INSTRUCTIONS FOR
INSTALLATION AND MAINTENANCE
of the
CONSOLIDATED MAXIFLOW SAFETY VALVE

Service Manual No. 8

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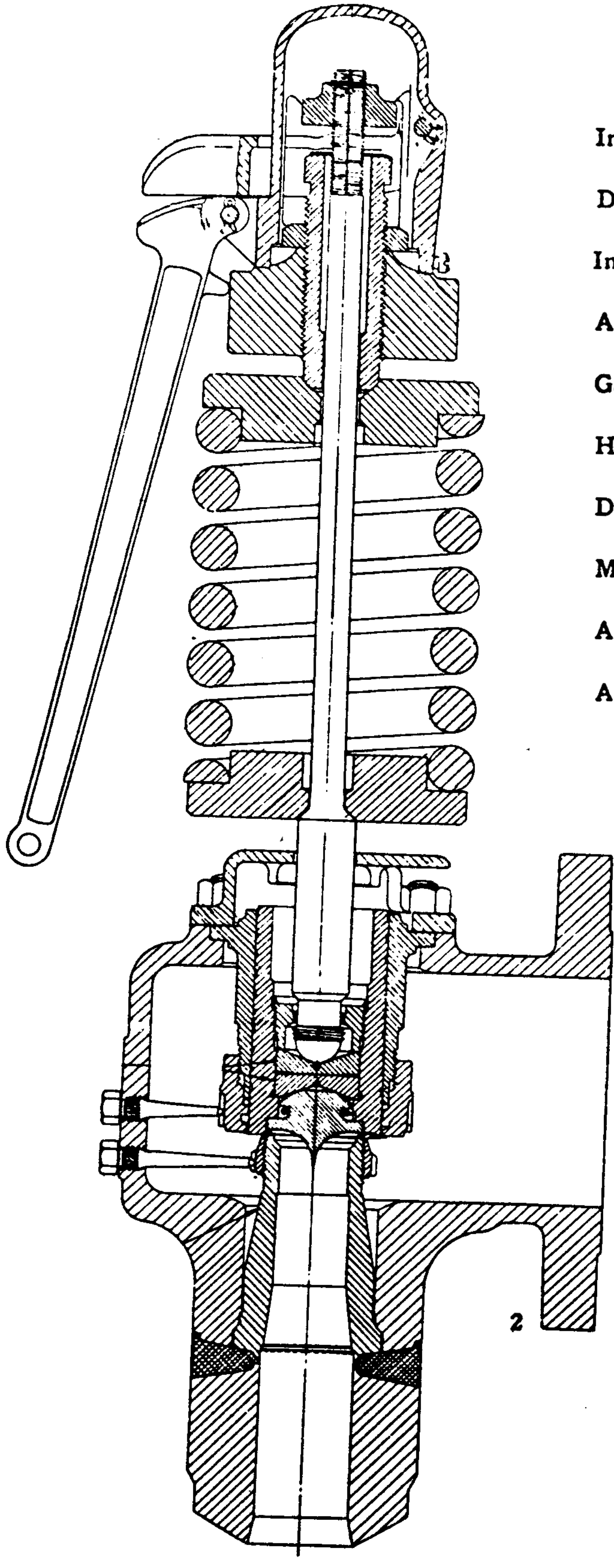
ALEXANDRIA LOUISIANA



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INTRODUCTION

In its improved design, the Consolidated Maxiflow Safety Valve represents the sum of experience gained on hundreds of field installations since 1950, at steam pressures as high as 5000 psi and temperatures up to 1150° F. The rapid increase in steam pressures and temperatures in the past few years has required both the selection of better materials and more rigid control of manufacturing practices. While the maintenance of precision equipment requires precision work, every effort has been made to provide a design which can readily be serviced in the field. Knowledge of the following design features will assist the Service Engineer in explaining the construction and advantages of the Maxiflow Safety Valve to those persons involved in its use and maintenance.

1. **Body and Neck Materials**

   All pressure retaining parts, except in reheat valves rated 900 psi and lower, are made of forged materials. Welded inlet valves have the three-piece weld construction; flanged inlet valves have a top-inserted, seal-welded bushing.

2. **Service Life**

   For most service conditions, pressure retaining parts and parts subject to mechanical stresses, such as valve necks, yoke rods, etc., are designed for a service life of 35 years, equivalent to that of the boiler and well in excess of the requirements of the Power Boiler Code. The use of ferritic materials in valves for high pressure, high temperature superheater service limits the designed service life under these conditions to the minimum specified by the Power Boiler Code.

3. **Thermal Compensation**

   The yoke rod design, together with the proper selection of yoke rod and spindle materials, renders the valve relatively free from changes in setting due to temperature variations. We do not recommend, "compensating" this valve for temperature by increasing the spring load after setting.

4. **Thermodisc**

   The thermodisc design, in providing for rapid equalization of temperature around the valve seat, produces a degree of tightness far above that offered by competitive valves. Better selection of materials and minor changes providing "thermal flexibility" rather than "mechanical flexibility" have reduced or eliminated inherent weakness. Thermodiscs are now giving excellent results at 5000 psi and 1150° F.

5. **Blowdown Adjustment**

   The blowdown adjustment is designed, and standard spring selections are made, to produce a blowdown in the three to four percent range under most service conditions. Factors such as long inlet necks, entrained water, and high back pressures tend to lengthen the blowdown actually obtained in the field. In cases where short blowdown is difficult to obtain due to such adverse field conditions, it may be possible to improve the valve performance by installing a spring having a slightly different deflection rate. However, this is a difficult and expensive process and should not be undertaken unless absolutely necessary.

DETAILED DESCRIPTION

Maxiflow Safety Valves are manufactured with two different internal designs, both of which are based on the same sound principles of transmitting the seat and roof loads along the true centerline of the valve. One design is more suitable for small sizes and is used in valves up to and including 3 inch inlet size. These valves are more commonly used for boiler drums and superheaters and will be referred to herein as **Boiler Safety Valves.** The other design is more suitable for larger sizes and is used in valves with 4 inch and 6 inch inlets. These valves are more commonly used on reheater service and will be referred to herein as **Reheater Safety Valves.** There is another valve design, used for supercritical pressures, which uses the same internal design as the Boiler Safety Valves. This Supercritical Valve is discussed in Appendix 1.

The above two types of internal construction are combined with bases with both welded and flanged inlets to form a complete line of Safety Valves to fit all applications. For any given orifice size, pressure rating, and temperature class, internal parts are interchangeable between flanged inlet and welded inlet bases.

Flanged Inlet Bases (Figures 7 and 8) are manufactured of carbon or alloy steel depending on service temperature. The seat bushing is made of forged austenitic Stainless Steel and extends down to a point below the center of the thickness of the inlet flange. The bushing is threaded into the base neck and seal welded at its lower end. The seal weld is radiographed and the base and bushing assembly is hydrostatically tested in accordance with ASA B 16.5. This construction conforms to Consolidated's practice of confining steam pressures above 900 psi by the use of forged, rather than cast, materials.

Welded Inlet Bases are divided into two general types, one (Fig. 9) used on all Boiler Safety Valves and on Reheater Safety Valves for service above

TABLE I — PARTS AND MATERIALS

PART	SATURATED	TO 750° F.	TO 900° F.	TO 1020° F.	TO 1060° F.	TO 1100° F.	TO 1120° F.
Body	Cast Carbon Steel A.S.T.M. A-216-WCA		Cast Alloy Steel A.S.T.M. A-217-WC6		Cast Alloy Steel A.S.T.M. A-217-WC9		Cast St. St. A.S.T.M. A-351-CF8M† (316)
Seat Bushing	Austenitic Stainless Steel					Austenitic St. Steel*	
Upper Adj. Ring	C. N. Alloy		Cast Chrome Stainless Steel				
Lower Adj. Ring	Cast Chrome Stainless Steel						
Adj. Ring Pins	Chrome Stainless Steel						
Disc	Hardenable Stainless Steel						Super Alloy
Disc Holder	C. N. Alloy		"S" Monel				
Thrust Buttons	Hardenable Stainless Steel						
Button Ret. Nut	Chrome Stainless Steel						
Disc Guide	C. N. Alloy		"S" Monel				
Spindle Head	Austenitic Stainless Steel, Stellited						
Yoke	Cast Carbon Steel						
Yoke Rods	Low Alloy Steel			High Alloy Steel			
Guide Ret. Plate	Cast Carbon Steel						
Spring	Carbon Steel			Alloy Steel Suitable for Pressure and Temperature Conditions			
Spring Washers	Steel						
Comp. Screw	Copper Nickel Alloy						
Lifting Gear	Malleable Iron						

*Integral with inlet neck on welded inlet valves.
†A-351-CF8C (347) Available on request.
NOTE: Materials for temperatures over 1120° F. on application.

