# GLANDS

Figures 1 and 2 show the type of glands used to prevent steam leakage at the points where the rotor shaft passes through the cylinder. Each gland consists essentially of an impeller pump and suitable labyrinth seals. The principal parts are:- the runner "20", the outer case "4" and "22" and the inner case "12" and "25". Both sections of the case are split horizontally to facilitate dismantling and assembling. The construction is shown in the Figure. It should be noted that the outer case is bolted rigidly to the bearing housing and is connected to the cylinder by means of a flexible diaphragm "7". The gland is thus supported on a comparatively cool housing and the diaphragm joining it to the hot cylinder wall avoids serious distortion caused by the large temperature gradient.

The shims "1" which are placed in the joint between the gland case and the bearing pedestal oil ring provide a convenient means of adjusting the axial position of the case. By varying the thickness of these shims, the case "4" can be set to give the desired clearance on each side of the runner "20".

Each runner consists of four segments which are secured on the rotating sleeve "15" by interlocking shoulders and the restraining rings "19". These restraining rings are installed with a light drive fit and further secured by peening the edge of the runner over the ring. The sleeve "15" is bolted against a shoulder, on the rotor shaft. It is centered by a spigot fit adjacent to the bolting face and is clear of the shaft at all other points. One surface of the fit is scraped to eliminate leakage between the sleeve and the shaft.

This type of gland is designed to have a continuous circulation of water through the runner cavity. As shown in Figure 1, the gland case liner "3" separates the runner cavity from the annular chambers "X" and "Y". The water passes through this liner by means of a series of small holes. This construction distributes the water supply around the entire periphery of the runner and eliminates any undesirable turbulent effect which may tend to break the seal. To further eliminate turbulence in the water, the holes for water passage which would be directly in line with the inlet pipe are omitted. The inlet water first enters the annular chamber "X" and passes through the small holes into the runner cavity. Then it passes through another series of small holes into the annular chamber "Y", from which it is discharged. With water thus supplied at its periphery, the pumping action of the runner maintains in the runner cavity a solid annulus of water which effectively seals the gland against leakage.

The liner "3" protects the main gland case against any erosive or corrosive action of the water in the runner cavity. It is made in halves and fits in grooves as shown. In addition, each half is secured by four cap screws at the horizontal joint. Hence if the liner should become eroded or corroded, it can be renewed without difficulty, thus restoring the gland case to its original conditions.

Labyrinth seal strips (items "18" and "21") are provided on both sides of the runner to reduce the water leakage to a minimum. An auxiliary drain is provided just inside the two outer strips which eliminates all leakage outward along the shaft. On the inner side of the runner, the diaphragm flange (items "17" and "24") forms a water catcher which minimizes the leakage of water inward toward the hot parts of the shaft. A drain from the cavity formed by this water catcher is connected directly to the leak-off pipe. Part of the labyrinth seal strips are carried in the rotating sleeve "15" and part in the gland case, as shown in the Figure. They are all of the same type, consisting of very thin flat strips and are held in place by

soft steel caulking strips which are rolled into the grooves. All of these labyrinth seals should have a close running clearance, as shown on the "Spindle Clearance Drawing". The slop drain at the bottom of the cavity between the seal strips "21" and the Bearing Pedestal Oil Seal Ring is provided to carry off any leakage of either water from the gland or oil from the bearing.

The inner case consisting of items "12" and "25" is bolted to the cylinder by the screws "11". It carries a series of labyrinth seals of the same type as described above. In order to prevent any vapor, which may pass the labyrinth strips "18", from coming in contact with the hot rotor, live steam is introduced into the center of the inner gland labyrinth seals, at sufficient pressure to assure some flow of steam toward the runner. Suitable connections are provided in either the cylinder base, the cylinder cover, or both base and cover, to which the live steam line can be connected.

Two leakoff openings, (one on each side) which connect with external drains, are provided to carry off the steam which leaks past the inner labyrinth, and any water which may accumulate in this chamber. These openings should be connected to a zone of lower pressure as determined by the particular operating conditions, and the piping arranged with drains where necessary.

Condensate should be used as the sealing medium so that the leakage can be returned to the system and also to eliminate scale deposits in the gland which would impair the seal. The supply should be maintained at the proper pressure by either an overhead tank or a relief valve.

The water pressure required to seal the gland properly depends largely on the actual pressure existing in the leakoff chamber. If this pressure is below atmospheric, the water supply pressure should be maintained at approximately 5 pounds gauge at the turbine centerline. If the leakoff chamber pressure is above atmospheric, the water supply pressure should be increased (above 5 pounds) one pound for every pound above atmospheric, which the manufacturer approves carrying in the leakoff chamber. For example, if the approved leakoff chamber pressure is 5 pounds gauge, the water supply pressure should be approximately 10 pounds gauge.

