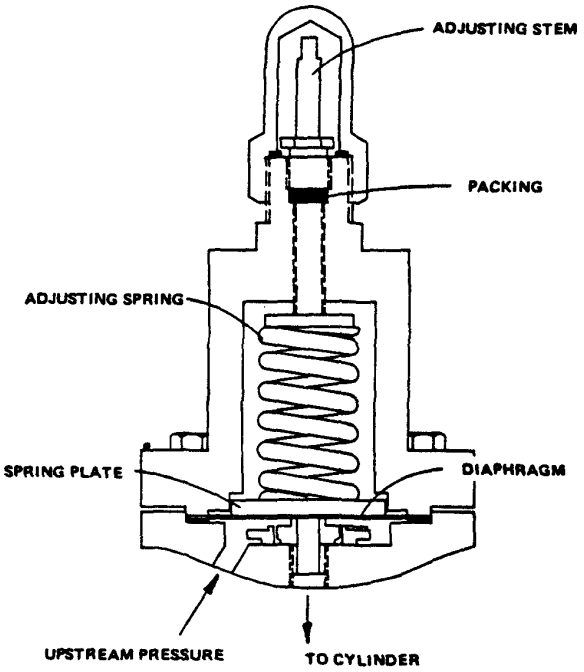


Figure 5-23. Bonnet Assembly. (Typical on all Hubble back pressure regulators)

When reassembling the unit, check the pressure holes in the lower body, in the body gaskets, in the cylinder flange, in the bonnet gasket, and in the bonnet to be sure they are in their proper positions. The pressure holes in the cylinder flanges, bonnet, lower body, and gaskets must all be in line.

TROUBLESHOOTING

Erratic operation or no adjustment of regulator.

1. Regulator will not function on air operated pilot.
   a. No power to coil or coil burned out. Coil leads broken or shorted. Check line voltage and repair circuits.
   b. High air pressure on pilot. Check and adjust air pressure.

2. Regulator will not function on spring operated pilot.
   a. Regulator drawbar not seating or sealing. Clean, repair or replace drawbar assembly and/or seat.

3. Regulator operation is erratic.
   a. Damaged pilot seat bead and/or diaphragms.
   b. Dirt binding pistons or dirt lodged in seat bead area. Clean repair or replace dirty or damaged components.

4. Regulator is short cycling, hunting, or chattering.
   a. Oversize regulator for load conditions. Install properly sized regulator.
   b. Power piston O.D. worn, creating excessive clearances. Replace piston.
   c. Bleed hole in power piston enlarged. Replace piston, contact factory for sizing.

5. Excessive pressure drop across regulator.
   a. Regulator too small for load. Replace regulator with correctly sized unit.
   b. Blocked passage to sensing chamber. Remove obstructions.
   c. Strainer blocked by debris. Clean or replace strainer.

Product Holdback Valve

Product holdback valves are available in 1-1/2" and 2" sizes with either I-Line, Q-Type, or threaded connections. A product holdback valve is used to restrict the flow of product exiting the Thermutator thus creating a back pressure in the Thermutator tube. This back pressure is desirable for several reasons:

1. The restricted flow aids in keeping the Thermutator tube full of product.

2. Because of the pressure/temperature effect, the application of sufficient back pressure allows the product to be heated to a temperature above its normal boiling point at atmospheric pressure without the product boiling.

NOTE

In some cases, a product holdback valve cannot be used because it would reduce the size of or damage particles in the product. In such cases, long discharge piping assembly can be used to create a back pressure in the tube.

If a product is being processed through a single Thermutator, the product holdback valve should be placed at the outlet of the Thermutator tube. If a product is being processed through a series of Thermutators, a product holdback valve need only be placed at the outlet of the last Thermutator in the series. The single valve will create a back pressure in all of the tubes in the series.

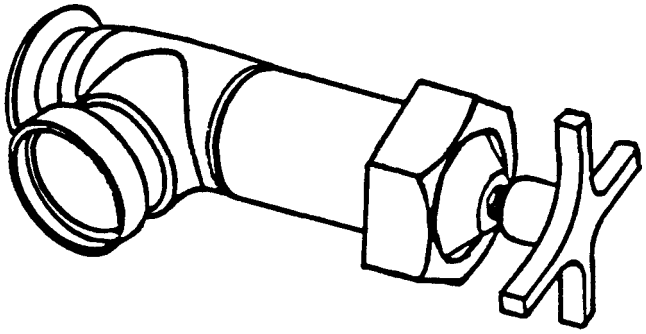


Figure 5-24. Product Holdback Valve

Pressure Gauge Assembly - Sanitary

The sanitary pressure gauge assembly is composed of a tee with 2" I-Line flanges, a pressure gauge and all interconnecting hardware. The standard gauge reads from 0 to 160 psig. The sanitary design of the assembly allows product pressure readings within this range.

The sanitary pressure gauge may be used in conjunction with the product holdback valve. Located upstream from the holdback valve, the sanitary pressure gauge will indicate the product pressure as set by the holdback valve.

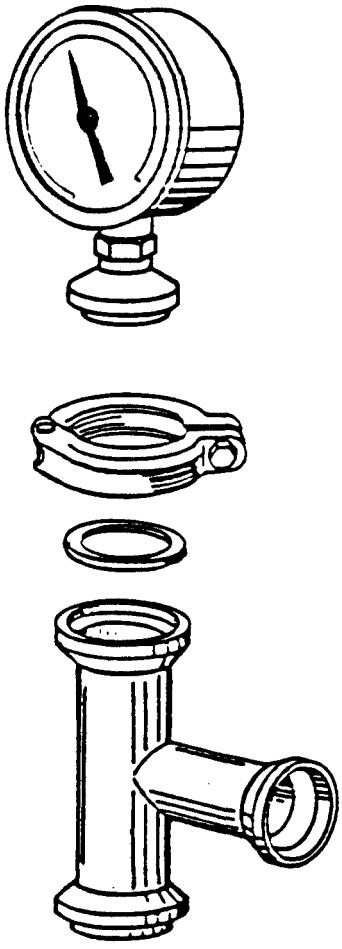


Figure 5-25. Pressure Gauge Assembly.

Dial Thermometer Assembly - Sanitary

Two models of the sanitary dial thermometer are available. One, the 1-1/2 inch model is designed for coupling to a 1-1/2, ferrule, I-line flange. This model has a gauge that reads from 0 to 240°F. The other model is designed for coupling to a 2", ferrule, I-Line flange. The 2" model has a gauge that reads from 0 to 300°F. Both models come compete as assemblies consisting of the dial thermometer itself, a thermometer mounting socket, a tee, and the necessary coupling hardware.

These thermometers can be used to measure the temperature of the product at the input to the Thermutator, the product temperature at the Thermutator output, or both. In series systems, it is often desirable to measure the product temperature at the input and output of each stage.

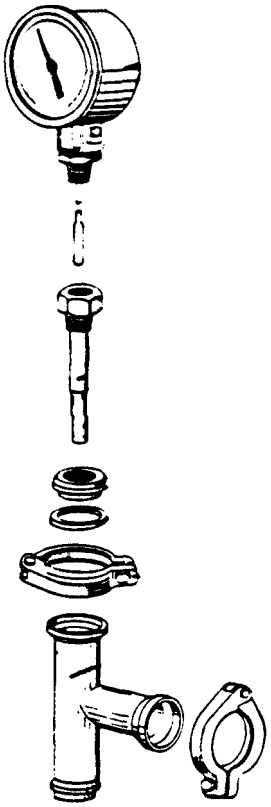


Figure 5-26. Dial Thermometer Assembly.

Interconnecting Piping

Stacked Thermutators use standard piping to connect successive heat exchange tubes. The standard interconnect piping is included in the parts list.

Installations that deviate from standard may require different piping. Consult your Waukesha Cherry-Burrell Sales Engineer when ordering repair parts for custom installations.

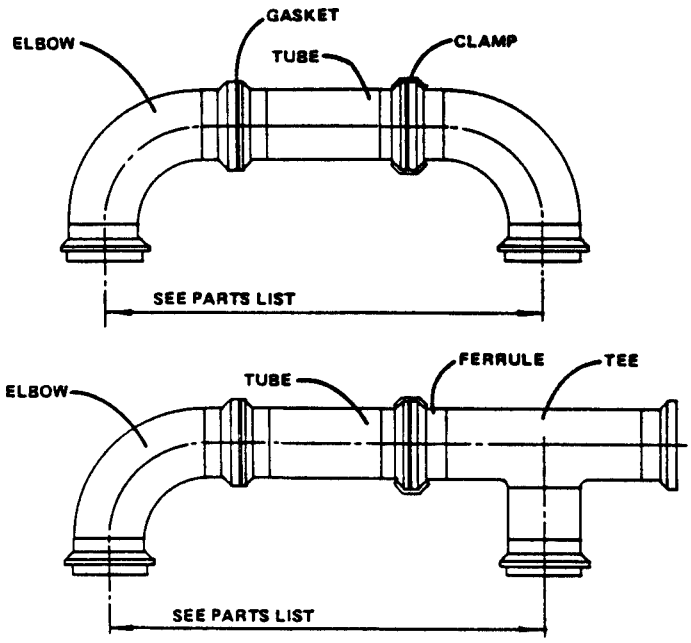


Figure 5-27. Interconnecting Piping.

Water Circulating Valve

Model "648" and "672" Thermutators may be equipped with a water circulating valve to flood the interior or of the mutator with warm water. This option is employed in applications where a product, which is being cooled, builds up on the mutator reducing the heat transfer rate and increasing the power required to turn the mutator.

The circulating water warms the mutator, preventing product build up. This option is not available on 2-1/4" mutators.

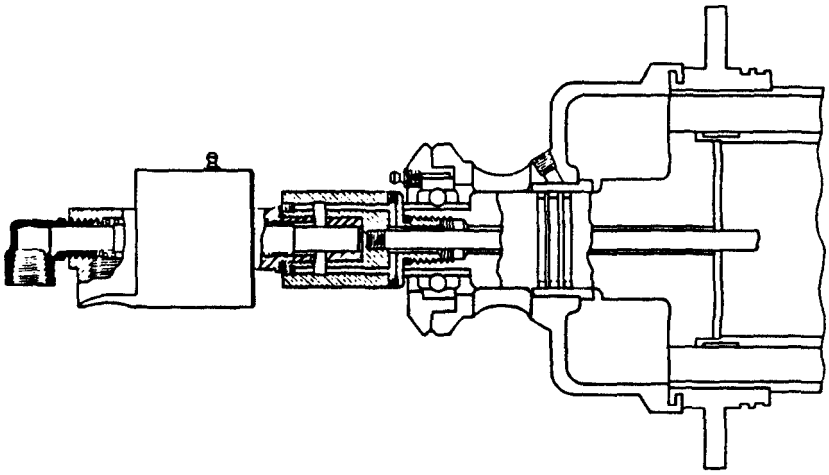


Figure 5-28. Water Circulating Valve

INSTANT START - INSTANT STOP SYSTEM

This option is only applicable to direct expansion model Thermutators.

On direct expansion model Thermutators where an extremely low temperature media is used to cool or freeze a product, the possibility always exists that the system must be shut down and the product will be frozen in the heat exchange tube. The Instant Start - Instant Stop System option eliminates this possibility through the use of a hot gas defrost during shut down.

Normal Operation

Liquid Line Solenoid Valve: Energized and Open.

Back Pressure Regulator Solenoid: energized and Open.

Hot Gas Solenoid: De-energized and Closed.

Back Pressure Regulator: Controlled by the Air Operated Pilot.

Temporary Shut Down.

Liquid Solenoid Valve: De-energized and Closed.

Back Pressure Regulator Solenoid: De-energized and Closed.

Hot Gas Solenoid: Energized and Open until Pressure Limit Switch setting is reached.

Back Pressure Regulator: Controlled by the Spring Operated Pilot.

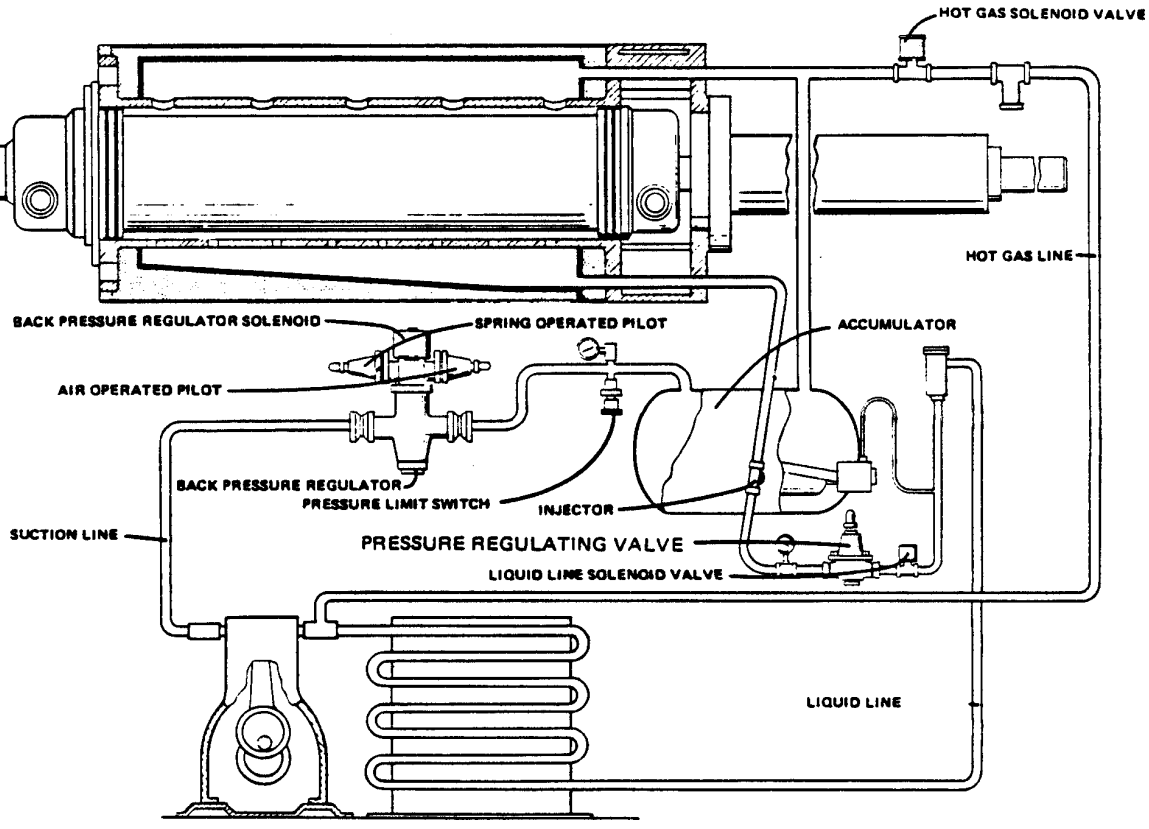


Figure 5-29. Direct Expansion System

FRONT MUTATOR BEARING

The front ball bearing for the mutator is a shielded type unit which requires regular lubrication. It is recommended that this bearing be greased after every 24 hours of mutator operation. When inspection discloses that the balls or races are worn to the extent that the inner race is loose, replace the bearing. (See Figure 6-1.)

Never immerse the front mutator bearing in a cleaning solution. Never direct steam against the bearing. Clean by wiping with a dry cloth.

PRODUCT SEALS

Thermuators are equipped with mechanical rotary product seals.

The seals should be periodically checked for signs of wear and replaced as required. Lubricating these seals daily with orange solid oil will increase their working life. (On aseptic units, a silicone or other type high temperature grease should be used.) (See Table 6-1.)

MUTATOR DRIVE SHAFT BEARINGS

All Thermutators are equipped with a centralized greasing station which is located at the rear of the cabinet. (See figure 6-2.) Grease is directed from the central panel to the front and rear drive shaft bearings. (See Figure 6-3).

The drive shaft bearings should be greased once each week.

MUTATOR DRIVE MOTOR

The mutator drive motor is equipped with two anti-friction (ball or roller) bearings. These bearings should be lubricated at extended intervals (usually every 6 months) as recommended in the motor manufacturers instructions that are packed in the instruction envelope.

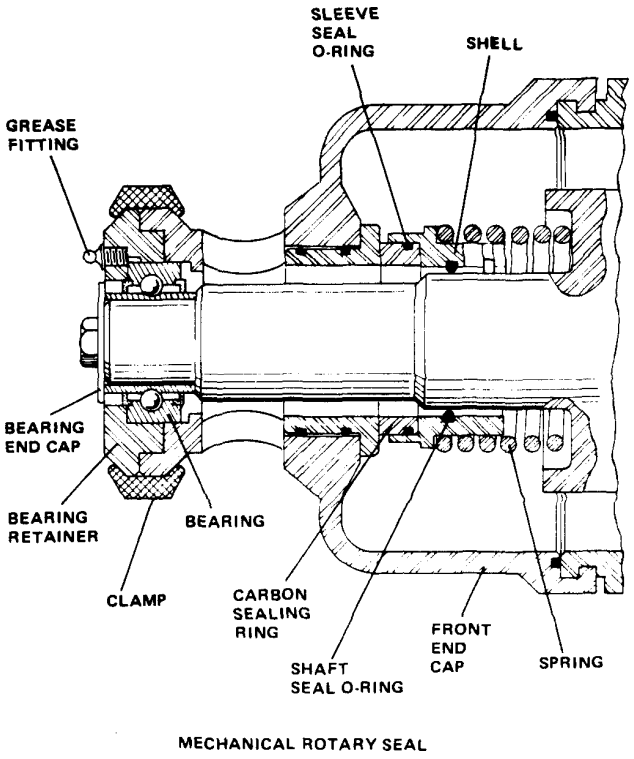


Figure 6-1. Front Mutator Bearing and Seals

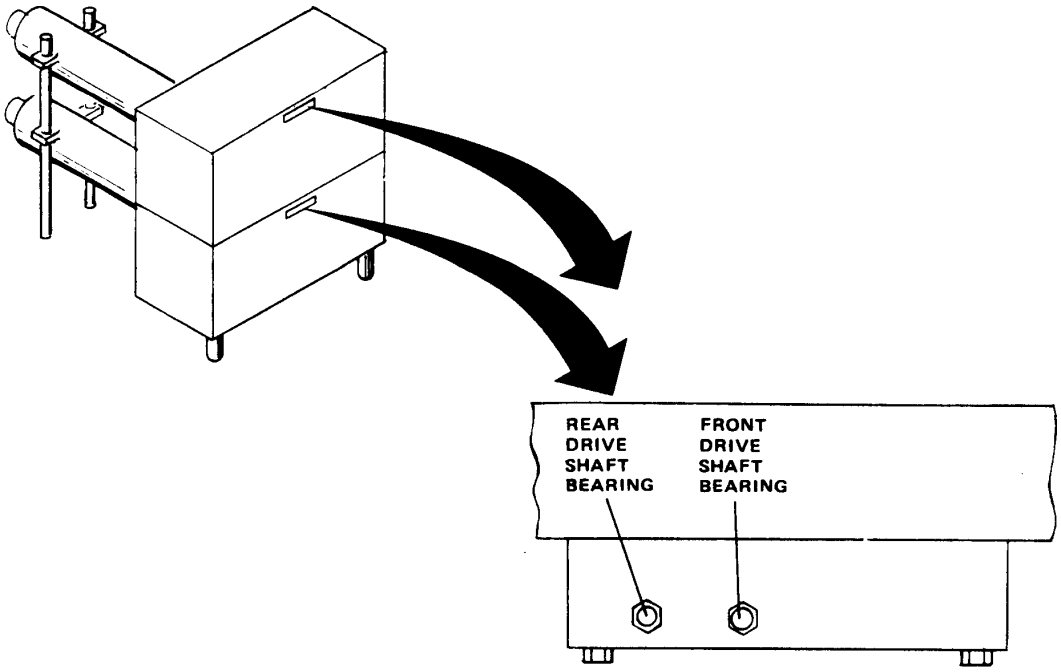
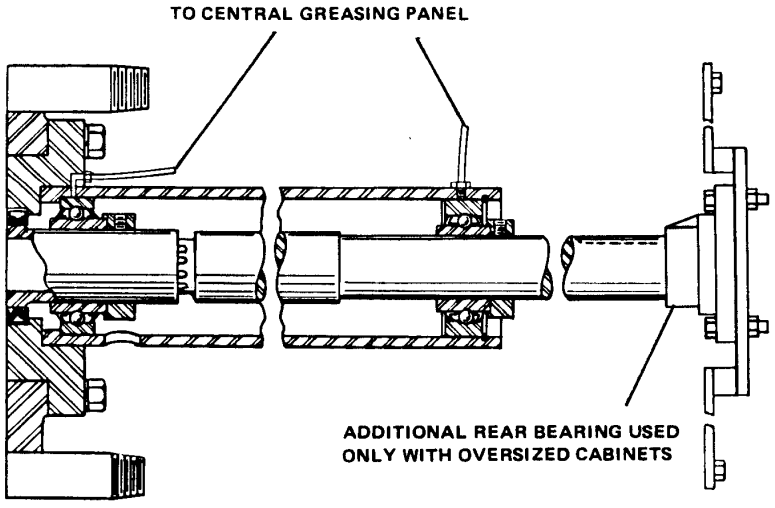


Figure 6-2. Grease Station



BEARINGS GREASED THROUGH
CENTRAL GREASING PANEL

Figure 6-3. Mutator Drive Shaft

LUBRICATION

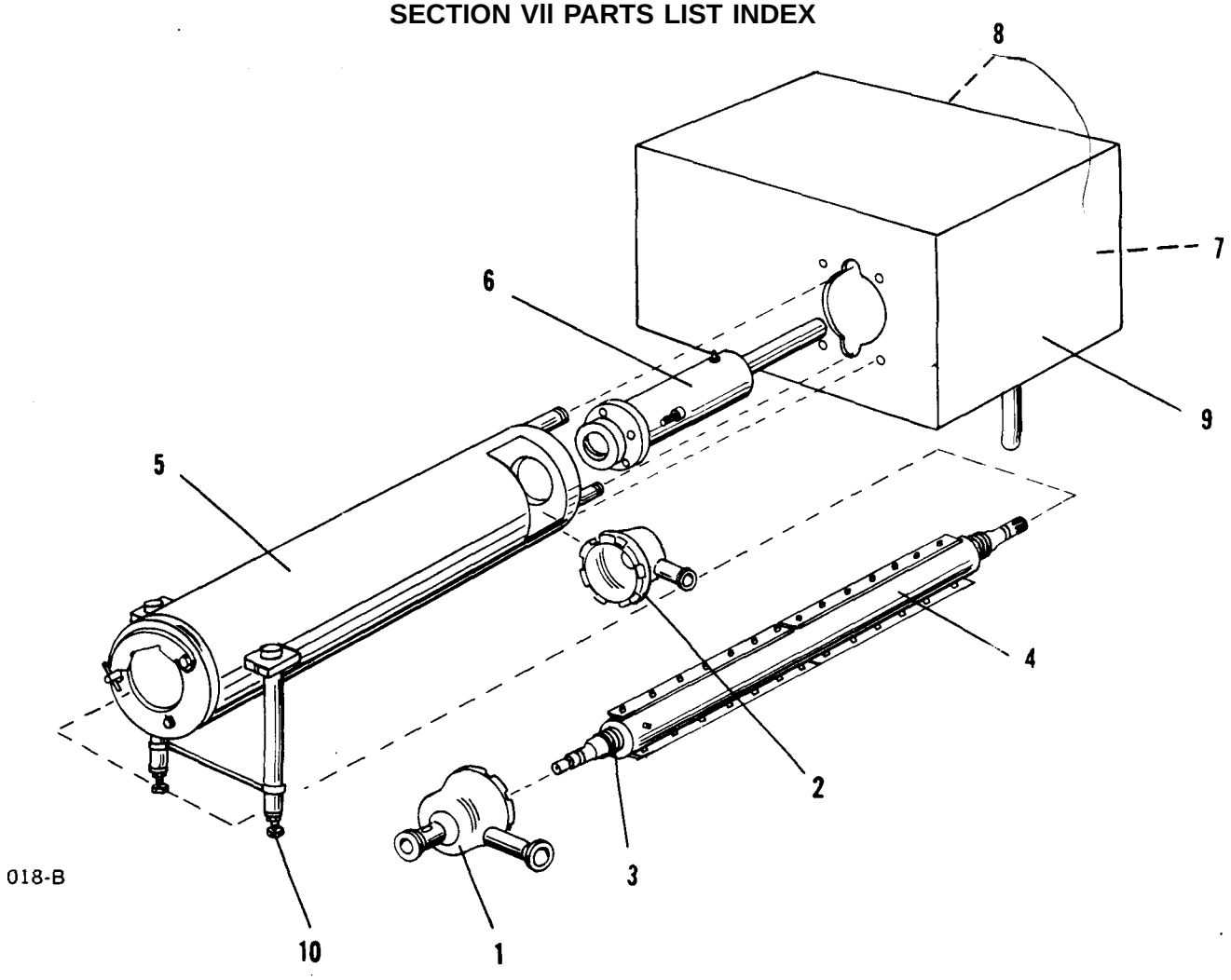
TABLE 6-1.

RECOMMENDED LUBRICANTS

NAME & MANUFACTURER	**TEMP. RANGE - °F** °C IN ( )	**RECOMMENDED SERVICE** Application and Rubber Product
Celvacene Consolidated Vacuum Co. Rochester, NY	-40 to +130 (-40 to +54)	Silicone, Nitrile, Neoprene, Viton, Butyl, Ethylene-Propylene
DC 55 Dow Corning Corp. Midland, MI	-65 to +400 (-54 to +204)	High Temperature. Nitrile, Butyl, Ethylene- Propylene, Viton, Neoprene
Apiezon N England	+60 to +85 (+15 to +30)	Vacuum (1 x 10-8). Nitrile, Butyl, Ethylene- Propylene, Viton, Neoprene
Fluorolube Hooker Chemical Corp. Niagara Falls, NY	-65 to +400 (-54 to +204)	Oxygen Service. Silicone, Nitrile, Neoprene, Ethylene-Propylene, Butyl

PARTS LIST INDEX

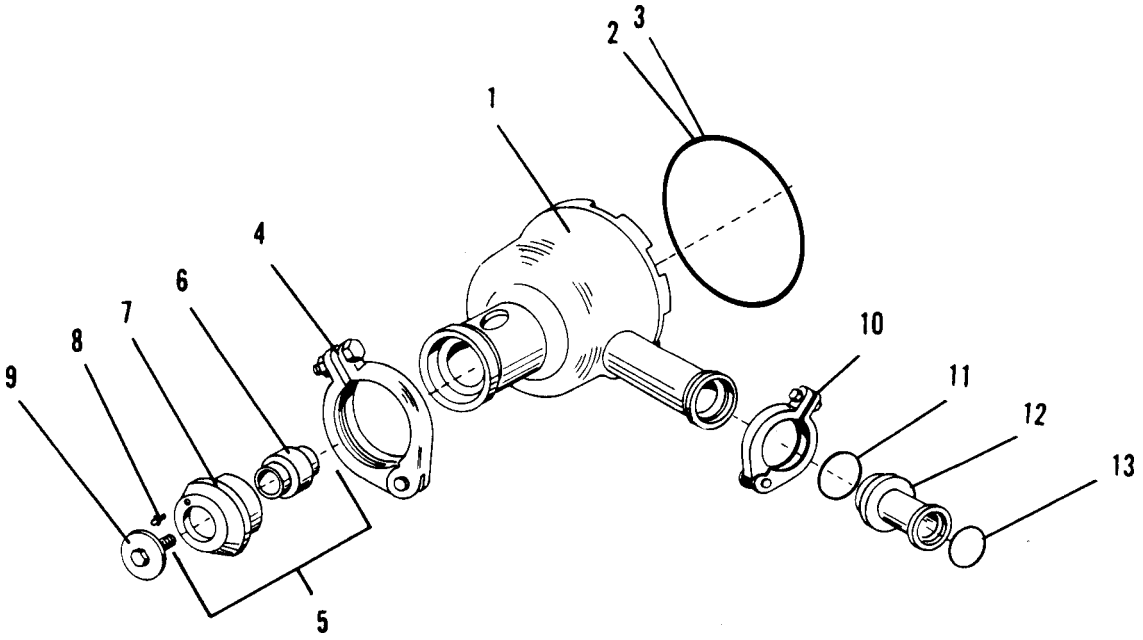
SECTION VII PARTS LIST INDEX



INDEX NO.	ASSEMBLY NAME	FOR PARTS BREAKDOWN SEE PAGE NO.
1	Front Product Outlet Assembly	67
2	Rear Product Inlet Assembly	68
3	Rotary Seal	69
4	Mutator (and related parts)	70
5	Heat Exchanger Tube, Cylinder and Related Parts	78
6	Drive Shaft (and related parts)	80
7	Constant Speed Drive System	81
8	Grease Station & Piping	134
9	Outboard Legs	135
10	Cabinets	136

PARTS LIST INDEX

FRONT PRODUCT OUTLET ASSEMBLY



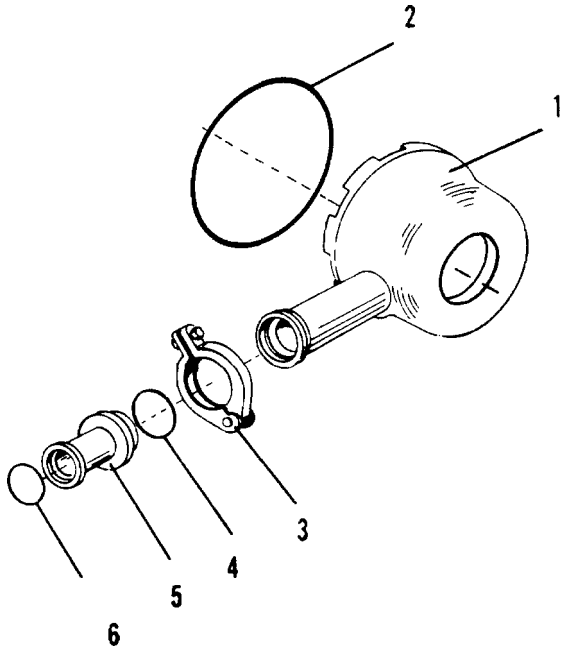
INDEX NO.	DESCRIPTION	PART NO.	QTY.
1	*Product Outlet Front Cap (Less Bushing, see page 69) for Bushings and Seals) - 2" Std.	300-1622	1
	*Product Outlet Front Cap - 3" Std.	300-1630	1
	*Product Outlet Front Cap - 2" Aseptic	300-1624	1
	*Product Outlet Front Cap - 3" Aseptic	300-1632	1
2	+O-Ring (Direct Expansion & Liquid Only)	554-0234	1
3	+O-Ring (Steam Only)	554-0233	1
4	Clamp, 131 - 3" (all)	034-5223	1
5	Mutator Bearing Assembly (all) (Consists of parts 6, 7 & 8)	43126	1
6	Bearing, Ball (all)	559-0342	1
7	Retainer, Bearing	43130	1
8	Fitting, Grease	590-0198	1
9	Cap, End Bearing	300-0448	1
10	Clamp, 131 - 2"	034-3223	1
	Clamp, 131 - 3"	034-5223	1
11	+Gasket,401H-2"	554-0326	1
	+Gasket 401H - 3"	554-0328	1
12	Reducer, 401H - 2" x 1-1/2" (Used w/2" Port Only)	034-3552	1
13	+Gasket, 401H - 1-1/2"	554-0325	1

*This component is not interchangeable with the corresponding front product outlet component used on Thermutators equipped with 2-1/4" mutators. To obtain replacement part numbers for product outlet assemblies on these units, refer to: Page 72 Product Inlet/Outlet - Standard 2-1/4" Mutators; Aseptic, all models.

