

**Improvements in Locomotive Boilers.**

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(CONTINUED FROM AUGUST ISSUE.)

BOILER STAYING is either of the gusset plate type in figs. 1 and 5, or the rod type indicated in figs. 3 and 4, detail of the usual design of rod staying being shown in fig. 12. Administrations replying, indicate on the whole, a preference for rod staying, and those having experience with both styles, prefer the rod stays to the gusset plates. The rods are both cheaper to instal and easier to repair, the strain on the stay can be more accurately adjusted, and any defects which may occur more easily detected. The gusset plates have been found in some cases to loosen and crack with age, and should such cracks occur through the rivet holes in the gusset plates they are hidden, and can only be detected by a most careful inspection. These defects are probably caused by the gusset plates not being applied in such a way as to ensure the rivets being strained to an equal amount, but as this is difficult in practice, there seems to be no doubt that the rod staying is actually preferable, both on account of its being possible to cause it to bear its proper portion of strain and the greater ease with which it can be inspected and maintained.

**FIRE-BOX STAYING.**—The administrations using the round top fire-box construction employ almost universally the direct radial stay for fire-box crown stays, with the exception of the first few rows, which are usually sling stays of various types. A number of rows of sling stays varies with different administrations, but, while some use two or three rows, usually the first four front rows are of this construction. The majority of administrations use button headed stays screwed into the fire-box sheet from the inside of the fire-box for the six or eight centre rows of radial stays. This general arrangement is shown in fig. 13, which shows eight rows of button headed stays in the centre, and ordinary radial stays for the rows on either side. Fig. 14 shows the form of buttonhead usually used on the central rows of stays, the part next the fire-box sheet being recessed near the centre, so as to force the head of the stay to bear tightly against the sheet on its outer edges, in order to allow of it being more easily caulked and kept tight. This construction has largely superseded the rivetted head stay, and the type common in Belpaire boilers in which a nut is used underneath the fire-box crown sheet in order to provide greater strength than is given by the ordinary rivet head.

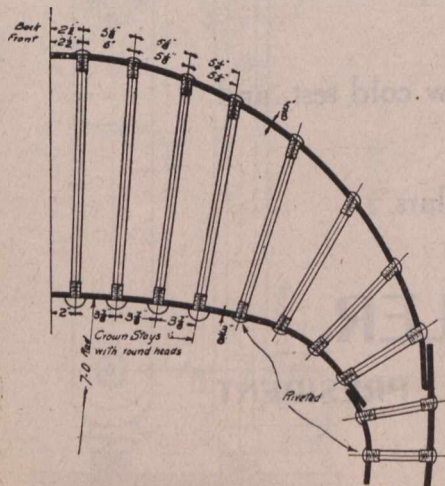


Fig. 13

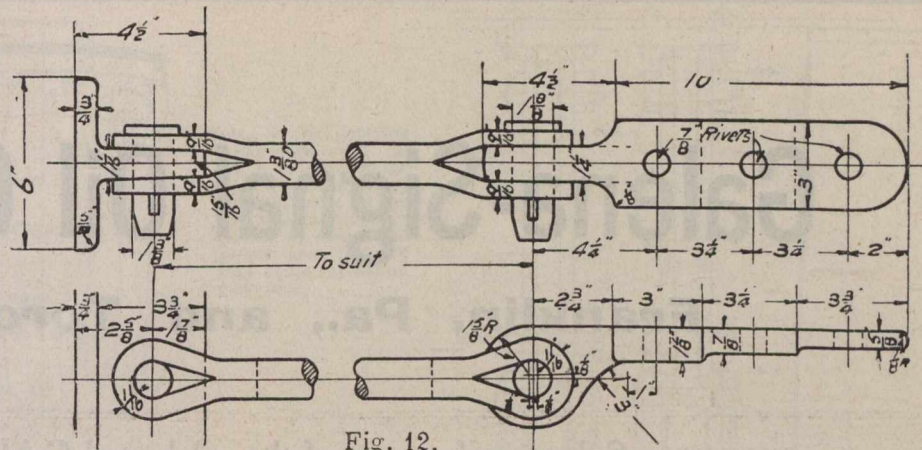


Fig. 12.

