Referring to Fig. 2 only.

In this case the gauge-cocks are attached to a bent pipe of comparatively large diameter (at least 3 in. in the bore), the upper end of which communicates with the steam-space, and the lower end with the water-space of the boiler. Owing to the bore of the pipe being large it is not liable to become choked or stopped under the ordinary conditions of working. The water-gauge is therefore in practically the same condition as if it were attached direct to the boiler as in Fig. 1. This gauge, when at work, is tested in precisely the same manner as the one shown in Fig. 1.

Screw plugs are inserted at P P and Q Q, by the removal of which the apertures in the pipe can be cleared, if necessary, by the insertion of a wire or rod when steam is down.

Referring to Fig. 3 only.

In this gauge there is an open communication from A to C through the column Y, and in order to "blow through the *glass*" it is only necessary to shut cocks D and B alternately, keeping E open. But to "blow through the *water-gauge*," including the pipes H and I, it is necessary, after blowing through the glass as described above, to shut A and C alternately, at the same time keeping B, D, and E open for such time as will ensure the complete discharge of the contents of the gauge and its connections. When B, D, and C are clear and A choked, the steam lodging in the glass and in the pipe I leading from Y to A becomes condensed, and the water flowing through C to take its place rises in column Y and in the glass to a level above that of the water in the boiler. In other words, the gauge shows a false level. If now E be opened and water is blown out, then on E being again closed the water in the gauge will rise higher than before and be still further misleading. On the other hand, when B, D, and A are clear and C choked, the water (if any) in the glass is trapped, and no longer rises and falls with the water in the boiler or with the motion of the vessel; it, however, slowly rises in the glass owing to condensation of the steam in the upper part of the gauge until such time as E is opened, when the whole of the water in the glass is blown out, and on E being closed the glass does not show any water, notwithstanding that the water in the boiler may be at the proper level. When the test-cocks T T T are attached to column Y, as shown in Fig. 3, they cease to be reliable when either cock A or C or the pipe in connection therewith is choked or nearly choked.

Referring to Fig. 4 only.

Sometimes the water-gauge fittings are arranged as shown in Figs. 4 and 5, with no passage up the column, the central portion (N) of the column being simply a pillar or connecting-piece of any convenient section between the upper and lower portions to which the cocks B and D are attached.

By this arrangement double communications are obviated, and there is no need for what is known as "double shut-off" in testing the accuracy of the gauge. When, however, the gauges are constructed in this manner the cocks B and D are unreliable as test-cocks in the event of there being no glass in the gauge. This feature should be carefully noted. Moreover, when in working-condition the reduction of pressure in the glass which arises when E is opened causes the water in pipe H to rise above its normal level. This objectionable feature should also be noted.

Referring to Fig. 5 only.

Sometimes there is a bend (L) in the steampipe (I) leading from cock A to cock B. This has occasionally escaped observation when new boilers have been fitted on board ship. In most cases this bend arises from the pipe being led in an abnormal direction to escape other pipes, beams, or fittings near the smoke-box. With such a bend the condensed steam collects in the pipe and falls to the bottom of the bend, and in time it completely fills the pipe from J to K. The steam from K down to the level of the water in the glass is thereby trapped, and as condensation proceeds leads to a reduction of pressure in the pipe below that of the boiler and an equivalent rise of the water in the bend and also in the gauge-glass. When the vessel is quiescent the water in the gauge-glass increases in height until cock E is opened, or until the pressure in the boiler is so much in excess of that in the lower part of pipe I as to cause the water in the bend to be blown into the gauge-glass. In either case instantaneous change of water-level ensues.

In the ordinary course of working the phenomenon described above is more or less modified by the presence of air in the upper part of the gauge, and by the rise and fall of the water in the boiler and gauge-glass arising from the rolling or pitching motions of the vessel.

Other Special Points to be noted.

When the cocks A and C are omitted, as in Fig. 2, it is owing to the bore of the standpipe being sufficiently large to enable it to be regarded as part of the boiler. Such pipes require, however, to be examined and cleared at intervals by passing a rod through the holes provided for the purpose at P P and Q Q.

Cocks at A and C are not necessary for the testing of gauges arranged as shown in Figs. 4 and 5. Examiners ought, however, to make sure that candidates are aware of the impossibility of testing the reliability of the indications of water-gauges arranged as in Fig. 3 when the cocks A and C are absent, and of the effect which the choking of cock A or C, or pipe H or I, has on the indications of the test-cocks T T T attached to column Y.

Probably more than half the steamers afloat are fitted with water-gauges as shown in Figs. 3 and 4, and it is therefore specially important that engineer candidates should thoroughly understand their construction, the principle on which they act, and the steps which must be taken to keep them in an efficient condition.

When fitting a gauge-glass into its place it is specially important that it should not be placed so high as to prevent a clearing-rod being inserted at G, Figs. 1, 2, 3, 4, and 5. This defect, especially if it occurs in a water-gauge attached to a boiler subject to priming, permits a rapid accumulation of scum around the top of the glass, and results in the choking of the orifice leading from cock B to the gauge-glass in each of the figures.

When a gauge-glass is too short, or is placed either too high or too low in the fittings, it is also liable to become choked by the packing-material being forced over its ends by the glands whilst being screwed up.

The use of unsuitable or insecure internal pipes in connection with either the ordinary glass gauge-cocks of the description shown in Fig. 1, or with test-cocks which are jointed to the boiler itself, should also be carefully guarded against.

Boiler casualties have resulted from the cocks B and D having the parts wrongly placed, as shown in Fig. 6, Plate II. In one case of that kind,