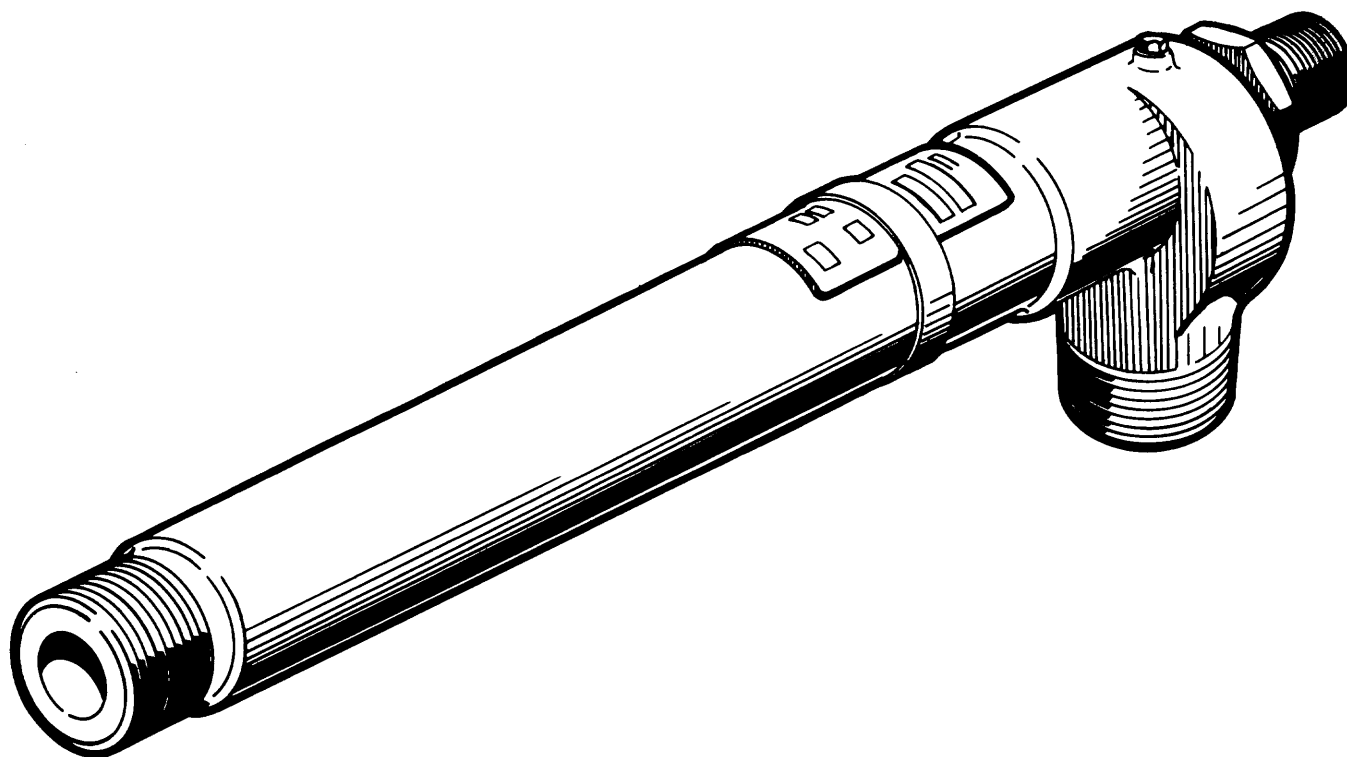


PENBERTHY®

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● Jet Pumps

Models U, L & 2NC



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Installation / Operation / Maintenance Instructions

PENBERTHY

INSTALLATION / OPERATION / MAINTENANCE FOR JET PUMP MODELS U, L & 2NC

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow *any* instruction could result in a malfunction of the jet pump with subsequent sudden release of pressure, property damage, or physical injury to personnel.

CAUTION

Penberthy does not have control over the manner in which its jet pump is handled, installed, or used, and Penberthy cannot and does not warrant or guarantee that a jet pump is suitable or compatible with the user's specific application.

WARNING

Safety glasses should be worn when in the area of a jet pump during its installation or operation.

I. INTRODUCTION:

A. Features and Specifications

Penberthy steam operated jet pumps models U and L are single stage ejectors designed for exhausting and evacuating applications using steam as the operating medium in the range of 80 to 200 psig.

The model U operates most efficiently in a vacuum range of 6 to 12 inches HG. ABS. The model L operates most efficiently in a range of 3 to 6 inches HG. ABS.

Penberthy steam operated jet pump model 2NC is a two stage non-condensing ejector designed for exhausting and evacuating applications using steam as the operating medium in the range of 100 to 200 PSIG.

