Oct. 18, 1932. H. S. HORSMAN 1,882,845

WATER TUBE BOILER

Filed Nov. 13, 1928

Fig. 1

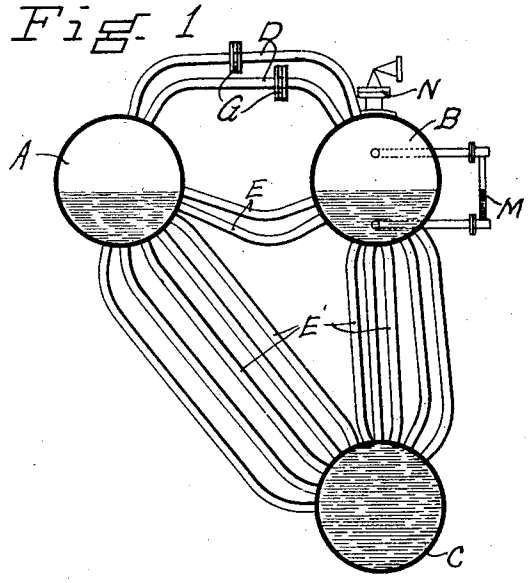


Fig. 2

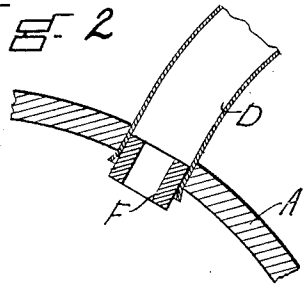


Fig. 3

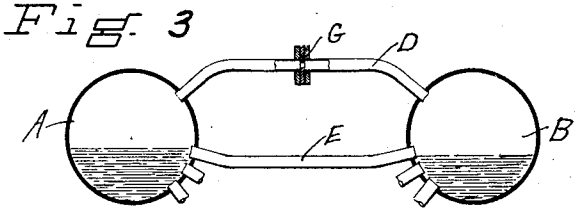


Fig. 4

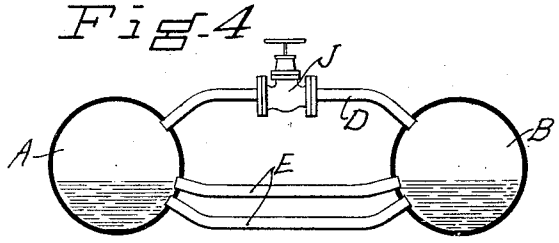
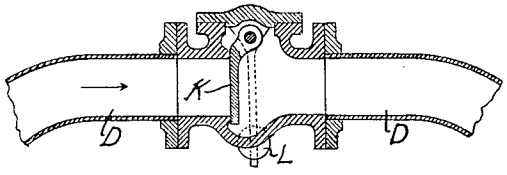


Fig. 5



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1,882,845

UNITED STATES PATENT OFFICE

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WATER TUBE BOILER

Application filed November 13, 1928, Serial No. 319,029, and in Great Britain January 25, 1928.

This invention relates to improvements in water tube boilers having more than one steam and water drum or a divided steam and water drum.

It is found in certain types of water tube boilers having more than one steam and water drum or a divided drum that the water levels are different in the several drums or steam and water spaces and these levels vary with each change in load. The difference in levels may be so great that when one drum or one half of the drum has a normal water level as indicated in the water gauge, the other drum or other half may be quite full of water.

In most designs the steam and water drums are connected by steam and also by water connecting tubes. It is found that the freer the passage through the steam connectors the greater the level differences will be for a particular load. As a result of experimental research I have found that the resistance of the steam cross tubes or steam passages may be depended on to prevent excessive level differences, and also to prevent the passage of a so-called emulsion of steam and water through the so-called steam connectors. This invention is especially useful where the steam outlet to the steam main and the water level gauge are connected to the same drum.

The difference of pressure due to the resistance of the steam connectors has to be balanced by a modification of the water levels, the hydraulic head corresponding to the change of levels being equivalent to the pressure loss through the steam connectors.

Experiments already conducted go to show that when the boiler is evaporating 8 pounds per hour for every square foot of external tube heating surface, the excess pressure within the front drum should not be less than $\frac{1}{10}$th of a pound per square inch, if filling of the front steam and water drum is to be avoided at all rates of steaming.

According to the present invention, therefore, the steam connectors between the drums or steam passages between the divided drum are arranged to afford a resistance which causes a pressure loss of not less than $\frac{1}{10}$th of a pound per square inch, when the evaporation of the boiler is 8 pounds per hour for every square foot of external tube surface.