The form of sling or expansion stays in use for the front rows of staybolts are shown in figs. 15, 16 and 17. Fig. 15 shows a T-iron sling stay which is in very general use. Figs. 16 and 17 show sling stays employing an eye bolt on the portions rivetted into the fire-box crown sheet and outside fire-box sheet, which are respectively connected by two bars or welded rods forming a link between the top and bottom bolts. A type of expansion stay has also recently been introduced which simply consists of a flexible staybolt rivetted into the fire-box crown sheet. In some cases these designs are modified to permit the use of a button head on the side underneath the fire-box crown sheet, or nuts are used in order to furnish additional strength. The button head construction has about twice the strength of the ordinary rivet head stay when heated to a dull red heat and it has been found that when the crown sheet becomes overheated through an absence of water, that, if the centre rows of stays are of the button head or nut construction throughout, they do not give way until the crown sheet is heated to such a high temperature, that, when failure finally occurs, the sheet is liable to be forced down from end to end. Such an explosion is serious and has torn the boiler apart from the frames and caused serious damage. By using rivetted heads for the front four rows, which are in modern boilers, with sloping top fire-boxes, the highest part of the fire-box and in a location which is overheated before the remainder of the crown sheet is uncovered, these rows will give way before the button heads or nutted stays supporting the remainder of the sheet are overheated sufficiently to seriously affect their strength. They thus act to a certain extent in the same way as a fusible plug and by allowing the steam and water to escape into the fire-box and put out the fire, prevent serious damage occurring.

The universal use of sling or expansion stays for the front rows is largely due to their having been found to reduce the tendency of the flue sheet to crack along the root of the upper flange. Considerable upward movement has been found to occur in the crown sheet of the fire-box with reference to the outer fire-box sheet as the boiler is being heated. No upward movement could of course occur when the crown sheet is exposed to the boiler pressure, as it is not of sufficient strength to sustain this pressure without the load being taken by the stays, but while the water in the boiler is being heated, the pressure on the crown sheet is comparatively small, while the inside fire-box and the outer sheets of the boiler may not be of the same temperature, and if the connections are rigid and relative movement is not permitted, the crown sheet and flue sheet may be forced to bend.

The ordinary crown bar construction

supported from the sides or ends of the fire-box is practically obsolete on new construction. A modification of this arrangement is shown in fig. 2 and in detail in fig. 18. This arrangement is used on the Union Pacific Rd. boilers, and is standard on the Harriman lines. It will be noticed that the front crown stay angle irons are connected to the sides of the boilers by links which provide the necessary staying to prevent the sides of the outer fire-box moving outwards under boiler pressure. Behind these horizontal stay rods are provided for the same purpose, and this arrangement thus closely resembles the Belpaire method of staying, with the exception that flat surfaces are not used, and crown bar construction is used in place of the staying of the Belpaire type. In fig. 18 the construction of the crown sheet stays is shown, from which it will be seen that the stays have a taper fit in the crown sheet, while the head of the stay is pressed tight against the sheet, a collar being used between the crown bar and the sheet in order to keep it in place. This construction is not a usual one in the U. S., although the administrations using it control a large number of locomotives. The administrations using radial stays combined with various designs of expansion stays for the front rows, report that their use is satisfactory and that they are preferable to crown stays which have of course been in extensive use on boilers of an older type. The Buenos Ayres and Rosario Ry. reports that it has both in use, but prefers the crown staying construction as with radial stays, cracking occurs along the top flange of the flue sheet, whereas with crown stays it does not. The general preference for radial stays in the U.S. must be ascribed to its being possible to keep the crown sheet free from scale with this form of staying whereas with the crown bar arrangement it is practically impossible to do so unless the water used is exceedingly good.

**INSIDE FIRE-BOXES** in the U.S. are universally of steel, and with very few exceptions the crown sheet, side sheet and back sheet are  $\frac{5}{8}$  inch in thickness. A few of the administrations use 7-16 or

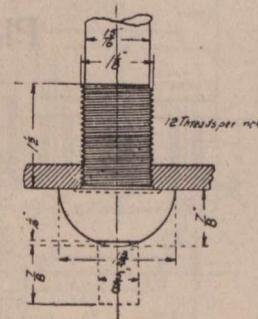


Fig. 14