900 psi; the other used on Reheater Safety Valves for service pressures up to 900 psi.

The design used on all Boiler Safety Valves and on Reheater Safety Valves above 900 psi consists of a cast base joined to an austenitic Stainless Steel bushing and a forged inlet neck by means of a three-piece weld. This weld is radiographed and the base and bushing assembly are hydrostatic tested in accordance with ASA B 16.5. The cast base and forged inlet neck are made of chemically identical materials to effect a better weld and provide adequate materials for each temperature class. Refer to Table I for material selections. This design, as in the case of Flanged Valves on page 4, uses only forged materials to contain steam pressure above 900 psi.

In the design used on Reheater Safety Valves for service up to 900 psi, the seat bushing is threaded into the cast base and seal welded at its lower end. This seal weld is radiographed. The bushing is made of forged or centrifugally cast austenitic stainless steel and the assembly is hydrostatic tested in accordance with ASA B 16.5.

Internal Construction:

Boiler Safety Valves (Fig. 9)

In this design the disc is held on the seat by the bearing between the spherical surface on the top of the disc and the conical surface of the lower thrust button. Since the thrust button is an integral part of the disc holder (See Fig. 9) the centerline of the disc can only assume a position truly coincident with the centerline of the disc holder. The disc-holder-to-guide clearance is small and this construction permits the disc to "wander" on the seat only the amount of this clearance.

The center of the spherical surface on the top of the disc is located in the plane of the seating surface and at the center of the seat. This design permits the disc to rotate to compensate for slight angular misalignment of the bushing seat, and, at the same time, limits the relative horizontal movement between the two seating surfaces to an absolute minimum. If the center of the spherical surface were located above or below the plane of the seat, some relative horizontal movement between the two seating surfaces would be necessary in compensating for angular misalignment. Such relative movement will cause galling of the seating surfaces and resulting leakage.

The disc is loosely retained in the disc holder by two cotter pins. It is important that neither the head nor split end of the cotter pins protrude outside the recesses provided in the outside of the disc holder and cause interference with the guide.

The ball end of the spindle locating in the conical bearing of the upper thrust button insures that the centerline of the spindle coincides with the true centerlines of the disc-holder and disc. Manufacturing tolerances maintain the total misalignment betwen the disc and spindle centerlines to less than .005 inches.

The disc-holder assembly consists of the disc holder, two thrust buttons and the retaining nut. The thrust buttons are press-fitted into the disc holder and the retaining nut tightened down. The lip at the top of the retaining nut is then expanded into the under cut in the disc-holder. The retaining nut cannot be removed without machining off this lip. The disc-holder assembly is, therefore, not repairable in the field and must be replaced as a unit if the disc-holder itself or either of the two thrust buttons become damaged in service.

The one-piece spindle has a hard insert at its lower end, providing a bearing which will stand up exceptionally well under the high loads encountered. It is extremely important to good valve performance that the spindle be as nearly straight as possible. The spindles are heavier and stronger than in the old design valves. However it is still possible to bend them by overgagging. See Fig. 1

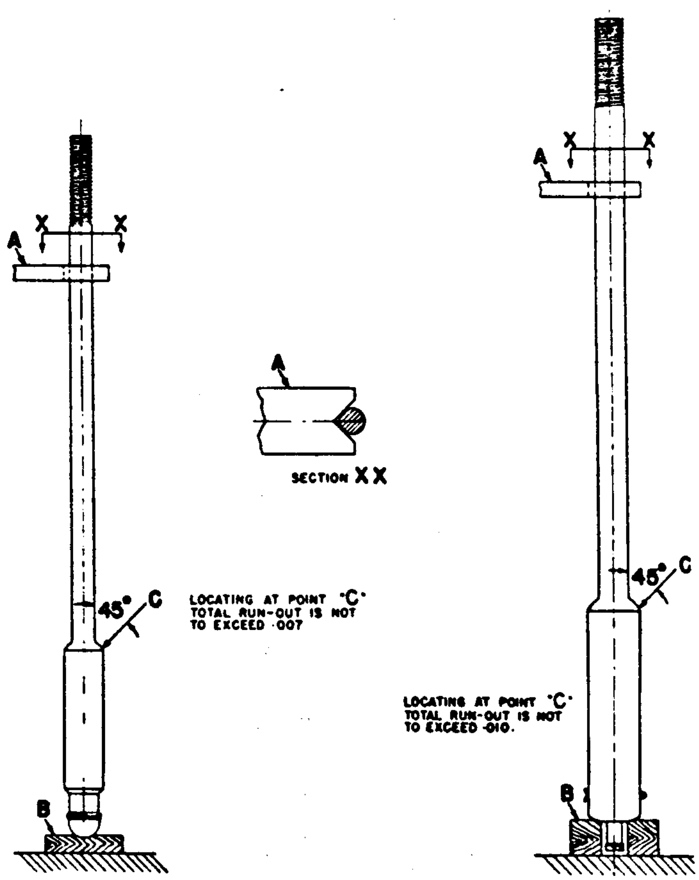


Figure 1 — Spindles

for the correct method of insuring that the spindle is not seriously bent.

When the valve is completely assembled, the spindle should be in a position approximately in the center of the guide drilling in the compression screw. If it bears hard against one side of the guide drilling, and cannot be easily centered by tapping the lower spring washer, the spindle is probably bent.

Internal Construction:
Reheater Safety Valves (Fig. 7)

The internal construction used in Maxiflow Safety Valves having 4" and 6" inlets follows the same principles of spherical-to-conical bearings as is used in smaller sizes. The larger disc holders permit the use of the stem extension passing through the hole in the single thrust button and through the drop-out thread in the top of the disc.

The thrust button is provided with four holes near its outer edge for the purpose of venting the steam which passes around the disc up to the space above the disc holder. If these holes were not provided, this steam would tend to flow through the central hole in the thrust button, depositing foreign matter in the bearings and causing leakage.

INSTALLATION, INLET AND EXHAUST PIPING

The details of the installation of any safety valve are governed to a large extent by the ASME Power Boiler Code. Pertinent paragraphs are:

P-277 — The safety valve or valves shall be connected to the boiler independent of any other steam connection, and attached as close as possible to the boiler, without any unnecessary intervening pipe or fitting. Such intervening pipe or fitting shall be not longer than the face-to-face dimension of the corresponding tee fitting of the same diameter and pressure under the corresponding American Standard as given in Tables A-6, A-7, and A-8 and shall also comply with Pars. P-12(b) and P-286. Every safety valve shall be connected so as to stand in an upright position, with spindle vertical.

P-278 — The opening or connection between the boiler and the safety valve shall have at least the area of the valve inlet. No valve of any description shall be placed between the required safety valve or valves and the boiler, nor on the discharge pipe between the safety valve and the atmosphere. When a discharge pipe is used, the cross-sectional area shall be not less than the full area of the valve outlet or of the total of the areas of the valve outlets discharging thereinto and shall be as short and straight as possible and so arranged as to avoid undue stresses on the valve or valves.

