SCREAMING MANOEUVRING VALVES

The emission of a high pitched scream by main manoeuvring valves under certain critical conditions of opening has been noted from time to time in H.M. ships, but in general the range of speed concerned is very narrow. In some Cockburn valves of a recent " improved " design, however, the scream has persisted over a wide range of speed and has caused acute discomfort in the engine rooms and adjacent mess decks. A cure has now been found for the ahead valves, but the same method has failed when applied to the astern valves.

Conventional Cockburn double beat valves of the vertical type have the two valve lids mounted on the spindle, the upper lid being provided with a flexible disc to ensure seating of both beats in spite of differential expansion. Both seats are screwed solidly into the chest casting (Fig. 1). In the improved type, the two valve lids are combined in a single dumb-bell shaped casting or forging, with an integral guide pintle projecting at the upper end. Flexibility between the two beats is provided by mounting the lower seat from the chest casting on a flexible disc (Fig. 2). The new design was produced with the object of facilitating " grinding in " procedure and maintenance generally.

The new valves with flexible seats were fitted as an alteration in *H.M.S. King George V* and *Howe* whereupon complaints about the noise were soon received. The obvious alteration, the flexible seat, naturally attracted attention and various modifications to the valve, principally by changes of shape where the lid forms a shroud inside the seat, were tried out. The idea behind the alterations was that, if " screaming " occurred at certain valve lifts, it should be possible to alter the range by altering the lift required for a given speed. The modifications were not effective.

In the meantime, the same type of valve had been fitted in the 1942 Light Fleet Carriers, and here the scream proved to be even more serious as it covered almost the entire cruising speed range ahead, from about 90 to 196 R.P.M. and the whole range astern. Experiments were therefore made during the trials of *H.M.S. Glory* and later *Ocean* in the hope of finding a solution.

Obviously, the first requirement was to find a palliative for ships already in service and the following methods of silencing were found to be effective :—
When steaming ahead, throttling was effected by partly closing the parallel slide valves in the main steam line from each boiler, the ahead manoeuvring valve being left wide open. When steaming astern, two of the four astern nozzle control valves were closed. The former palliative was clearly unacceptable except possibly for long runs at a steady speed in view of the difficulty of controlling at the parallel slide valves.

The second and fundamental requirement was to find the real cause of the noise and re-design the valves for silence. Trials were carried out with the flexible seat made rigid by screwing it up hard against a spacing washer, in order to make vibration of the seat on its disc impossible. The modification made no difference to the noise, showing that the flexible seat was not responsible. A further modification tried was to machine out the top pintle guide bush and fit a gland and soft packing. This effected some reduction of the speed range over which screaming occurred, but the improvement was only slight. An analysis of the noise was made on board with a sound analyser to determine the frequencies making up the scream. The sounds emitted on bowing or striking various internal parts were analysed at Cockburn's works.

The results suggested that one component of the scream might come from vibration of the flexible seat, not on its disc but as a ring and that another component might come from the top guide pintle. Further modifications were therefore made. In one ahead valve a stiffening ring was shrunk over