The excess pressure within the front drum or front half will increase almost as the square of the load and consequently the water in the front drum or front half will be forced down as the load increases. The amount of depression, as this is called, is limited by the fact that at a certain critical load the ends of the uppermost row of water cross tubes or passages will become uncovered, and they will then convey an emulsion of steam and water to the rear drum or rear half. If the uppermost row of water cross tubes or passages has a large carrying capacity, the level of the front drum or front half will remain constant at the level of these tubes for any load above the critical value. Under these conditions, moreover, the level in the front drum or front half is practically independent of that in the rear drum or rear half.

The steam connectors generally take the form of tubes or passages, but steam pipes containing valves or other devices to regulate the resistance may be used. The highest connecting tube or passage between the drums, or the highest row of connecting tubes or passages, constitutes or constitute the main steam carriers and these are the tubes referred to herein.

The invention is illustrated in the accompanying drawing in which

Fig. 1 shows diagrammatically a tri-drum boiler in which the level in the front drum is depressed due to the provision of the arrangement of the invention; Figs. 2, 3, 4, and 5 are sectional detail views illustrative of various ways in which a resistance can be interposed in the steam connectors whereby the pressure within the front steam and water drum may be increased and the level in such drum thereby depressed.

In the various figures, in which like references indicate like parts, A is the front steam and water drum or front half, B the rear steam and water drum or rear half and C the lower or mud drum. D indicates the steam connectors or passages between the drums A and B, and E indicates the water

connectors. E′ indicates the boiler tubes connecting the drums A and B to the drum C. The front bank of tubes E′ connecting the drums A and C is contacted by the hottest gases so that most or all of the steam is generated in these tubes with the result that the drum A receives most of the steam or all of it, while very little, if any, steam is generated in the tubes E′ between the drums B and C and passes into the drum C from these tubes.

In Fig. 1, the tubes are made of such a diameter as to afford sufficient resistance to produce the higher pressure drop.

In the arrangement shown in Fig. 2, the resistance in the steam connectors D is provided by means of a ferrule F driven into the end or ends of such steam connectors.

In Fig. 4 the arrangement employed consists of a screw-down valve J adapted for adjustment by the operator.

In Fig. 5 is shown an arrangement consisting of a flap valve K interposed in the steam connector D and loaded by means of an external lever and weight L or by internal or external springs.

A water gauge M is connected to the rear drum B from which drum the steam is taken off through the outlet N. By this invention the restriction or resistance in the steam connection between the drums A and B will prevent the water from rising so high in the drum A as to cause priming when the gauge M indicates the proper water level in the drum B.

The invention is also applicable to a boiler having a single steam and water drum that is divided into separate steam and water spaces by a partition with openings therethrough connecting the separate spaces, the openings above the water spaces being restricted as above indicated to provide the proper pressure drop.

The illustration shows a Stirling boiler, but there are numerous other boilers in which the same problem arises. The invention is not necessarily confined to boilers having a divided steam and water drum or two steam and water drums, but is also applicable to boilers having any greater number of such drums. For the purposes of the invention a steam and water header may be regarded as equivalent to a steam and water drum.

I claim:

1. In a boiler having a front steam and water drum and a rear steam and water drum, a lower drum connected by tubes to said steam and water drums, the tubes connecting said lower drum to said front drum being located so that they are contacted by the hottest gases and have the most of the steam generated in them and delivered to said front drum, steam connections between said front and rear drums, and a restriction in said connections to cause greater pressure in said front drum and tend to equalize the water levels in said steam and water drums.

2. In a boiler having a front steam and water drum and a rear steam and water drum, a lower drum connected by tubes to said steam and water drums, the tubes connecting said lower drum to said front drum being located so that they are contacted by the hottest gases and have the most of the steam generated in them and delivered to said front drum, a steam outlet from the steam space of said rear drum, steam connections between said front and rear drums, so that steam flows from said front drum to said rear drum and thence through said outlet, and a restriction in said connections to cause greater pressure in said front drum and tend to equalize the water levels in said steam and water drums.

3. In a boiler having a front steam and water drum and a rear steam and water drum, a lower drum connected by tubes to said steam and water drums, the tubes connecting said lower drum to said front drum being located so that they are contacted by the hottest gases and have the most of the steam generated in them and delivered to said front drum, steam connections between said front and rear drums, and a restriction in said connections sufficient to cause a pressure loss of not less than one tenth of a pound per square inch when the evaporation rate in said boiler is eight pounds per hour per square foot of external tube surface.

HENRY SHILLETO HORSMAN.

CERTIFICATE OF CORRECTION.

Patent No. 1,882,845. October 18, 1932.

HENRY SHILLETO HORSMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, after line 18, insert the following paragraph —

> "In Fig. 3 the resistance comprises an orifice plate G interposed in the steam connecter D.";

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of February, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.