+Indicates part with limited service life. On-hand spares are recommended.

PARTS LIST INDEX

REAR PRODUCT INLET ASSEMBLY



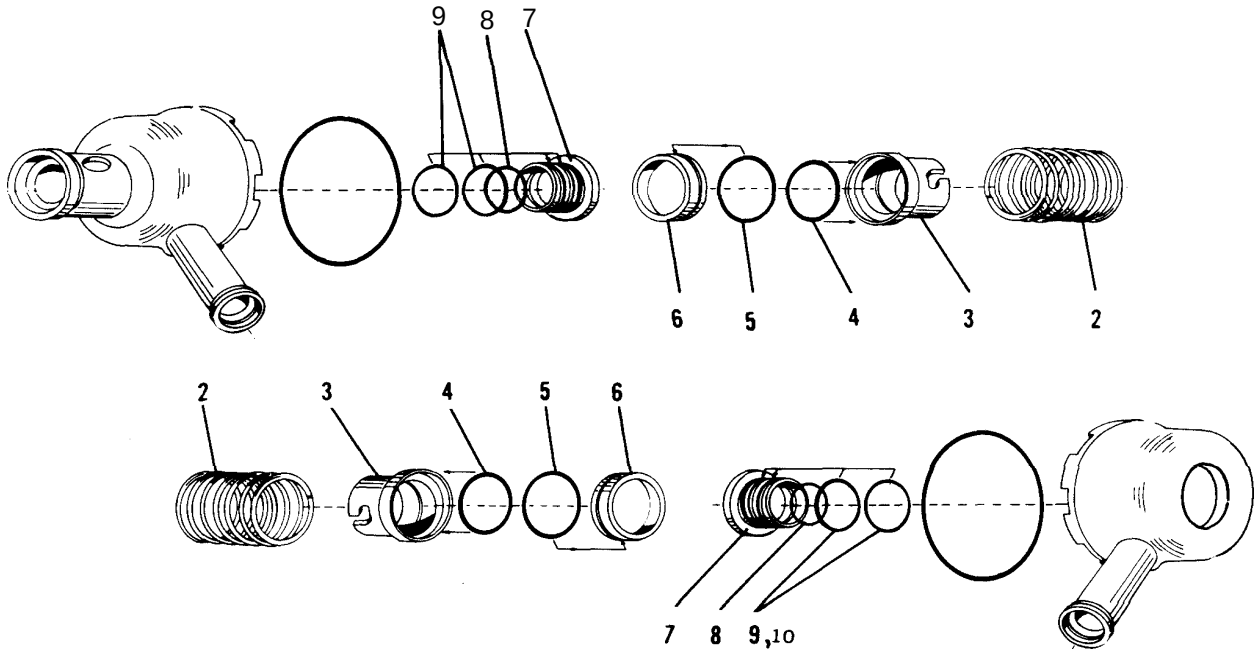
INDEX NO.	DESCRIPTION	PART NO.	QTY.
1	*Product Inlet Less Bushing, see page 7-4 for Bushings & Seals) - 2" Std.	300-1621	1
	*Product Inlet - 3" Std.	300-1629	1
	*Product Inlet - 2" Aseptic	300-1623	1
	*Product Inlet - 3" Aseptic	300-1631	1
2	+O-Ring (Direct Expansion & Liquid Only)	554-0234	1
	+O-Ring (Steam)	554-0233	1
3	Clamp, 131 - 2"	034-3223	1
	Clamp, 131 - 3"	034-5223	1
4	+Gasket 401H - 2"	554-0326	1
	+Gasket, 401H - 3"	554-0328	1
5	Reducer, 2" x 1-1/2" (Used w/2" Port Only)	034-3553	1
6	+Gasket, 401H - 1-1/2"	554-0325	1

*This component is not interchangeable with the corresponding front product inlet component used on Thermutators equipped with 2-1/4" mutators. To obtain replacement part numbers for product inlet assemblies on these units, refer to: Pages 70 & 77 Product Inlet/Outlet - Standard 2-1/4" Mutators; Aseptic; all models.

+Indicates part with limited service life. On-hand spares recommended.

PARTS LIST INDEX

ROTARY SEALS

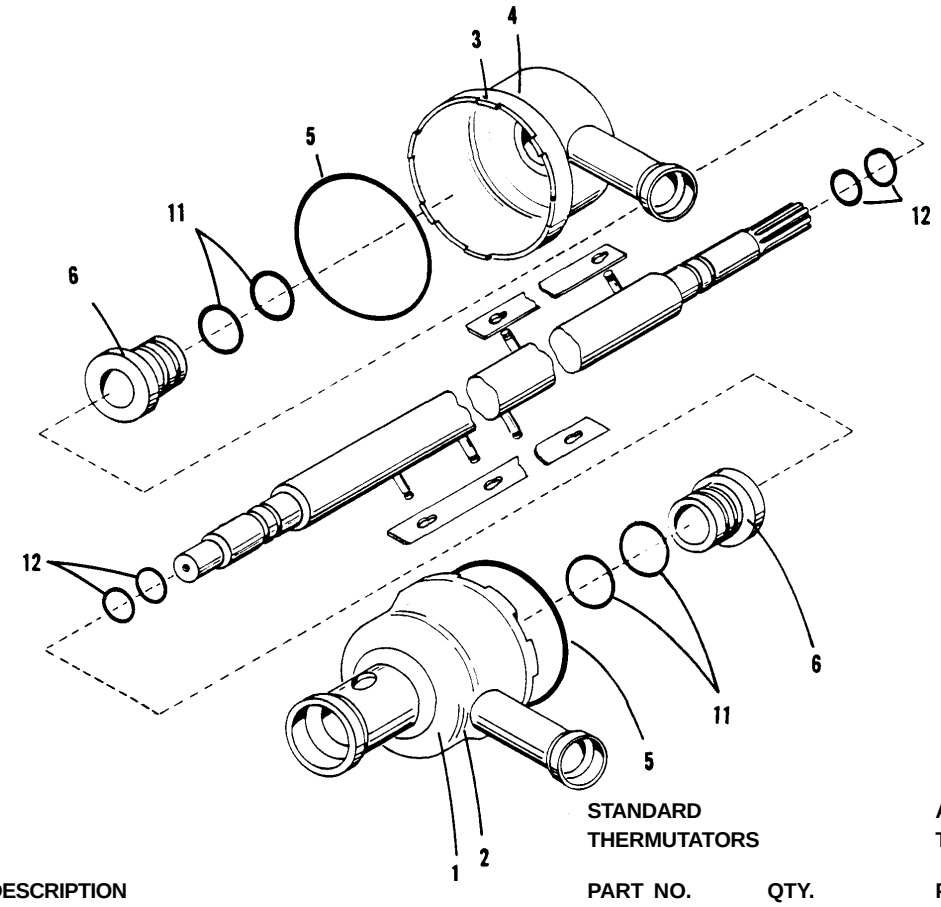


NOTE: SEALS ON THIS PAGE ARE NOT APPLICABLE TO THERMUTATORS WITH 2-1/4" MUTATORS WITH O-RING SHAFT SEALS, SEE PAGE 77 FOR 2-1/4" MUTATOR SEALS.

INDEX NO.	DESCRIPTION	PART NO.	QTY.
1	Seal Assembly Consists of Parts 2 thru 5		
2	Spring	590-1120	A.R.
3	Shell	300-1571	A.R.
4	O-Ring, Shaft Seal - E.P.R.	554-0587	+
	O-Ring, Shaft Seal - Viton	554 0754	+
	O-Ring, Shaft Seal - Buna-N	554-0192	+
	O-Ring, Shaft Seal - Teflon Encapsulated	700-5513	+
5	O-Ring, Carbon Seal - E.P.R.	554-0813	+
	O-Ring, Carbon Seal - Viton	554-1153	+
	O-Ring, Carbon Seal - Buna-N	554-0733	+
6	Ring, Sealing - Carbon	554-0909	+
	Ring, Sealing - Teflon	554-1125	+
7	Bushing, Std.	300-2743	+
	Bushing, Aseptic	300-2742	+
8	Seal, Lip	554-0917	+
9	Snap Ring	959-0181	+
10	O-Ring, Bushing	554-0812	+

+Indicates part with limited service life. On-hand spares recommended.

Product Inlet/Outlet Assembly - Aseptic (or Water Flush)
(for Ultra-Wide Clearance Mutator and/or O-Ring Seal)



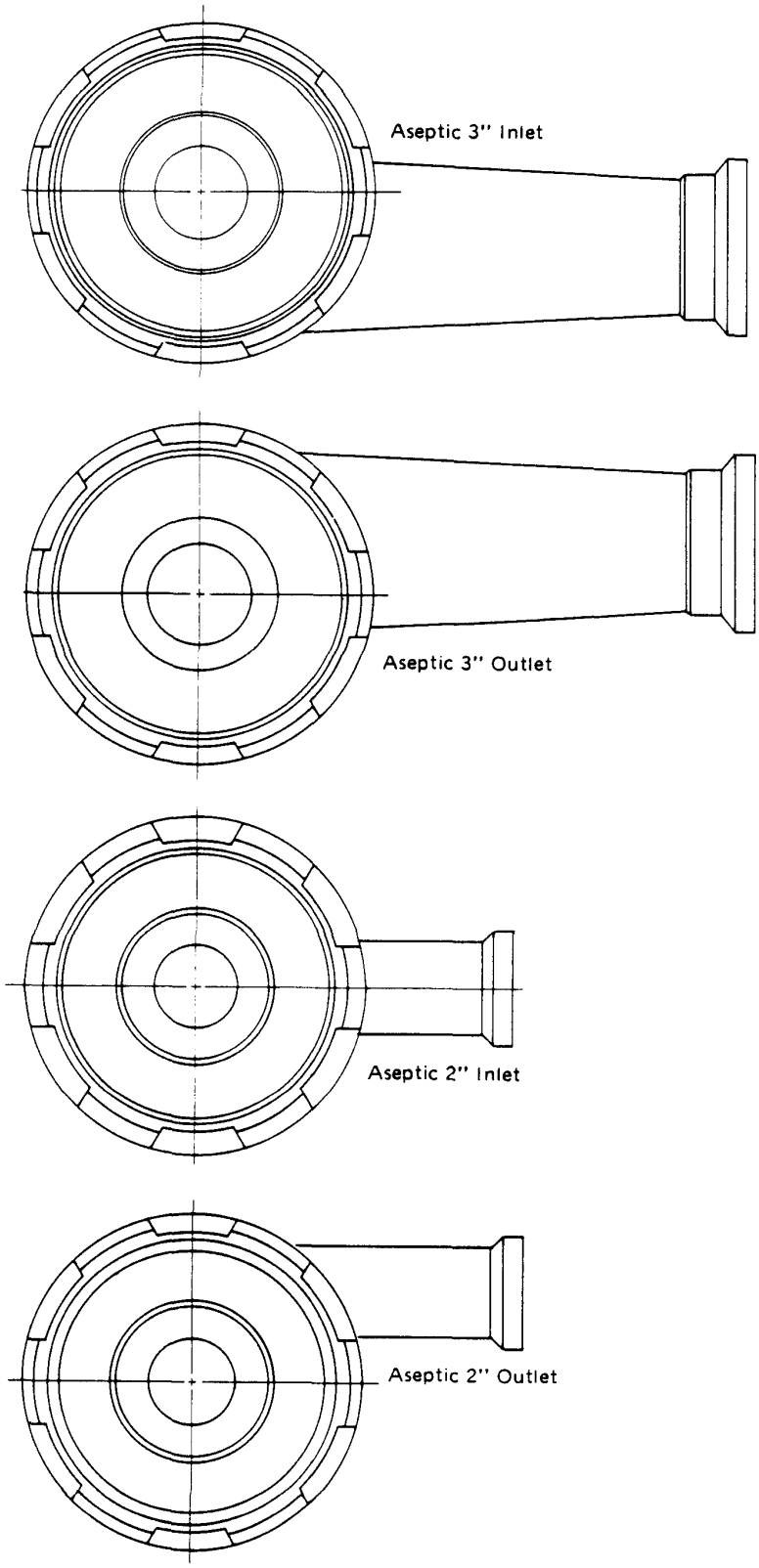
INDEX NO.	DESCRIPTION	STANDARD THERMUTATORS PART NO.	QTY.	ASEPTIC THERMUTATORS PART NO.	QTY.
1	Product Outlet Assembly, Front - 2" I-Line - Complete (Consists of parts 6, 7 & 11)	300-1815	1	300-1817	1
2	Product Outlet Assembly, Front - 3" I-Line - Complete (Consists of parts 6, 8 & 11)	300-1820	1	300-1822	1
3	Product Inlet Assembly, Rear - 2" I-Line - Complete (Consists of parts 6, 9 & 11)	300-1814	1	300-1816	1
4	Product Inlet Assembly, Rear - 3" I-Line - Complete (Consists of parts 5, 6 & 10)	300-1819	1	300-1821	1
5	O-Ring (Models L and DE only)	+554-0234	1	+554-0234	
5	O-Ring (Model S only)	+554-0233	1	+554-0233	1
6	Bushing	+300-1824	1	+300-1818	1
*7	Cap, Front Product Outlet - 2" I-Line	300-1622	1	300-1624	1
*8	Cap, Front Product Outlet - 3" I-Line (Less Bushing)	300-1630	1	300-1632	1
*9	Cap, Rear Product Inlet - 2" I-Line	300-1621	1	300-1623	1
*10	Cap, Rear Product Inlet - 3" I-Line	300-1629	1	300-1631	1
11	O-Ring - Bushing EPR	+554-0812	2	+554-0812	2
11	O-Ring- Bushing Viton	554-1152	2	554-1152	2
11	O-Ring - Bushing Buna N	554-0908	2	554-0908	2
12	O-Ring, Shaft Seal (Model DE and L) Buna-N	554-0182	2	554-0182	2
12	O-Ring, Shaft Seal (Model S) EPR	554-0181	2	554-0181	2
13	Screw, Blade Locking	300-1501	2 or 3	300-1501	2 or 3
14	Wire, Locking Screw Safety (No. 13 W & M gauge stainless steel)				

+Indicates parts with limited service life. On-hand spares are recommended.

*See Figure 7-2 and 7-3, Items 6 thru 11, for standard inlet/outlet assembly.

PARTS LIST INDEX

Product Inlet-Outlet



PARTS LIST INDEX

Product Inlet-Outlet

STANDARD & ASEPTIC FOR 2-¼" MUTATOR - O-RING SEAL

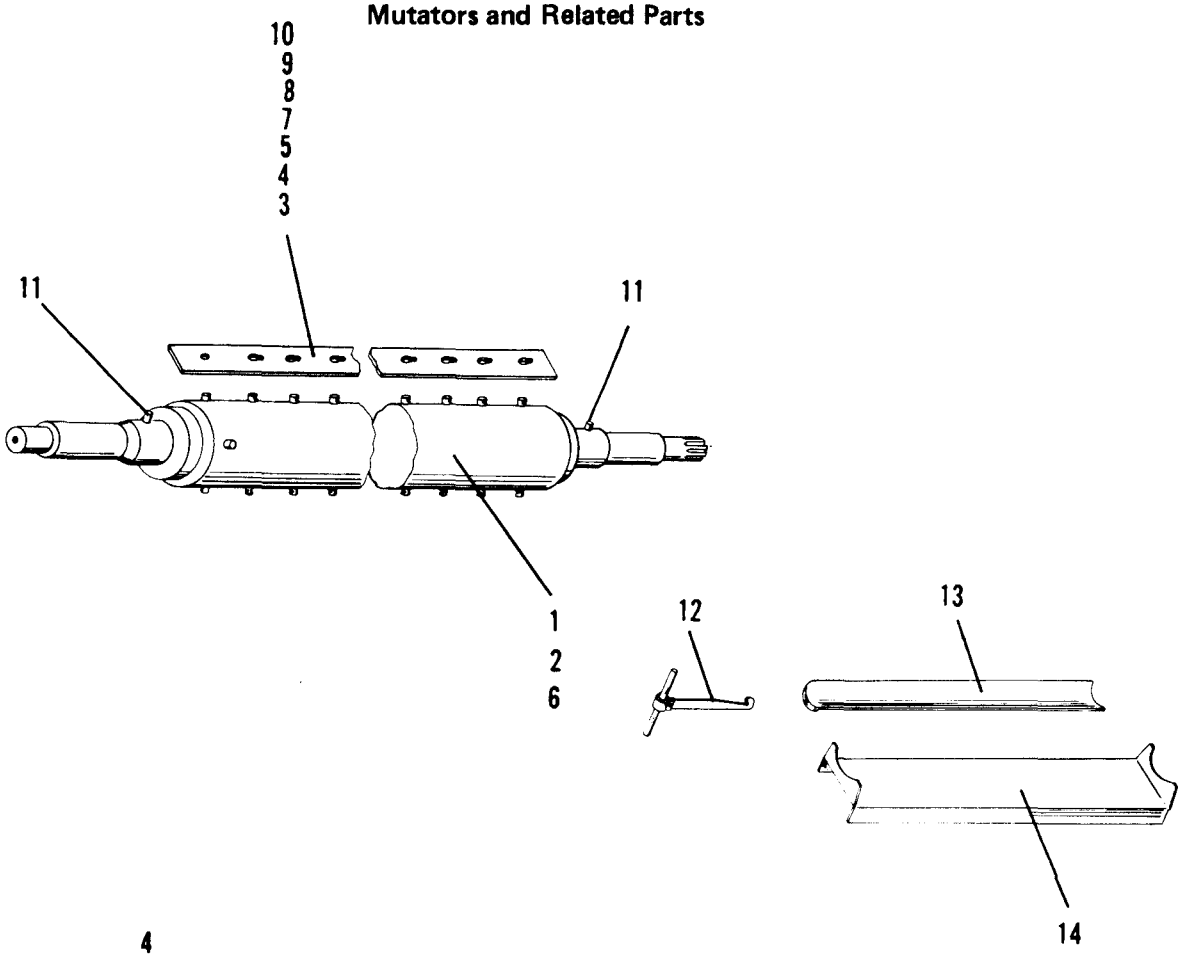
INDEX NO.	DESCRIPTION	QTY.	2" STANDARD INLET	2" STANDARD OUTLET	2" ASEPTIC INLET	2" ASEPTIC OUTLET
+6	*Busing Seat	1	300-1824	300-1824	300-1818	300-1818
+3	Inlet (Rear) Less Bushing	1	300-1621		300-1623	
+11	*O-Ring (Bushing O.D.)	2	554-0812	554-0812	554-0908	554-0812
+1	Outlet (Front) Less Bushing	1		300-1622		300-1624
	**Inlet (Assembly)		300-1814		300-1816	
	**Outlet (Assembly)			300-1815		300-1817

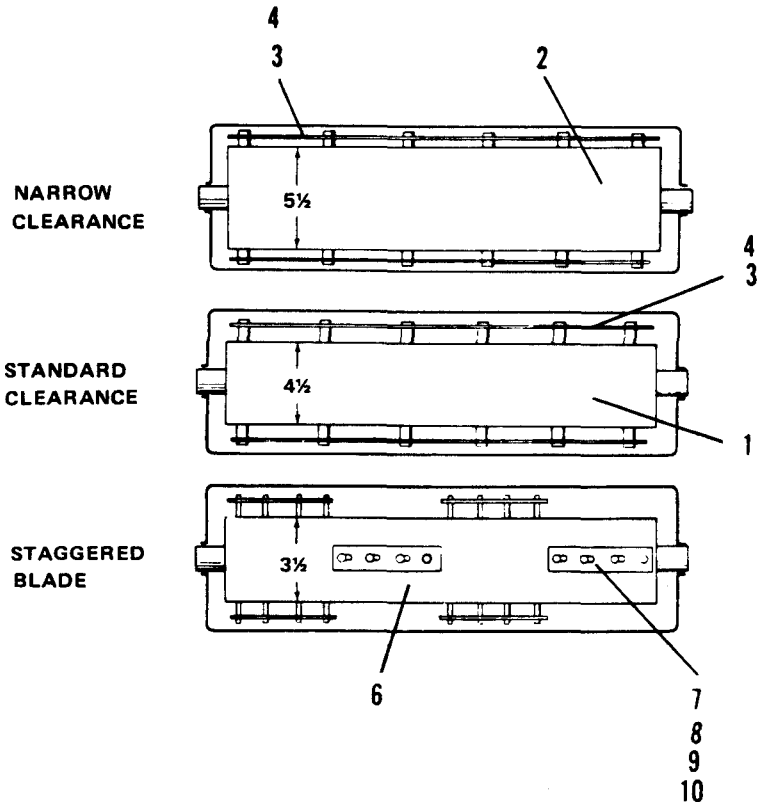
			3" STANDARD INLET	3" STANDARD OUTLET	3" ASEPTIC INLET	3" ASEPTIC OUTLET
+6	*Bushing Seat	1	300-1824	300-1824	300-1818	300-1818
+3	Inlet (Rear) Less Bushing	1	300-1629		300-1631	
+11	*O-Ring (Bushing O.D.)	2	554-0908	554-0812	554-0812	554-0812
+1	Outlet (Front) Less Bushing	1		300-1630		300-1632
	**Inlet (Assembly)		300-1819		300-1821	
	**Outlet (Assembly)			300-1820		300-1822

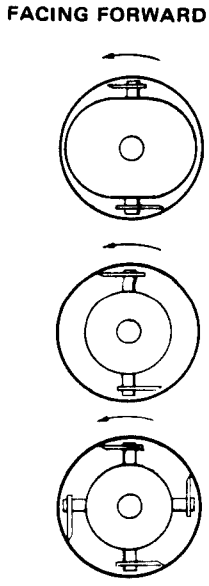
*Indicates Component With Limited Service Life, On Hand Spares Recommended.
**Assembly Consists of Preceding Individual Parts.
+These Index Numbers Relate to Figure on Page 70.