The model 2NC operates most efficiently in a vacuum range of .5 to 3 inches HG. ABS.

B. Design Ratings PSIG at Maximum and Minimum Operating Temperatures.

Iron Bodies	Stainless Steel Bodies
80 PSIG at -20°F to +150°F	200 PSIG at -150°F to +150°F
50 PSIG at +350°F	125 PSIG at +400°F

To determine the maximum allowable working pressure for a specific temperature within the design limits stated above, the user should refer to Penberthy dimension sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

C. Application Data

Penberthy models U and L are single stage steam operated jet pumps for exhausting or evacuating applications with the model U operating at a higher vacuum

range than the model L. The model 2NC is a two stage non-condensing ejector with a vacuum range lower than that of the model L jet pump.

Note: For specific application data within the above ranges, the user should consult the Penberthy product proposal for the specific model and size jet pump, or should request Penberthy to supply the applicable technical data bulletin.

WARNING

Under no circumstances should these design ratings or application data be exceeded. Exceeding design ratings or application data may cause property damage or physical injury to personnel.

II. INSPECTION AND PERFORMANCE CONFIRMATION:

A. Receiving Inspection

Upon receipt of jet pump, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

B. User's Rating Inspection

The user should confirm:

1. That the jet pump size, model, part number and motive pressure rating stamped on nameplate (163) conforms to the description on the user's purchase order.
2. That the operating conditions described in the purchase order agree with the actual operating conditions at the installation site.
3. That the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above.
4. That the materials of construction of the jet pump are compatible with both the contained fluid and surrounding atmosphere in the specific application.

CAUTION

If the size, model or performance data of the jet pump as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for direction on what to do.

III. INSTALLATION:

Installation should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model jet pump.

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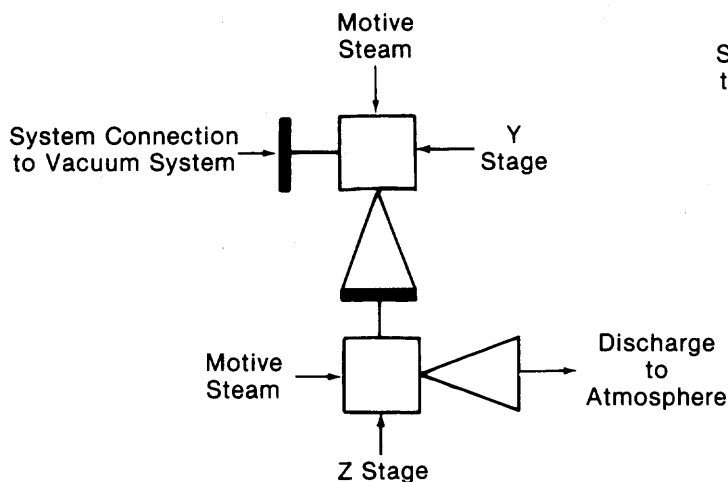


Figure 1

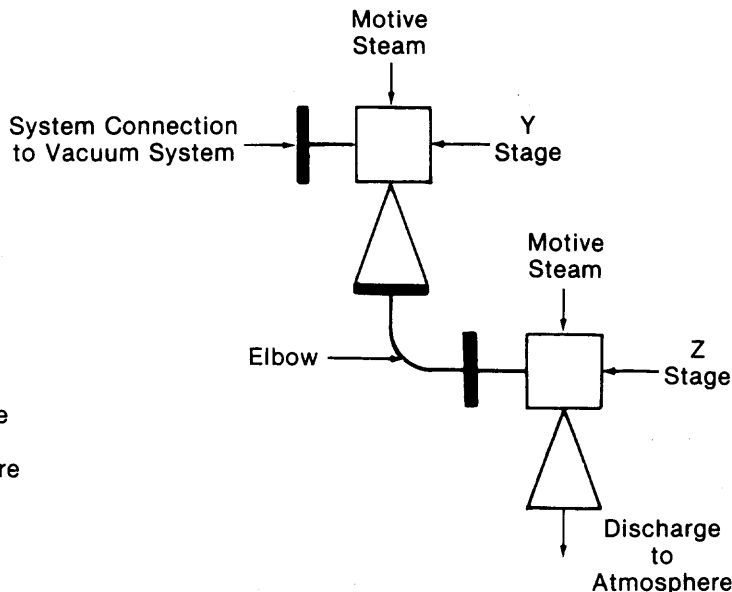


Figure 2

steam inlet, suction, and discharge connections to insure proper hook up.