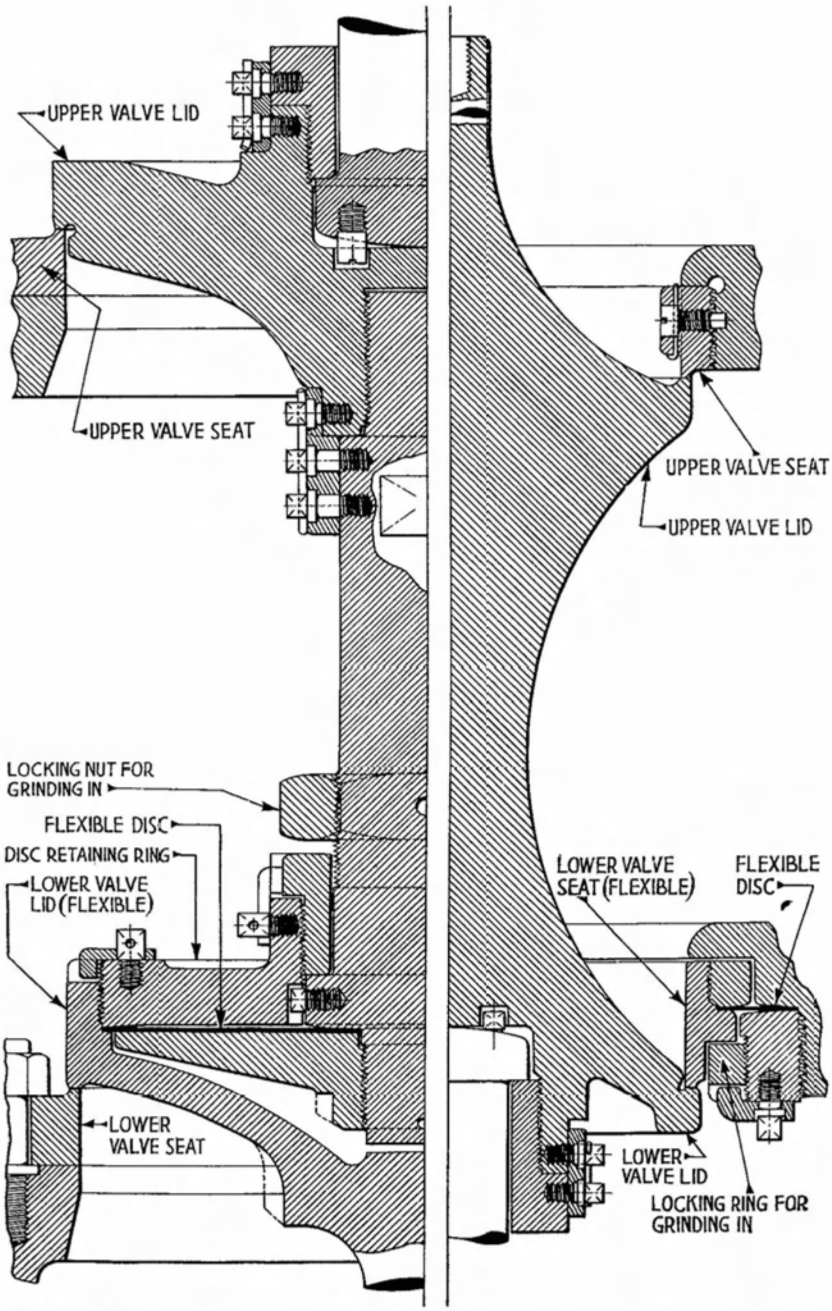
UPPER VALVE LID
UPPER VALVE SEAT
UPPER VALVE SEAT
UPPER VALVE LID
LOCKING NUT FOR GRINDING IN
FLEXIBLE DISC
DISC RETAINING RING
LOWER VALVE LID (FLEXIBLE)
LOWER VALVE SEAT
LOWER VALVE SEAT (FLEXIBLE)
FLEXIBLE DISC
LOWER VALVE LID
LOCKING RING FOR GRINDING IN

FIG. 1. FIG. 2.

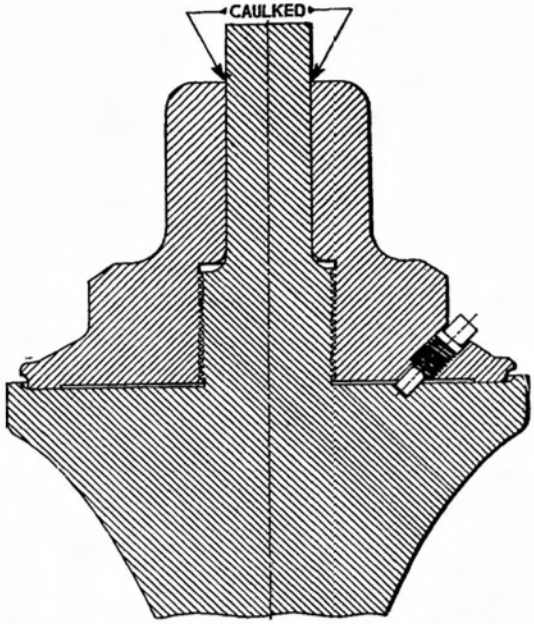

FIG. 3

the ring of the flexible seat while, in another, a combined shroud and pintle support was fitted to the top of the valve. The former modification was ineffective, but the latter made the ahead valve silent throughout the entire speed range.