All safety-valve discharges shall be so located or piped as to be carried clear from running boards or platforms. Ample provision for gravity drain shall be made in the discharge pipe at or near each safety valve, and where water of condensation may collect. Each valve shall have an open gravity drain through the casing below the level of the valve seat. For iron and steel-bodied valves exceeding 2-inch size, the drain hole shall be tapped not less than ⅜-inch pipe size.

P-279 — If a muffler is used on a safety valve it shall have sufficient outlet area to prevent back pressure from interfering with the proper operation and discharge capacity of the valve. The muffler plates or other devices shall be so constructed as to avoid any possibility of restriction of the steam passages due to deposit.

When a safety valve is exposed to outdoor elements which may affect operation of the valve, it is permissible to shield the valve with a satisfactory cover. The shield or cover shall be properly vented and arranged to permit servicing and normal operation of the valve.

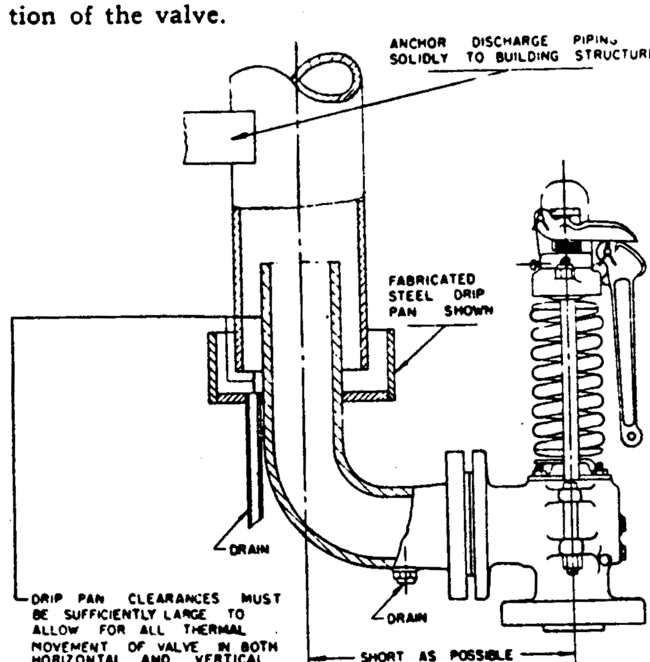


Figure 2 — Discharge Elbow and Drip Pan Unit

Exhaust piping must be installed so that it will not impose undue stress on the Safety Valve, as noted in P-278 on page 6. Stresses set up in the valve body from any source will cause distortion and leakage at pressures below the setpoint. If standard drip pans are used, see Fig. 2, sufficient clearance must be provided to allow for movement of the valve due to expansion and contraction of the drum or header on which it is installed. If blow back around the drip pan occurs, the vent piping is inadequate and its design should be investigated.

Flexible metal hoses, if used to connect safety valve outlets to discharge stacks, must have sufficient length and must be designed and installed in such a manner that they will not become "solid" in any position of the valve. Better results are obtained if the hoses are installed so that they will permit movement by bending, rather than by stretching and compressing along their length.

Steam flowing vertically out of the discharge elbow produces a downward reaction on the elbow, depending on the quantity of steam flowing and its velocity. In large, high capacity valves this force can equal several thousand pounds and can produce severe stresses in the valve necks. The bending stresses are determined by the amount of the reactive force, combined with the moment arm, or horizontal distance between the vertical centerline of the valve and the vertical centerline of the outlet elbow. Maxiflow Safety Valves are designed so that the neck stresses will not exceed ASME Code limits as long as this moment arm does not exceed 24 inches in length.

When installing flanged inlet valves, the flange bolts must be pulled down evenly in order to prevent body distortion and consequent misalignment and leakage.

ADJUSTMENT

All Maxiflow Safety Valves are steam tested at the factory. Every valve is set to have a clean popping action and to reseat tightly. However, because the boiler used in setting the valves has a small capacity compared to the capacities of the Maxiflow line of valves, slight adjustments on the actual installation are necessary to maintain proper action and blowdown.

Popping Point Adjustment:

To change the popping pressure of the valve remove the cap and lever assembly, loosen the lock nut and turn the compression screw clockwise to increase pressure, or counter-clockwise to decrease pressure. After each adjustment of the compression screw the lock nut should be tightened. The arm on the top spring washer should always be free from bearing against the yoke rod. This can be accomplished by holding a screw driver between the arm and the rod to prevent any movement of the top spring washer while adjusting the compression screw.

Ring Adjustment:

Always gag the safety valve for protection, in case boiler pressure rises while making ring adjustments. (See instructions for gagging).

The positions of the upper adjusting ring and the lower adjusting ring are locked by means of the upper adjusting ring pin and the lower adjusting ring pin respectively. These pins are threaded into the valve body and engage notches which are cut or cast into the rings. To adjust either ring the corresponding ring pin must be removed. A screw driver can be used to turn the rings.

Adjustment of the valve can best be understood by a consideration of the function of the two rings. Together, the rings form a secondary orifice which governs the pressure acting on the disc when the valve is open. The position of the upper ring relative to the seat will vary the degree to which the steam changes direction in flowing through the valve and will therefore vary the "reaction" on the lower face of the disc holder. A low position of the upper ring will result in a long blowdown, a high position will result in a short blowdown.

The lower ring is used to obtain a clean popping action and to cushion the closing action of the valve. (DO NOT ATTEMPT TO ADJUST BLOWDOWN WITH THE LOWER RING).

In detail, the rings should be used as follows in adjusting the valve. The lower ring should be set initially at about one notch below the seat level for every 200 psi of set pressure (10 notches for a 2000 psi valve). The upper ring should be set at about 13 notches above seat level, regardless of pressure.

The lower ring should be moved upward slowly, one notch at a time, to remove simmer. The most ideal position for the lower ring is the lowest position that does not introduce simmer or buzzing. In this connection, it is imperative that extreme care be used in conditioning the seat surfaces, insuring correct alignment, and establishing the proper clearances, so that mechanical causes of simmer will be reduced to a minimum.

In some cases where the valve closes from a low lift, but otherwise operates satisfactorily, the disc, being free to swivel and rock through a small angle, will flutter against the seat damaging the seating surfaces. This produces a characteristic "buzzing sound." It can be corrected by raising the lower ring one or two notches, causing the valve to close from a slightly higher lift. If the lower ring is set at too high a position, the valve will have a long blowdown and may close from a high lift, with possible seat damage.

The upper ring should be raised to reduce the blowdown and lowered to increase the blowdown, five notches at a time being considered a good average change. One notch will produce approximately a two pound change in blowdown throughout the 3% to 4% range.

In attempting to obtain blowdown on the order of 2½% to 3%, it is important to be sure that the rings are not separated so as to lose control of the valve. The first indication of reaching this condition is a slow up-and-down "hunting" action of the valve immediately before closing. If this action occurs at a blowdown longer than desired, moving both rings downward a small amount will sometimes produce a slightly shorter blowdown. When making this adjustment, move the upper ring twice as many notches as the lower.

As a starting point the position of the rings can be determined by using the gauge in Figure 3 and the corresponding Table II. Run the lower ring up until it touches the lower face of the disc holder, and refer to the table to locate this position, in number of notches above the seat. Then run the upper ring up until the disc holder is exposed, insert the gauge through a service port and rotate it until the gauge rod is flush against the lower face of the disc holder. Run the upper ring down until it contacts the gauge rod and refer to the table for this position, in number of notches above the seat. Remove the gauge and set the rings in the desired position, relative to the seat.