PARTS LIST INDEX

Mutators and Related Parts







PARTS LIST INDEX

Mutators and Related Parts

INDEX NO.	DESCRIPTION	MODEL 624 THERMUTATORS PART NO.	QTY.	MODEL 648 THERMUTATORS PART NO.	QTY.	MODEL 672 THERMUTATORS PART NO	QTY.
1	Mutator, Standard Clearance	300-1609	1	300-1610	1	300-1611	1
2	Mutator, Narrow Clearance (Scraper blades parts 9 and 10 for use on mutators parts 7 and 8 only)	300-1612	1	300-1613	1	300-1614	1
3	Blade, Standard Scraper - Stainless Steel	+69814	2	+69814	4	+69814	6
4	Blade, Standard Scraper - Polysulfone	+477-3000	2	+477-3000	4	+477-3000	6
5	Blade, Standard Scraper - G-ll Epoxy	481-0800	2	481-0800	4	481-0800	6
6	Mutator, Staggered Blade	300-1904	1	300-1905	1	300-1906	1
	(Scraper blades parts 12 thru 15 for use on mutator part 11 only)						
7	Blade, Staggered Scraper - Stainless Steel	+300-1901	4	+300-1901	8	+300-1901	12
8	Blade, Staggered Scraper - Relieved Stainless Steel	+300-1903	4	+300-1903	8	+300-1903	12
9	Blade, Staggered Scraper - G-ll Epoxy	+300-1902	4	+300-1902	8	+300-1902	12
10	Blade, Staggered Scraper - LB-31 Plastic	+300-1909	4	+300-1909	8	+300-1909	12
11	Pin, Shell Lock	959-0127	2	959-0127	2	959-0127	2
12	Hook, Mutator Removing	300-1640	1	300-1640	1	300-1640	1
13	Trough, Mutator Removing	300 0455	1	484-0399	1	484-0400	1
14	Rack, Mutator Wash	300-0456	1	300-4441	1	300-4442	1
	3 1/2" Stagger Mutators w/std Blades	300-5148	2	300-5149	4	300-5150	6

Specials:

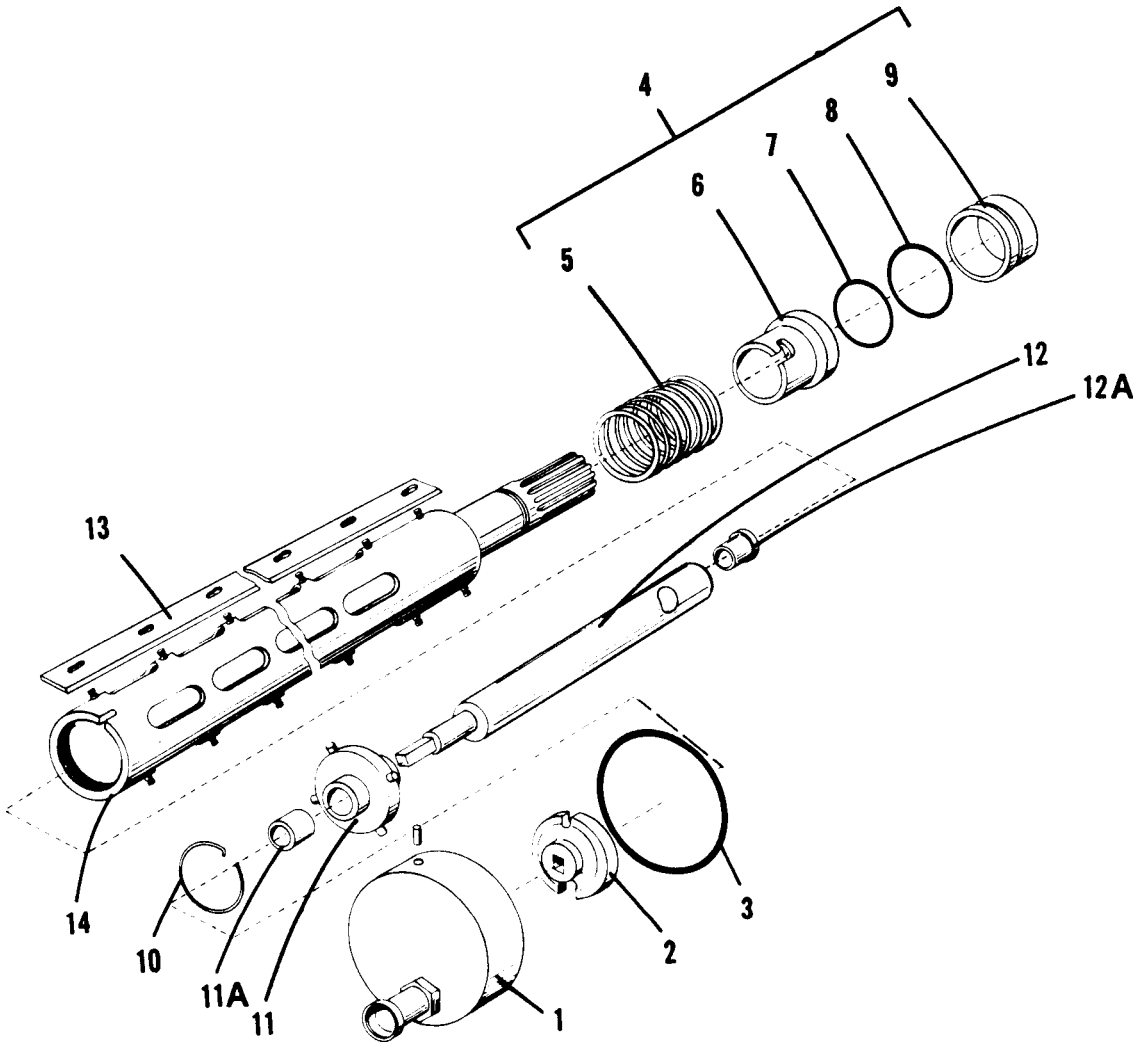
Mutator _____

Blades _____

For Machine #_____ Only

PARTS LIST INDEX

Whipping Dasher - 24" and 48"



PARTS LIST INDEX

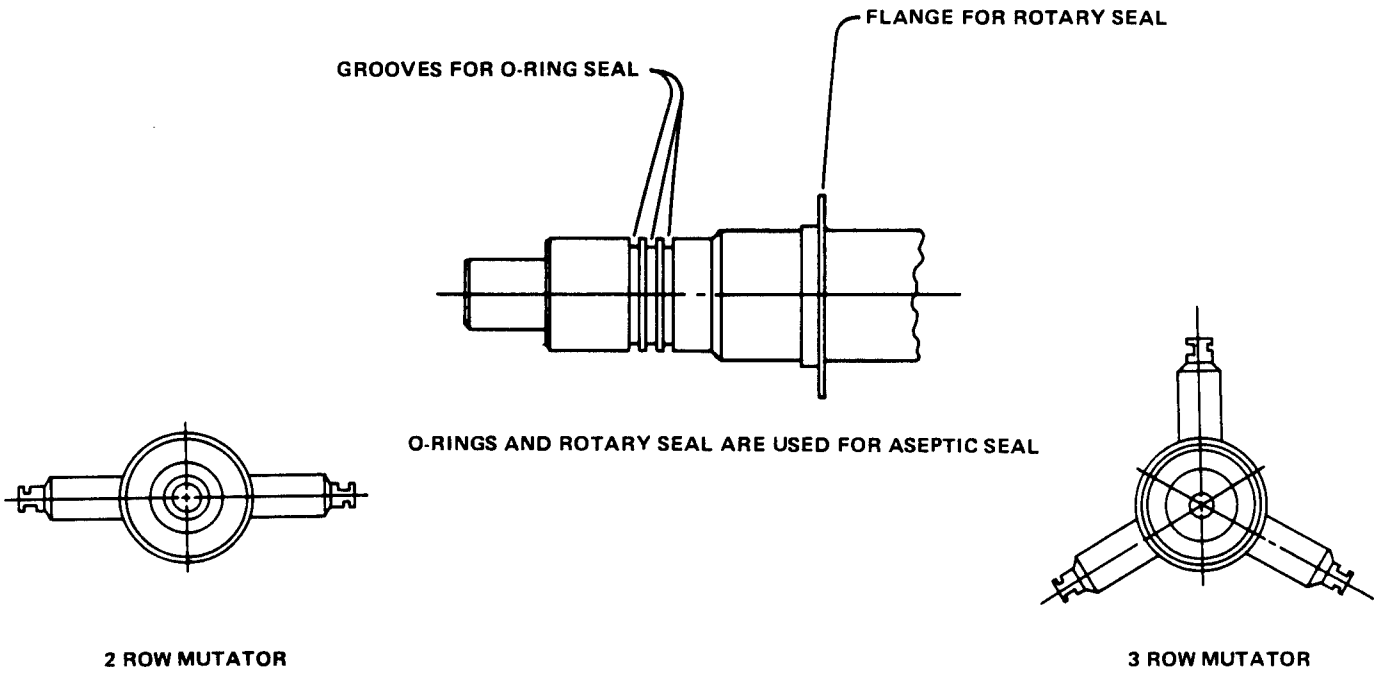
Whipping Dasher, 24" and 48"

INDEX NO,	DESCRIPTION	24 INCH DASHER	48 INCH DASHER	QTY.
	Dasher, Whipping - Complete	680-3208	300-0795	
1	2" Product Inlet/Outlet Assembly, Front	300-0779	300-0779	1
2	Spider, Front	484-0065	484-0065	1
3	O-Ring, Product Inlet/Outlet	+554-0234	+554-0234	2
4	Mechanical Rotary Seal Assembly (each assembly consists of parts 5 thru 9)			
5	Spring	590-1120	590-1120	1
6	Shell	300-1571	300-1571	1
7	O-Ring, Shell l.D. - Buna-N, 65° to 250°F	+554-0192	+554-0192	1
	O-Ring, Shell l.D. - E.P.R., 65° to 300°F	554-0587	554-0587	1
	O-Ring, Shell l.D. -Viton, 175° to 450°F (Dry Air)	554-0754	554-0754	1
8	O-Ring, Sleeve Seal	+554-0733	+554-0733	1
	O-Ring, Sleeve Seal - E.P.R.	551-0813	551-0813	1
	O-Ring, Sleeve Seal, - Viton	551-1153	551-1153	1
9	Ring, Sealing (Carbon)	+554-0909	+554-0909	1
10	Snap Ring	590-0236	590-0236	1
11	Bearing, Beater	484-0053	484-0053	1
11A	Bushing for Beater Bearing	+264-2881	+264-2881	1
12	Beater, Displacement	680-3202	680-3179	1
12A	Bushing for Displacement Beater	+263-5749	+263-5749	1
13	Blade, Scraper (No. 410 Stainless Steel)	+484-0076	+484-0054	4
14	Dasher Tube and Journal	835-1222	300-0793	1

+indicates parts with limited service. On-hand spares recommended.

PARTS LIST INDEX

Ultra-Wide Clearance Mutator



2¼" MUTATOR - 2 ROWS OF BLADES

	'624'		'648'	
	O-RING SEAL	ROTARY SEAL & O-RING	O-RING SEAL	ROTARY SEAL & O-RING
Mutator Complete	300-3199	300-300-5261	300-3202	300-300-52622
	Blades @ 180°		2 Rows of Blades @ 180° 4 Blades	

2¼" MUTATOR - 3 ROWS OF BLADES

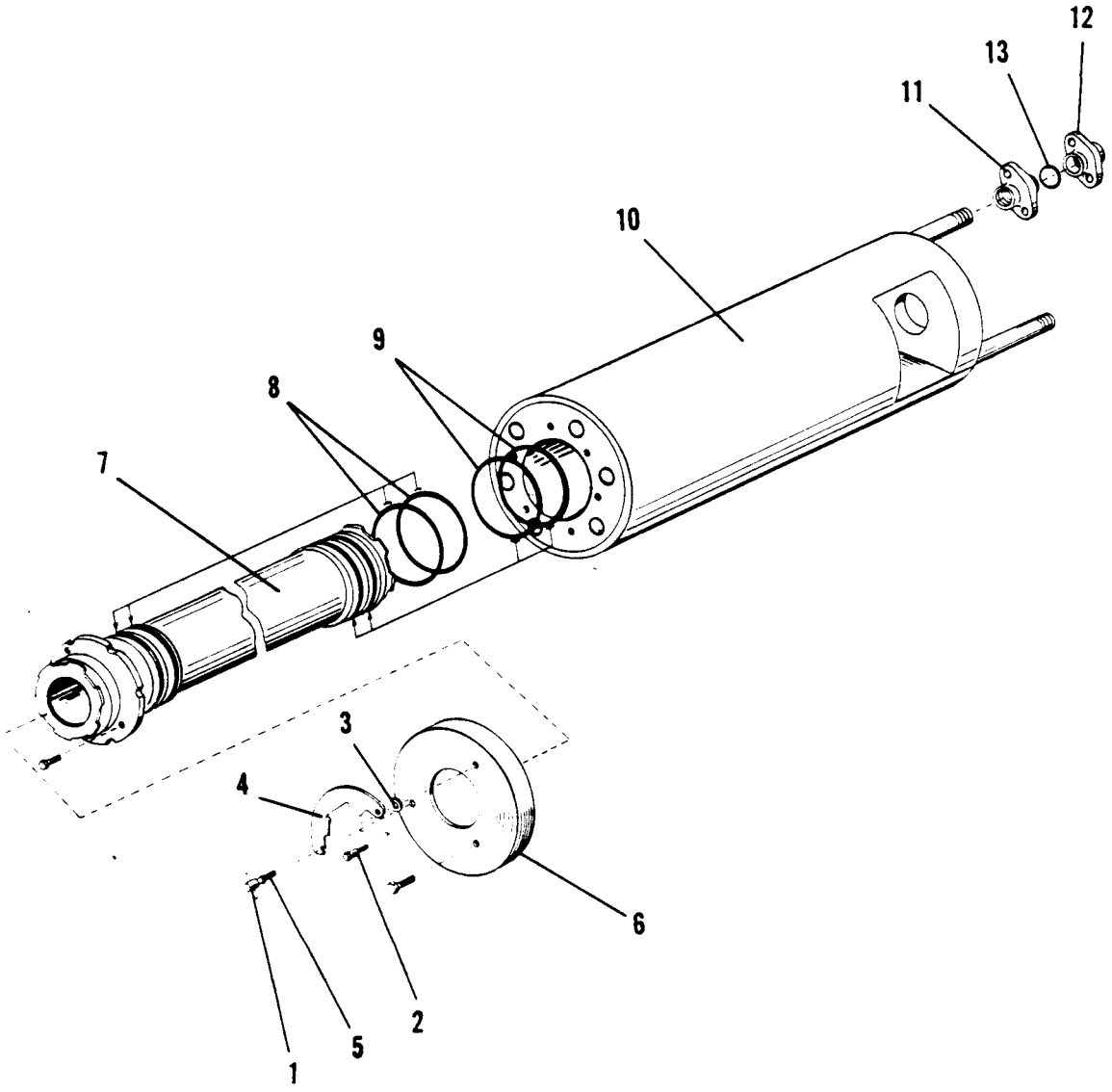
	'672'		
	O-RING SEAL	ROTARY SEAL & O-RING	ROTARY SEAL ONLY
Mutator Complete	300-1500	300-3201	300-1615

24" MUTATOR BLADES FOR 2¼" MUTATORS - ALL MODELS

PART NO.	DESCRIPTION
300-2600	Relieved Blade
68914	Standard Blade

PARTS LIST INDEX

Heat Exchange Tube, Cylinder, and Related Parts



PARTS LIST INDEX

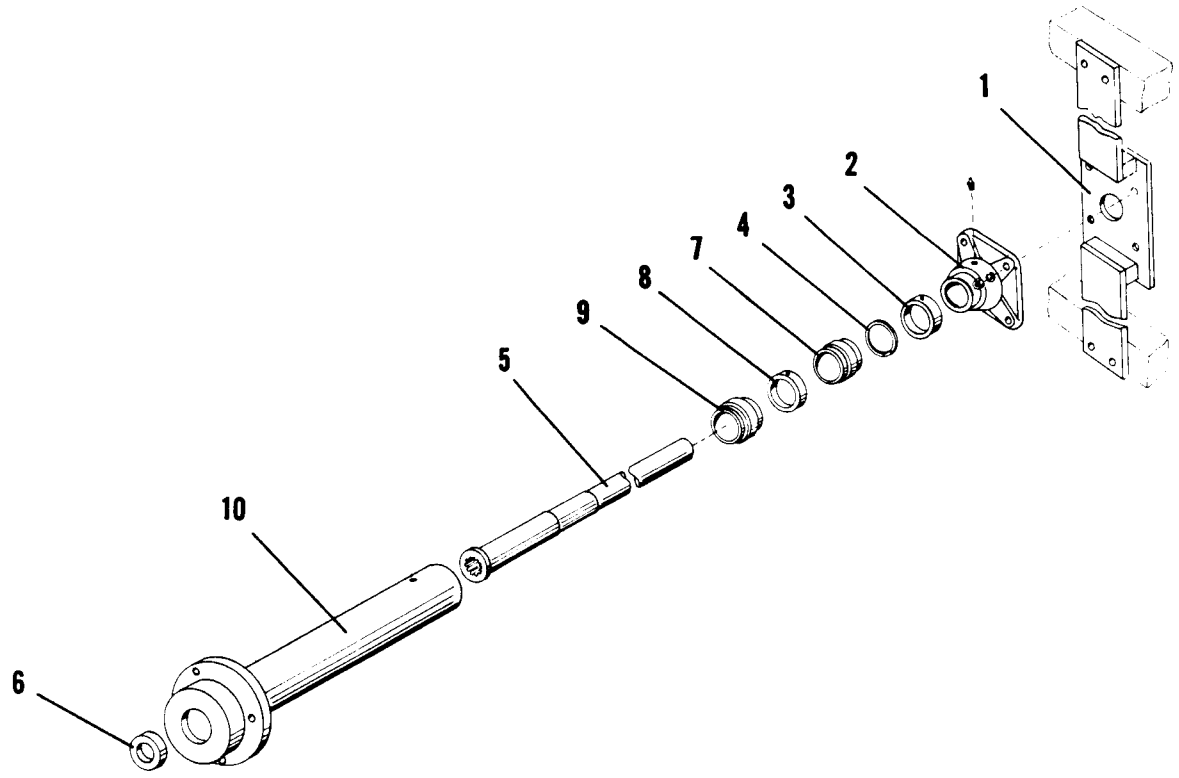
Heat Exchange Tube, Cylinder, and Related Parts

INDEX NO.	DESCRIPTION	624 Liquid PART NO,	QTY.	624 Steam PART NO.	QTY.	624 Direct Expansion PART NO.	QTY.	648 Liquid PART NO,	QTY.	648 Steam PART NO.	QTY.	648 Direct Expansion PART NO.	QTY.	672 Liquid PART NO.	QTY.	672 Steam PART NO.	QTY.	672 Direct Expansion PART NO.	QTY.
1	Retainer, Latch	220-0281	1	220-0281	1	220-0281	1	220-0281	1	220-0281	1	220-0281	1	220-0281	1	220-0281	1	220-0281	
2	Screw, Shoulder Pivot	41486	1	41486	1	41486	1	41486	1	41486	1	41486	1	41486	1	41486	1	41486	1
3	Spacer, Latch	220-0321	1	220-0321	1	220-0321	1	220-0321	1	220-0321	1	220-0321	1	220-0321	1	220-0321	1	220-0321	1
4	Latch, Locking	484-0052	1	484-0052	1	484-0052	1	484-0052	1	484-0052	1	484-0052	1	484-0052	1	484-0052	1	484-0052	1
5	Stud, Latch	220-0277	1	220-0277	1	220-0277	1	220-0277	1	220-0277	1	220-0277	1	220-0277	1	220-0277	1	220-0277	1
6	Head, Cylinder	484-0051	1	484-0051	1	484-0051	1	484-0051	1	484-0051	1	484-0051	1	484-0051	1	484-0051	1	484-0051	1
7	Tube, Heat Exchange - Nickel - UM Certification	300-4244	1	300-0122	1	300-0123	1	300-4252	1	300-0120	1	300-0079	1	300-4260	1	300-0279	1	300-0281	1
7	Tube, Heat Exchange - Nickel - U Certification	300-4245	1	300-0125	1	300-0126	1	300-4253	1	300-0116	1	300-0117	1	300-4261	1	300-0280	1	300-0282	1
7	Tube, Heat Exchange - Stn. Stl. - UM Certification	300-4246	1	300-0300	1	300-0302	1	300-4254	1	300-0295	1	300-0299	1	300-4262	1	300-0286	1	300-0288	1
7	Tube, Heat Exchange - Stn. Stl. - U Certification	300-4247	1	300-0301	1	300-0303	1	300-4255	1	300-0294	1	300-0298	1	300-4263	1	300-0285	1	300-0287	1
8	O-Ring, Tube - Front	+554-0649	2	+554-0650	2	+554-0649	2	+554-0649	2	+554-0650	2	+554-0649	2	+554-0649	2	+554-0650	2	+554-0649	2
9	O-Ring, Tube - Rear	+554-0648	2	+554-0651	2	+554-0648	2	+554-0648	2	+554-0651	2	+554-0648	2	+554-0648	2	+554-0651	2	+554-0648	2
10	Cylinder - UM Certification	300-3429	1	300-3429	1	300-3429	1	300-3431	1	300-3431	1	300-3431	1	300-3433	1	300-3433	1	300-3433	1
10	Cylinder - U Certification	300-3428	1	300-3428	1	300-3428	1	300-3430	1	300-3430	1	300-3430	1	300-3432	1	300-3432	1	300-3432	1
11	Flange Half, 2" IPS Female			555-3783	1					555-3783	1					555-3783	1		
12	Flange Half, 2" IPS Male			555-3782	1					555-3782	1					555-3782	1		
13	Gasket, 2" Flange			554-1147	1					554-1147	1					554-1147	1		

+Indicates part with limited service life. On-hand spares are recommended.

PARTS LIST INDEX

Drive Shaft and Related Parts

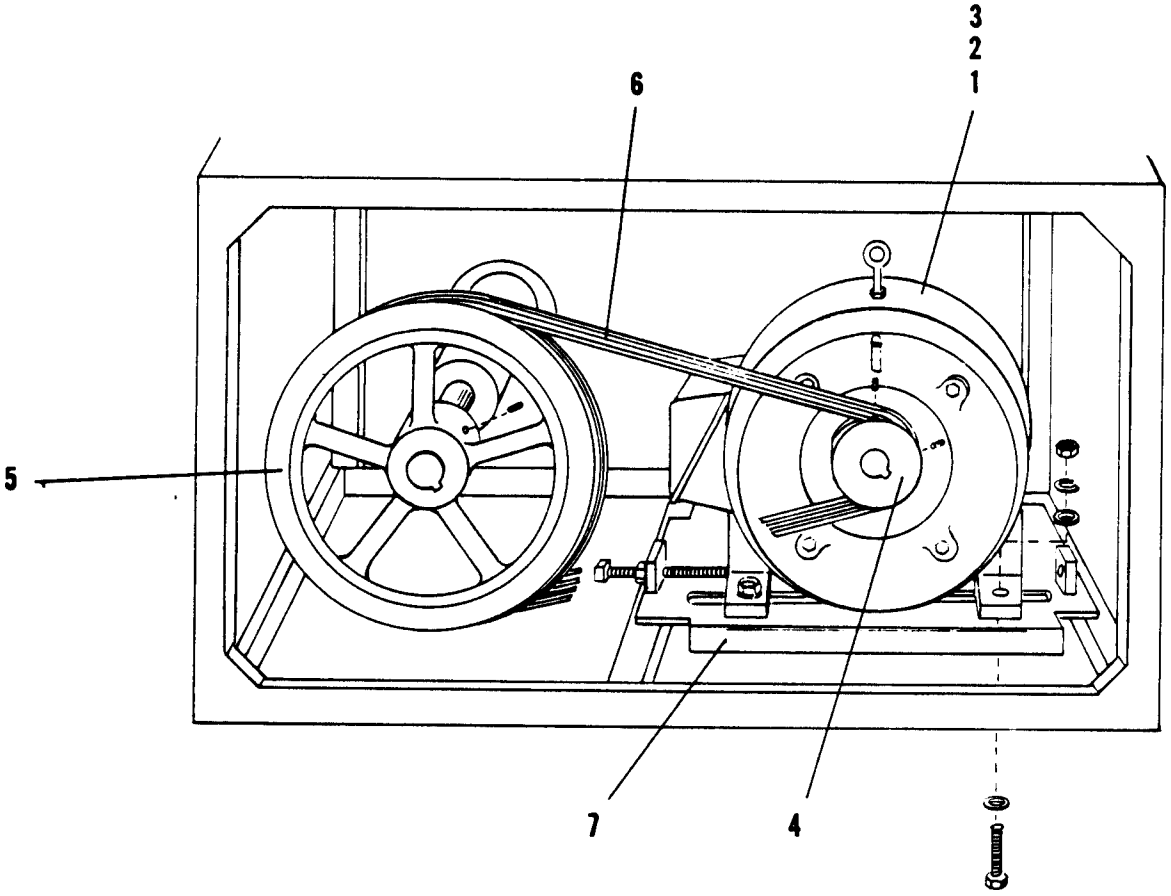


007-D

Index No.	Description	Standard Style V & H Cabinets		Oversize Style H Cabinet	
		Part No.	**Qty.**	**Part No.**	**Qty.**
1	Bracket, Outboard Bearing (Oversized Cabinet Only)			300-0227	1
2	Bearing, Flanged (Oversized Cabinet Only)			559-0175	1
3	Collar, Locking - Rear	559-0246	1	559-0246	1
4	Ring, Retaining	959-0061	1	959-0061	1
5	Drive Shaft	300-0030	1	300-0065	1
6	Seal, Grease	554-0363	1	559-0363	1
7	Bearing, Ball - Rear	559-0245	1	559-0245	1
8	Collar, Locking - Front	559-0242	1	559-0242	1
9	Bearing, Ball - Front	559-0243	1	559-0243	1
10	Tube-gear reduction bearing drive shaft	300-3256	1	300-3256	1
10	Tube, Bearing Drive Shaft	300-0031	1	300-0031	1

PARTS LIST INDEX

Constant Speed Drive Systems
(W.O. Dodge Gear Reducer)



PARTS LIST INDEX

Constant Speed Drive Systems (W.O. Dodge Gear Reducer)

INDEX NO.	DESCRIPTION	5 HP (Motor Frame - 184T) PART NO.	QTY.	7½ HP (Motor Frame - 213T) PART NO.	QTY.	10 HP (Motor Frame-215TJ PART NO.	QTY.	15 HP (Motor Frame - 254T) PART NO.	QTY.	20 HP (Motor Frame-256TJ PART NO.	QTY.
1	Motor, 60 Hz-230/460 V, 1800 rpm,H mtg.	550-0199	1	550-0202	1	550-0205	1	550-0208	1	550-0211	1
2	Motor, 60Hz - 230/460 V, 1800 rpm, V mtg.	550-0200	1	550-0203	1	550-0206	1	550-0209	1	550-0212	1
3	Motor, 50 Hz - 220/380 V, 1500 rpm, H mtg.	550-0201	1	550-0204	1	550-0207	1	550-0210	1	550-0213	1
4 *	Sheave, Drive - 325 rpm (3-5/32" O.D.) (use with 1 and 2)	475-4200	1	475-4700	1	475-4700	1	70052	1	70052	1
4 *	Sheave, Drive - 325 rpm (3-25/32" O.D.) (use with 3 only)	475-4300	1	475-4800	1	475-4800	1	70155	1	70155	1
4 *	Sheave, Drive - 425 rpm (4-3/32" O.D.) (use with 1 and 2)	475-3900	1	475-4400	1	475-4400	1	70321	1	70321	1
4 *	Sheave, Drive - 425 rpm (4-15/16" O.D.)	475-4000	1	475-4500	1	475-4500	1	475-4900	1	475-4900	1
4*	Sheave, Drive - 610rpm (5-29/32" O.D.) (use with 1 & 2 only)	475-4100	1	475-4600	1	475-4600	1	475-5000	1	475-5000	1
5*	Sheave,Driven(17" 0.D.)	91117	1	91117	1	91117	1	91117	1	91117	1
6 *	V-Belts (set of 4 or 8) ((3V800)	+552-1943	1	+201-5400	1	+201-5400	1	+ 201-5400	1	201-5400	1
7	Rails, Motor Base (2 Required)	300-3258	1	300-3258	1	300-3258	1	300-3258	1	300-3258	1

+Indicates part with limited service life On-hand spares are recommended.

*see next page for additional listings

PARTS LIST INDEX

DRIVE & DRIVEN SHEAVE, BUSHINGS AND BELT SETS
LISTED BY DRIVE HP AND RPM

Constant Speed Drive (With Dodge Gear Reducer)

	MUTATOR		DRIVER		DRIVEN		
	RPM	RPM	SHEAVE	BUSHING	SHEAVE	BUSHING	MATCHED
HP	60 CYCLE	50 CYCLE					BELT SETS
			PART NO.	PART NO.	PART NO.	PARTNO.	PART NO.
30	100	100	552-1483	552-0397	552-1483	552-0398	552-1494
	150		552-1483	552-0397	552-1486	552-0402	552-1495
		150	552-1484	552-0397	552-1486	552-0402	552-1495
	225		552-1485	552-0397	552-1486	552-0402	552-1498
		225	552-1483	552-0397	552-1484	552-0402	552-1494
	325		552-1483	552-0397	552-1482	552-0402	552-1494
		325	552-1485	552-0397	552-1484	552-0402	552-1496
	425		552-1484	552-0397	552-1481	552-0402	552-1494
		425	552-1485	552-0397	552-1482	552-0402	552-1494
20	100		552-1488	552-0353	552-1490	552-1780	552-1499
		100	552-1490	552-0353	552-1489	552-1 780	552-1499
15	100		552-1488	552-0353	552-1490	552-0350	552-1499
		100	552-1490	552-0353	552-1489	552-0350	552-1499
20	150		552-1490	552-0353	552-1493	552-0402	552-1501
		150	552-1488	552-0353	552-1492	552-0402	552-1500
15	150		552-1490	552-0353	552-1493	552-0398	552-1501
		150	552-1488	552-0353	552-1492	552-0398	552-1500
15	225		552-1487	552-0353	552-1491	552-0398	552-1499
		225	552-1490	552-0353	552-1491	552-0398	552-1499
10	100		552-1488	552-0349	552-1490	552-0347	552-1499
OR		100	552-1490	552-0349	552-1489	552-0347	552-1499
7-1/2	150		552-1490	552-0349	552-1493	552-0393	552-1501
		150	552-1488	552-0349	552-1492	552-0393	552-1500
	225		552-1487	552-0349	552-1491	552-0393	552-1499
		225	552-1490	552-0349	552-1491	552-0393	552-1499

NOTE; Drive speeds listed above are available with Dodge Gear Reducers only.