This effective modification was made by turning down and threading the lower portion of the top guide pintle where it is sweeping out to join the upper face of the valve dumb-bell and screwing over it what is virtually a flange with a hub. The hub continues up beyond the screwed portion and is made a close fit on the parallel part of the pintle, being subsequently caulked or silver soldered to ensure contact with the latter (Fig. 3). The outer periphery of the flange is made slightly smaller than the bore of the upper valve seat and lies inside it, thus reducing the steam flow for a given lift and at small lifts deflecting the high velocity steam upwards and preventing it from striking the pintle.

This modification has been put in hand for all the ahead valves in the 1942 Light Fleet Carriers and also for *King George V* and *Howe* where it is hoped that it will also be effective.

Following the success of this method with the ahead valve, it was tried for the asterns, but without result. After the failure of the first attempt it was concluded that in the smaller valve the pintle was not getting sufficient support and a further test was made in which a new pintle of increased diameter was incorporated in the screwed-on shroud (Fig. 4). This also failed. A similar alteration, but with a stiffer pintle, was fitted in *Perseus* without noticeable improvement.

To find a cure for the astern valves is of less importance in itself than for the ahead valves in view of the limited amount of astern steaming likely to be carried out. Habitability of the ship is not therefore greatly affected. It is, on the other hand, regarded as important in influencing the design of similar ahead valves. Frequencies of vibration have been little changed by the alterations and it begins to appear doubtful whether the pintle is the sole or even

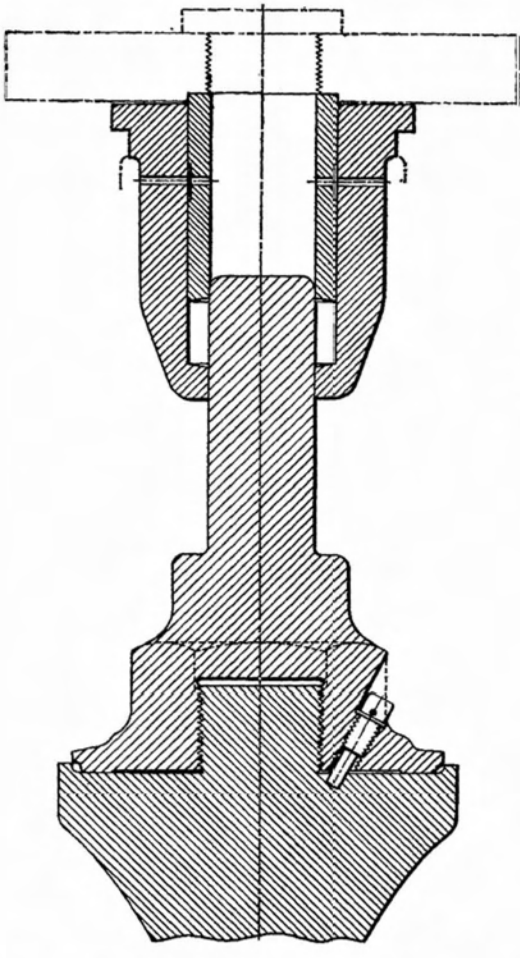

FIG. 4.

the predominating cause in this case, but the evidence of sound analysis still points to it. The analyses from both ahead and astern valves show a fundamental, agreeing in each case with the observed and calculated natural frequency of their respective pintles as cantilevers, and multiples of the fundamental. Usually one of the multiples dominates the sound, but not always the same one. This presumably is because a particular multiple coincides with the " organ pipe " frequency of the steam in some part of the valve. Further methods which may be tried are :—

(*a*) Removing the pintle entirely and drilling the dumb-bell to receive a guide pintle attached to the valve chest.

(*b*) Making a complete valve and pintle in cast iron, to the original design. The high damping of this material would be expected to prevent pintle vibration and if silent would prove that the pintle is responsible.

It may be asked, "Why not revert to the original Cockburn design ? " The answer is that the advantages of the new design, as a valve, are considered to be such as to justify the time spent in making it silent.