A special arrangement is provided by means of which the gland can be sealed with the turbine at rest for testing the system with air or water. This consists of a seal ring "23" (in halves) which is bolted to the gland case and clamps a rubber packing between the gland case and the shaft.

## Dismantling and Assembling

It should be noted that the diaphragm "7" and the two gaskets (item "6" and item "10") are made in complete rings. Therefore, these parts must be handled with the rotor when dismantling or assembling the unit. Due to its unusual construction the best method of dismantling and assembling this gland may not, at first, be apparent. The following procedure is recommended.

## Dismantling

1. Remove the tap bolts "2" and "5" in the vertical joints. Remove all bolts and nuts which hold the gland case horizontal joint. Remove the shims "1" and both upper and lower halves of the outer case.

In each gland case vertical flange, four of the bolt holes (two at the top and two at the bottom) are tapped for lifting eyes to facilitate the handling of these parts.

2. Remove the countersunk head screws which hold the water catcher "17" and "24" to the diaphragm. Allow the upper half "17" to rest on the shaft, taking care that it does not damage the seal strips.

3. Remove the flange ring "9" and lower the diaphragm until it rests on the shaft. (Protect the seal strips as much as possible). As this diaphragm is moved away from the cylinder, remove the water catcher "17" and "24".

The diaphragm "7", the gasket "6" and gasket "10" cannot be removed from the shaft until the rotor is lifted out of the cylinder.

4. Remove the round head cap screws "11" from the inner gland case (upper half) vertical joint. The cap screws in the lower half should then be loosened and the entire inner gland case should be backed off a slight amount by means of jacking screws. Care should be taken to prevent damage to the seal strips.

After the cylinder cover has been lifted the upper half of the inner gland case can be removed by removing the dowel stud nuts at the horizontal joint. The lower half of the inner gland case can be removed by rolling it around to the top of the shaft.

**Assembling**

1. It is important to note that the gaskets "6" and "10" and the diaphragm "7" must be hung on the rotor shaft before it is placed in the cylinder base.

2. Install the inner gland case halves in the cylinder base in their approximate location and make up the horizontal joint. After the cylinder cover is in place the inner gland case should be centered to the gland sleeve "15" to obtain equal clearances at the top, bottom and both sides. This clearance can be checked by measurements between the inner gland case counterpore and the gland sleeve water thrower tip. Install the round head cap screws "11" and make up the vertical joint.

3. Place the water catcher, parts "17" and "24", in their approximate locations and bolt the diaphragm to the cylinder making up the joint loosely. Bolt the water catcher to the diaphragm by means of the countersunk screws. Then bolt the diaphragm to the cylinder permanently, being careful to center it to the shaft so as to obtain equal clearances, between the water catcher and the seal strips, at the top, bottom and both sides. This should be done very carefully because the position of the water catcher serves also to center the outer gland case.

4. Install both halves of the outer gland case and the shims "1". Make up all joints finally.

It is possible to dismantle the entire gland, including the inner gland case, without lifting the cylinder cover. This can be done as follows:

1. Remove all outer gland parts, the bearing pedestal oil ring and the bearing.

2. Remove the complete circle of screws "11" and the gland sleeve screws "16".

3. Then pull the gland sleeve "15" and with it the inner case "12" and 25 outward toward the bearing pedestal until all parts clear.