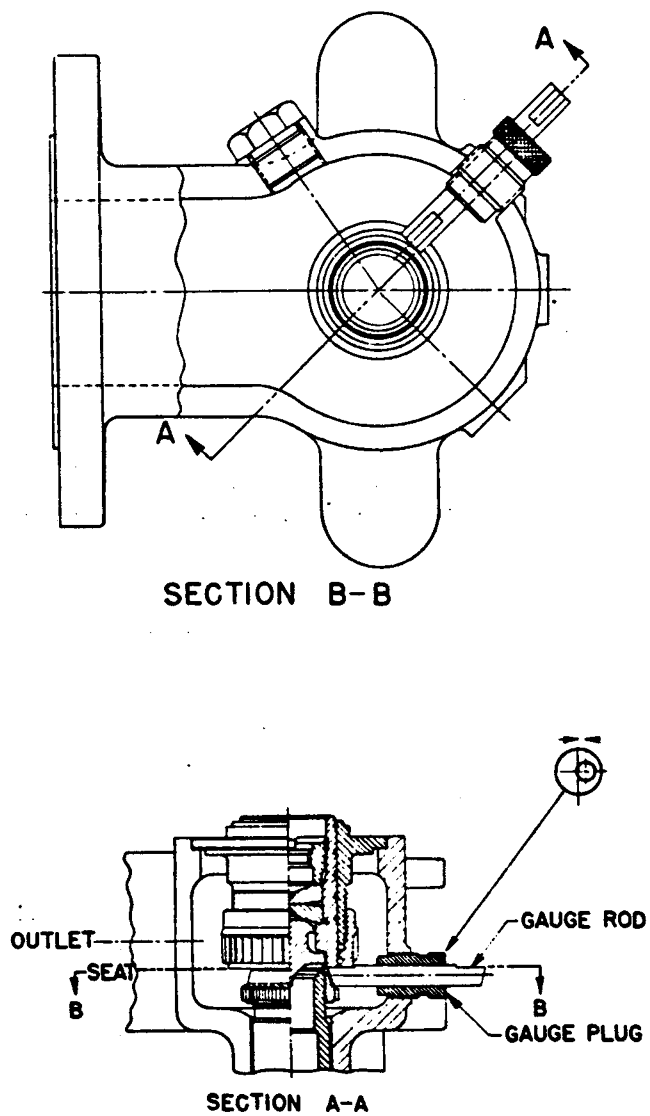


Figure 3

TABLE II — NOTCHES OF RING MOVEMENT BETWEEN DISC HOLDER AND SEAT

Orifice	Upper Ring Notches Between Disc Holder and Seat	Lower Ring Notches Between Disc Holder and Seat
9	7	6
1	10	7
2	12	8
3	17	12
5	17	12
4	17	12
6	45	30
7-Q	45	30
8	45	37
R*		
K**	17	12

* Proposed large reheater valve.
** Supercritical applications only.

GAGGING

Probably the most common source of Safety Valve trouble is overgagging. During hydrostatic testing, and during safety valve setting, gags should be applied only hand tight. When hydrostatic plugs are in place, overgagging will bend the spindle, destroying the alignment of the valve and causing erratic and otherwise unsatisfactory performance. During setting, overgagging will also cause damage to the seating surfaces and resultant leakage. In applying gags, remember that the valve spring will hold the valve closed against its set pressure. The additional gag load applied should be only enough to insure that the valves does not lift at the expected over-pressure.

Gags should never be applied when the boiler is cold. The spindle of the Safety Valve expands considerably with the temperature increase as pressure is brought up. If it is not free to expand with this temperature change, it may become seriously bent. Boiler pressure should be brought up to within one to two hundred pounds of the set pressure of the lowest set valve before applying gags.

No wrench should ever be used in tightening a gag.

HYDROSTATIC TESTING

Flanged Inlet Valves

Flanged inlet safety valves should be removed from the boiler during hydrostatic tests and the boiler nozzles blanked off.

Welded Inlet Valves

When supplied for pressures over 1200 psi, welded inlet safety valves are shipped with hydrostatic test plugs installed. These are steel plugs placed in the bore of the valve, inside the seating surface. Their purpose is two-fold. First, they effect closure at a point differing from the seating surface of the valve so that if the valve is lifted on hydrostatic test, the seating surface will not be as liable to become damaged. Second, by raising the disc of the valve off its seat and increasing spring compression, the set pressure of the valve is increased to a point where the valve will not lift at one and one half times design boiler pressure. It is not necessary to gag safety valves tightly when hydrostatic plugs are used.

These plugs must, of course, be removed from the valves prior to placing the boiler in service. However, they should be retained and reinstalled whenever a hydrostatic test exceeding the boiler design pressure is to be made.

DISASSEMBLY

The Maxiflow Safety Valve can be easily disassembled for inspection, reconditioning seats, or replacing internal parts and the spring load can be maintained after reassembly. Refer to figures 7, 8, and 9 for nomenclature.

Before starting to disassemble the valve, be sure that there is no steam pressure in the drum or header. Then proceed as follows:

Remove the Top Lever Pin and Top Lever. Loosen Cap Set Screw and lift off Cap and Drop Lever assembly. Remove Release Nut and Dust Cover. Remove the two top Yoke Rod Nuts and lift the assembly off of the valve. Remove the Spring and Spring Washers. Unscrew the four Stud Nuts and remove the Guide Retaining Plate. Lift the Spindle, Disc and Disc Holder assembly out of the valve.

NOTE: To retain the spring setting of the valve when and only when a disc is to be replaced or the seating surfaces are to be touched up, the following procedure should be followed. Remove the Top Lever Pin and Top Lever. Loosen Cap Set Screw and lift off Cap and Drop Lever assembly. Remove the Cotter Pin from the Release Nut and turn the Release Nut down until it is tight against the top of the Compression Screw. Remove the two Top Yoke Rod Nuts and the four Guide Retaining Plate Stud Nuts, and lift the Spindle, Spring, Spring Washers, Guide Retaining Plate, Disc, and Disc Holder assembly out of the valve.

The Disc Guide and Adjusting Ring Assembly can now be removed from the Base by lifting it straight up. In order that the blowdown of the valve will be unchanged, the position of the Upper Adjusting Ring should be marked for reassembly.

Make punch marks in an axial line on a tooth of the Upper Adjusting Ring and the outside barrel of the Disc Guide. Then measure the overall height of the disc guide and upper adjusting ring assembly and record this information.

Mark the Lower Ring in line with the Lower Ring Pin. Now place a straight edge or a ring lap across the top of the seat and count the number of notches that the ring is below the seat. Record this information for reassembly.

MAINTENANCE

It is not necessary to remove Maxiflow flanged or welded valves from the boiler for any maintenance. The actual maintenance required is generally confined to touching up seats and occasionally replacing the disc.

The following tools are recommended for this work:

A. Three ring-laps per valve.

B. Flat lapping plate.

C. Grinding compound (Kwik-Ak-Shun Grade No. 1000).

D. High temperature lubricant.

All of these tools can be procured from the factory, prices on application. It may not be necessary to use all of the ring-laps at any one time, but having a sufficient supply on hand will save the time of reconditioning them during a boiler outage. After the boiler is back on the line, the ring-laps should be reconditioned on the flat lapping plate, or returned to the factory for reconditioning, at a nominal cost, on a special lapping machine. A lap should not be used on more than one valve without being reconditioned.

The following spare parts are recommended:

A. Discs for 50% of each type drum valve, 100% of each type superheater valve and 50% of each type low pressure reheater valve.

B. One set of ring pins for each type valve.

C. One set of adjusting rings for each type superheater valve.

Valves that have been leaking should be disassembled in accordance with prior instructions. Since the position of the adjusting rings has been recorded, the rings can be disassembled for cleaning if necessary. Parts for each valve should be kept together or marked, to make sure that they are replaced in the same valve.

Reconditioning of the seat surfaces of the disc and seat bushing is accomplished by lapping with a flat cast iron-ring-lap coated with Grade No. 1000 Kwik-Ak-Shun silicon-carbide compound, or equivalent.

Lapping a flat seat is extremely simple. No special skill is required and the technique is readily apparent after a few minutes of actual lapping.

The following precautions and hints will enable anyone to do a "professional" job of lapping seats.

A. Keep the work clean.

B. A lap should not be used on more than one valve without being reconditioned.

C. Apply a very thin layer of compound to the lap. This will prevent rounding off the edges of the seat.

D. When lapping the bushing seat, keep a firm grip on the lap to prevent the possibility of dropping it and damaging the seat.

