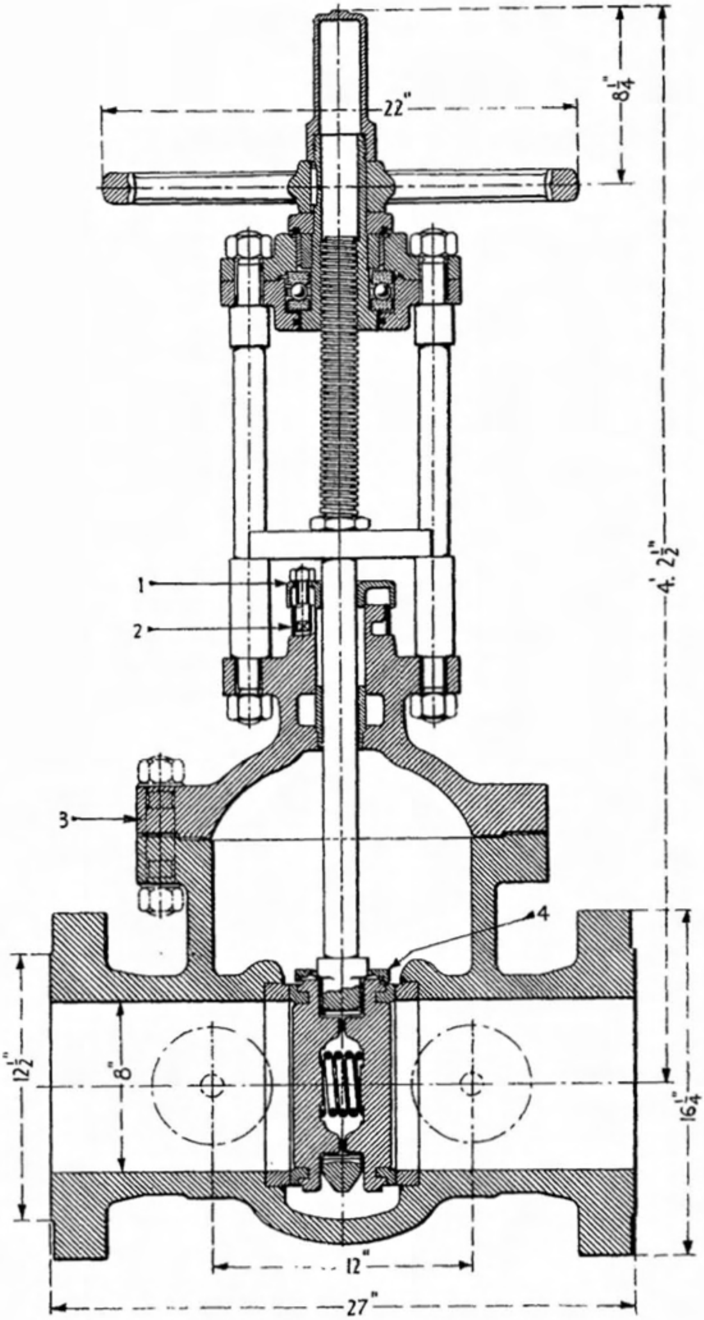

FIG. 1.—PARALLEL SLIDE VALVE

VALVES FOR HIGH TEMPERATURES AND PRESSURES

by

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For steam pressures of 650 lb. per sq. in. and a temperature of 850° F. there is no marine experience in Great Britain and it has therefore been necessary to obtain suitable valves from specialist firms. The adoption of higher pressures has meant a considerable reduction in the size of pipes and valves. A destroyer, for example, has a 7½-in. main steam pipe and all the auxiliary master valves except two are 1½ in. diameter or less.

Parallel slide valves are being adopted for most purposes not involving throttling. The reasons for this are :

(*a*) There is considerable experience in this country with parallel slide valves for temperatures up to 930° F., but there is little or no experience with screw-down valves for these conditions.

(*b*) With the screw-down valve, as it is not possible to achieve such accuracy in finishing the seating faces as in the case of the flat-faced slide valve, it is necessary to employ high seat pressures to achieve a steam-tight valve. One method of achieving this with a screw-down valve is to employ a narrow seat, frequently of the mitre type, but this suffers from the objections that it is rather easily damaged and, with hard seat materials, it is difficult to refit, particularly because the seat must be kept narrow to keep an equal seat pressure around the valve. The other method of achieving a high seat pressure with a screw-down valve is to employ a small cone angle seat in conjunction with a relatively large seat width. This requires a valve of very great strength and is a solution which has been largely adopted in U.S.A., but is outside the scope of this article.