PARTS LIST INDEX

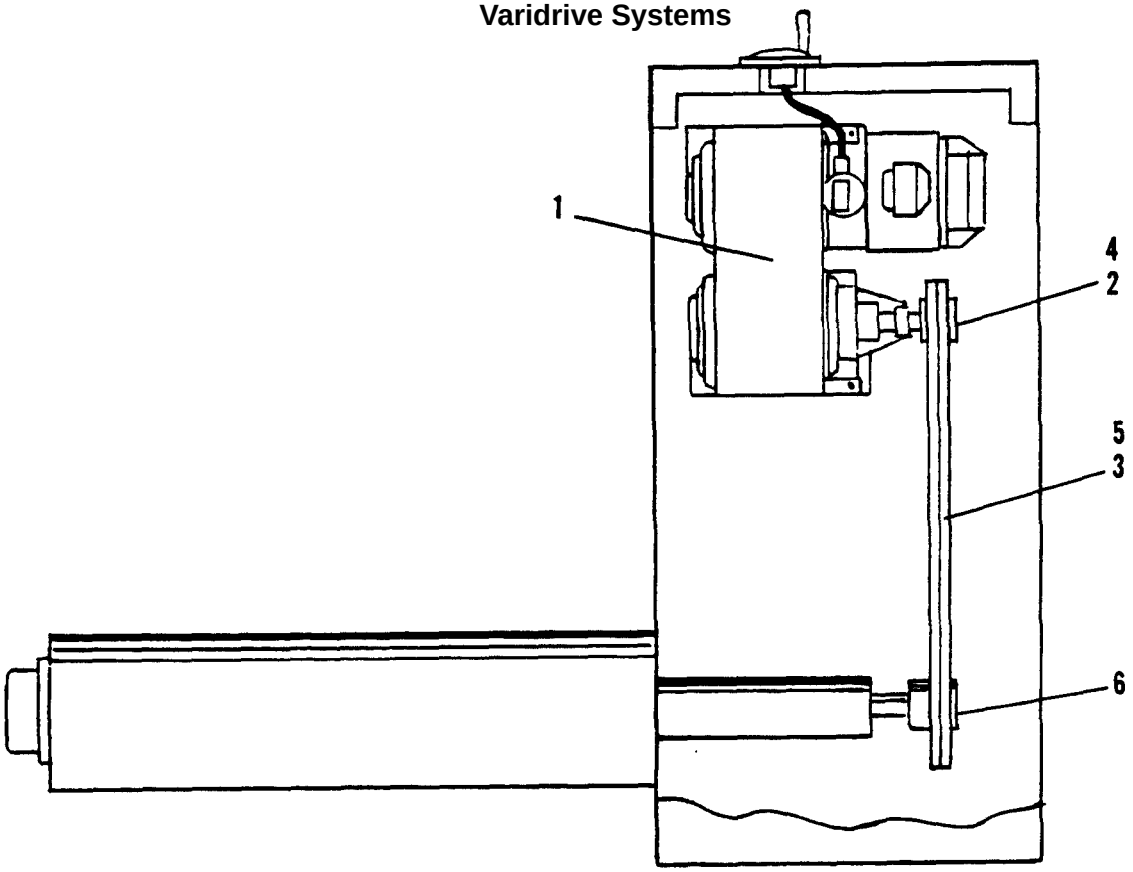
Constant Speed Drive (With Dodge Gear Reducer)

COMPLETE REDUCER ASSEMBLY

HP	MUTATOR RPM	TYPE	WAUKESHA CHERRY-BURRELL PART NO. COMPLETE ASSEMBLY
30	100	TDT515	552- 1508
	150	T15	552-1504
	225	T15	552-1504
	325	T15	552-1504
	425	T15	552-1504
20	100	TDT515	552-1508
15	100	TDT415	552-1507
20	150	T15	552-1504
15	150	T 14	552 - 1503
15	225	T14	552-1503
10 OR 7-1/2	100	TDT315	552-1506
	150	T13	552-1502
	225	T13	552-1502
		T13	552-1502

PARTS LIST INDEX

Varidrive Systems

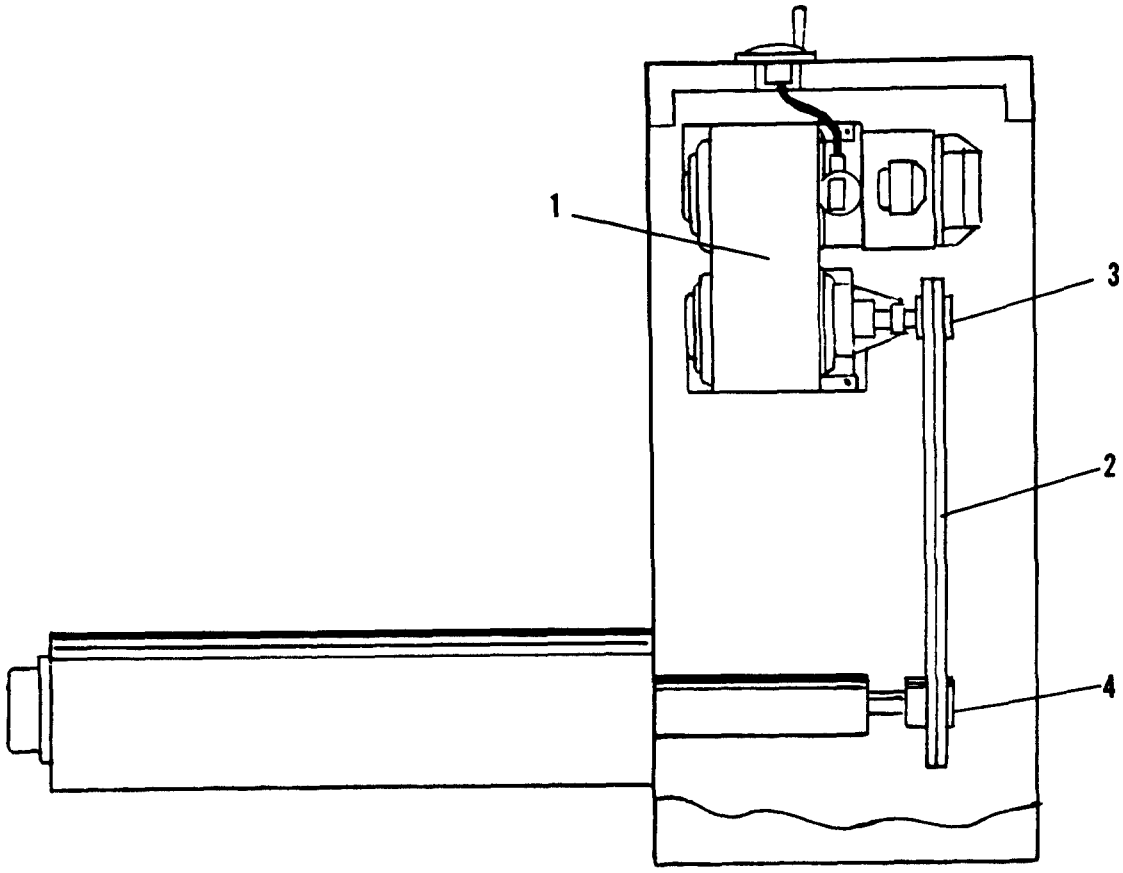


017-A

INDEX NO.	DESCRIPTION	10 HP PART NO.	QTY.	15 HP PART NO.	QTY.	20 HP PART NO.	QTY.	25 HP PART NO.	QTY.
1	Drive Unit, Varidrive- 60 Hz, 230/460 V	553-0152	1	553-0153	1	553-0154	1	553-0155	1
2	Sprocket, Drive - (950 to 121 RPM) High Speed	552-1948	1	552-1948	1				
	Sprocket, Drive - (785 to 118 RPM) High Speed					552-1950	1	552-1946	1
3	Chain, Silent - High Speed	552-1304	1	552-1304	1	552-1304	1	552-1306	1
4	Sprocket, Drive - (350 - 45 RPM)	552-1347	1	552-1347	1				
	Low Speed Sprocket, Drive - (290 - 44 RPM) Low Speed					552-1937	1	552-1935	1
5	Chain, Silent - Low Speed	552-1302	1	552-1302	1	552-1302	1	552-1305	1
6	Sprocket, Driven	552-1949	1	552-1949	1	552-1949	1	552-1947	1

PARTS LIST INDEX

Varidrive Systems

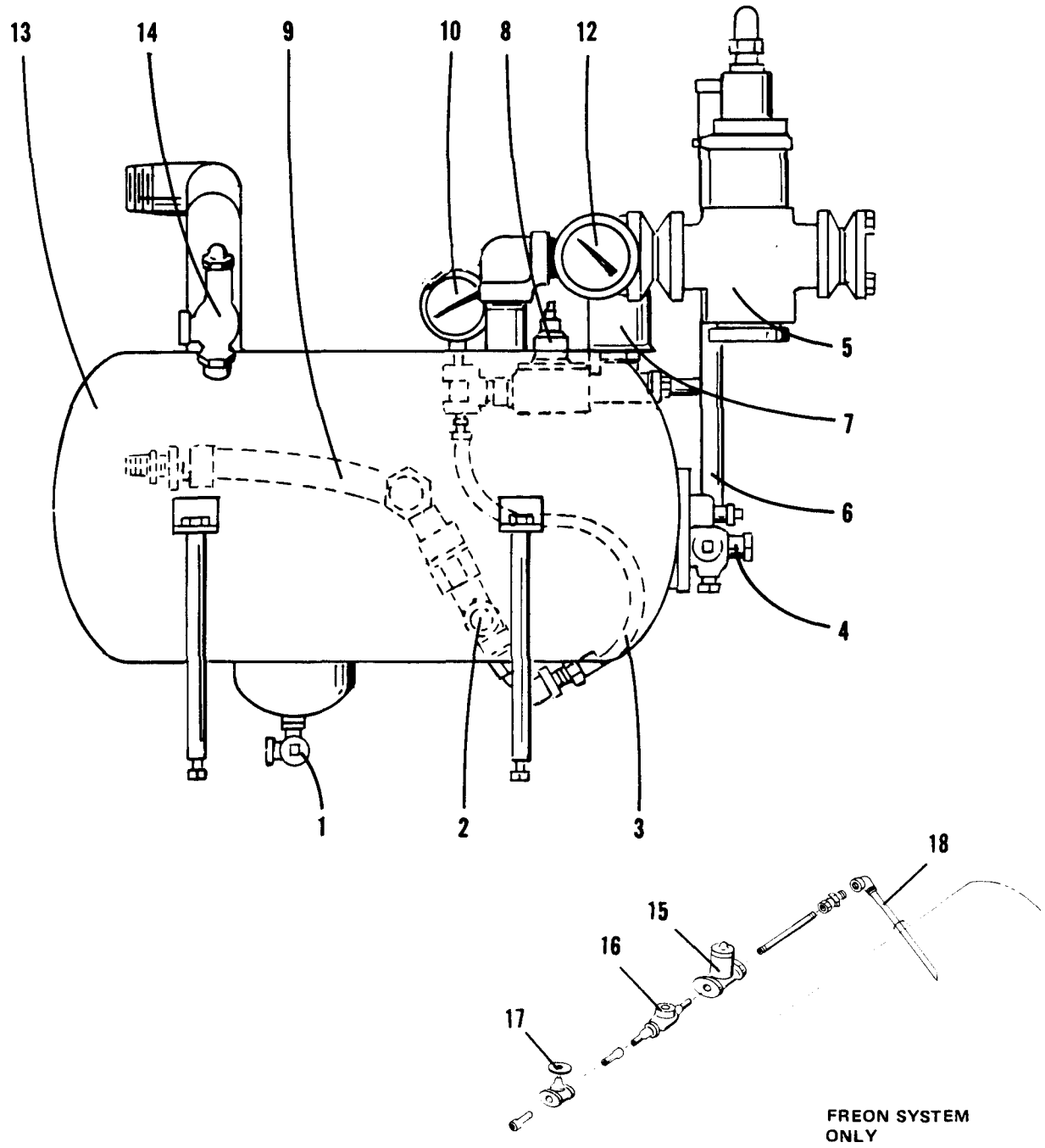


017-A

INDEX NO.	DESCRIPTION	5 HP PART NO.	QTY.
1	Drive Unit, Varidrive - 60 Hz, 230/460 V (420 105 R PM)	553-0145	1
1	Drive Unit, Varidrive - 60 Hz, 230/460 V (640 160 RPM)	553-0146	1
3	Chain, Roller #80	552-1510	1
3	Sprocket, Drive - 15 Tooth	552-1905	1
4	Sprocket, Driven - 15 Tooth	552-1311	1

PARTS LIST INDEX

Freon and Ammonia Systems (DE Thermutators Only)



PARTS LIST INDEX

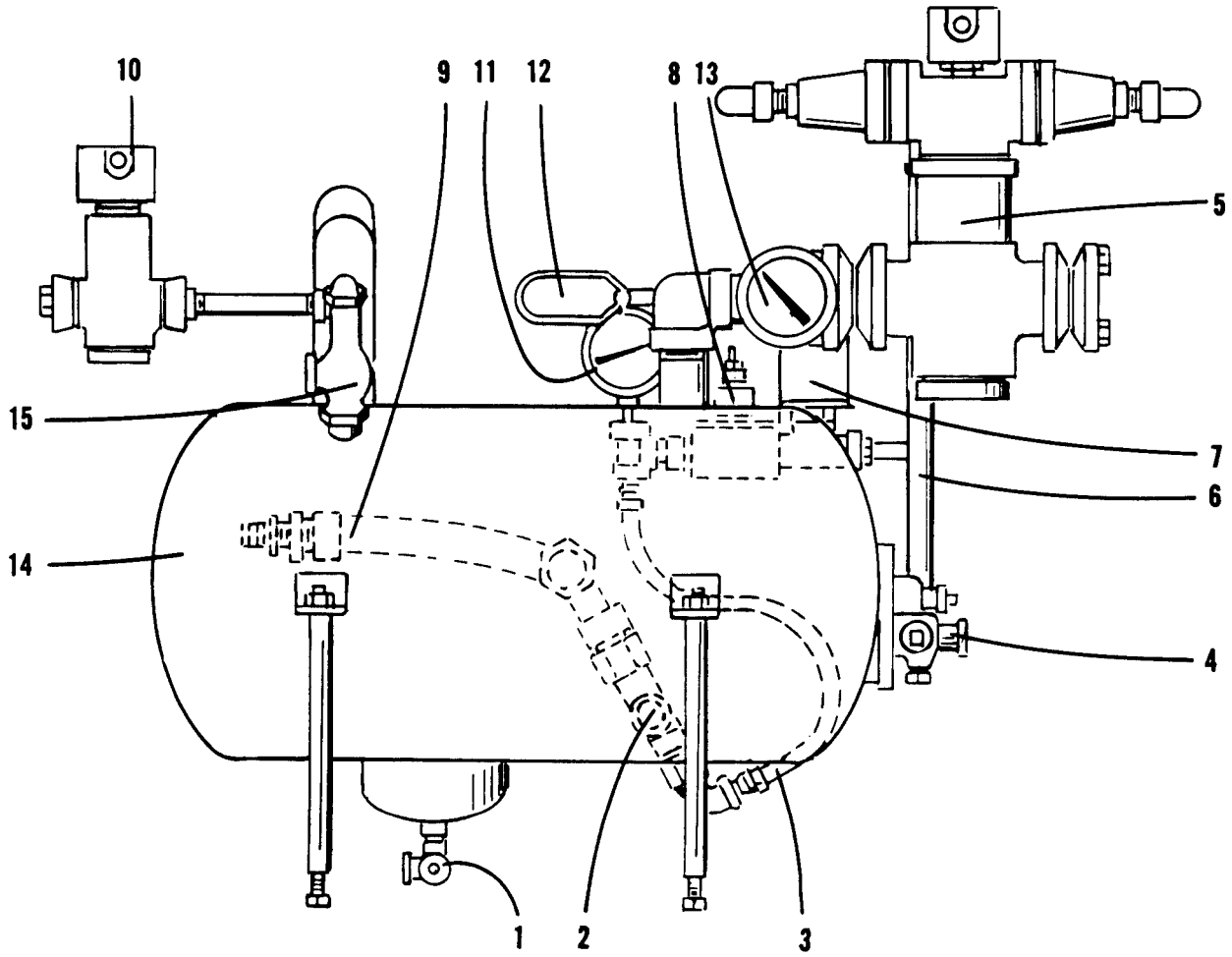
Freon and Ammonia Systems

INDEX NO.	PART NO.	QTY.	DESCRIPTION
1	555-2554	1	Valve - Purge - ¼"
*2	590-0245	1	Jet Injector Assembly
3	300-0070	1	Jet Tube
**4	556-0074	1	Valve, Ammonia Float - 3/16" Cartridge
	a. 556-0188	1	Valve, Freon Float - 5/32" Cartridge
	b. 556-0189	1	Valve, Freon Float - 3/16" Cartridge
	c. 556-0190	1	Valve, Freon Float - 3/32" Cartridge
***5	556-0430	1	Valve, 3/4" Type M.P.A. Back Pressure
	a. 556-0431	1	Valve, 1" Type M.P.A. Back Pressure
	b. 556-0432	1	Valve, 1-1/4" Type M.P.A. Back Pressure
	c. 556-0433	1	Valve, 1-1/2" Type M.P.A. Back Pressure
	d. 556-0434	1	Valve, 2" Type M.P.A. Back Pressure
			Manual Pilot Control Valve (included with Index No. 5)
6.	300-0048	1	Manifold, Bottom Unit Liquid (Std. Cab.)
	a. 300-0068	1	Manifold, Bottom Unit Liquid (Large & Vert. Cab.)
+7	556-0415	1	Valve, Liquid Solenoid Valve
++8	556-0412	1	Valve, Automatic Expansion
9	590-0791	1	Flexible Liquid Line
10	557-0183	1	Gauge, Liquid Line Pressure, Ammonia
	a. 557-0229	1	Gauge, Liquid Line Pressure, Freon
12	557-0183	1	Gauge, Back Pressure, Ammonia
	a. 557-0299	1	Gauge, Back Pressure, Freon
13	300-5306	1	Accumulator, ASME "UM"
	a. 300-5307	1	Accumulator, ASME "U"
14	556-0050	1	Valve, 200 lb. Pressure Relief
15	556-0056	1	Oil Wick Assembly (Consists of parts 15 thru 18)
		1	Valve, Solenoid - Alco Catalog No. S-155, Body Style 3/8" ODF Solder, 7/32" Port dia., 115V-60Hz
16	557-0121	1	Sight Glass
17	556-0055	1	Valve, Needle
18	205-2401	1	Wick, Oil (Complete)

*See page 93
**See page 91
***See page 99 thru 110
+See page 95
++See page 97

PARTS LIST INDEX

Hot Gas System Components



PARTS LIST INDEX

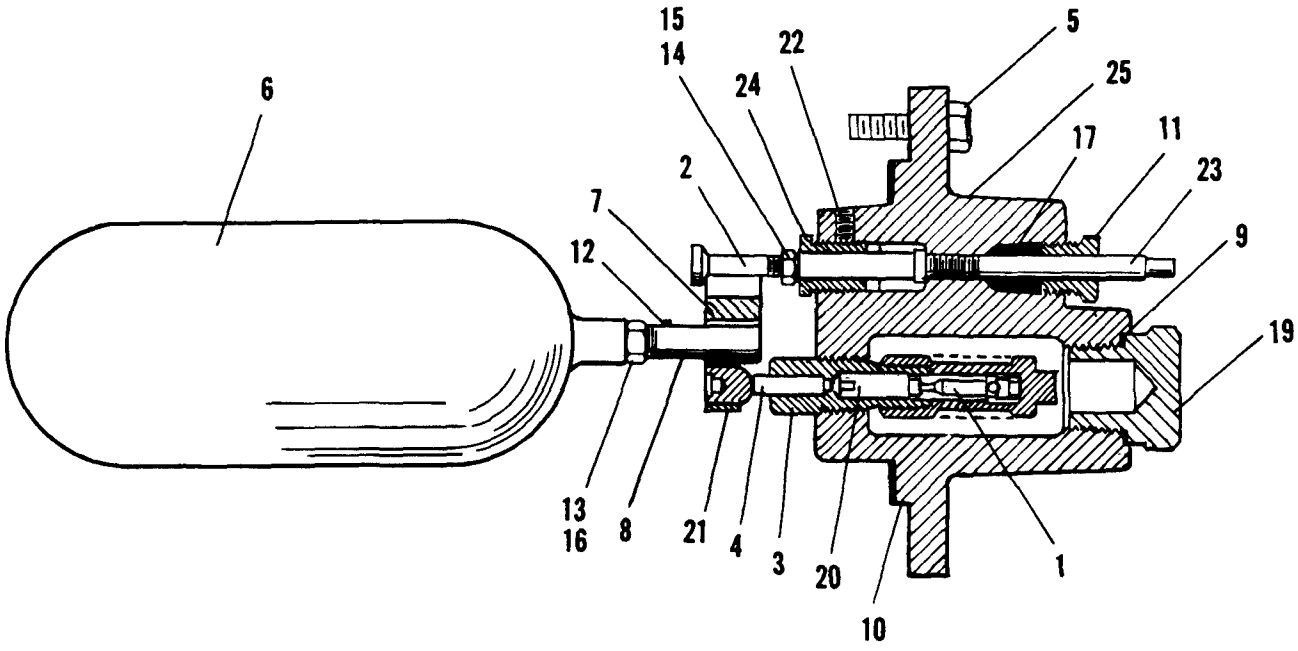
Hot Gas System Components

INDEX NO.	WAUKESHA CHERRY-BURRELL PART NO.	QTY	DESCRIPTION
1	555-2554	1	Valve - Purge ¼"
2	590-0245	1	Jet Injector Assembly - See Page 93
3	300-0070	1	Jet Tube
	a. 555-2691	2	Tube End Connections
4	556-0074	1	Valve - Ammonia Float - See Page 91 3/16" Cartridge
	a. 556-0188	1	Valve - Freon Float 5/32" Cartridge
	b. 556-0189	1	Valve- Freon Float 3/16" Cartridge
	c. 556-0190	1	Valve- Freon Float 7/32" Cartridge
	d. 556-		Valve- Freon Float Cartridge
*5	556-0420	1	Valve - 3/4" Type M.D.P.A. Back Pressure See Page 102
	a. 556-0421	1	Valve- 1" Type M.D.P.A. Back Pressure See Page 108
	b. 556-0422	1	Valve - 1-1/4" Type M.D.P.A. Back Pressure See Page 111
	c. 556-0423	1	Valve- 1-1/2" Type M.D.P.A. Back Pressure See Page 111
	d. 556-0424	1	Valve - 2" Type M.D.P.A. Back Pressure See Page 111
6	300-0048	1	Manifold - Bottom Unit Liquid (Std. Cab.)
	a. 300-0068	1	Manifold - Bottom Unit Liquid (Large & Vertical Cab.)
7	556-0415	1	Valve - Liquid Solenoid Valve - See Page 95
8	556-0412	1	Valve - Liquid Pressure Regulator - See Page 97
9	590-0791	1	Flexible Liquid Line
10	556-0609	1	Valve - Hot Gas Solenoid - See Page 119
11	557-0183	1	Gauge - Liquid Line Pressure - Ammonia
	a. 557-0299	1	Gauge - Liquid Line Pressure - Freon
12	551-2420	1	Switch Pressure Limit - See Page 129
13	557-0183	1	Gauge - Back Pressure - Ammonia
	a. 557-0299	1	Gauge - Back Pressure - Freon
14	300-5306	1	Accumulator ASME "UM"
	a. 300-5307	1	Accumulator Nat'l. Br'd. "U"
15	556-0050	1	Valve - 200 lb. Pressure Relief

*See Separate Page For Parts Breakdown.

PARTS LIST INDEX

Float Valve (DE Thermutators Only)



015-B

PARTS LIST INDEX

Float Valve (DE Thermutators only)

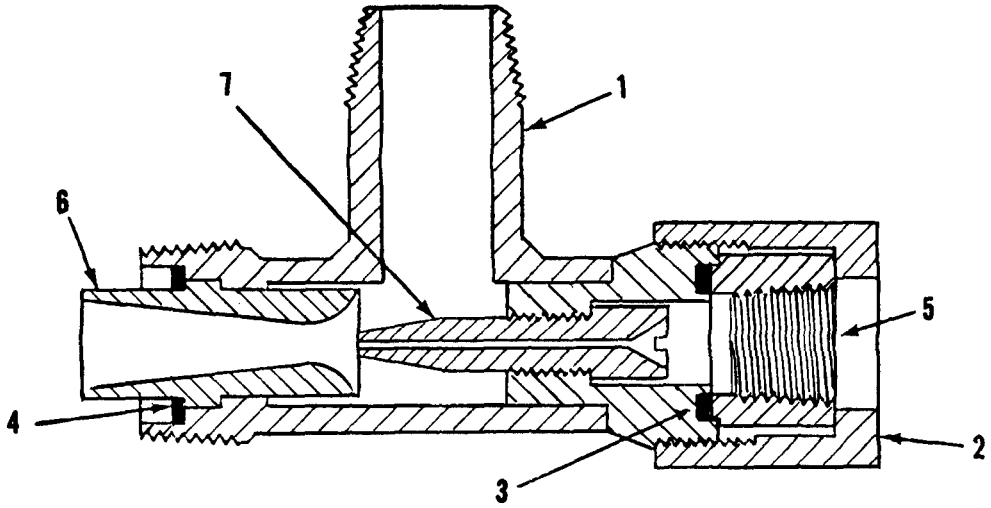
INDEX NO.	DESCRIPTION	FREON SYSTEM CHERRY-BURRELL PART NO.	FREON SYSTEM VENDOR PART NO.	AMMONIA SYSTEM CHERRY-BURRELL PART NO.	AMMONIA SYSTEM VENDOR PART NO.
	Float Valve - Complete with Cartridge	5/32" 556-0188	300-AMF		
	Float Valve - Complete with Cartridge	3/16" 556-0189	300-AMF	556-0074	300-AM
	Float Valve - Complete with Cartridge	7/32" 556-0190	300-AMF		
1	Cartridge, 5/32"	+557-0132	+310-A-5/32"		
1	Cartridge, 3/16"	+557-0133	+310-A-3/16"	+557-0133	+310-A 3/16"
1	Cartridge, 7/32"	+557-0134	+310-A-7/32"		
2	Adjusting Piece		319-P		319-P
3	Boss		307-A		307-A
4	Cam Needle		314-A		314-A
5	Capscrew	952-1992	952-1992		
6	Float Ball		370-MF		370-M
7	Float Block		315-PM		315-PM
8	Float Rod		313-AM		313-AM
9	Gasket, Plug		+365		+365
10	Gasket, Valve		+326		+326
11	Gland		8		8
12	Lever Pin		411		411
13	Locknut, Float		88		88
14	Locknut, Adjustable Piece		324		324
15	Lockwasher, Adjustable Piece		55		55
16	Lockwasher, Float		55-A		55-A
17	Ring, Packing		775		775
18	Plug, Pipe		333		333
19	Plug, Access		363		363
20	Pusher		+308-A		+308-A
21	Setscrew, Block		87-S		87-S
22	Setscrew, Stem Stop		316		316
23	Stem		327-P		327-P
24	Stem Stop		318-P		318-P
25	Valve Body		300-A		300-A

+Indicates part with limited service life. On-hand spares are recommended.