E. Lap using a reciprocating motion in all directions, at the same time applying uniform pressure and rotating the lap slowly. When lapping the disc seat, the lap should be held stationary and the disc moved as above.

F. Replace the compound frequently after wiping off the old compound, and apply more pressure to speed the cutting action of the compound.

G. To check the seat, remove all compound from both the seat and the lap. Then shine up the seat with the same lap using the lapping motion described above.

Low sections on the seating surface will show up as a shadow in contrast to the shiny portion. If shadows are present, further lapping is necessary, and only laps known to be flat should now be used, as only a few minutes will be required to remove the shadows.

H. When the lapping is completed, any lines appearing as cross scratches can be removed by rotating the lap, which has been wiped clean of compound, on the seat about its own axis.

I. The seat should now be thoroughly cleaned with kerosene, light oil, or carbon tet., using a lint-free cloth or tissue paper.

If extensive lapping of the bushing seat is required, a great deal of time will be saved if a "Roto-Lap" is used. See "Instructions for Assembling and Operating the Consolidated Maxiflow Roto-Lap Machine", Appendix 2.

If the seat bushing is lapped more than .010" it should be re-machined to the proper dimensions. For this purpose there is available for use by the Service Department a "Reseating Machine" which eliminates the need to remove the valve from the unit. This machine is mounted in place of the guide retaining plate and cuts the top face, inside diameter and outside diameter of the bushing to establish the correct height relationships and angles.

In re-machining the bushing seat, the length of the disc holder extending above the disc guide will decrease. Referring to Fig. 4, the top of the disc guide should be kept to a distance of at least 1/16 inch below the top of the disc holder to facilitate freeing the disc holder in case a deposit of dirt forms in the pocket between the two parts. This dimension is obtained by machining the top of the disc guide.

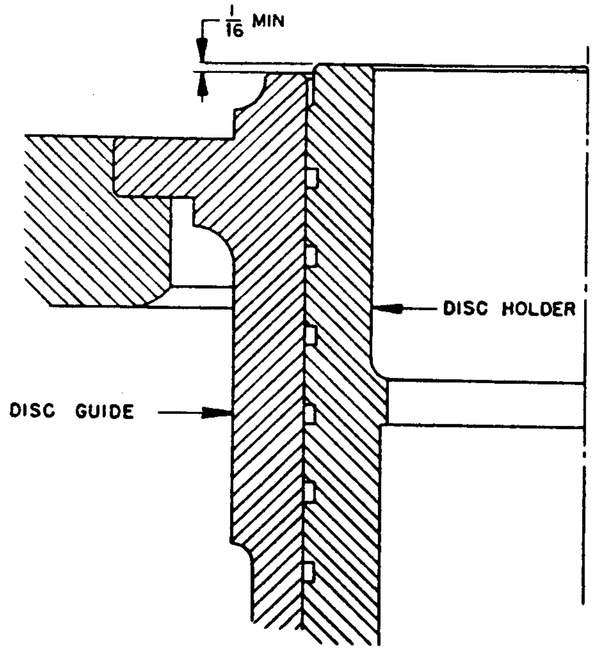


Figure 4

On new installations, during initial setting of safety valves, there is a possibility of damaging the superheater valve seat due to foreign matter, such as mill scale, weld splatter and beads, etc., being drawn into the steam flow.

This foreign matter batters and cuts the seats of the valve although damage to the bushing seat is usually considerably less than to the disc seat. This type of damage causes the valve to leak quite badly and generally requires that the disc be replaced and the bushing seat relapped.

However, before bringing the boiler down, the leaking valve should be hand-blown at least 10 times and held open for a period of one minute each time. This should clean any remaining foreign material out of the superheater and minimize the possibility of damage to the seats after overhaul, although this particular trouble sometimes persists until the boiler has been operating for a considerable period of time.

Drum safety valves do not, generally, draw foreign matter into the steam flow, and no difficulty of this type is to be expected.

To replace the disc, disassemble the valve in accordance with prior instructions. Then proceed as follows:

A. The bushing seat can be reconditioned by hand lapping as explained under "LAPPING PROCEDURE". We also have available, for sale, a rotary lapping machine of unique design, Appendix 2, which reduces the "hand" lapping needed on the bushing seats.

The replacement disc has been lapped on our special lapping machine and requires only that the seat be touched up. However, the thrust button bearing must be re-established by grinding with Kwik-Ak-Shun compound or equivalent. On boiler valves this is accomplished as follows:

Remove the disc holder by unscrewing it from the coarse right hand thread on the spindle. Then remove the two disc retaining cotter pins and lift the old disc out of the holder. Apply a layer of grinding compound to the spherical bearing surface of the new disc. Place the disc in the holder and grind the bearing surfaces of the disc and the lower thrust button. When the bearing is re-established clean both surfaces with kerosene, light oil, or carbon tetrachloride. Then apply some high temperature lubricant to the spherical surface of the disc and work it into the pores by rotating the disc on the thrust button. Insert the disc and replace the disc retaining cotter pins, making sure that they do not protrude beyond the surface of the disc holder. Then screw the disc holder onto the spindle threads.

The procedure for replacing Reheater valve discs is slightly different. Unscrew the spindle out of the drop out threads in the disc and remove the spindle and disc from the disc holder. (Re-establish the bearing of the new disc by grinding) and apply high temperature lubricant to the bearing surfaces. Then replace the spindle in the holder and screw it into the new disc.

Spindle Runout:

It is important that the spindle be kept very straight in order to transmit the spring force to the thrust button without lateral binding. Overgagging is one of the common causes of bent spindles. A method to check the essential working surfaces of the spindle is illustrated in Fig. 1.

Clamp a V block (A) made of wood, fiber or other suitable material onto the platform railing. Imbed the ball end of the spindle in a piece of soft wood (B) placed on the grating and adjust the V block so it supports the spindle below the threads, at a point where the spindle passes through the compression screw. Clamp a dial indicator onto the railing and locate at point (C). The total indicator reading should not exceed .007 when the spindle is rotated.

Essentially the same method is used to check the spindle runout on reheater valves except that the piece of soft wood (B) must be drilled to allow the spindle extension to pass through so the spindle can be checked from the bearing surface.

If drilling is not desired an alternate procedure requires removing the extension from the spindle.

Other parts of the spindle not used as working surfaces may run out considerably more than .007 but this should not be regarded as an indication of crookedness or faulty manufacture.

APPENDIX 1 — SUPERCRITICAL VALVE

The Maxiflow Supercritical Valve is used for steam at pressures above the critical of approximately 3200 psia. Its internal design is similar to that used in the Boiler Safety Valves. Due to the demand for various designs of supercritical valves, there has been no standardization of any one valve.

The springs are made from high speed steel, the discs from Inconel "X", and the seating surface of the bushing from Stellite. These materials have been found to work very well under the high temperatures and pressures to which the valve is subjected. A ball thrust bearing is used on the compression screw of some of the valves for better adjustment.

The gagging arrangement (Fig. 5) on the supercritical valves can be used as either a gag or a lift stop. To gag the valve, the gag should be turned down on top of the spindle wrist tight. In using the gag as a lift stop, the gag can be set at a distance above the top of the spindle equal to the required lift.