A. Effect of Related Piping and Precautions

1. Penberthy model U and L jet pumps can be installed and operated in any position.
2. Penberthy model 2NC pumps must be installed in correct sequence in accord with outline drawings furnished with the jet pump. Two stage jet pumps may be assembled directly with the Y stage connected to the Z stage as shown above in Figure 1, or an elbow may be located between the Y stage discharge and the Z stage inlet as shown in Figure 2.

CAUTION

It is very important that model 2NC two stage ejectors be assembled in the required sequence as noted above. First stage ejector suction connection is to be connected to the vacuum system and discharge into the second stage suction connection. Second stage discharge to atmospheric pressure.

3. Steam must be dry and saturated at not less than the specified motive steam pressure. Motive steam pressure is defined as that pressure at the ejector-steam-inlet connection as measured with a recently calibrated, good quality steam gage. A small amount of super-heat, 5 to 10° is preferred. Steam separators and small super-heaters are recommended as a cure for wet steam.
4. It is recommended that all single stage ejector models smaller than L-10H or U-10H and all two stage ejectors have a strainer installed in the steam line to prevent dirt and scale from collecting in the steam line flow to the nozzle where it can build up and block the nozzle causing a malfunction of the ejector.
5. Recommended minimum motive steam line sizes to the ejector are shown in the table Fig. 3 below. These sizes are based on a pressure drop of 2% per 100 ft. of pipe.

Standard ejector steam connections may not be identical with the steam line size selected, or shown in Figure 3 below. Correct bushings to suit the selected pipe size are not supplied by Penberthy and must be furnished by the user.

RECOMMENDED MINIMUM MOTIVE STEAM LINE SIZES

Model Number	Line Size (in.)	Model Number	Line Size (in.)
L-1H, U-1H	½	2NC1H, 2NC2H	¾
L-2H, L-3H, U-2H, U-3H	¾	2NC3H, 2NC4H	1
L-4H, L-5H, U-4H, U-5H	1	2NC5H, 2NC6H, 2NC7H	1¼
L-6H, L-7H, L-8H, U-6H, U-7H, U-8H	1¼	2NC8H, 2NC9H	1½
L-9H, L-10H, L-11H, U-9H, U-10H, U-11H	1½	2NC10H, 2NC11H, 2NC12H, 2NC13H	2
L-12H, L-13H, L-14H, U-12H, U-13H, U-14H	2	2NC14H, 2NC15H	2½
L-15H, L-16H, U-15H, U-16H,	2½	2NC16H	3

Figure 3

All motive steam piping should be insulated and liquid removed through traps in accord with good practice.

6. Steam valves should be installed at each ejector stage with pressure-tap openings for attachment of pressure gages when required. Pressure readings must be between the valve and the steam inlet.

7. Discharge piping must permit free flow of exhaust vapors to prevent back pressure from exceeding 32 in. hg. absolute and the ejector discharge connection and design flow conditions.



WARNING



Ejector exhaust must be piped to atmosphere in a safe place due to the nature of the gases being pumped. If exhaust is not properly piped to a safe place, it could cause property damage or physical injury to personnel.

Discharge silencers can be applied by the user when desired and when properly sized for pressure drop. If ejectors are discharged vertically upward to atmosphere, a discharge trap as shown in Figure 4 below should be provided.

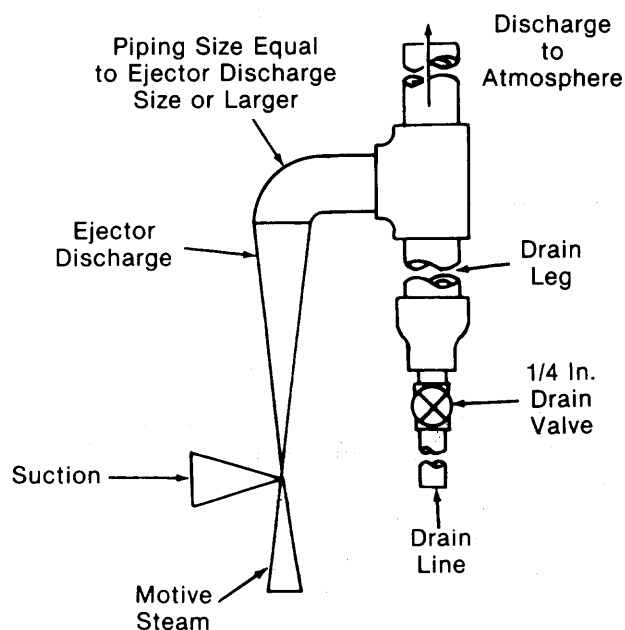


Figure 4

Intermediate ejector-stage-discharge piping must be as short as possible and limited to not more than one 90° bend. Other arrangements are possible, but are not recommended without factory approval of the proposed arrangement to evaluate pressure loss.