VENDOR: H.A. Phillips & Co.
3255 W. Carroll Avenue
Chicago, IL 60624

PARTS LIST INDEX

Injector Assembly (DE Thermutators Only)



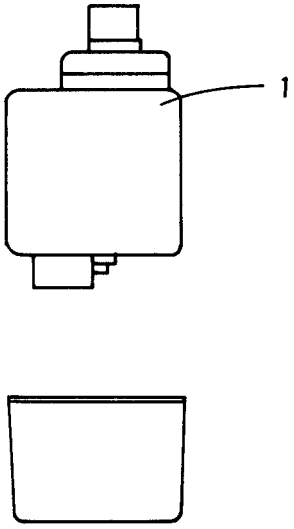
001-A

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
I	Injector Assembly - Complete	590-0245	2100WCBA	1
2	Nut, Phillips Special	44091	U4-1	1
3	Gasket	554-0427	U4-4	1
4	Gasket	554-0428	U6-4	1
5	Connector, Phillips Special	44092	U4-3	1
6	Throat - Select one of the following:			1
	Throat - 3/16" Dia.	590-0262	2107-W-3/16"	
	Throat - 1/4" Dia.	590-0263	2107-W-1/4"	
	Throat - 5/16" Dia.	590-0264	2107-W-5/16"	
	Throat - 3/8" Dia.	590-0265	2107-W-3/8"	
	Throat - 1/2" Dia.	590-0266	2107-W-1/2"	
	Throat - 5/8" Dia.	590-0267	2107-W-5/8"	
7	Nozzle - Select one of the following:			1
	Nozzle No. 23 - 0.154" Dia.	590-0249	2046-SL-0.154"	
	Nozzle No. 29 - 0.136" Dia.	590-0250	2046-SL-0.136"	
	Nozzle No. 31 - 0.120" Dia.	590-0251	2046-SL-0.120"	
	Nozzle No. 36 - 0.1065" Dia.	590-0252	2046-SL-0.1065"	
	Nozzle No. 40 - 0.098" Dia.	590-0253	2046-SL-0.098"	
	Nozzle No. 44 - 0.086" Dia.	590-0254	2046-SL-0.086"	
	Nozzle No. 48 - 0.076" Dia.	590-0255	2046-SL-0.076"	
	Nozzle No. 50 - 0.070" Dia.	590-0256	2046-SL-0.070"	
	Nozzle No 52 - 0.0635" Dia.	590-0257	2046-SL-0.0635"	
	Nozzle No. 54 - 0.055" Dia.	590-0258	2046-SL-0.055"	
	Nozzle No. 56 - 0.0465" Dia.	590-0259	2046-SL-0.0465"	
	Nozzle No. 59 - 0.041 " Dia.	590-0260	2046-SL-0.041 "	

VENDOR: H. A. Phillips & Company
3255 W. Carroll Avenue
Chicago, IL 60624

PARTS LIST INDEX

Pressure Limit Switch

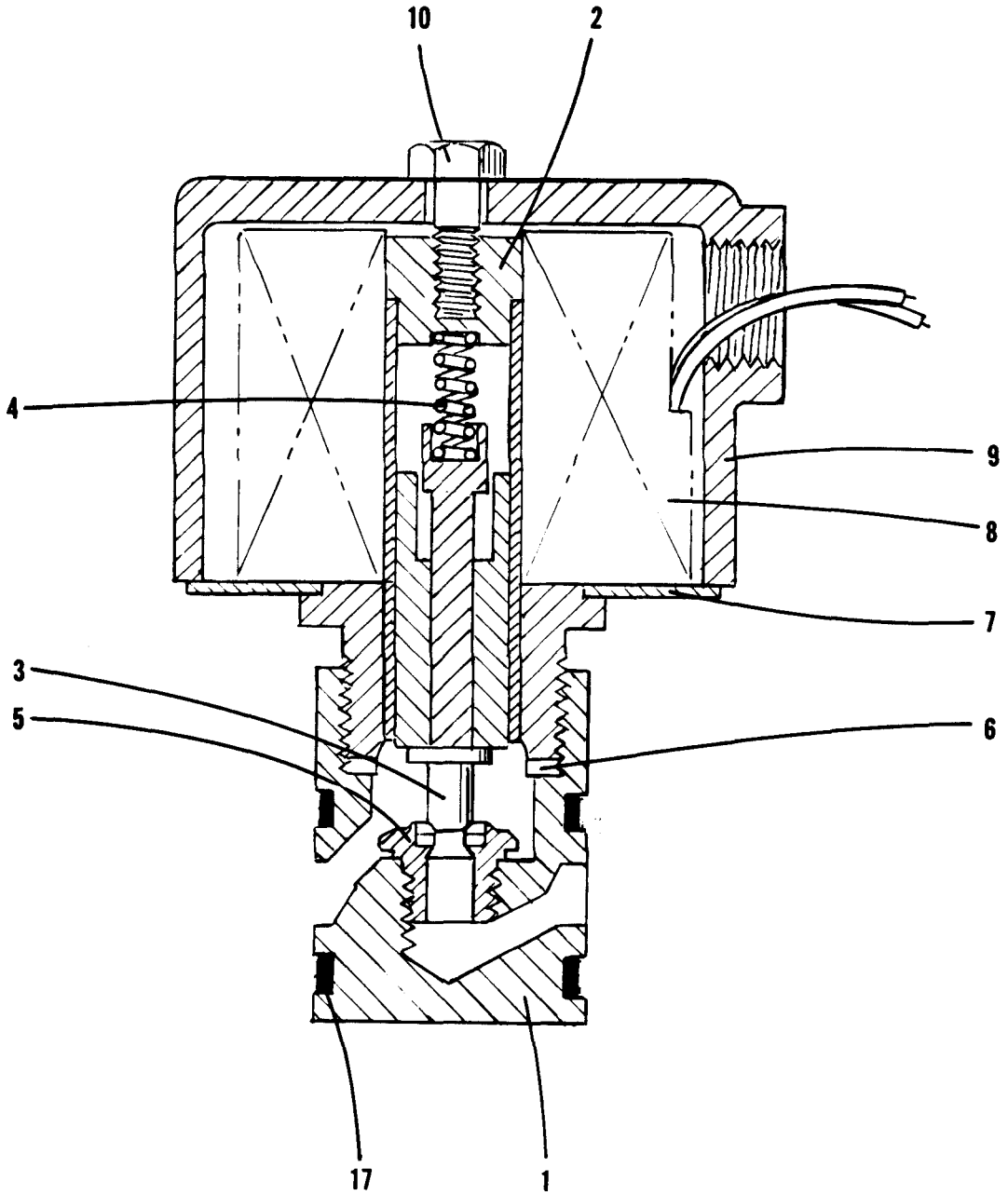


INDEX NO.	DESCRIPTION	CHERRY-BURRELL PART NO.	VENDOR PART NO.
l	Pressure Limit Switch	551-2420	E l H-H90-P6-PIS-T (Electrical: I.S.P.D.T. Switch) (10 amps, 125 or 250 VAC)

VENDOR: Barksdale Valve Company
Pressure Switch Division
5125 Alcoa Avenue
Los Angeles, CA 90058

PARTS LIST INDEX

Liquid Solenoid Valve (DE Thermutators Only)



PARTS LIST INDEX

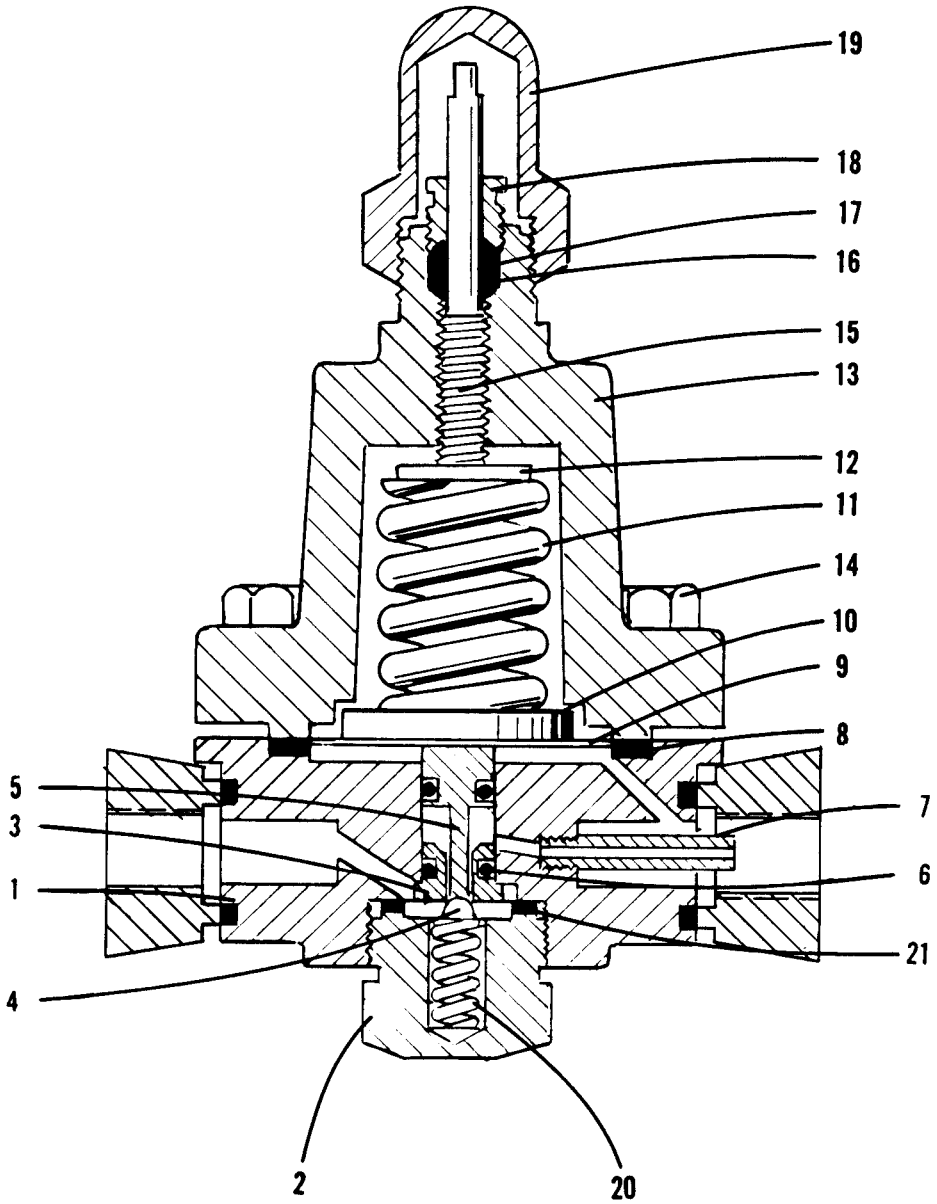
Liquid Solenoid Valve

INDEX NO.	*DESCRIPTION*	*CHERRY-BURRELL PARTNO.*	*VENDOR PARTNO.*	*QTY.*
	3/16 Solenoid Assembly, less flange and capscrews (items 16 - 18)	556-0415	000-109-000	
1	Body		000-107-068	1
2	Plunger Tube Assembly		000-178-000	1
3	Drawbar Assembly		000-188-000	1
4	Drawbar Spring		000-187-000	1
5	Seat Bead		000-117-021	1
6	Gasket		000-117-023	1
7	Coil Platform		000-117-024	1
8	Coil	50/60 cycle 551-2066	000-117-025	1
9	Coil Cover		000-117-026	1
10	Capscrew		000-000-714	1
11	*Opening Stem		000-107-068	1
12 *	Packing		000-000-794	1
13	*Packing Nut		000-000-778	1
14	*Seal Cap Gasket		000-107-105	1
15	*Seal Cap		000-107-106	1
17	Gasket, Oval		000-890-104	2
19 *	Opening Stem Washer		000-000-760	1
	Repair Parts Kit To Include:	556-0416		
2	Plunger Tube Assembly			1
3	Drawbar Assembly			1
4	Drawbar Spring			1
5	Seat Bead			1
6	Gasket, Body			1
17	Gasket, Oval			1

*Indicates Part Not Illustrated

PARTS LIST INDEX

Automatic Expansion Valve



PARTS LIST INDEX

Automatic Expansion Valve

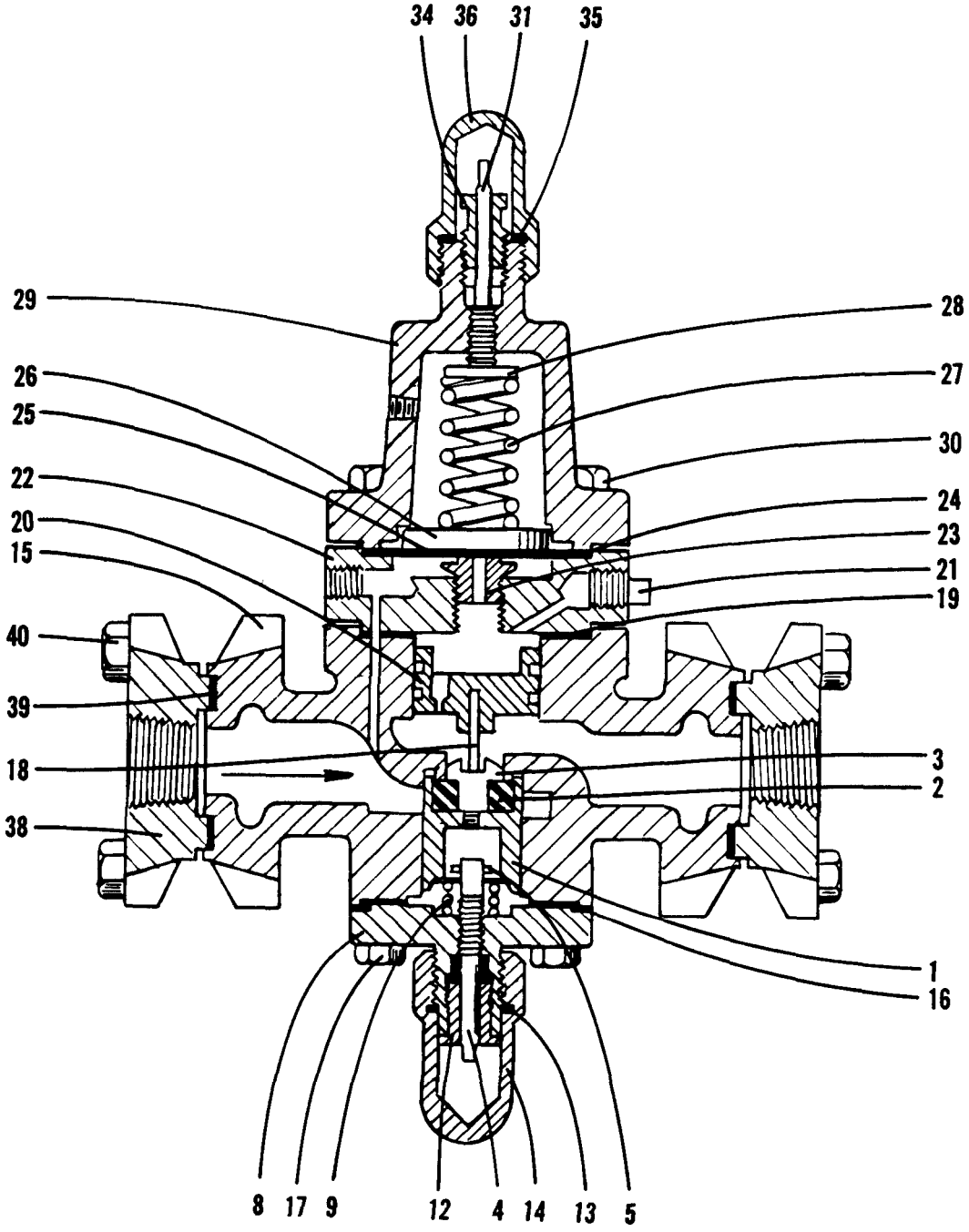
INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Valve Assembly +	556-0412	CFR19021	1
1	Body		CFR19021-1	1
2	Plug		CFR19021-2	1
3	Seat		*CFR19021-3	1
4	Ball		*CFR19021-4	1
5	Pusher Pin		*CFR19021-5	1
6	O-Ring		*CFR19021-6	2
7	Orifice Tube		CFR19021-7	1
8	Diaphragm Gasket		CFR19021-37	1
9	Diaphragm		CFR19021-38	2
10	Adjustment Spring Plate		CFR19021-39	1
11	Adjustment Spring		CFR19021-40H	1
12	Adjustment Spring Guide		CFR19021-41	1
13	Bonnet		CFR19021-42	1
14	Capscrew		CFR19021-43	4
15	Pressure Adjustment Stem		CFR19021-44	1
16	Pressure Adjustment Stem Washer		CFR19021-45	1
17	Packing		CFR19021-46	1
18	Packing Nut		CFR19021-47	1
19	Seal Cap		CFR19021-49	1
20	Ball Spring		*CFR19021-61	1
21	Gasket		*CFR19021-64	1
	Repair Parts Kit Includes:	556-0417		
3	Seat			1
4	Ball			1
5	Pusher Pin			1
6	O-Ring			1
8	Diaphragm Gasket			1
20	Ball Spring			1
21	Gasket			1
22	Gasket			2
9	Diaphragm			2

*Indicates Parts With Limited Life, On-Hand Spares Recommended.
+Assembly includes 3/8" NPT Flange Ends.

PARTS LIST INDEX

Back Pressure Regulating Valve - 3/4"

M P A



PARTS LIST INDEX

Back Pressure Regulating Valve - 3/4"

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	MPA Valve Complete - 3/4"	556-0430	PA 07521	1
1	Disc Piston		075-047-011	1
2	Seat Disc		075-047-012	1
3	Seat Disc Retainer		075-047-013	1
4	Opening Stem		075-047-014	1
5	Roll Pin		075-047-026	1
*6	(3/4" Only) Stem Retaining Washer		000-000-763	1
*7	(3/4" Only) Piston Retaining Ring		075-047-030	1
8	Bottom Cap		075-037-015	1
9	Disc Piston Spring		075-037-016	1
*10	Opening Stem Washer		000-000-760	1
*11	Packing		000-000-799	1
12	Packing Nut		000-000-775	1
13	Seal Cap Gasket		000-037-045	1
14	Seal Cap		000-037-046	1
15	Body (Oval Flanged)		075-007-022	1
16	Bottom Cap Gasket		075-007-019	1
17	Capscrew		000-000-701	4
18	Push Rod		075-007-020	1
19	Cylinder Gasket		075-007-021	1
20	Power Piston		075-007-023	1
21	Pipe Plug		000-067-016	1
22	Bead Plate		000-067-017	1
23	Pilot Seat Bead		000-067-006	1
24	Diaphragm Gasket		000-127-007	1
25	Diaphragm		000-127-008	2
26	Adjustment Spring Plate		000-127-009	1
27	Adjustment Spring		000-127-010	1
28	Adjustment Spring Guide		000-127-011	1
29	Bonnet		000-127-012	1
30	Capscrew		000-000-703	4
31	Pressure Adjustment Stem		000-127-013	1
*32	Pressure Adjustment Stem Washer		000-000-760	1
*33	Packing		000-000-798	1
34	Packing Nut		000-000-775	1
35	Seal Cap Gasket		000-127-014	1
36	Seal Cap		000-127-015	1
*37	Name Plate (Not Shown)		000-000-790	1
38	Threaded Flange		075-801-803	2
39	Gasket (Oval Flange)		075-890-000	2
40	Bolt (Oval Flange)		000-000-708	4

*Indicates Part Not Illustrated.

PARTS LIST INDEX

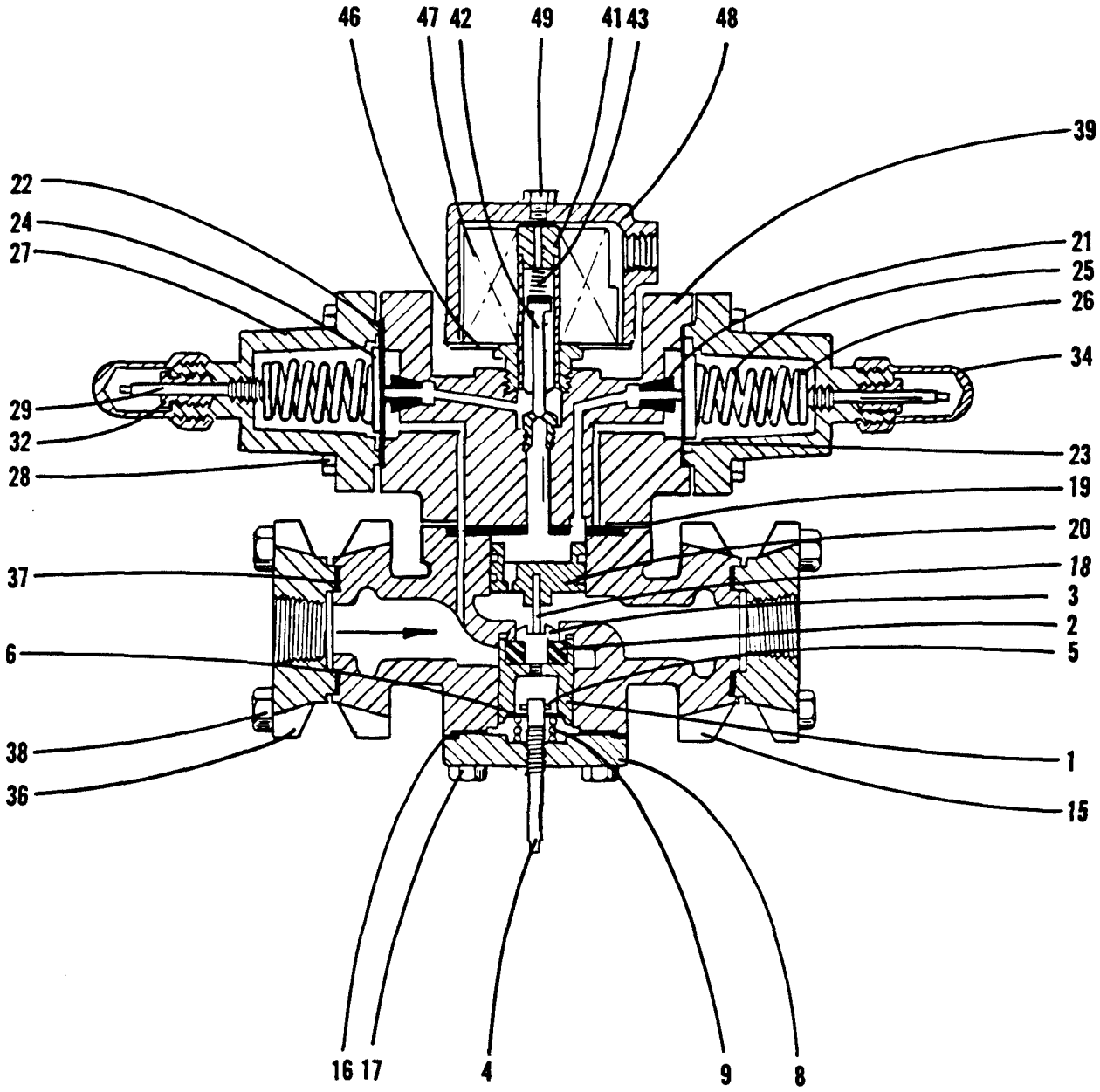
Component Parts Breakdown
Back Pressure Regulator - 3/4"

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Bottom Cap Assembly		075-038-000	
	Disc Piston Assembly		075-048-000	
	Body Assembly		075-008-000	
	Bead Plate Assembly		000-068-000	
	Bonnet Assembly		000-128-000	
	Repair Parts Kit includes:	556-0435	RKP075	
16	Bottom Cap Gasket			1
23	Pilot Seat Bead			1
24	Diaphragm Gasket			1
25	Diaphragm			1
39	Gasket (Oval Flange)			1
19	Cylinder Gasket			1

PARTS LIST INDEX

Dual Back Pressure Regulator - 3/4"

MPDA



PARTS LIST INDEX

Dual Back Pressure Regulator - 3/4”

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Valve Assembly Complete - 3/4"	556-0420	MPDA 07521	
1	Disc Piston		075-047-011	1
2	Seat Disc		075-047-012	1
3	Seat Disc Retainer		075-047-013	1
4	Opening Stem		075-047-014	1
5				
6	Stem Retaining Washer		000-000-763	1
*7	Piston Retaining Ring		075-047-030	1
8	Bottom Cap		075-037-015	1
9	Disc Piston Spring		075-037-016	1
*10	Opening Stem Washer		000-000-760	1
11	Packing		000-000-799	1
12				
13	Seal Cap Gasket		000-037-045	1
14				
15	Body (Oval Flanged)		075-007-022	1
16	Bottom Cap Gasket		075-007-019	1
17	Capscrew		000-000-701	4
18	Push Rod		075-007-020	1
19	Cylinder Gasket		075-007-021	1
20	Power Piston		075-007-023	1
21	Pilot Seat Bead		000-067-006	1
22	Diaphragm Gasket		000-127-007	2
23	Diaphragm		000-127-008	4
24	Adjustment Spring Plate		000-127-009	2
25	Adjustment Spring		000-127-010	2
26	Adjustment Spring Guide		000-127-011	2
27	Bonnet		000-127-012	2
28	Capscrew		000-000-701	8
29	Pressure Adjustment Stem		000-127-013	2
*30	Pressure Adjustment Stem Washer		000-000-760	2
*31	Packing		000-000-798	2
32	Packing Nut		000-000-775	2
*33	Seal Cap Gasket		000-127-014	2
34	Seal Cap		000-127-015	2
*35	Name Plate		000-000-790	1
36	Threaded Flange (Oval)		075-801-803	2
37	Gasket (Oval Flange)		075-890-000	2
38	Bolt (Oval Flange)		000-000-708	4
39	"PD" Adaptor		000-227-035	1
*40	Capscrew		000-000-702	4

*Indicates Part Not Illustrated.

PARTS LIST INDEX

Dual Back Pressure Regulator - 3/4”
M P D A

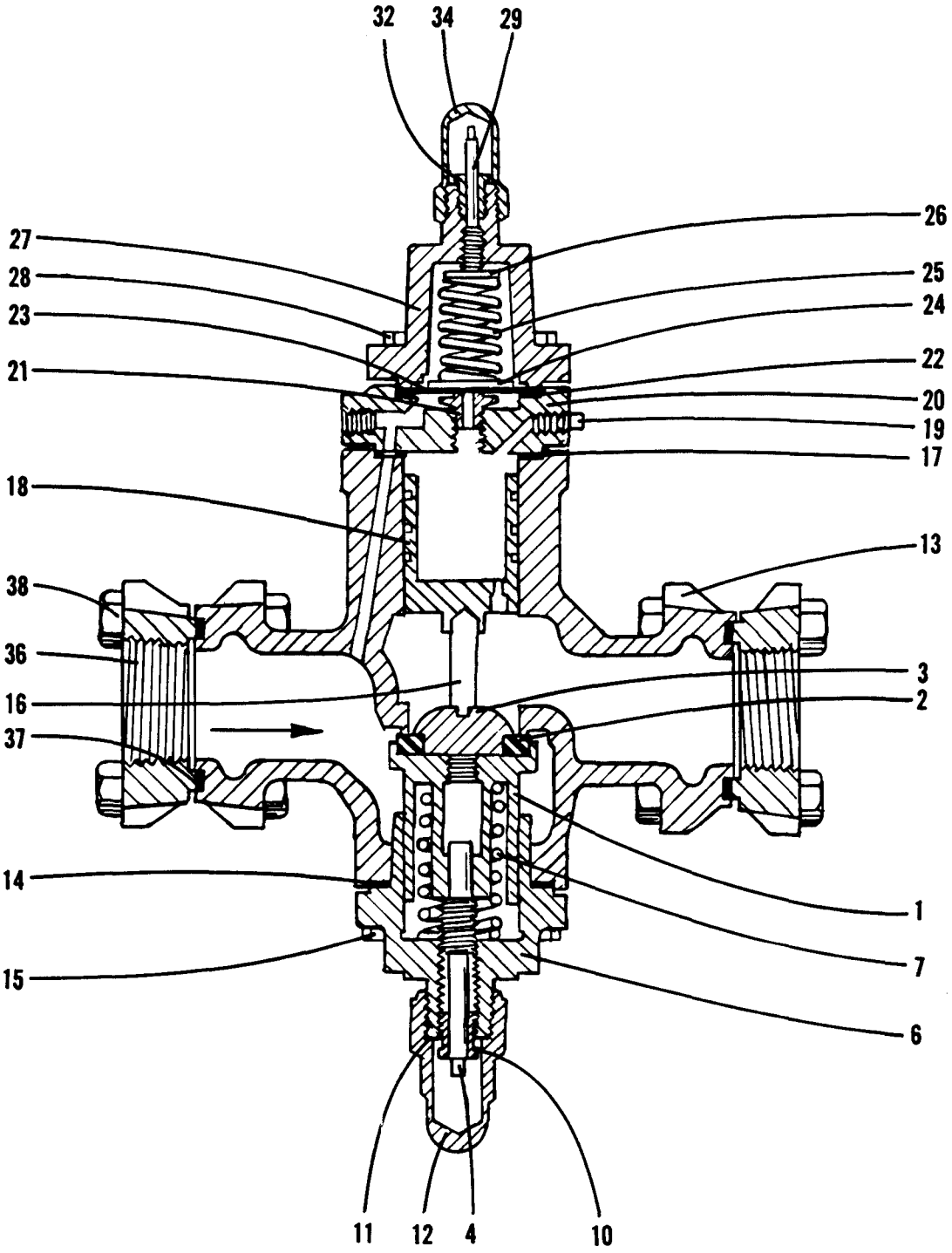
INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
41	Plunger Tube Assembly		000-178-000	1
42	Drawbar Assembly		000-188-000	1
43	Drawbar Spring		000-187-022	1
*44	Seat Bead		000-117-021	1
*45	Gasket		000-117-023	1
46	Coil Platform		000-117-024	1
47	Coil	50/60 cycle 551-2066	000-117-025	1
48	Coil Cover		000-117-026	1
49	Capscrew		000-000-714	1
	Bottom Cap Assembly		075-038-000	
	Disc Piston Assembly		075-048-000	
	Body Assembly		075-008-000	
	Bonnet Assembly		000- 128-000	
	"PD" Adaptor Assembly		000-228-000	
	Solenoid Coil Assembly		000- 118-000	
	Repair Parts Kit Includes:	556-0425	RKPD075	
2	Seat Disc			1
16	Bottom Cap Gasket			1
21	Pilot Seat Bead			1
22	Diaphragm Gasket			1
23	Diaphragm			1
37	Gasket (Oval Flange)			1
19	Cylinder Gasket			1
33	Seal Cap Gasket			1

*Indicates Part Not Illustrated.

PARTS LIST INDEX

Back Pressure Regulating Valve - 1"

MPA



PARTS LIST INDEX

Back Pressure Regulating Valve -1"
M P D A

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	MPA Valve Compete - 1"	556-0431	PA 10021	
1	Disc Piston		100-047-011	1
2	Seat Disc		100-047-012	1
3	Seat Disc Retainer		100-047-013	1
4	Opening Stem		100-047-014	1
*5	Roll Pin		100 047-026	1
6	Bottom Cap		100-037-015	1
7	Disc Piston Spring		100-037-016	1
*8	Opening Stem Washer		000-000-760	1
*9	Packing		000-000-799	1
10	Packing Nut		000-000-775	1
11	Seal Cap Gasket		000-037-045	1
12	Seal Cap		000-037-046	1
13	Body (Oval Flanged)		100-007-022	1
14	Bottom Cap Gasket		100-007-019	1
15	Capscrew		000-000-701	4
16	Push Rod		100-007-020	1
17	Cylinder Gasket		100-007-021	1
18	Power Piston		100-007-023	1
19	Pipe Plug		000-067-016	1
20	Bead Plate		000-067-017	1
21	Pilot Seat Bead		000-067-006	1
22	Diaphragm Gasket		000-127-007	1
23	Diaphragm		000-127-008	2
24	Adjustment Spring Plate		000-127-009	1
25	Adjustment Spring		000-127-010	1
26	Adjustment Spring Guide		000-127-011	1
27	Bonnet		000-127-012	1
28	Capscrew		000 000-703	4
29	Pressure Adjustment Stem		000-127-013	1
*30	Pressure Adjustment Stem Washer		000-000-760	1
*31	Packing		000-000-798	1
32	Packing Nut		000-000-775	1
*33	Seal Cap Gasket		000-127-014	1
34	Seal Cap		000-127-015	1
*35	Name Plate		000-000-790	1
36	Threaded Flange		100-801-807	2
37	Gasket (Oval Flange)		100-890-000	2
38	Bolt (Oval Flange)		000-000-713	4

*Indicates Part Not Illustrated.