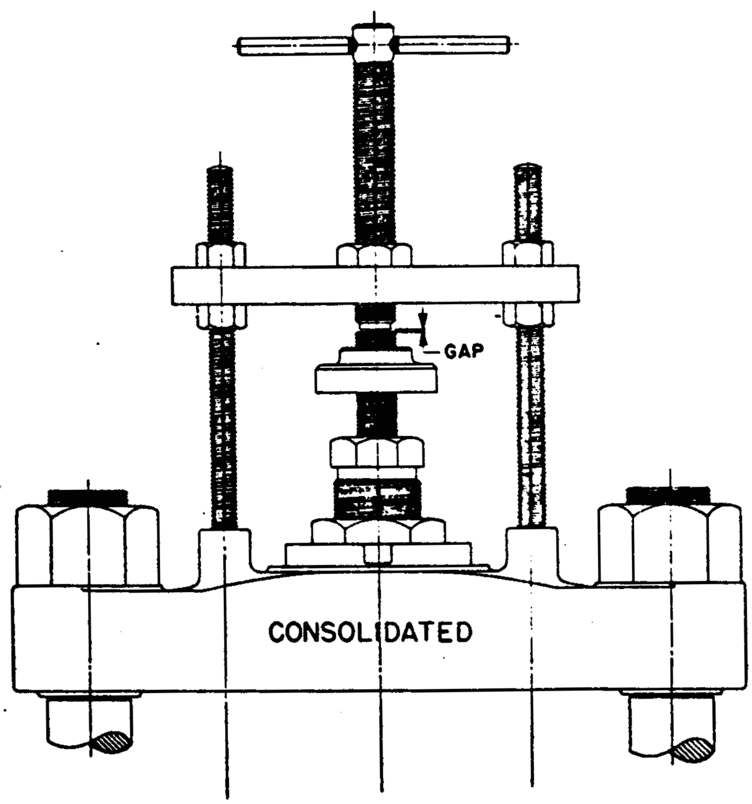


Figure 5 — Gagging Arrangement

APPENDIX 2

INSTRUCTIONS FOR ASSEMBLING & OPERATING THE CONSOLIDATED MAXIFLOW ROTO-LAP MACHINE

GENERAL DESCRIPTION

The Consolidated Maxiflow Roto-Lap Machine is a hand operated tool for refinishing damaged or worn nozzle seats in Consolidated Maxiflow Safety Valves. It has been expressly developed for the purpose of generating a flat surface and its use materially reduces lapping time.

The Roto-Lap will not correct a seating surface which is out of square with the valve center line, nor will it reshape the original dimensions of the nozzle seat. For either of these purposes, a special reseating machine is required or the valve must be removed from the boiler and the base and bushing assembly remachined.

GENERAL NOTES

The Maxiflow Roto-Lap Machine is made up of parts as shown in the illustration on the reverse side of this sheet. A duplicate bill of material is also pasted inside the cover of the carrying case furnished with the Roto-Lap.

A Mounting Flange, Item 6, fabricated with three sets of four holes on three diameters is provided for use on all valves with orifice sizes #1 thru #5. Kits for #1 and #2 orifice valves include two sets of four Laps each, Item 10. Kits for #3 and #4 and #5 orifice valves include one set of four Laps, Item 10, and one set of four larger or alternate Laps, Item 11.

ASSEMBLY

Proper assembly of the Roto-Lap can be accomplished by referring to the illustration on the reverse side of this sheet. The mounting Flange, Item 6, has three sets of four holes each; the inner set marked 1-2; the center set marked 3; and the outer set marked 4-5. First select the set of marked holes corresponding to the size of the orifice to be lapped and insert the Shoulder Screws, Item 7, downward through these holes.

The orifice size can be identified by referring to the valve type number stamped on the valve name plate. The third digit in the type number is the valve orifice size or number. As an example, if the valve is Type 1747WA, the third digit, #4, is the orifice size or number and the Shoulder Screws would be inserted in the set of holes marked "4-5" on the Mounting Flange.

Next assemble the four Lap Gear Washers, Item 8, four Lap Gears, Item 9, Center Gear, Item 5, and Laps, Item 10, in this order. The shoulders on the Shoulder Screws should seat against the recesses in the top surfaces of the Laps. An Allen Set Screw Wrench is provided for tightening the Shoulder Screw to the Lap. Each Lap, Lap Gear and Shoulder Screw assembly should rotate freely in the Mounting Flange.

The *Center Gear* must engage in all four Lap Gears and must be in place before the Laps are assembled to the Shoulder Screws. When properly assembled, the Center Gear should "float" in the space between the Laps and the Mounting Flange.

Attach the Handle Assembly to point "Y" on the Mounting Flange spud by means of the Allen Set Screw provided.

Place the Bore Guide, Item 2, inside the bore of the safety valve seat bushing or nozzle and push it down as far as it will go. The top of the flange, point "R" *must* be below the seating surface of the nozzle. A small amount of light oil on the O-Ring, Item 3, will assist in getting the guide into this position.

USE

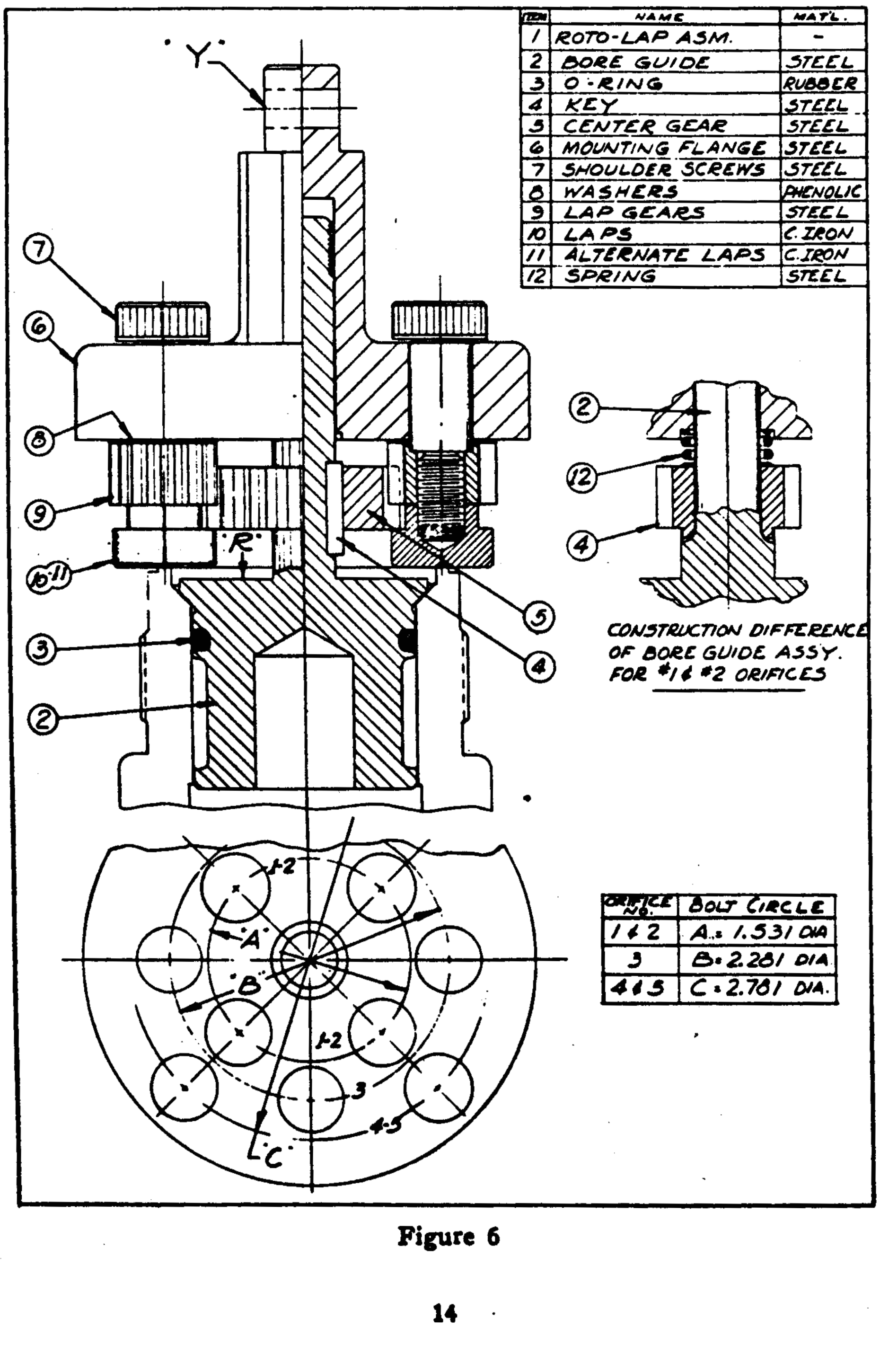
Where two different sizes of Laps are provided, the larger set will cut faster than the smaller and should be used for removing nicks and other severe damage. The smaller set of Laps cuts slower and is better for finishing the seat surface.