The parallel slide valve

The parallel slide valve, because of its flat seat faces, which can be finished by lapping to a high degree of accuracy, employs relatively low seat pressures to achieve steam tightness and is light in construction. Although the valves are not suitable for continuous throttling they will stand up to the amount involved in warming through a line.

A typical parallel slide valve is shown in Fig. (1). The steam pressure supplies the necessary force to maintain pressure on the seat. Details of the valve which may not be immediately obvious are (1) tee type gland studs which are removable to improve accessibility to the gland, and (2) a gland ring which retains the studs when the gland nuts are slack. It will be noted that with (3) there are no studs screwed into blind holes in the cover joint, a flanged joint with two nuts to each stud being employed instead, and (4) is a disc holder whose function is to prevent the discs falling out when the valve is open.

For small valves a single-faced valve takes the place of a parallel slide valve. It is simpler and has certain advantages in ease of refitting. Such a valve is

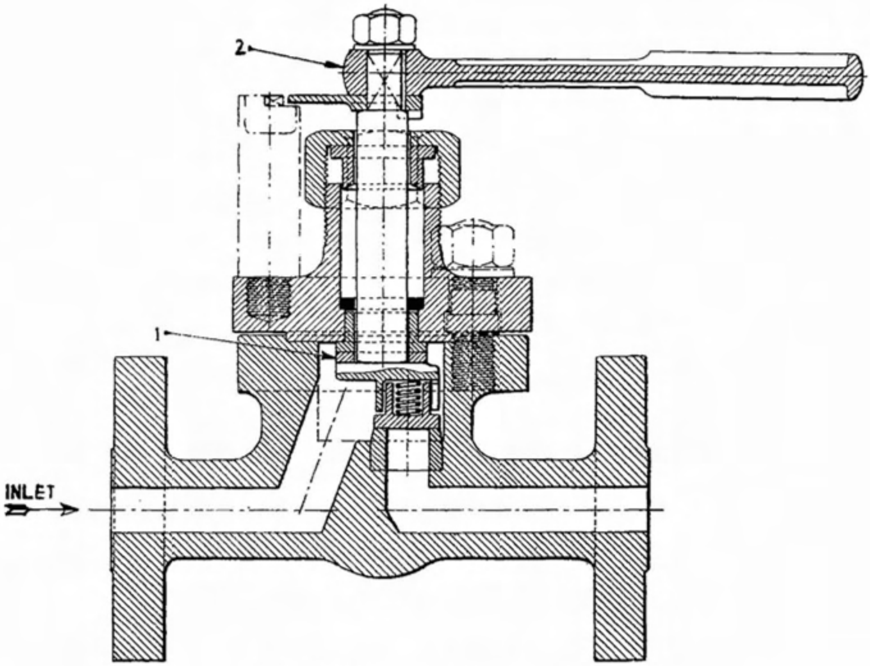

FIG. 2.—SMALL HIGH PRESSURE VALVE

shown in Fig. (2). Points which may not be immediately obvious are (1) a hardened thrust washer, and (2) the handle turns 180 degrees between wide open and shut. In the open position the lid still overlaps the seat at one edge and cannot fall out.

Valve seats

Valve seats are in general of the *pressed-in* type, that is, pressed in with a definite interference between seat and body. Screwed seats have not been entirely satisfactory for low temperatures and are likely to be more unsatisfactory at high temperatures. With a pressed-in seat it is easy to control the manufacture and obtain consistent steam tightness between seat and body, because the sealing is by radial pressure between two cylindrical surfaces which can be easily controlled for size. The requirements for seat materials are : correct coefficient of expansion, erosion and corrosion resistance, freedom from galling or seizing during pressing in, low coefficient of friction in sliding, low rate of wear in sliding and adequate strength and general stability of properties at operating temperature. The erosion resistance is related to the hardness, but the hardness in itself is no indication of its resistance to erosion, as a material consisting of a hard constituent in a soft matrix, e.g. some tungsten carbide alloys, are not erosion-resistant though hard. All these requirements are not possessed by any one material and are usually met by one of a series of alloys depending on the relative importance of the particular requirements for a particular application. An alloy of the composition Ni50% Si3% Cu42% Sn7% is typical.