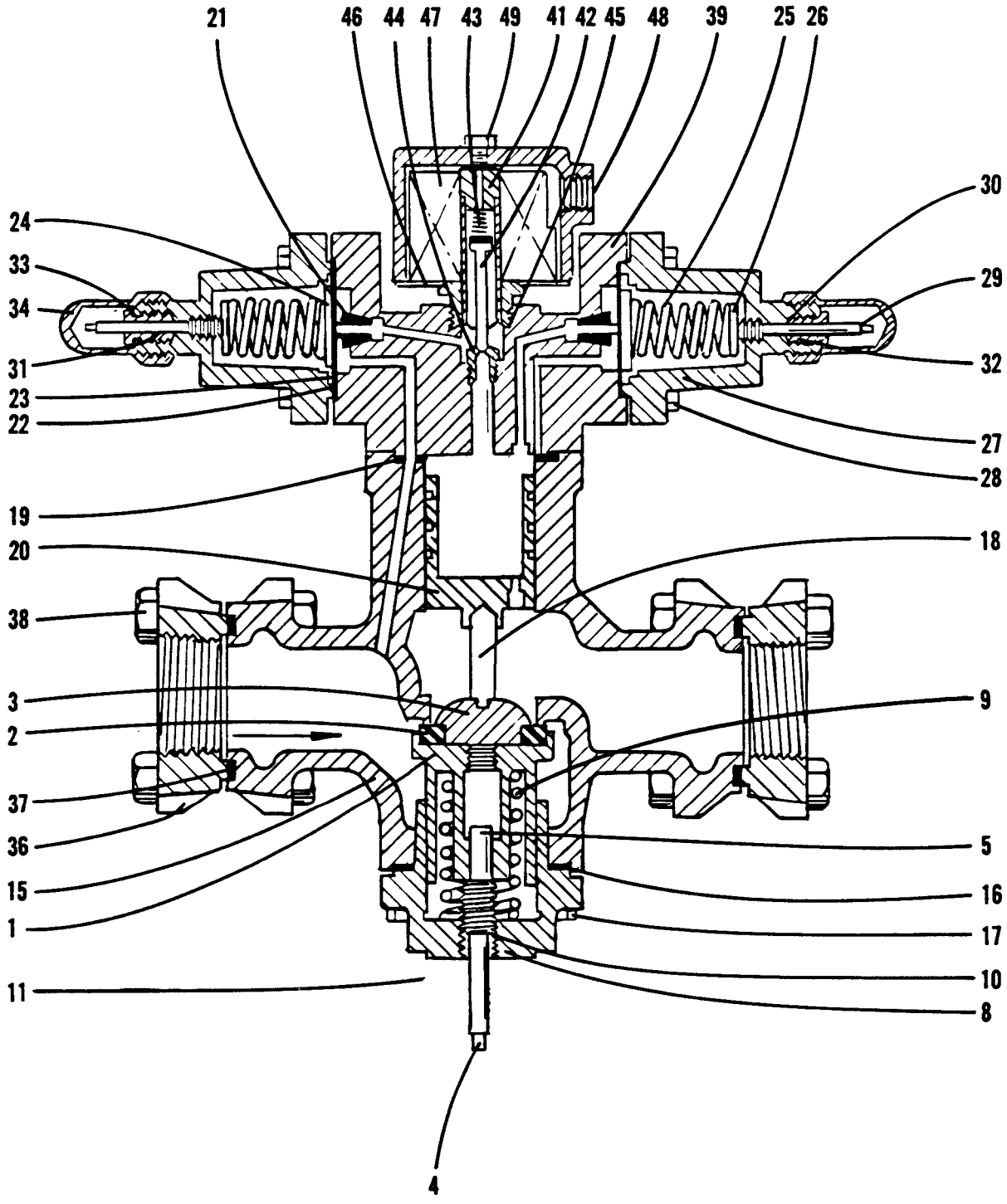
PARTS LIST INDEX

Back Pressure Regulating Valve -1"
M P D A

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Bottom Cap Assembly		100-038-000	
	Disc Piston Assembly		100-048-000	
	Body Assembly		100-008-000	
	Bead Plate Assembly		000-068-000	
	Bonnet Assembly		000- 128-000	
	Repair Parts Kit Includes:	556-0436	RKP100	
2	Seat Disc			1
14	Bottom Cap Gasket			1
21	Pilot Seat Bead			1
22	Diaphragm Gasket			1
23	Diaphragm			1
37	Gasket (Oval Flange)			1
17	Cyl inder Gasket			1

PARTS LIST INDEX

Dual Back Pressure Regulator - 1”
M P D A



PARTS LIST INDEX

Dual Back Pressure Regulator - 1”
M P D A

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Valve Assembly Complete - 1"	556-0421	MPDA 10021	
1	Disc Piston		100-047-011	1
2	Seat Disc		100-047-012	
3	Seat Disc Retainer		100-047-013	
4	Opening Stem		100-047-014	
5	Roll Pin		100-047-026	
6	Stem Retaining Washe			
7	Piston Retaining Ring			
* 8	Bottom Cap		100-037-015	1
9	Disc Piston Spring		100-037-016	1
10	Opening Stem Washer		000-000-760	1
14				
15	Body (Oval Flanged)		100-007-022	1
16	Bottom Cap Gasket		100-007-019	1
17	Capscrew		000-000-701	4
18	Push Rod		100-007-020	1
19	Cylinder Gasket		100-007-021	1
20	Power Piston		100-007-023	1
21	Pilot Seat Bead		000-067-006	1
22	Diaphragm Gasket		000-127-007	1
23	Diaphragm		000-127-008	2
24	Adjustment Spring Plate		000-127-009	1
25	Adjustment Spring		000-127-010	
26	Adjustment Spring Guide		000-127-011	
27	Bonnet		000-127-012	
28	Capscrew		000-000-701	
29	Pressure Adjustment Stem		000-127-013	
30	Pressure Adjustment Stem Washer		000-000-760	
31	Packing		000-000-798	
32	Packing Nut		000-000-775	
33	Seal Cap Gasket		000-127-014	
34	Seal Cap		000-127-015	
35	Name Plate		000-000-790	
36	Threaded Flange (Oval)		100-801-807	2
37	Gasket (Oval Flange)		100-890-000	2
38	Bolt (Oval Flange)		000-000-713	4
39	"PD" Adaptor		000-227-035	1
40	Capscrew		000-000-702	4

*Indicates Part Not Illustrated.

PARTS LIST INDEX

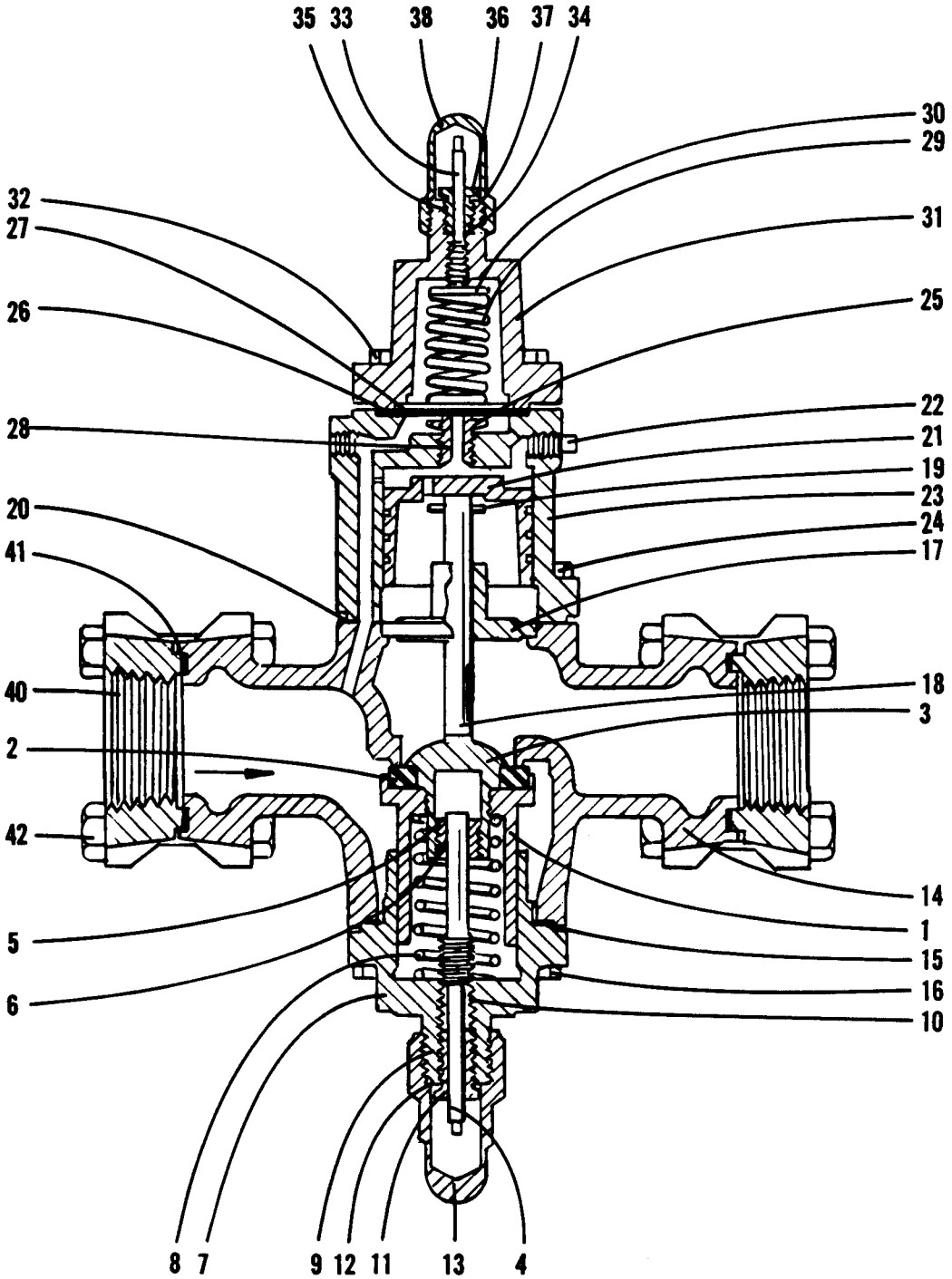
Dual Back Pressure Regulator - 1”
M P D A

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
41	Plunger Tube Assembly		000-178-000	1
42	Drawbar Assembly		000-188-000	1
43	Drawbar Spring		000-187-022	1
44	Seat Bead		000-117-021	1
45	Gasket		000-117-023	1
46	Coil Platform		000-117-024	1
47	Coil	50/60 cycle 551-2066	000-117-025	1
48	Coil Cover		000-117-026	1
49	Capscrew		000-000-714	1
	Bottom Cap Assembly		100-038-000	
	Disc Piston Assembly		100-048-000	
	Body Assembly		100-008-000	
	Bonnet Assembl y		000-128-000	
	"PD" Adaptor Assembly		000-228-000	
	Solenoid Coil Assembly		000-118-000	
	Repair Parts Kit includes:	556-0426	RKPD100	
2	Seat Disc			1
16	Bottom Cap Gasket			1
21	Pilot Seat Bead			1
22	Diaphragm Gasket			1
23	Diaphragm			1
37	Gasket (Oval Flange)			1
19	Cylinder Gasket			1
33	Seal Cap Gasket			1

PARTS LIST INDEX

Back Pressure Regulating Valve - 1-1/4", 1-1/2" & 2"

M P A



PARTS LIST INDEX

Back Pressure Regulating Valve - 1¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
	PA Valve Complete					
	1-1/4"		556-0432	MPA 12541		
	1-1/2"		556-0433		MPA 15041	
	2"		556-0434			PA 20041
1	Disc Piston	1		125-047-011	150-047-011	200-047-011
2	Seat Disc	1		125-047-012	150-047-012	200-047-012
3	Seat Disc Retainer	1		125-047-013	200-047-013	200-047-013
4	Opening Stem	1		125-047-014	150-047-014	200-047-014
5	Roll Pin	1		125-047-026	150-047-026	200-047-026
6	Stem Retaining Nut	1			000-000-780	000-000-781
7	Bottom Cap	1		125-037-015	150-037-015	200-037-015
8	Disc Piston Spring	1		125-037-016	150-037-016	200-037-016
9	Opening Stem Washer	1		000-000-760	000-000-760	000-000-761
10	Packing	1		000-000-799	000-000-799	000-000-797
11	Packing Nut	1		000-000-775	000-000-775	000-000-776
12	Seal Cap Gasket	1		000-037-045	000-037-045	000-037-047
13	Seal Cap	1		000-037-046	000-037-046	000-037-048
14	Body (Square)	1		125-007-024	150-007-024	200-007-024
15	Bottom Cap Gasket	1		125-007-019	150-007-019	200-007-019
16	Capscrew	4		000-000-704	000-000-708	000-000-708
17	Guide Plate	1		125-007-028	150-007-028	200-007-028
18	Push Rod	1		125-007-020	150-007-020	200-007-020
19	Roll Pin	1		125-007-027	150-007-027	200-007-027
20	Cylinder Gasket	1		127-007-021	150-007-021	200-007-021

PARTS LIST INDEX

Back Pressure Regulating Valve - 1¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
21	Power Piston	1		125-017-023	150-017-023	200-017-023
22	Pipe Plug	1		000-067-016	000-067-016	000-067-016
23	Cylinder	1		125-017-029	150-017-029	200-017-029
24	Capscrew	1		000-000-712	000-000-707	000-000-708
25	Pilot Seat Bead	1		000-067-006	000-067-006	000-067-006
26	Diaphragm Gasket	1		000-127-007	000-127-007	000-127-007
27	Diaphragm	2		000-127-008	000-127-008	000-127-008
28	Adjustment Spring Plate	1		000-127-009	000-127-009	000-127-009
29	Adjustment Spring	1		000-127-010	000-127-010	000-127-010
30	Adjustment Spring Guide	1		000-127-011	000-127-011	000-127-011
31	Bonnet	1		000-127-012	000-127-012	000-127-012
32	Capscrew	4		000-000-701	000-000-701	000-000-701
33	Pressure Adjustment Stem	1		000-127-013	000-127-013	000-127-013
34	Pressure Adjustment Stem Washer	1		000-000-760	000-000-760	000-000-760
35	Packing	1		000-000-798	000-000-798	000-000-798
36	Packing Nut	1		000-000-775	000-000-775	000-000-775
37	Seal Cap Gasket	1		000-127-014	000-127-014	000-127-014
38	Seal Cap	1		000-127-015	000-127-015	000-127-015
* 39	Name Plate	1		000-000-790	000-000-790	000-000-790
40	Threaded Flange	2		125-811-815	150-811-816	200-811-817
41	Gasket	2		125-893-000	150-893-000	200-893-000
42	Bolt & Nut	2		000-000-747	000-000-747	000-000-746
	Bottom Cap Assembly			125-038-000	150-038-000	200-038-000
	Disc Piston Assembly			125-048-000	150-048-000	200-048-000
	Body Assembly			125-008-000	150-008-000	200-008-000
	Bonnet Assembly			000-128-000	000-128-000	000-128-000
	Cylinder Assembly			125-018-000	150-018-000	200-018-000

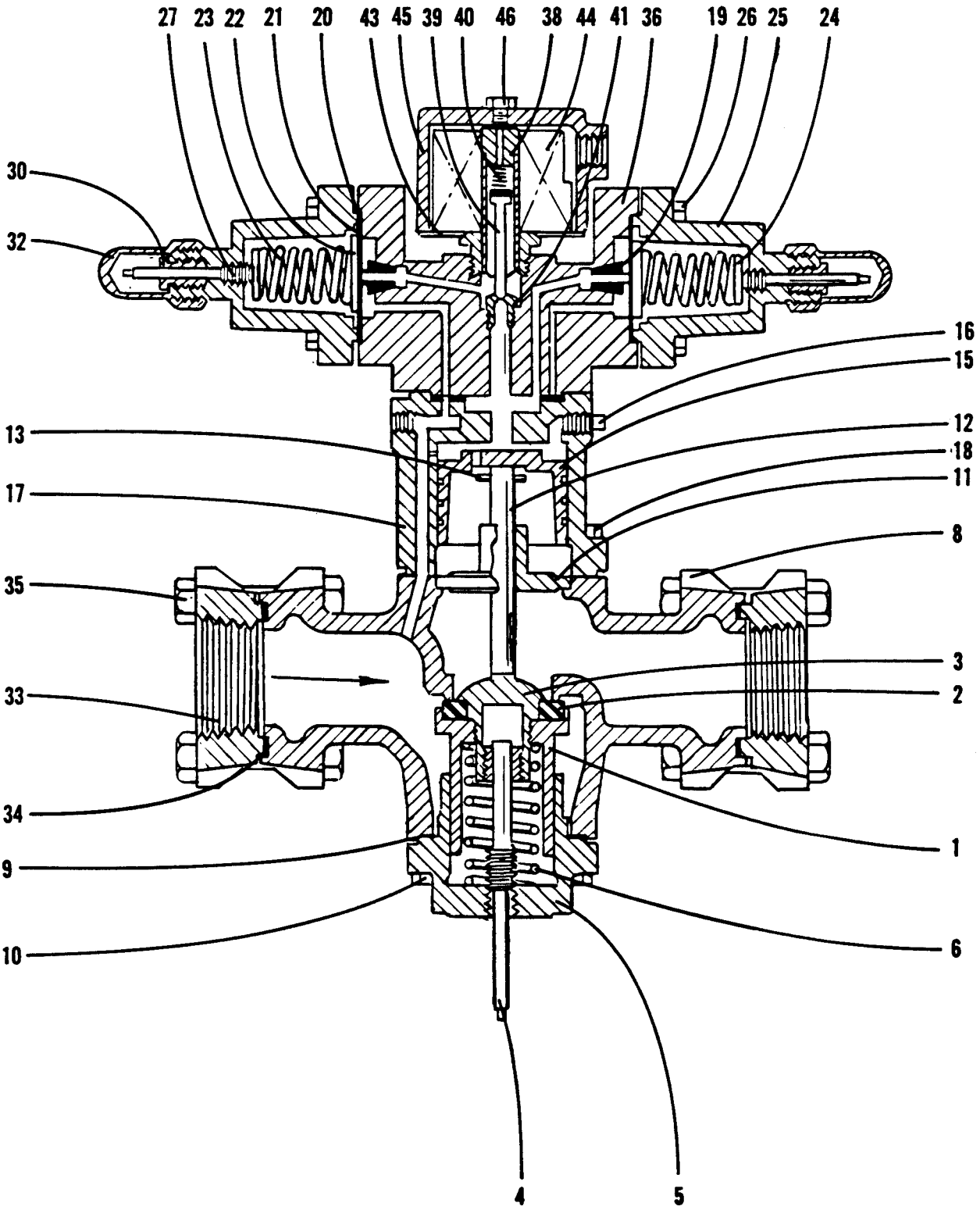
PARTS LIST INDEX

Back Pressure Regulating Valve - 1¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
	Repair Parts Kit includes					
	1 - 1/4"		556-0437	RKPl 25		
	1 - 1/2"		556-0438		RKP 150	
	2"		556-0439			RKP200
2	Seat Disc	1				
15	Bottom Cap Gasket	1				
25	Pilot Seat Bead	1				
26	Diaphragm Gasket	1				
27	Diaphragm	1				
41	Gasket	1				
20	Cylinder Gasket	1				

PARTS LIST INDEX

Dual Back Pressure Regulator - 1-¼", 1-½" & 2"
M P D A



PARTS LIST INDEX

Dual Back Pressure Regulator - 1¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
	Valve Assembly Complete					
	1-1/4"		556-0422	MPDA 12541		
	1-1/2"		556-0423		MPDA 15041	
	2"		556-0424			MPDA 20041
1	Disc Piston	1		125-047-011	150-047-011	200-047-011
2	Seat Disc	1		125-047-012	150-047-012	200-047-012
3	Seat Disc Retainer	1		125-047-013	150-047-013	200-047-013
4	Opening Stem	1		125-047-014	150-047-014	200-047-014
5	Bottom Cap	1		125-037-015	150-037-015	200-037-015
6	Disc Piston Spring	1		125-037-016	150-037-016	200-037-016
* 7	Opening Stem Washer	1		000-000-760	000-000-760	000-000-761
8	Body (Square)	1		125-007-024	150-007-024	200-007-024
9	Bottom Cap Gasket	1		125-007-019	150-007-019	200-007-019
10	Capscrew	4		000-000-704	000-000-704	000-000-708
11	Guide Plate	1		125-007-028	150-007-028	200-007-028
12	Push Rod	1		125-007-020	150-007-020	200-007-020
13	Roll Pin	1		125-007-027	150-007-027	200-007-027
* 14	Cylinder Gasket	1		127-007-021	150-007-021	200-007-021
15	Power Piston	1		125-017-023	150-017-023	200-017-023
16	Pipe Plug	1		000-067-016	000-067-016	000-067-016
17	Cylinder	1		000-027-018	000-027-018	000-027-018
18	Capscrew	4		000-000-712	000-000-707	000-000-708
19	Pilot Seat Bead	2		000-067-006	000-067-006	000-067-006
20	Diaphragm Gasket	3		000-127-007	000-127-007	000-127-007
21	Diaphragm	4		000-127-008	000-127-008	000-127-008
22	Adjustment Spring Plate	2		000-127-009	000-127-009	000-127-009
23	Adjustment Spring	2		000-127-010	000-127-010	000-127-010
24	Adjustment Spring Guide	2		000-127-011	000-127-011	000-127-011
25	Bonnet	2		000-127-012	000-127-012	000-127-012

*Indicates Part Not Illustrated.

PARTS LIST INDEX

Dual Back Pressure Regulator - 1-¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
26	Capscrew	8		000-000-701	000-000-701	000-000-701
27	Pressure Adjustment Stem	2		000-127-013	000-000-013	000-127-013
*28	Pressure Adjustment Stem Washer	2		000-000-760	000-000-760	000-000-760
*29	Packing	2		000-000-798	000-000-798	000-000-798
30	Packing Nut	2		000-000-775	000-000-775	000-000-775
*31	Seal Cap Gasket	2		000-127-014	000-127-014	000-127-014
32	Seal Cap	2		000-127-015	000-127-015	000-127-015
33	Threaded Flange	2		125-811-815	150-811-816	200-811-817
34	Gasket	2		125-893-000	150-893-000	200-893-000
35	Bolt & Nut	8		000-000-747	000-000-747	000-000-746
36	"PD" Adaptor	1		000-227-035	000-227-035	000-227-035
*37	Capscrew	4		000-000-702	000-000-702	000-000-702
38	Plunger Tube Assembly	1		000-178-000	000-178-000	000-178-000
39	Drawbar Assembly	1		000-188-000	000-188-000	000-188-000
40	Drawbar Spring	1		000-187-022	000-187-022	000-187-022
41	Seat Bead	1		000-117-021	000-117-021	000-117-021
*42	Gasket	1		000-117-023	000-117-023	000-117-023
43	Coil Platform	1		000-117-024	000-117-024	000-117-024
44	Coil	1	50/60 cycle 551-2066	000-117-025	000-117-025	000-117-025
45	Coil Cover	1		000-117-026	000-117-026	000-117-026
46	Capscrew	1		000-000-714	000-000-714	000-000-714
	Bottom Cap Assembly			125-038-000	150-038-000	200-038-000
	Disc Piston Assembly			125-048-000	150-048-000	200-048-000
	Body Assembly			125-008-000	150-008-000	200-008-000
	Cylinder Assembly			000-028-000	000-028-000	000-028-000
	Bonnet Assembly			000-128-000	000-128-000	000-128-000
	"PD" Adaptor Assembly			000-228-000	000-228-000	000-228-000
	Solenoid Coil Assembly			000-118-000	000-228-000	000-118-000

*Indicates Part Not Illustrated.