Apply lapping compound to the lower face of each of the Laps. Normally 1000 grit grinding compound similar to KWIK-AK-SHUN Grade #1000, should be used. However, a heavier grit compound may be used where necessary. A small amount of oil placed on the Laps with the compound will produce a better finish.

Drop the Mounting Flange Assembly over the Bore Guide extension shaft so that the shaft passes through the Center Gear and into the center hole in the Mounting Flange. TURN THE HANDLE CLOCKWISE slowly until the Key, Item 4, engages in the keyway in the Center Gear and prevents its further rotation. At this point, the Laps will drop onto the seating surface. Further rotation of the handle causes the Laps to move in a planetary fashion, rotating as they travel around the seat. Lap by turning CLOCKWISE until the desired finish is produced.

You will note that the Mounting Flange Assembly lifts off easily for periodic inspection of the seat as lapping progresses, and is easily replaced for further lapping if necessary. Also, the Bore Guide, remaining in the bore throughout the entire operation, prevents foreign material from falling into the boiler.

After the removal of nicks, etc., the surface finish can be improved if the surplus compound is wiped away from both the nozzle seat and the laps and the lapping continued with a minimum amount of compound. Final finishing should be done with a new hand lap, using 1000 grit compound to insure minimum deviation from a perfectly flat surface. Ring laps or hand laps are provided in the Roto-Lap Kit for this purpose.



ITEM	NAME	MAT'L.
1	ROTO-LAP ASM.	-
2	BORE GUIDE	STEEL
3	O-RING	RUBBER
4	KEY	STEEL
5	CENTER GEAR	STEEL
6	MOUNTING FLANGE	STEEL
7	SHOULDER SCREWS	STEEL
8	WASHERS	PHENOLIC
9	LAP GEARS	STEEL
10	LAPS	C. IRON
11	ALTERNATE LAPS	C. IRON
12	SPRING	STEEL

ORIFICE NO.	BOLT CIRCLE
1 & 2	A = 1.531 DIA
3	B = 2.281 DIA.
4 & 5	C = 2.781 DIA.

Figure 6

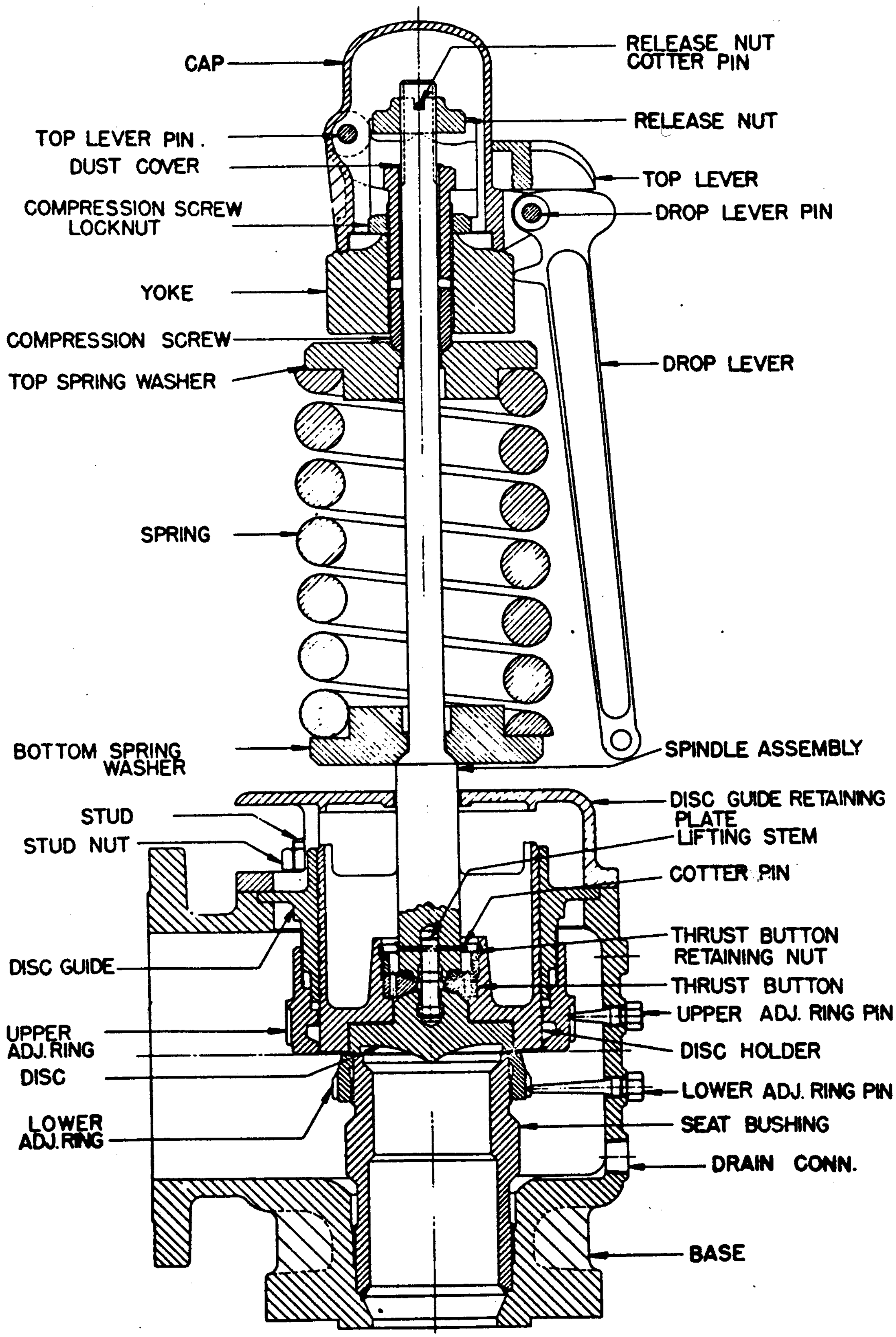

CAP
RELEASE NUT COTTER PIN
RELEASE NUT
TOP LEVER PIN
DUST COVER
TOP LEVER
COMPRESSION SCREW LOCKNUT
DROP LEVER PIN
YOKE
COMPRESSION SCREW
TOP SPRING WASHER
DROP LEVER
SPRING
BOTTOM SPRING WASHER
SPINDLE ASSEMBLY
STUD
STUD NUT
DISC GUIDE RETAINING PLATE
LIFTING STEM
COTTER PIN
DISC GUIDE
THRUST BUTTON RETAINING NUT
THRUST BUTTON
UPPER ADJ. RING PIN
UPPER ADJ. RING
DISC HOLDER
DISC
LOWER ADJ. RING PIN
LOWER ADJ. RING
SEAT BUSHING
DRAIN CONN.
BASE