Pressed-in seats can be removed if required by machining a groove and driving

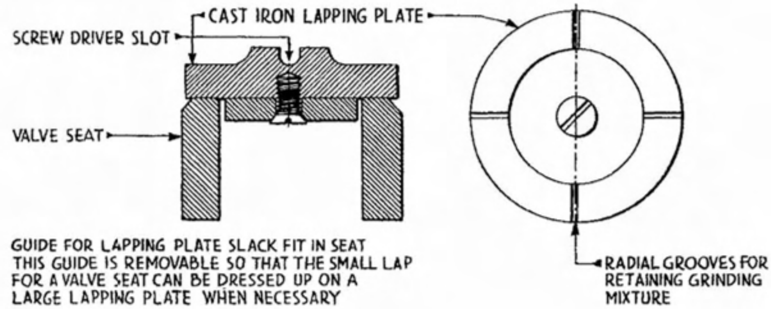

FIG. 3

out or machining out, replace seats being supplied oversize, the body having to be remachined to achieve the correct interference before pressing in the replace seat.

Refitting parallel slide valves

The adoption of parallel slide valves leads to a different practice in the refitting of valves. The seat materials employed can only be machined with a tungsten-carbide-tipped tool, or alternatively grinding is possible. After machining, both lid and seat are finished by lapping to a cast-iron lapping plate or lap. When lapping valve lids, fine emery and tallow are smeared on the plate and, in the case of a small lid, it is rubbed to and fro, or with a larger size it is pressed down by hand and rotated on the plate—a very large lid may require two men to do this. In the case of the seat, a lap as shown in Fig. (3) is used, rotary motion being applied by means of a brace. Laps and lapping plates must be kept in good condition and trued up by machining as often as necessary. Laps for the seat are prepared before use and trued up after use by lapping to a master plate. This master plate is simply a cast-iron plate (say) 2 ft. 6 in. square, which has been finished by planing with a feed of about 30 to the inch. It is prepared for use by putting fine emery and tallow on the surface of the plate and then working it in by means of a flat piece of cast iron. The lapping process on a lid or seat should not occupy more than about 5 minutes on all except the largest sizes of valve, and if it does the valve lid or seat requires machining. The surface produced by this process is flatter and truer than can be achieved by hours of hand scraping. A lid is never lapped in to its mating seat because, due to their hardness, they will groove ; it is always lapped in separately to a plate. It will be noted that it is really necessary to take large parallel slide valves out of the pipe line to lap in the seats, but in an emergency a repair can sometimes be effected by turning the valve box round so that the other lid and seat come into operation. The majority of valves, being $1\frac{1}{2}$ in. diameter and below, are of the single-face slide valve type and can be refitted in place.

Valve bodies are of molybdenum steel, either cast or forged, according to size. Cover joints on all valves above $1\frac{1}{2}$ in. diameter are so arranged (as mentioned above) that there are no studs screwed into blind holes. The object of this is to try to eliminate some of the delay that often occurs in refitting, due to broken studs. As far as practicable this practice is employed on valves smaller than $1\frac{1}{2}$ in. diameter, but it is not always possible to eliminate blind studs in these sizes. To try to minimise seizure of nuts, hardened steel washers are fitted under nut heads and nuts are copper-plated.

Spindles and glands

Considerable trouble has been experienced in the past with corrosion of 13% chromium steel spindles in contact with graphite, but in parallel slide valves, with the much lower strength required in the spindle, it is possible to use an austenitic steel of the 18%Cr 8%Ni type, which is much more corrosion-resistant.

Gland packings consist of good quality asbestos and graphite only. The asbestos is in the form of loose asbestos fibre. To simplify packing the glands the bridges are removable so that a tube can be placed over the end of the spindle to follow up the packing ; this is particularly useful when using loose asbestos fibre. The elimination of any oil, grease or rubber bonding is extremely important, as these substances boil away or decompose well below 850° F., which causes a reduction in the volume of the packing and necessitates following up the gland, while the decomposition products get deposited on the spindle and soon tear the packing to pieces. A well-packed gland using loose asbestos fibre and no oil or grease should require little or no following up in service, neither should it be possible to follow up. It may be added that suitable packing is only one factor in achieving a steam-tight gland; other equally important factors are the mechanical perfection of the spindle assembly and the surface condition of the spindle.