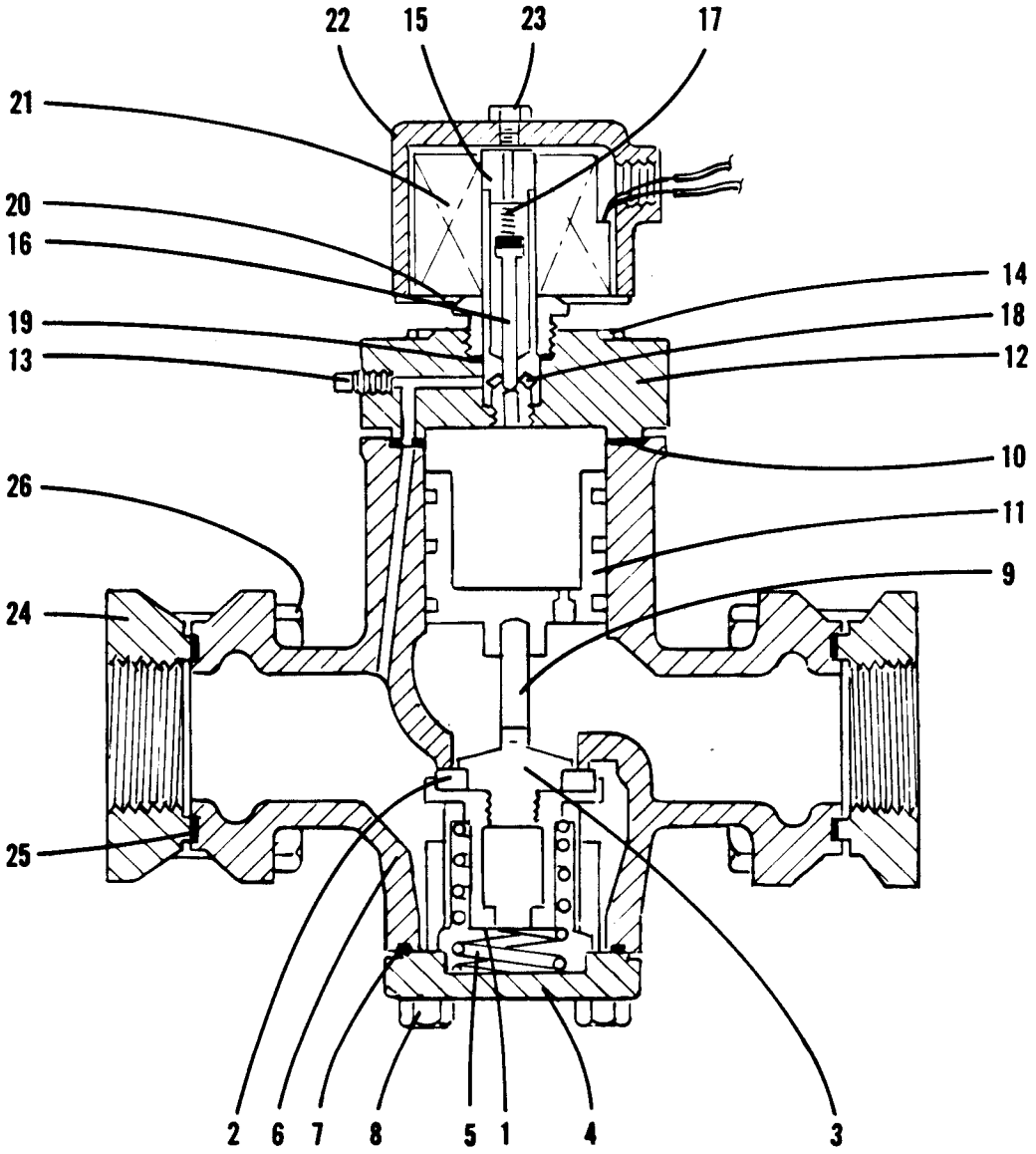
PARTS LIST INDEX

Dual Back Pressure Regulator - 1-¼", 1-½ & 2"
M P D A

INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO. 1-1/4"	1-1/2"	2"
	Repair Parts Kit Includes:					
	1-1/4"		556-0427	RKPD125		
	1-1/2"		556-0428		RKPD150	
	2"		556-0429			RKPD200
2	Seat Disc					
9	Bottom Cap Gasket					
19	Pilot Seat Bead					
20	Diaphragm Gasket	1				
21	Diaphragm	1				
42	Gasket	1				
14	Cylinder Gasket	1				
31	Seal Cap Gasket	1				

PARTS LIST INDEX

Hubbell Hot Gas Valve



PARTS LIST INDEX

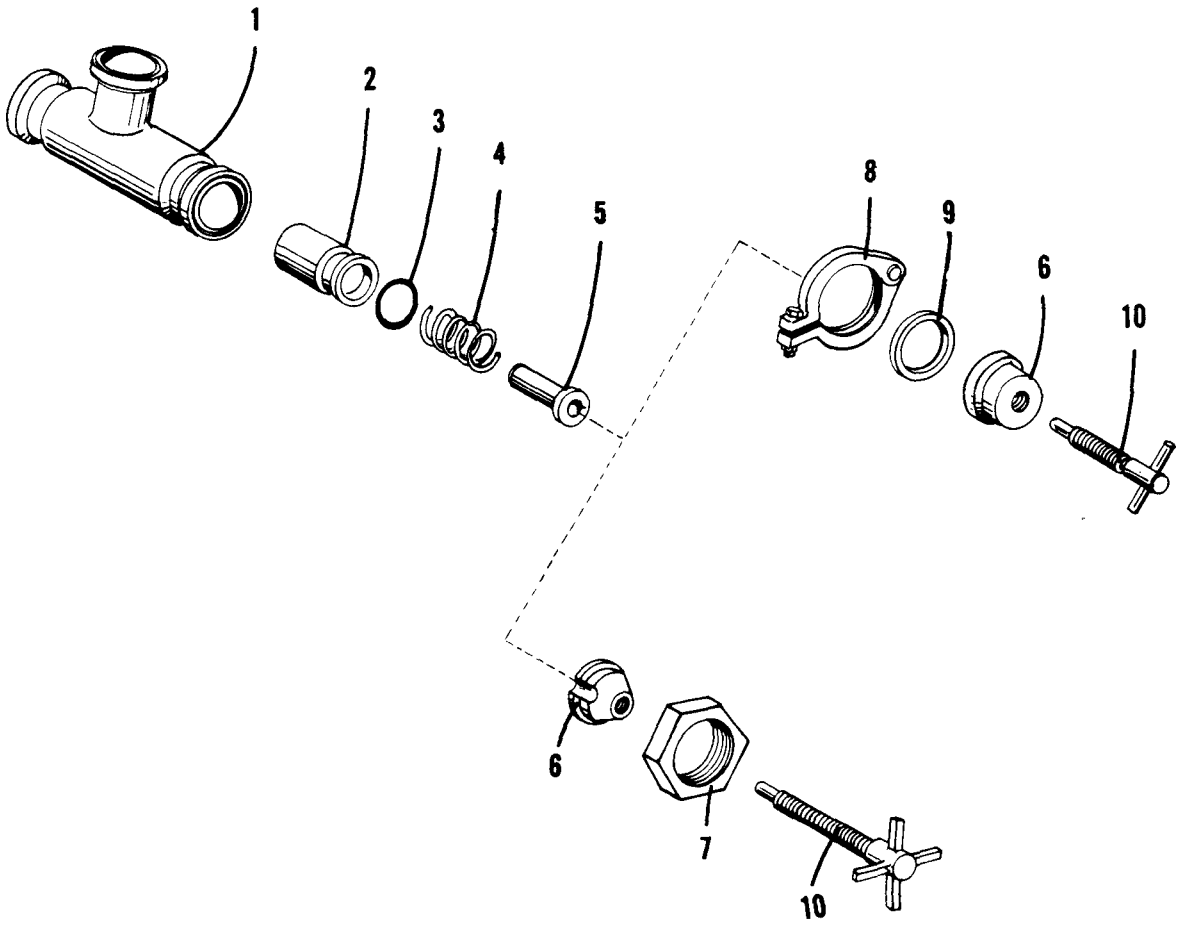
Hubbell Hot Gas Valve

INDEX NO.	DESCRIPTION	WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	QTY.
	Valve Assembly, Complete	556-0609	S05021	
1	Disc Piston		050-047-010	1
2	Seat Disc		050-047-012	1
3	Seat Disc Retainer		050-047-009	1
4	Bottom Cap		050-037	1
5	Disc Piston Spring Body Assembly		050-037-016	1
6	Body (Oval Flanged)		050-007-022	1
7	Bottom Cap Gasket		050-007-019	1
8	Capscrew		000-000-701	4
9	Push Rod		050-007-020	1
10	Cylinder Gasket		000-127-007	1
11	Power Piston		050-007-023	1
12	'U' Cylinder Cap		000-147-039	1
13	Pipe Plug		000-067-016	1
14	Capscrews		000-000-701	4
15	Plunger Tube Assembly		000-178-000	1
16	Drawbar Assembly		000-188-000	1
17	Drawbar Spring		000-187-022	1
18	Seat Bead		000-117-021	1
19	Gasket		000-117-023	1
20	Coil Platform		000-117-024	1
21	Coil	50/60 cycle 556-2066	000-117-025	1
22	Coil Cover		000-117-026	1
23	Capscrew		000-000-714	1
24	Threaded Flange, (Oval)		050-801-800	2
25	Gasket, (Oval Flange)		050-890-000	2
26	Bolt, (Oval Flange)		000-000-708	4
	Bottom Cap Assembly		050-038-002	
	Disc Piston Assembly		050-048-002	
	'U' Cylinder Assembly		000-148-000	
	Solenoid Coil Assembly	556-0416	000-218-000	
	Repair Parts Kit Includes:	556-0610		
2	Seat Disc			1
7	Bottom Cap Gasket			1
15	*Plunger Tube Assembly			1
16	*Drawbar Assembly			1
17	*Drawbar Spring			1
18	*Seat Bead			1
19	*Gasket			1
25	Gasket, (Oval Flange)			1

*Parts Also Included In Solenoid Coil Assembly - 556-0416

PARTS LIST INDEX

Product Holdback Valve 1-½” and 2”



PARTS LIST INDEX

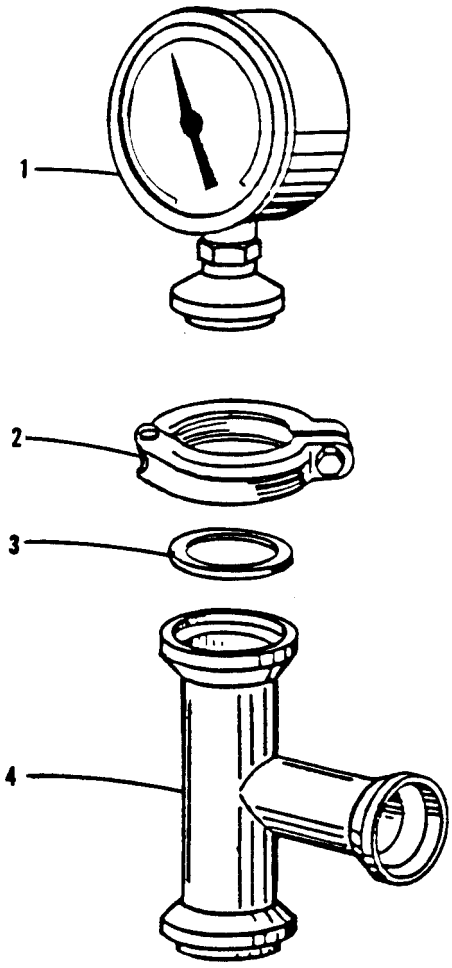
Product Holdback Valve - 1-½” and 2”

INDEX NO.	DESCRIPTION	1-1/2 INCH			2 INCH			QTY.
		I-LINE	Q-TYPE	THREADED	I-LINE	Q-TYPE	THREADED	
	Valve Assembly - Complete	300-0340	300-0341	300-0342	484-0436	484-0437	484-0438	
1	Body Valve	300-0337	300-0338	300-0339	484-0433	484-0434	484-0435	1
2	Plunger	42904	42904	42904	35146	35146	35146	1
3	O-Ring, Plunger	+554-0162	+554-0162	+554-0162	+554-0251	+554-0251	+554-0251	1
4	Spring	590-0268	590-0268	590-0268	590-0320	590-0320	590-0320	1
5	Cap	35282	35282	35282	35147	35147	35147	1
6	Ferrule	42903	42903	42903	35144	35144	35144	1
7	Nut - 2" 13H				0143226	0143226	0143226	1
8	Clamp - 31 - 1-1/2"	0342223	0342223	0342223				1
9	Gasket - 40QH - 1-1/2"	+554-0400	+554-0400	+554-0400				
10	Screw, Adjusting	42906	42906	42906	35149	35149	35149	1

+ - Indicates part with limited service life. On-hand spares are recommended.

PARTS LIST INDEX

Pressure Gauge Assembly - Sanitary

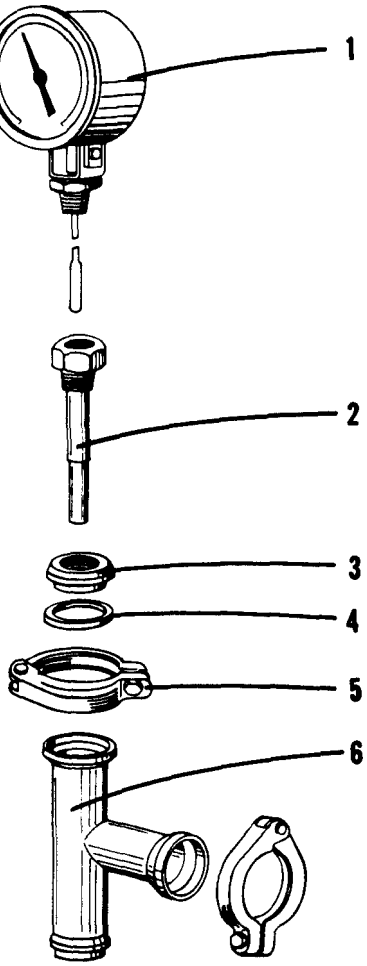


INDEX NO.	DESCRIPTION	PART NO.	QTY.
	Gauge Assembly, Sanitary Pressure Complete	300-5108	
1	Gauge - 3½ Dia., 0-160 psig	557-0463	1
2	Clamp, 131 - 2”	306-0252	1
3	Gasket, 401H - 2”	+554-0326	1
4	Tee, 7A1-2”	800-0112	1

+Indicates part with limited service life.
On-hand spares are recommended.

PARTS LIST INDEX

Dial Thermometer Assembly - Sanitary



INDEX NO.	DESCRIPTION	1-1/2"ASSEMBLY	2"ASSEMBLY	QTY.
	Sanitary Dial Thermometer Assembly - Complete	300-0432	300-0433	
1	Thermometer 1-1/2" Dial - 3-1/2" Dia., 0 - 300° F	557-0120		
1	Thermometer, 2" Dial - 3-1/2" Dia., 0-300° F		557-0175	1
2	Socket, Thermometer	557-0014	557-0174	1
3	Ferrule, 23B1	0342496	0343496	1
4	Gasket, 401H	+554-0325	+554-0326	2
5	Clamp, 131	0342223	0343223	2
6	Tee, 7B1	0342114	0343114	1

+ - Indicates part with limited service life. On-hand spares are recommended.

PARTS LIST INDEX

Accessory Gauges and Thermometers
Thermutators are equipped with a variety of gauges and thermometers to measure the temperature of both media and product. The range, connection and purpose of accessory gauges and thermometers varies considerably with the needs of the Thermutator customers. Most common gauges and thermometers are included in the parts lists that follow below and on the following page.

Thermocouple Sensing Devices
When Thermutators are used in highly automated systems or when chart recording of process temperatures is a necessity, thermocouple sensing devices are often used at the Thermutator's product or media inlets and outlets. Waukesha Cherry-Burrell makes available a limited line of thermocouples that are specifically designed for use with Thermutators. You should work with your Waukesha Cherry-Burrell sales engineer in selecting and applying thermocouples either within or without of the line offered by Waukesha Cherry-Burrell.

Cylinder Media Pressure Gauges

Waukesha Cherry-Burrell Part No.	Media	Range
43956	Steam	0-160 lbs.

Cylinder Media Temperature Gauges

Waukesha Cherry-Burrell Part No.	Media	Range
43954	Brine	40°-102°F
43955	Water	30°-220°F

Panel Mounted Accessary Gauges

Waukesha Cherry-Burrell Part No.	Type	Range	Diameter
43956	Gauge - Steam Pressure	0-160 PSI	3-½"
43955	Gauge - Thermometer	30°-220°F	3-½"
43954	Gauge - Thermometer	40°-120°F	3-½"

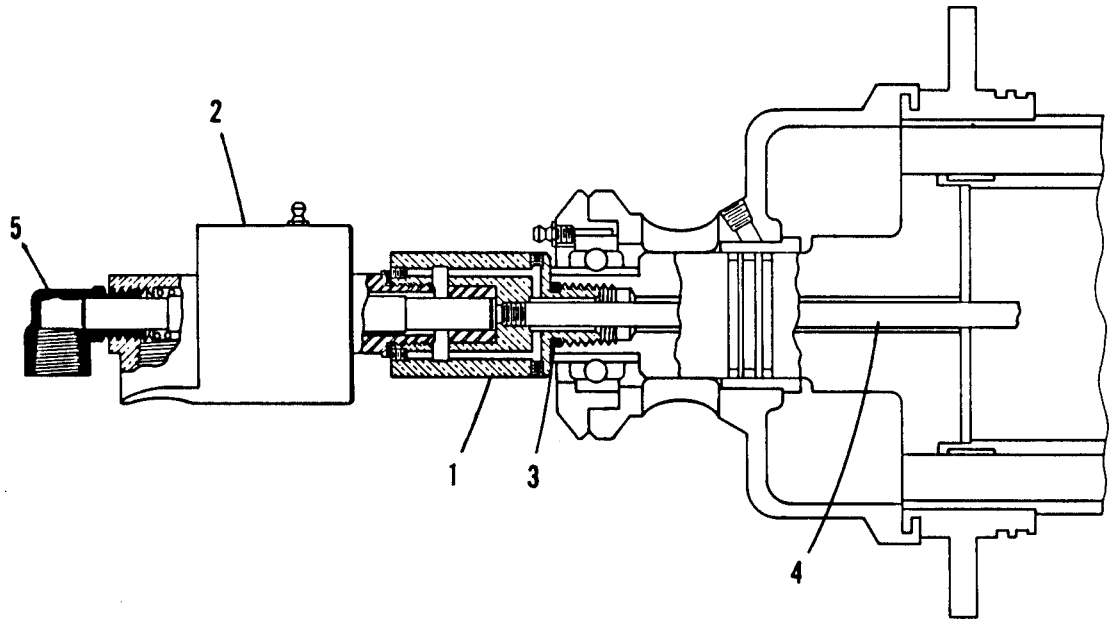
PARTS LIST INDEX

Accessory Thermometers

WAUKESHA CHERRY-BURRELL PART NO.	VENDOR PART NO.	SCALE RANGE	SCALE DIVISION	STEM LENGTH	STEM LENGTH	ANGLE	FITTING
557-0197	10-EM-265	0 -110°F	1°	7"	4-9/16"	90°	2" Pipe
557-0196	8-EM-265	0-110°F	1°	7"	4-9/16"	0°	2" Pipe
557-0218	8-EM-265	-5-+105°C	2°	7"	4-9/16"	0°	2" Pipe
557-0217	22-EM-265	-5-+105°C	2°	7"	4-9/16"	90°L	2" Pipe
557-0216	21-EM-265	-5-+105°C	2°	7"	4-9/16"	90°R	2" Pipe
557-0215	20-EM-265	-5-+105°C	2°	7"	4-9/16"	90°	2" Pipe
557-0214	8-EM-265	-20-+45°C	1°	7"	4-9/16"	0°	2" Pipe
557-0213	22-EM-265	-20-+45°C	1°	7"	4-9/16"	90°L	2" Pipe
557-0212	21-EM-265	-20-+45°C	1°	7"	4-9/16"	90°R	2" Pipe
557-0211	20-EM-265	-20-+45°C	1°	7"	4-9/16"	90°	2" Pipe
557-0210	8-EM-465	55-95°C	1/2°	10"	4-9/16"	0°	2" Pipe
557-0209	22-EM-465	55-95°C	1/2°	10"	4-9/16	90°L	2" Pipe
557-0208	21-EM-465	55-95°C	1/2°	10"	4-9/16"	90°R	2" Pipe
557-0207	8-EM-265	20-220°F	2°	7"	4-9/16"	0°	2" Pipe
557-0206	20-EM-465	55-95°C	1/2°	10"	4-9/16"	90°	2" Pipe
557-0205	22-EM-265	20-220°F	2°	7"	4-9/16"	90°L	2" Pipe
557-0204	21-EM-265	20-220°F	2°	7"	4-9/16"	90°R	2" Pipe
557-0203	20-EM-265	20-220°F	2°	7"	4-9/16"	90°	2" Pipe
557-0202	22-EM-465	135-200°F	1/2°	10"	4-9/16	90°L	2" Pipe
557-0201	22-EM-265	0-110°F	1°	7"	4-9/16"	90°L	2" Pipe
557-0200	21-EM-465	135-200°F	1/2°	10"	4-9/16"	90°R	2" Pipe
557-0199	21-EM-265	0-110°F	1°	7"	4-9/16	90°R	2" Pipe
557-0198	20-EM-465	135-200°F	1/2°	10"	4-9/16"	90°	2" Pipe
557-0195	8-EM-465	135-200°F	1/2°	10"	4-9/16"	0°	2" Pipe

PARTS LIST INDEX

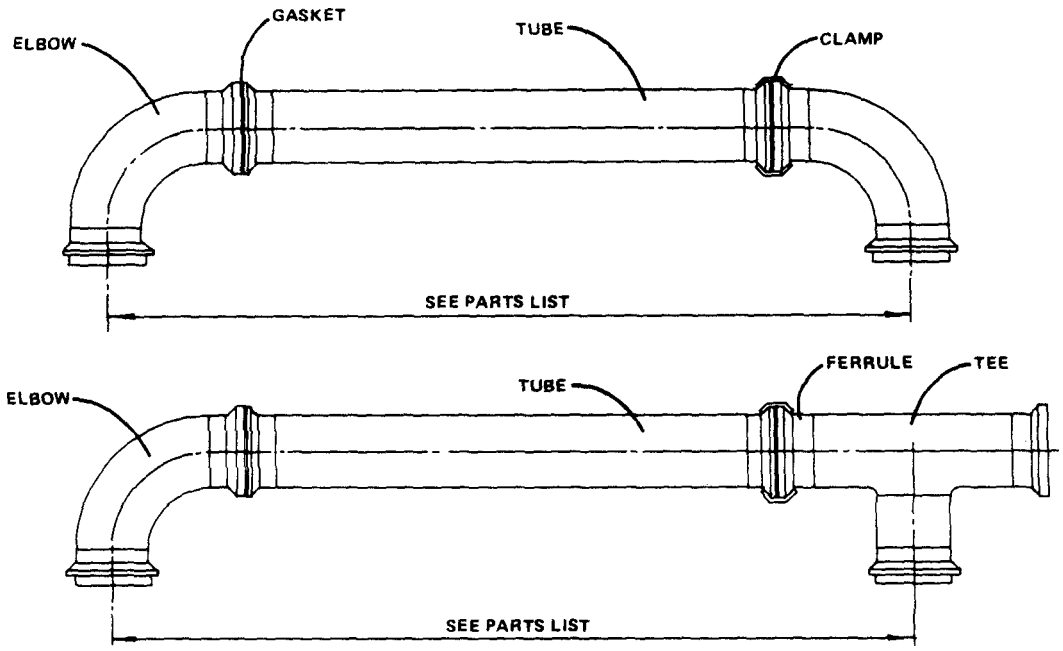
Water Circulating Valve



INDEX NO.	DESCRIPTION	QTY.	WAUKESHA CHERRY-BURRELL PART NO.
1	Adapter	1	300-5463
2	Rotary Union (Complete)	1	556-0687
3	O-Ring	1	554-0091
4	Pipe, Distributor (624)	1	300-5465
4	Pipe, Distributor (648)	1	300-5466
4	Pipe, Distributor (672)	1	300-5467
5	Stationary Pipe	1	300-5464

PARTS LIST INDEX

Interconnecting Piping



PARTS LIST INDEX

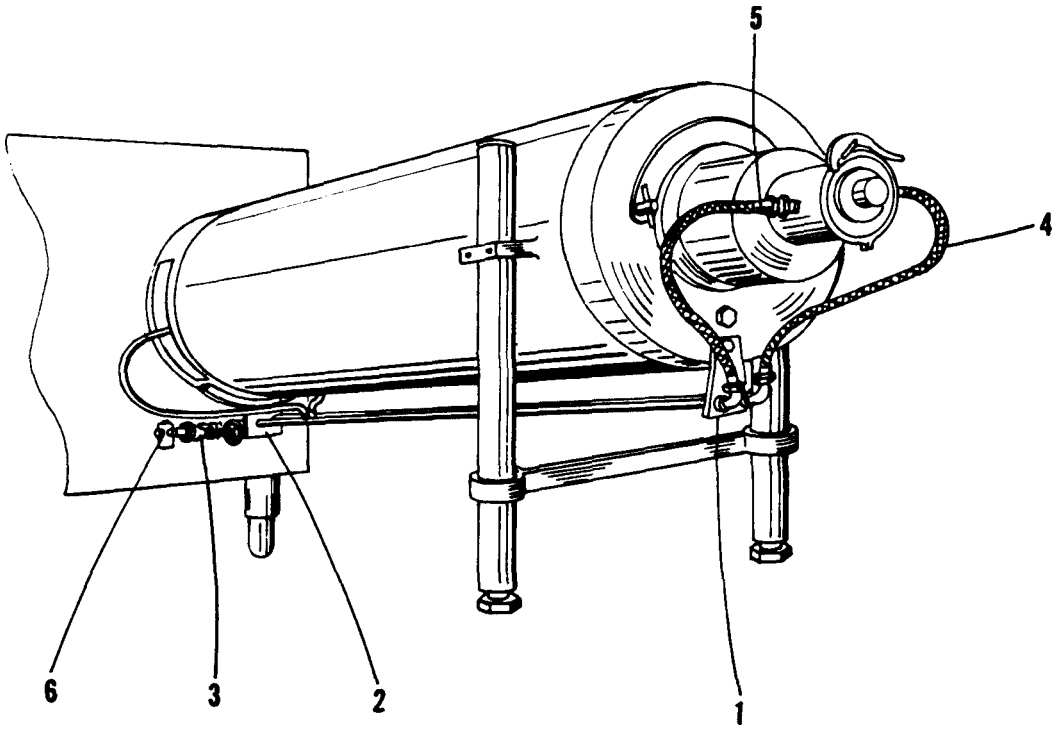
Interconnecting Piping

MACH. & TYPE OF ASSEMBLY	TUBING SIZE	COMPETE ASSEMBLY	ELBOW	TEE	TUBING	FERRULE	CLAMP	GASKET
Standard Cabinet	1-1/2"	300-2005	0372042	300-2000	936-0580 X 16-3/16"	6000813	0342223	554-0325
Tee To Elbow	2"	300-2006	0373042	300-2001	936-0707 X 15"	6000823	0343223	554-0326
	3"	300-2007	0375042	300-2003	936-0876 X 10-5/8"	6000843	0345223	554-0328
Standard Cabinet	1-1/2"	300-2008	0372042		936-0580 X 15-7/16"	6000813	0342223	554-0325
Elbow To Elbow	2"	300-2009	0373042		936-0707X 13-11/16"	6000823	0343223	554-0326
	3"	300-2010	0375042		936-0876 X 8-15/16"	6000843	0345223	554-0328
Oversize Cabinet	1-1/2"	300-2011	0372042	300-2000	936-0580 X 28-3/16"	6000813	0342223	554-0325
Tee To Elbow	2"	300-2012	0373042	300-2001	936-0707 X 27"	6000823	0343223	554-0326
	3"	300-2013	0375042	300-2003	936-0876 X 23-5/8"	6000843	0345223	554-0328
Oversize Cabinet	1-1/2"	300-2014	0372042		936-0580 X 27-7/16"	6000813	0342223	554-0325
Elbow To Elbow	2"	300-2015	0373042		936-0707 X 25-117/16"	6000823	0343223	554-0326
	3"	300-2016	0375042		936-0876 X 20-15/16"	6000843	0345223	554-0328

Tubing Must Be Trimmed To Length Before Welding Ferrule.

PARTS LIST INDEX

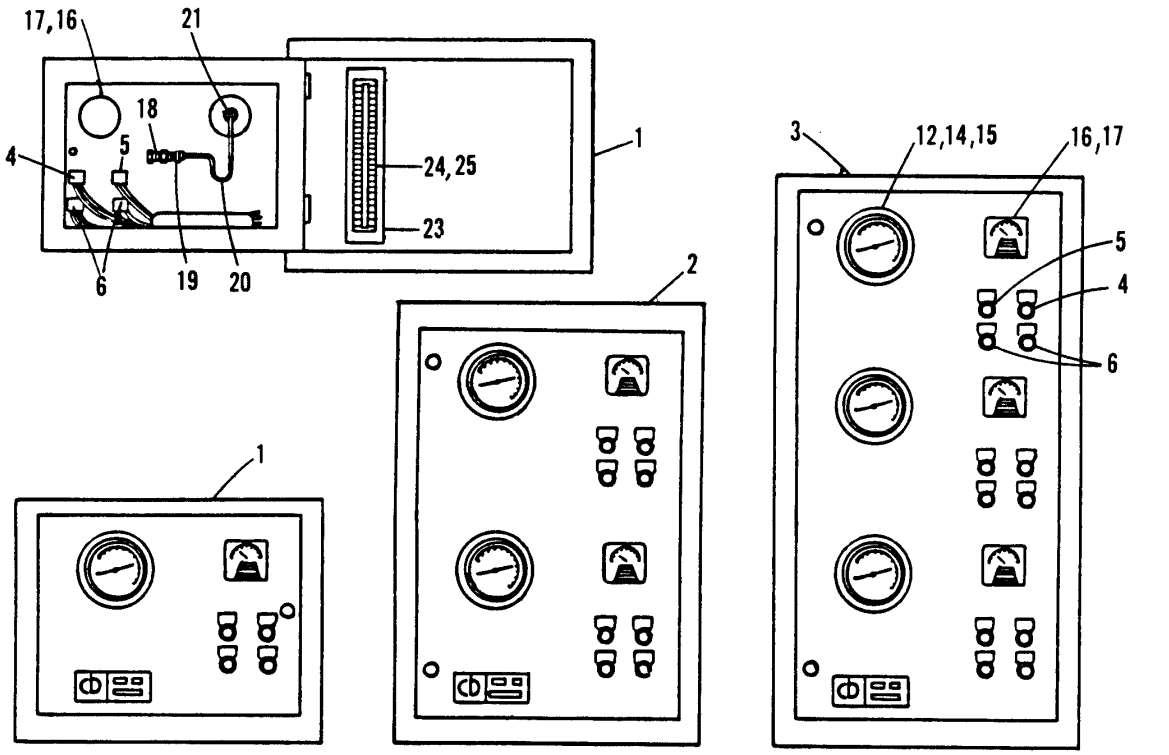
Aseptic Manifold Assembly



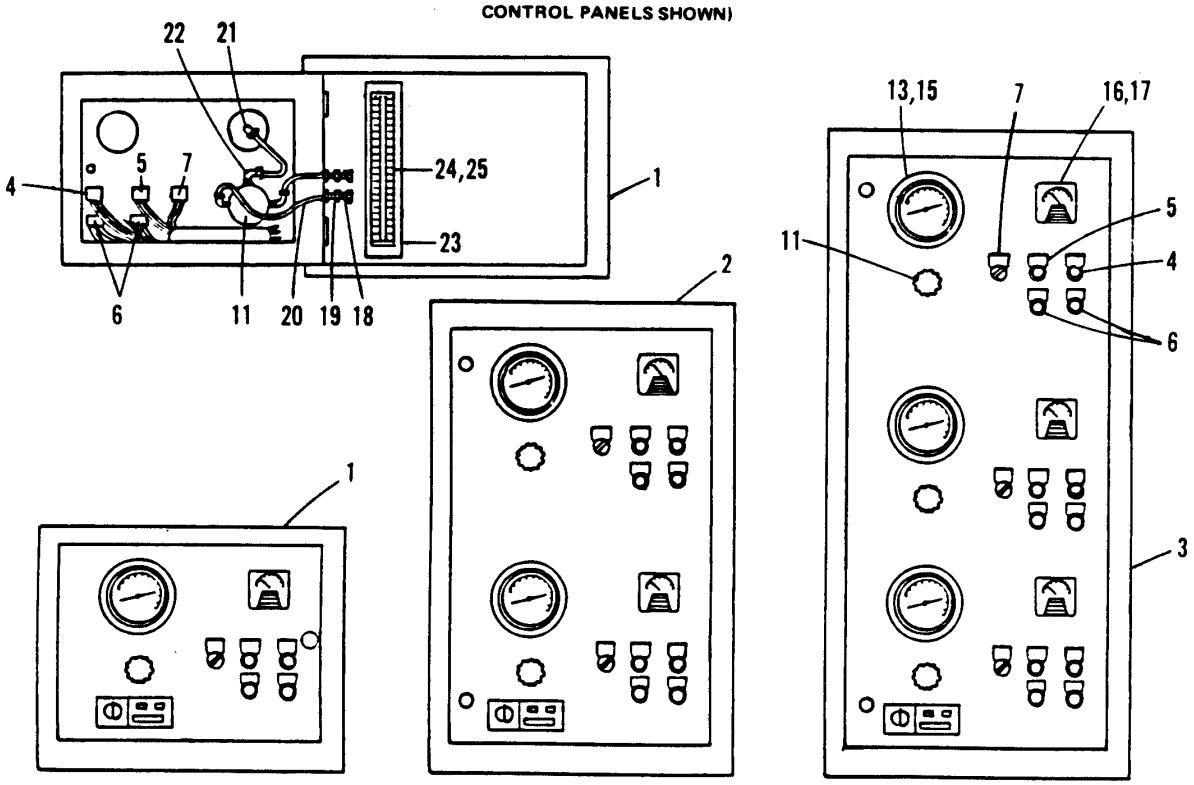
INDEX NO.	DESCRIPTION	MODEL '648' THERMUTATORS PART NO.	QTY.	MODEL '672' THERMUTATORS PART NO.	QTY.
	Aseptic Manifold Assembly - Complete (Consists Of Following Parts)	832-6200		832-6201	
1	Support, Front Manifold Hanger	208-9700	1	208-9700	1
2	Support, Rear Manifold Hanger	208-9600	1	208-9600	1
3	Valve, Metering	209-0000	1	209-0000	1
4	Hose, Standard (Less Quick-Disconnect Coupling)	300-0363	4	300-0363	
4	Hose, Oversize (Less Quick-Disconnect Coupling)	300-0364	4	300-0364	4
5	Coupling, Quick-Disconnect (Socket & Plug) S.S.	555-4073	4	555-4073	4
6	Valve, Solenoid (Optional - Must Be Ordered Separately)	209-0100	1	209-0100	1

PARTS LIST INDEX

Remote Control Panel



(LIQUID/STEAM MEDIA CONTROL PANELS SHOWN)



(DIRECT EXPANSION MEDIA CONTROL PANELS SHOWN)

PARTS LIST INDEX

Remote Control Panel

CABINETS
(Mounting Enclosures For Control Panels)

INDEX NO.	DESCRIPTION	PART NO.
1	Cabinet, Single - Complete	835-2056
2	Cabinet, Double -Complete	835-2057
3	Cabinet, Triple - Complete	835-2058

CONTROL PANELS
(Use one panel per Thermutator - Mount in cabinets listed above - Select panel and/or parts to agree with media).