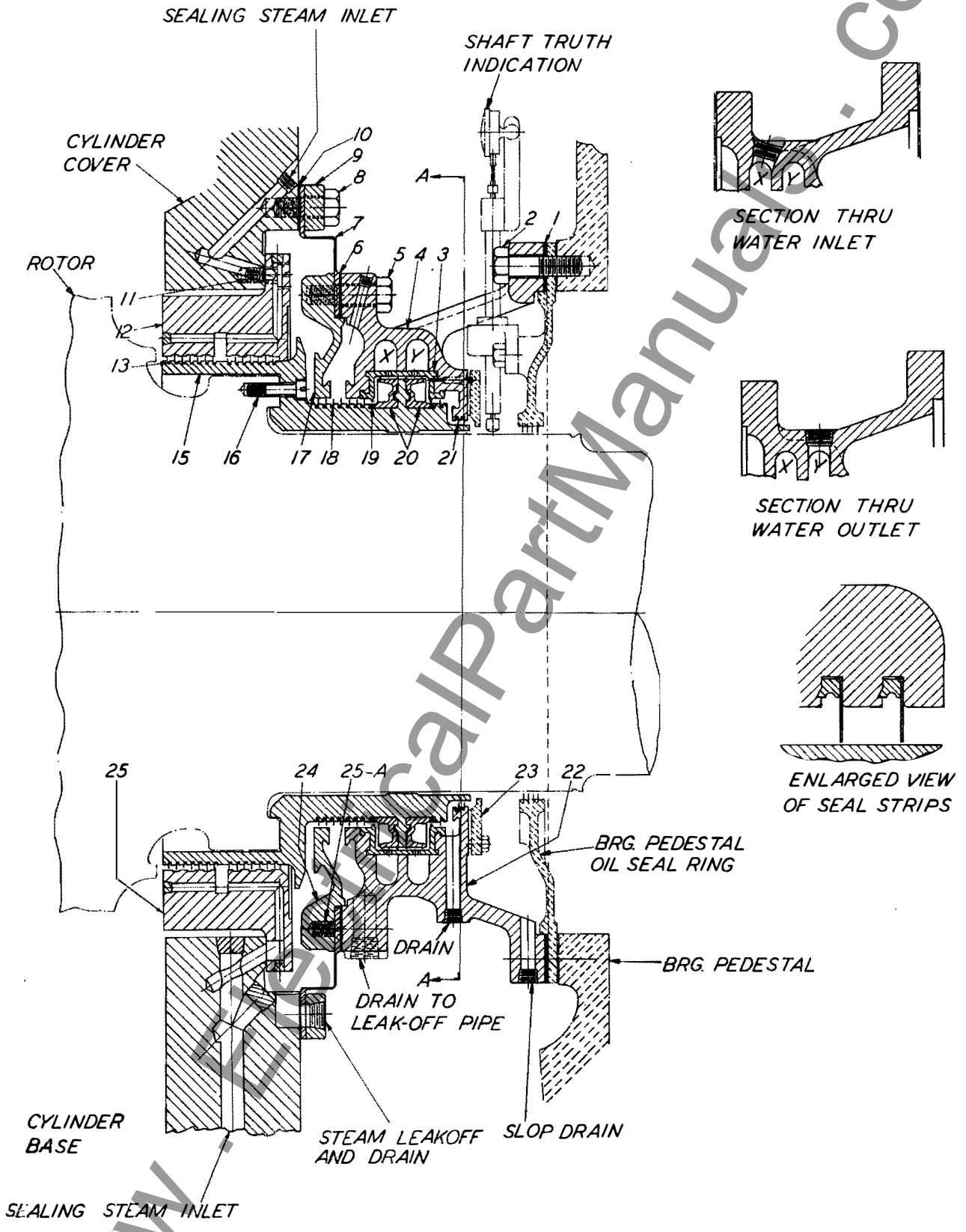


FIGURE 1

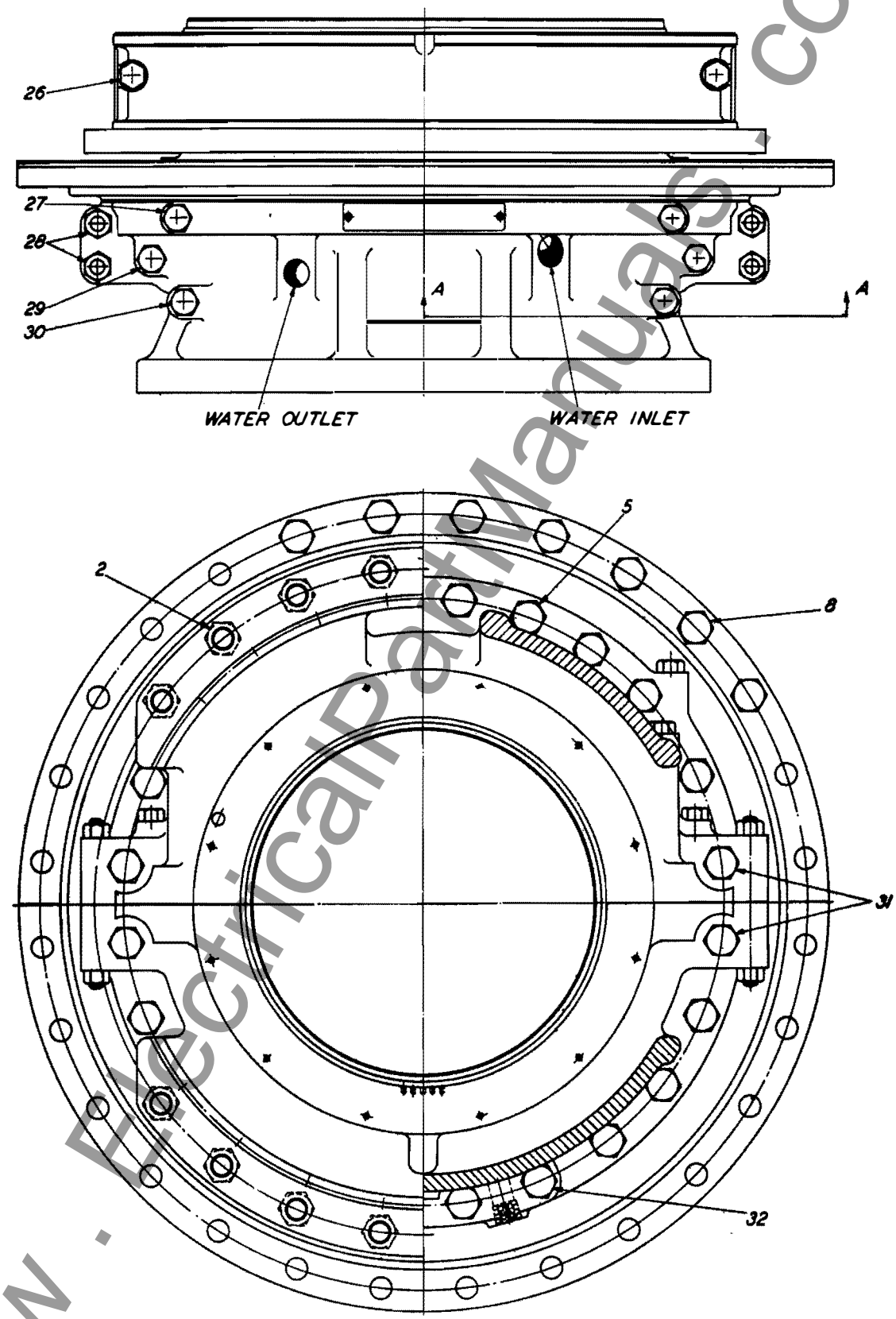


FIGURE 2

This work of pulling the sleeve off the shaft and re-installing it may be a difficult job especially after the machine has been in service for some time, and must be considered a major maintenance operation. It is believed that repair jobs on which this method would be justified are remote possibilities because the inner gland should require no attention except at regular inspection periods when the cylinder cover also would be lifted.

The following list has been compiled to facilitate ordering renewal parts by item number and name together with the serial number of the turbine.

Figure 1

| Item No. | Name |
|---|---|
| 1 | Gland Case Shims |
| 2 | Gland Case Tap Bolt (To Bearing Housing) |
| 3 | Gland Case Liner (In Halves) |
| 4 | Gland Case (outer) (upper half) |
| 5 | Gland Case Diaphragm Tap Bolt (To Gland Case) |
| 6 | Gland Case Diaphragm Gasket 1/16 inch thick |
| 7 | Gland Case Diaphragm |
| 8 | Gland Case Diaphragm Tap Bolt (To Cylinder) |