8. Care must be taken to insure leak-tight ejector suction piping connections. Ejector can be connected directly to the system from which gases and vapors are being pumped, however, it is recommended that an isolating valve be provided between the ejector suction connection and the system. Operating problems on new processes will be easier to diagnose and ejector performance will be more easily checked if an isolating valve is installed. Leak-tite gate or butterfly valves are most suitable for this application.

9. Eliminate or adequately drain possible points

of condensate collection to prevent freezing.

10. Insulate all steam lines.

11. Do not impose system piping stresses upon the ejector.

12. Allow clearance for removal of ejector.

IV. OPERATION:

A. Pre-Operational Check

1. Assure that all installation procedures have been completed.
2. Check to determine that all connections are pressure tight.

B. Hydrostatic or Vacuum Test

1. Take all precautions necessary to handle the possibility of leakage during the test.
2. Hydrostatic pressure test to 100 psig or vacuum test and correct any leakage before proceeding.

C. Operating

Note: Steam-jet ejectors are devices using the energy of the high velocity steam jet as it is reduced in pressure from steam-inlet pressure and expanded to suction pressure to entrain and compress suction gases and vapors from their inlet-pressure condition to a discharge pressure that may be 10 or more times greater than suction-inlet pressure for each individual stage. Ejector stages are connected in series to increase total system-compression range and permit pumping gases and vapors from as low as .25 in. Hg. ABS pressure to atmospheric-discharge pressure.

1. Single Stage Ejectors

- a. The first step in placing a single stage Model U or L ejector into operation, is to apply steam at the design pressure to the nozzle.
- b. The second step is waiting a period of time to heat up and clear the steam lines and ejector of all condensate. At this time, the ejector should meet its guaranteed performance.

2. Two Stage Ejectors

- a. The first step in the start up of the two stage model 2NC ejector system, particularly for evacuation service, that is, reducing the pressure within a closed space to some predetermined value, is to place the Z stage in operation by admitting design pressure steam to the Z stage steam inlet.
- b. The second step is to admit design steam pressure to the Y stage steam inlet after the vacuum system pressure has been reduced to 10 to 8 inches of mercury absolute.
- c. After a period of operation sufficiently long to heat up and clear the steam lines and ejectors of all condensate, the ejector system should meet its guaranteed performance.

V. MAINTENANCE:

Maintenance should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

CAUTION

Do not proceed with any maintenance unless the jet pump has been relieved of all pressure or vacuum has been allowed to reach ambient temperature, and has been drained or purged of all fluids.

A. Preventative Maintenance

The user must create maintenance schedules, safety manuals and inspection details for each specific installation of a jet pump.

On all installations, the following items should be regularly evaluated by the user for purposes of maintenance.

1. Jet pump, for corrosion or debris build up.
2. Piping and fittings, for corrosion or debris build up.
3. All connections for tightness.
4. Units for wear.
5. Strainers, for debris build up.

The user must determine upon evaluation of his or her own operating experience, an appropriate maintenance schedule necessary for his or her specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

B. System Shut-Down

WARNING

Safety procedures must be taken if hazardous gases are being discharged from the Z stage ejector, or they may cause property damage or injury to personnel.

Shut down of model 2NC ejector systems may follow the start up procedure in reverse or both stages may be shut down simultaneously.

When a system is shut down and the pressure in the vacuum system is still below atmospheric pressure, air will rush back into the process vacuum system. Since this action may create a harmful result to the product or may create a hazardous or explosive condition, it is recommended that the customer assess this problem prior to unit installation to protect against the event of such occurrences. Installing a manual shut-off valve in the suction line as close to the ejector as possible will help prevent such an occurrence.

Another method of preventing the back flow of air into the vacuum system is to break the system vacuum by admitting inert gas into the vacuum vessel.

C. Troubleshooting

Problem

Wet steam.

Cause

Steam temperature not high enough.

Cure

Drain steam inlet lines and install a steam separator in the line or add a steam superheater to raise steam temperature to about 10°F above saturation

temperature for particularly critical low flow units.

Problem

Jet pump not performing up to capacity.

Cause

Low steam pressure.

Cure

Check steam pressure with a recently calibrated steam-pressure gage. If steam pressure cannot be increased, contact an authorized Penberthy distributor for direction on what to do.

Cause

Motive steam nozzle becomes plugged.

Cure

Clean out and install a strainer in the motive steam line.

Cause

Air leakage into vacuum system.