INDEX NO.	DESCRIPTION	CONTROL PANEL FOR MODEL "L" THERMUTATORS PART NO.	QTY	CONTROL PANEL FOR MODEL "S" THERMUTATORS PART NO.	QTY	CONTROL PANEL FOR MODEL "DE" THERMUTATORS PART NO.	QTY
	Panel, Control - Complete (less items12, 13, 14 and 16)	300-5284		300-5283		300-5285	
4	Switch, Push Button (Dasher Start)	551-0731	1	551-0731	1	551-0731	1
5	Switch, Push Button (Auto Start)	551-0733	1	551-0733	1	551-0733	1
6	Switch, Push Button (Stop)	551-0726	2	551-0726	2	551-0726	2
7	Switch, 3-Position Selector					551-0547	1
8	Block, Contact					551-0551	1
9	Legend Plate (Hand - Off - Auto)					551-1232	1
10	Knob w/Ring, Regulator					551-0552	1
11	Regulator, 0 to 50 psi					551-0732	1
12	Gauge., Pressure (0 to 100 psi)	557-0011	1				
13	Gauge, Pressure (0 to 60 psi)					557-0010	1
14	Gauge, Pressure (0 to 160 psi)			557-0012	1		
15	Gasket, Pressure Gauge	554-0461	1	554-0461	1	554-0461	1
16	Ammeter (See "Ammeters" selection chart)						
17	Gasket, Ammeter	554-0460	1	554-0460	1	554-0460	1
18	Coupling (Bulkhead Connector)	555-2589	1	555-2589	1	555-2589	2
19	Fitting, Hose	555-2722	1	555-2722	1	555-2722	2
20	Hose, Rubber	908-1020	AR	908-1020	AR	908-1020	AR
21	Coupling, Hose	555 3632	1	555-3632	1	5553632	1
22	Elbow, 90					555-3631	3
23	Bracket, Terminal Block	220-1682	1	220-1682	1	220-1682	1
24	Terminal Block - End Section	551-0745	2	551-0745	2	551-0745	2
25	Terminal Block Sections	551-0744	15	551-0744	15	551-0744	15
	Following parts not illustrated:						
	Gasket, Door (12-1/2 long)	900-0398	2	900-0398	2	900-0398	2
	Gasket, Door (7-5/8" long)	900-0400	2	900-0400	2	900-0400	2
	Transformer, 100:5 (for 0-15, 0-30, and 0-75 ammeters)	551-0833	1	551-0833	1	551-0833	1
	Transformer, 150:5 (for 0-40 and 0-50 ammeters)	551-0834	1	551-0834	1	551-0834	
	Transformer, 200:5	551-0835	1	551-0835	1	551-0835	1

AR = As Required

PARTS LIST INDEX

Remote Control Panel

AMMETERS
(All meters fit standard control panel mounting hole)

IF POWER SOURCE IS:
3o, 60 Hz, 208/230/460 VAC
3o, 50 Hz, 208/220/380 VAC
3o, 50 Hz, 230/460 VAC

AND MOTOR H.P. IS:	SELECT METER WITH THIS METER RANGE	BY ORDER/NO THIS PART NO.
5 H.P.	0-20 AMPS	551-0844
7-1/2 H.P.	0-30 AMPS	551-0845
10 H.P.	0-40 AMPS	551-0846
15 H.P.	0-50 AMPS	551-0724
20 H.P.	0-75 AMPS	551-0847
25 H.P.	0-75 AMPS	551-0847
30 H.P.	0-100 AMPS	551-0728

If POWER SOURCE IS:
3o, 50 Hz, 380 VAC

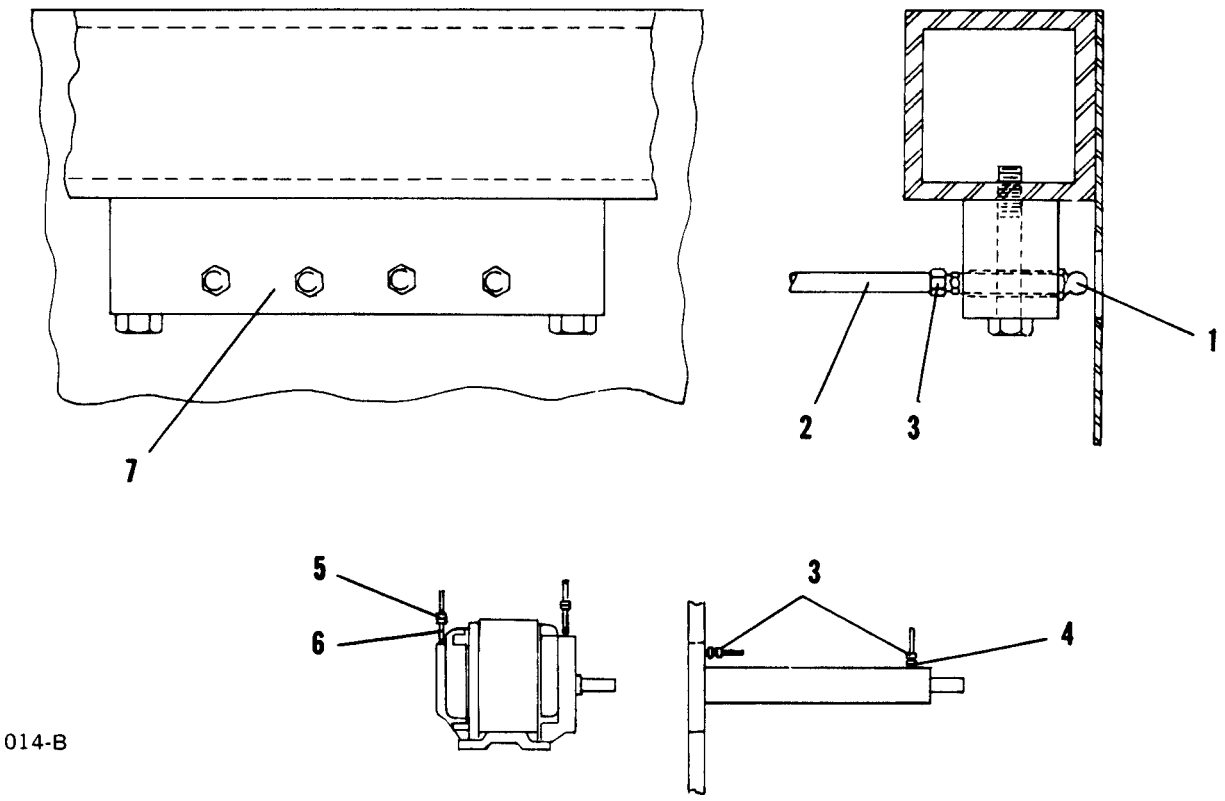
AND MOTOR H.P. IS:	SELECT METER WITH THIS METER RANGE	BY ORDERING THIS PART NO
5 H.P.	0-10 AMPS	551-0842
7-1/2 H.P.	0-15 AMPS	551-0843
10 H.P.	0-20 AMPS	551-0844
15 H.P.	0-30 AMPS	551-0845
20 H.P.	0-40 AMPS	551-0846
25 H.P.	0-40 AMPS	551-0846
30 H.P.	0-50 AMPS	551-0724

IF POWER SOURCE IS:
3o, 60 Hz, 550/575 VAC

AND MOTOR H.P. IS:	SELECT METER WITH THIS METER RANGE	BY ORDERING THIS PART NO.
5 H.P.	0-10 AMPS	551-0842
7-1/2 H.P.	0-10 AMPS	551-0842
10 H.P	0-15 AMPS	551-0843
15 H.P.	0-20 AMPS	551-0844
20 H.P. .	0-30 AMPS	551-0845
25 H.P.	0-30 AMPS	551-0845
30 H.P.	0-40 AMPS	551-0846

PARTS LIST INDEX

Grease Station and Piping

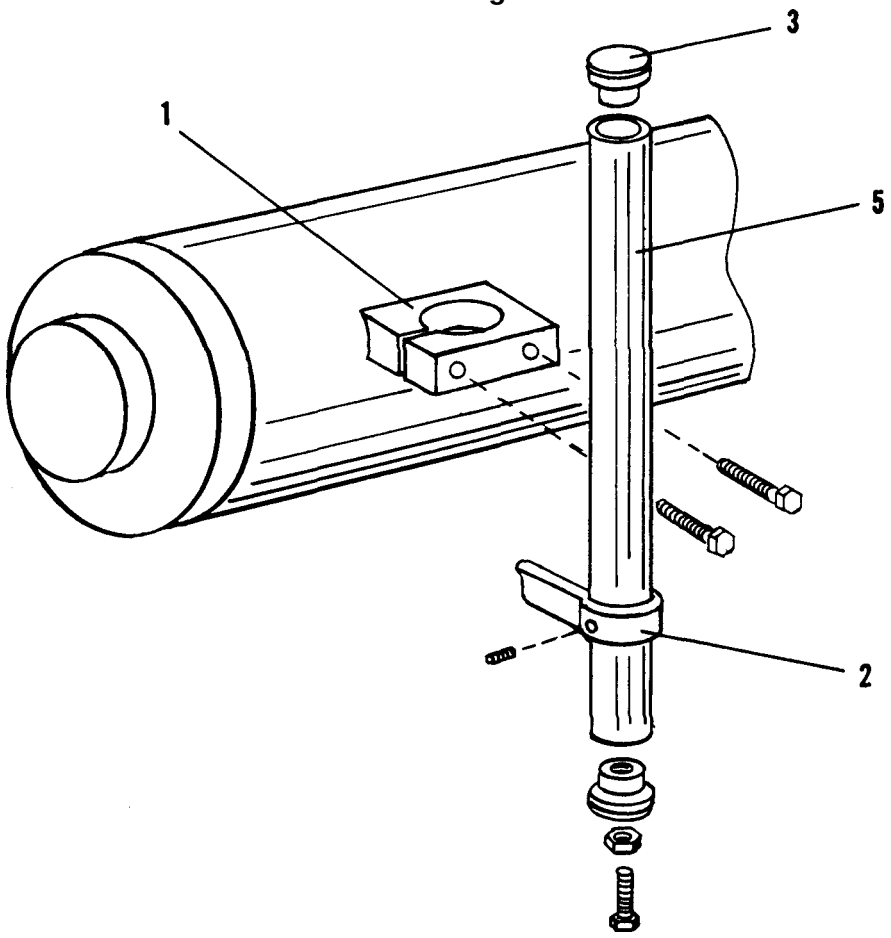


INDEX

NO.	DESCRIPTION	PART NO.	QTY.
1	Fitting, Grease - 1/8” 27 P.T. Straight	590-0154	4
2	Tubing, 1/4” Copper (Specify Length)	903-0045	_
3	Connector, 1/4” Tube x 1/8” M.P.T.	555-2607	6
4	Adapter	590-0432	2
5	Coupling, Female - 1/4” Tube x 1/8” N.P.T.	555-3046	2
6	Nipple, Brass - 1/8” N.P.T. x 1½” Lg.	555-1913	2
7	Header, Grease	300-1893	1

PARTS LIST INDEX

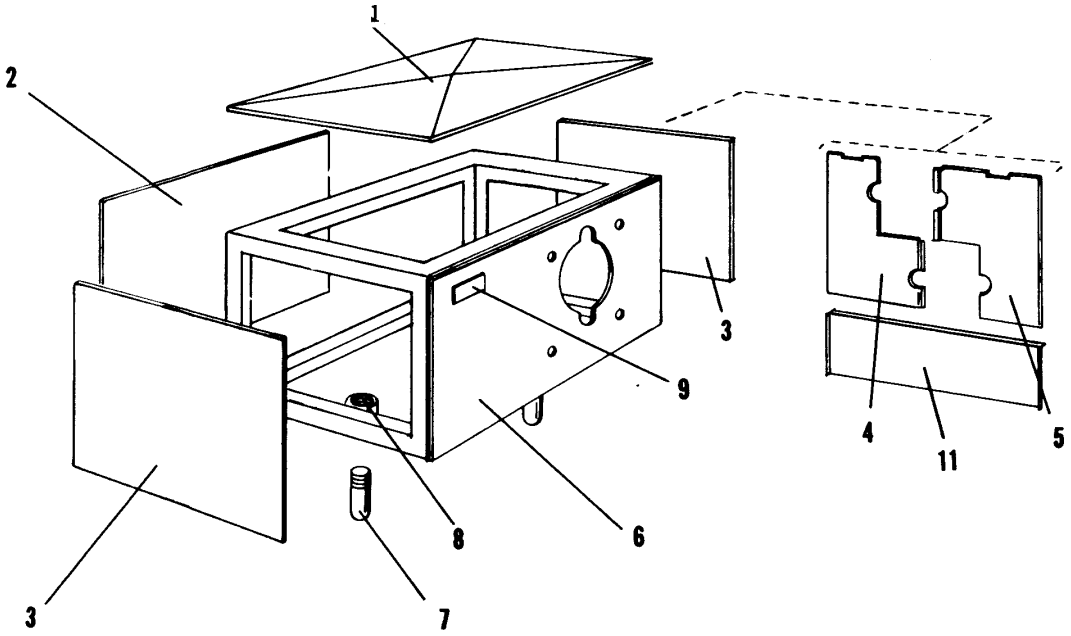
Outboard Legs



INDEX NO.	DESCRIPTION	STYLE H (STANDARD)		STYLE V (VERTICAL)		STYLE H (OVERSIZE)	
		PART NO.	QTY.	PART NO.	QTY.	PART NO.	QTY.
1	Bracket, Outboard Leg	44547	2	44547	2	44547	2
2	Tie Rod, Horizontal (Single Stack Only)	300-0080	1	300-0080	1	300-0080	1
3	Plug, Top-Bottom	300-5133	2	300-5133	2	300-5133	4
5	Leg, Outboard (Single Cabinet)	300-0329	2	300-0332	2	300-0333	2
5	Leg, Outboard (Two Cabinets Stacked)	300-0330	2			300-0334	2
5	Leg, Outboard (Three Cabinets Stacked)	300-0331	2			300-0335	2

PARTS LIST INDEX

Cabinets



016-B

INDEX NO.	DESCRIPTION	STYLE H (STANDARD) CABINET 46x22x32 STAINLESS STEEL PART NO.	QTY.	STYLE V (VERTICAL) CABINET 22x46x32 STAINLESS STEEL PART NO.	QTY.	STYLE H (OVERSIZE) CABINET 64x34x46 STAINLESS STEEL PART NO.	QTY.
1	Cover, Top	300-3246	1	300-3247	1	300-0106	1
2	Cover, Rear	300-3248	1	300-3249	1	300-0105	1
3	Cover, Side - Plain (Models L & S only)		300-3250	2	300-3251	2	300-0107 2
4	Cover, Left Side - Rear Half (Model DE only)	300-3255	1	300-3253	1	300-0109	1
5	Cover, Left Side - Front Half (Model DE only)	300-0037	1	300-3252	1	300-0108	1
6	Shroud, Front	300-3245	1	300-3245	1	300-0267	1
7	Legs, Cabinet	300-0038	2	300-0038	2	300-0038	4
8	Coupling, Cabinet Leg	675-2900	2	675-2900	2	675-2900	4
9	Nameplate*						
**10	Vert. Leg Coupling Cap			200-6100	2		
11	Cover - Side - Lower Bottom Half (Vert. Only) DE ONLY			300-3254	1		

*When ordering cabinet parts, be sure to include model and serial number as stamped on the units nameplate.
**Not Shown

ADDENDUM

ABOUT THIS ADDENDUM

This addendum attaches to the Thermutator manual # 5605-R87 and applies to Waukesha Cherry-Burrell Thermutators which utilize the six-inch plastic scraper blades.

At the back of this addendum is a parts page showing the mutator and blades.

DESCRIPTION

The scraper blades covered by this addendum are short compared to other scraper applications. Six inch long blades are mounted on the mutator in staggered rows, attached with specially designed pins, as shown in figure A-1.

The pins allow quick, easy removal of the scraper blades and ensure correct replacement. It is impossible to incorrectly mount a blade on the pins.

INSTALLATION

The Thermutator is shipped with the blades taped to the mutator. The mutator must be pulled out and the tape removed before the Thermutator may be used.

Removing the Mutator and Blades

1. Remove the product inlet/outlet assembly in accordance with the instructions provided in the Thermutator manual.

WARNING

Removing the mutator and blades requires two people. Do not attempt to accomplish it with only one person.

2. Lift up on the front of the mutator and slide the factory supplied mutator removal trough (shaped like a half-cylinder) into the tube under the mutator and blades.

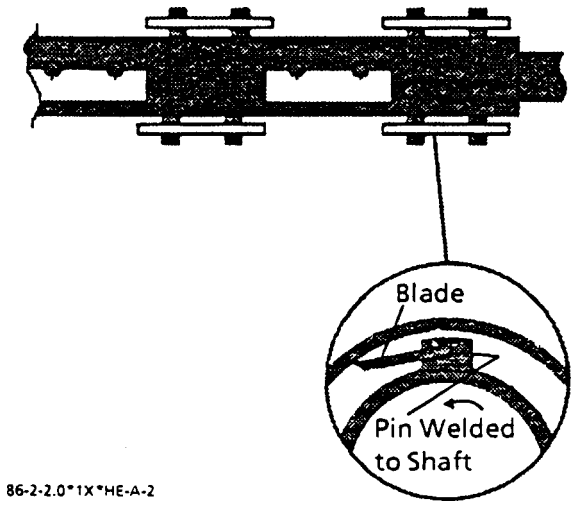


Figure A-1. Scraper Blade Positioning

CAUTION

Never remove or replace the mutator without the mutator removal trough. The trough is designed to protect the tube walls. Removing or replacing the mutator without it can cause gouging and pitting to the tube, reducing its effectiveness.

3. Pull the mutator out from the Thermutator until the first set of blades are fully exposed.

NOTE

It is important that the blades are marked for replacement as explained later in this addendum. Returning the blades to their original position enhances blade life and reduces the likelihood of damaging the cylinder(s).

4. The blades are taped to the mutator at the factory to prevent damage during shipping. Peel the tape off the mutator and blades, removing the blades from the mutator as they are released from the tape.

5. Carefully clean the mutator and blades, ensuring that any residue left by the tape is removed.

Reinstalling the Mutator and Blades

Once the mutator and blades have been thoroughly cleaned, they can be reinstalled in the Thermutator as follows:

1. Insert the mutator removal trough into the Thermutator cylinder.

2. Place the drive end of the mutator on the end of the trough.

3. Place the first pair of blades on the mutator. Refer to figure A-2. This is done by inserting the blade into the pins at a 45-degree angle (1) and then pushing the blade edge towards the mutator (2). Hold the blades in place while pushing the mutator into the cylinder.

4. Continue adding blades to the mutator and pushing the mutator and blades into the cylinder until the last of the blades cleared the end of the cylinder.

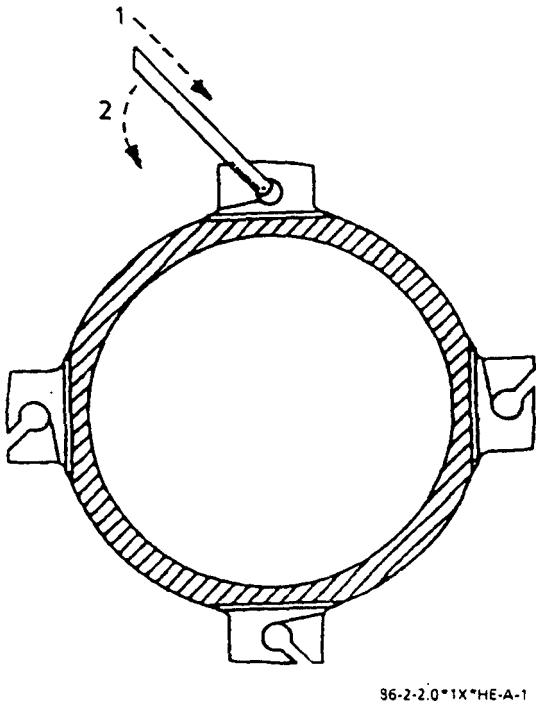


Figure A-2. Scraper Blade Mounting

5. Push the mutator into the cylinder until the mutator spline slips into the drive coupling. Continue pushing the mutator, while turning slightly, until the spline fully seats in the drive coupling.

6. Install the front product inlet/outlet assembly in accordance with the instructions contained in the Thermutator manual.

ADDENDUM

MAINTENANCE

Scraper Blade Wear

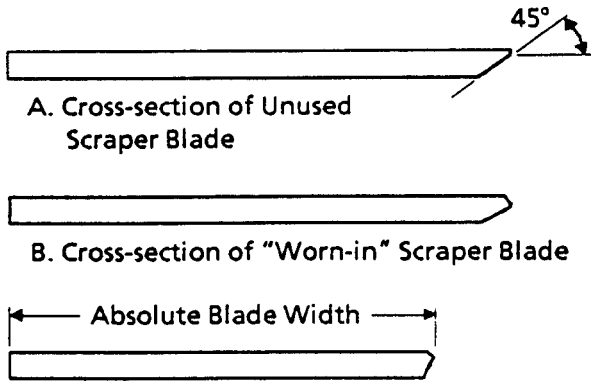
As the blades scrape across the interior of the Thermutator cylinder, they wear into the contour of the cylinder. After a little use a flat surface called a heel, forms on the contact area of the blades.

The heel forms unevenly across the length of the blade. This is due to slight irregularities in the surface of the cylinder walls. After a short period of time, the heel runs evenly across the length of the blade. When this happens, the blade is said to be "worn-in" to the tube.

Maximum scraping efficiency is realized when the blades are "worn-in". For that reason, blades should always be marked and kept in the same cylinder, on the same mutator, in the same position. As time goes on, the blades continue to wear on the heel of the blade.

NOTE

Do not resharpen blades, but replace them. When the blade wears down to 1-3/4"' replace it.



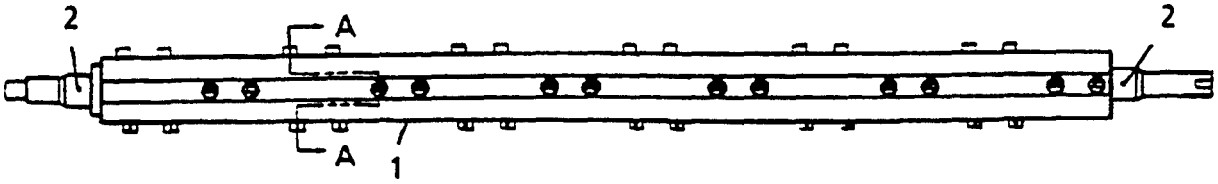
MINIMUM BLADE WIDTH

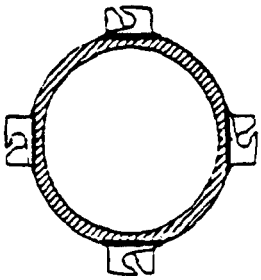
TYPE	ORIGINAL WIDTH	MINIMUM WIDTH
Plastic	2 Inches	1-3/4 Inches

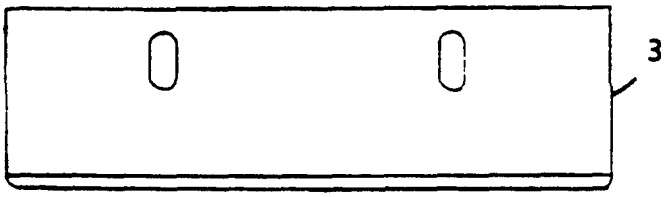
86-2-2.0"1x"HE-A-3

Figure A-3. Scraper Blade

ADDENDUM







No.	Part No.	Qty.	Description
1	704-1275	1	Mutator With Pins
2	959-0127	2	Pin
3	300-7913	24	Blade - Ultem - EC1006

March 28, 2008

You probably recognize that your Votator® and Thermutator® Heat Exchangers are valuable elements of your production facility. Day in and day out, they continuously and efficiently heat and cool products that often cannot be handled in any other equipment. You may not be aware that these units are considered pressure vessels under the ASME Code, and that SPX Process Equipment is the only facility authorized to make OEM repairs to the removable tubes that maintain their ASME Code certification. This certification is your assurance that the equipment meets its original design pressure rating.

The removable tubes are wear parts, and must be replaced when they lose too much metal. Their inner surface is scraped by rotating blades and is potentially exposed to corrosive or abrasive products or cleaners. In some cases chrome plating is applied to resist mechanical wear, but it eventually wears away or the tubes become damaged or scored and lose performance. SPX Process Equipment can inspect the tubes against the original drawings and determine whether they can be honed to restore a smooth inner surface, while keeping enough tube wall thickness to satisfy the ASME Code design calculations. Removable tubes that are worn beyond repair are condemned by our facility for your protection.

A breach in the removable tube that occurs during operation could be an extremely costly and hazardous event. In a recent incident, a removable tube was honed by an unauthorized machine shop that removed too much metal. The extremely thin tube wall flexed under the pressure of the product and the scraping blade edge, until one blade penetrated and tore a hole in the tube. Consequences of this kind of failure can include: contamination of product - with a damaging recall; circulation of product throughout a media system like a refrigeration compressor installation; and/or release of a hazardous substance like ammonia refrigerant inside your facility! Even if these are not high risks in your application, your production line will be down or operating at reduced capacity for some time until a replacement tube can be obtained.

Having your tubes professionally repaired by SPX Process Equipment just makes sense, but there are other potential benefits as well. Maintaining ASME certification keeps you in compliance with state and local regulations, depending on the location of your facility. It is also a requirement of most business insurance carriers, so you are helping to protect your company against potential fines and uninsured losses. With stakes this high, tube repair by SPX Process Equipment is the smart bet.

Waukesha Cherry-Burrell

SPX PROCESS EQUIPMENT
611 SUGAR CREEK ROAD
DELAVAN, WI 53115
UNITED STATES

TEL | 262 | 728 | 1900
FAX | 262 | 728 | 4904

www.spxpe.com

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