Figure 7

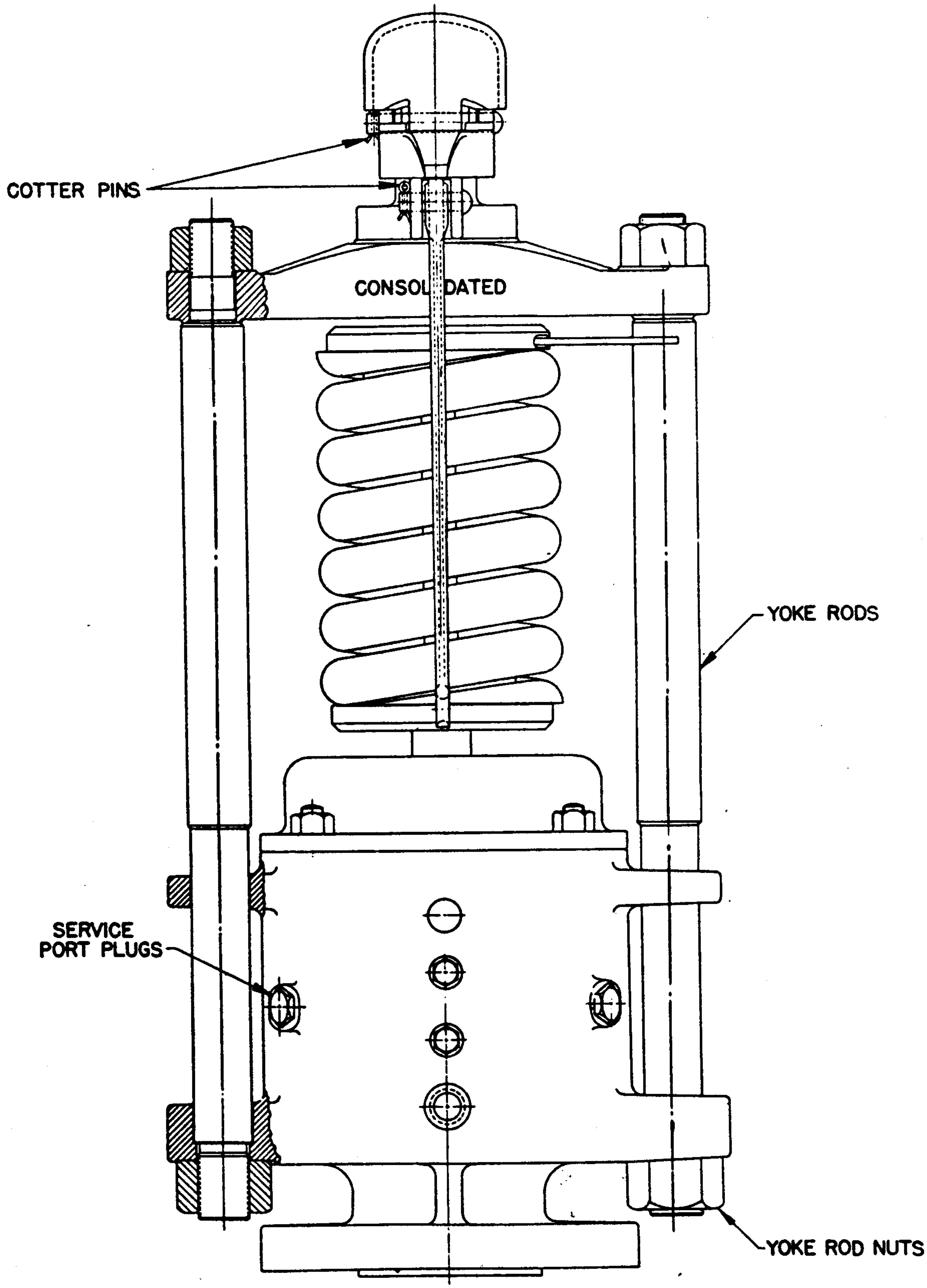

COTTER PINS
CONSOLIDATED
YOKE RODS
SERVICE PORT PLUGS
YOKE ROD NUTS

Figure 8

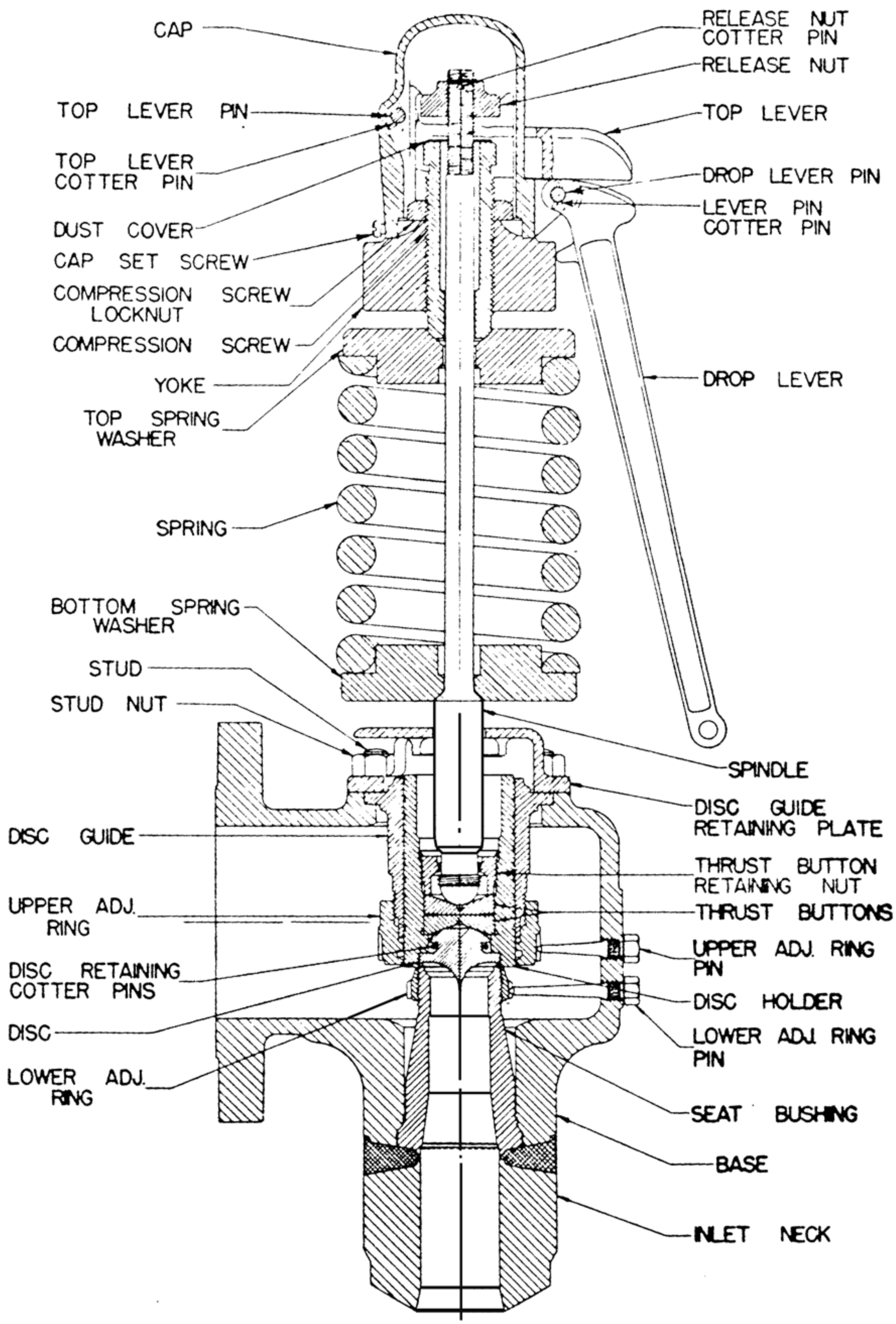

CAP
RELEASE NUT COTTER PIN
RELEASE NUT
TOP LEVER PIN
TOP LEVER
TOP LEVER COTTER PIN
DROP LEVER PIN
LEVER PIN COTTER PIN
DUST COVER
CAP SET SCREW
COMPRESSION SCREW LOCKNUT
COMPRESSION SCREW
DROP LEVER
YOKE
TOP SPRING WASHER
SPRING
BOTTOM SPRING WASHER
STUD
STUD NUT
SPINDLE
DISC GUIDE RETAINING PLATE
DISC GUIDE
THRUST BUTTON RETAINING NUT
UPPER ADJ. RING
THRUST BUTTONS
UPPER ADJ. RING PIN
DISC RETAINING COTTER PINS
DISC HOLDER
DISC
LOWER ADJ. RING PIN
LOWER ADJ. RING
SEAT BUSHING
BASE
INLET NECK

Figure 9