Cure

Hydrostatic and vacuum test unit to locate leaks.

Cause

Superheated steam.

Cure

Contact an authorized Penberthy representative for direction on what to do.

D. Removal — Disassembly — Reassembly

CAUTION

Do not proceed with the removal of jet pump from connecting piping unless the jet pump has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids.

To disassemble the unit, first attach a short piece of pipe to the suction connection as a handle. Then grip the nozzle flats and rotate in a counterclockwise direction.

When ready to reassemble the unit, be sure the seal face of the nozzle and body are free of foreign material and raised metal due to nicks. A non-hardening pipe seal compound may be applied to the threads to further promote sealing. Thread the body back on to the nozzle turning in a clockwise direction.

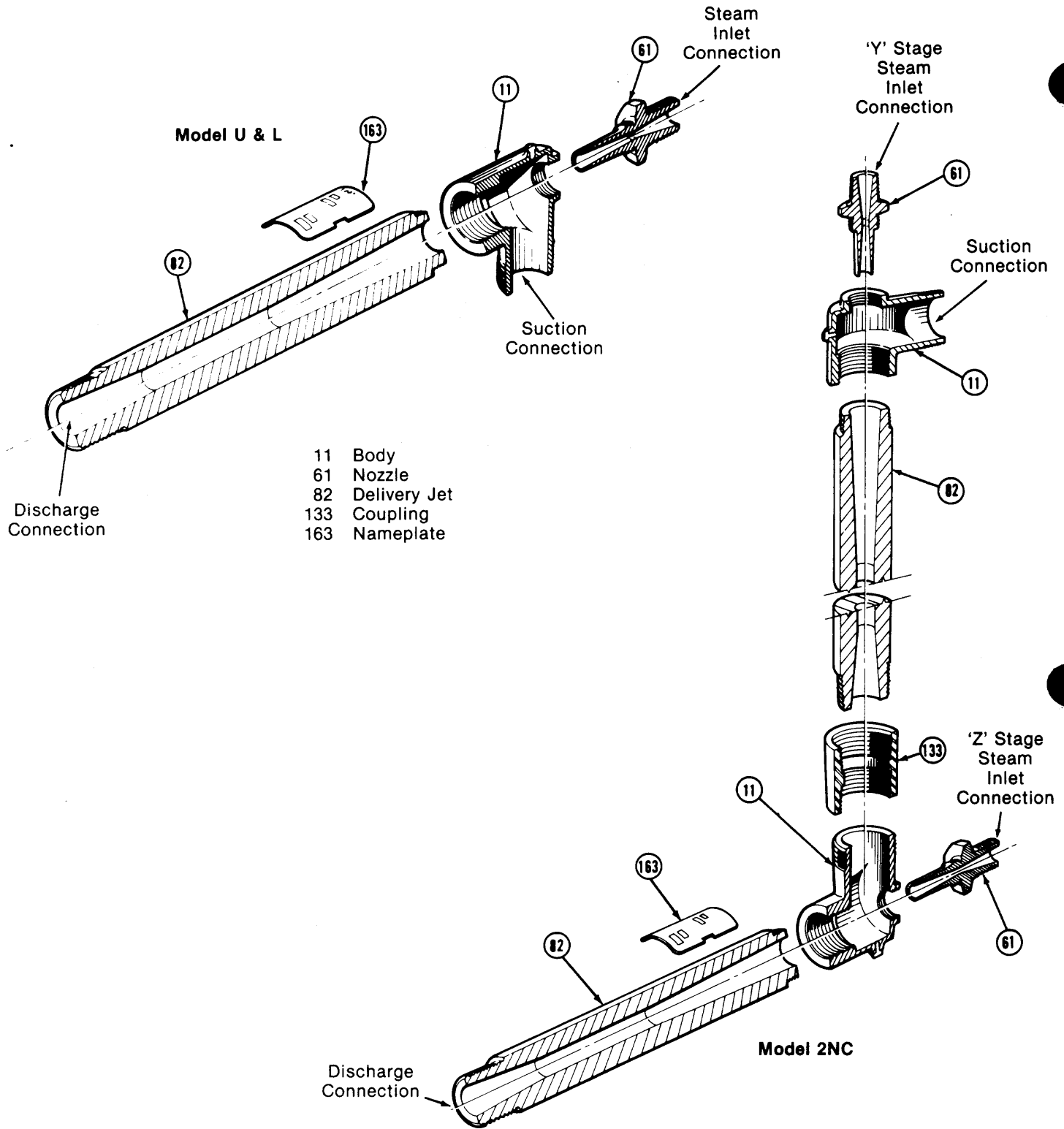


Figure 5

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