| 9 | Gland Case Diaphragm Outer Flange (In Halves) |
| 10 | Gland Case Diaphragm Flange Gasket - 1/16 inch thick |
| 11 | Inner Gland Case Screw |
| 12 | Inner Gland Case (Upper Half) |
| 13 | Inner Gland Case Seal Strips |
| 15 | Gland Sleeve |
| 16 | Gland Sleeve Screw |
| 17 | Gland Case Diaphragm Inner Flange (Upper Half) |
| 18 | Gland Sleeve Seal Strips |
| 19 | Gland Runner Restraining Ring |
| 20 | Gland Runner |
| 21 | Gland Case Seal Strips |
| 22 | Gland Case (outer) (lower half) |
| 23 | Gland Case Seal Ring (for Testing) |
| 24 | Gland Case Diaphragm Inner Flange (Lower Half) |
| 25 | Inner Gland Case (Lower Half) |
| 25A | Gland Case Diaphragm Countersunk Head Screw |

Figure 2

| | |
|---|---|
| 26 | Inner Gland Case Dowel Stud and Extension Nut |
| 27 | Gland Case Tap Bolt (Horizontal Joint) |
| 28 | Gland Case Dowel Bolt (Horizontal Joint) |
| 29 | Gland Case Tap Bolt (Horizontal Joint) |
| 30 | Gland Case Tap Bolt (Horizontal Joint) |
| 31 | Gland Case Tap Bolt (Vertical Joint) |
| 32 | Gland Case Tap Bolt (Vertical Joint) |