Dec. 11, 1951 A. WILLIAMS 2,578,332

WATER TUBE FIREBOX FOR LOCOMOTIVE BOILERS

Filed Feb. 12, 1946 2 SHEETS—SHEET 1

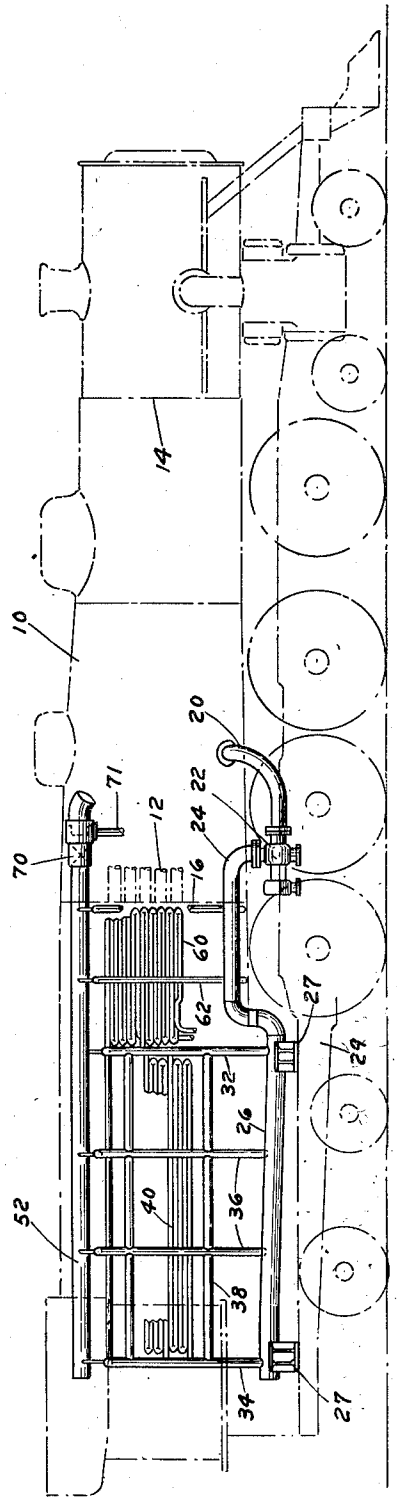


FIG. 1.

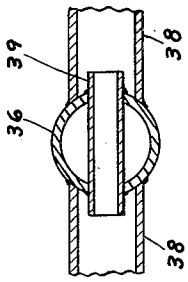


FIG. 2.

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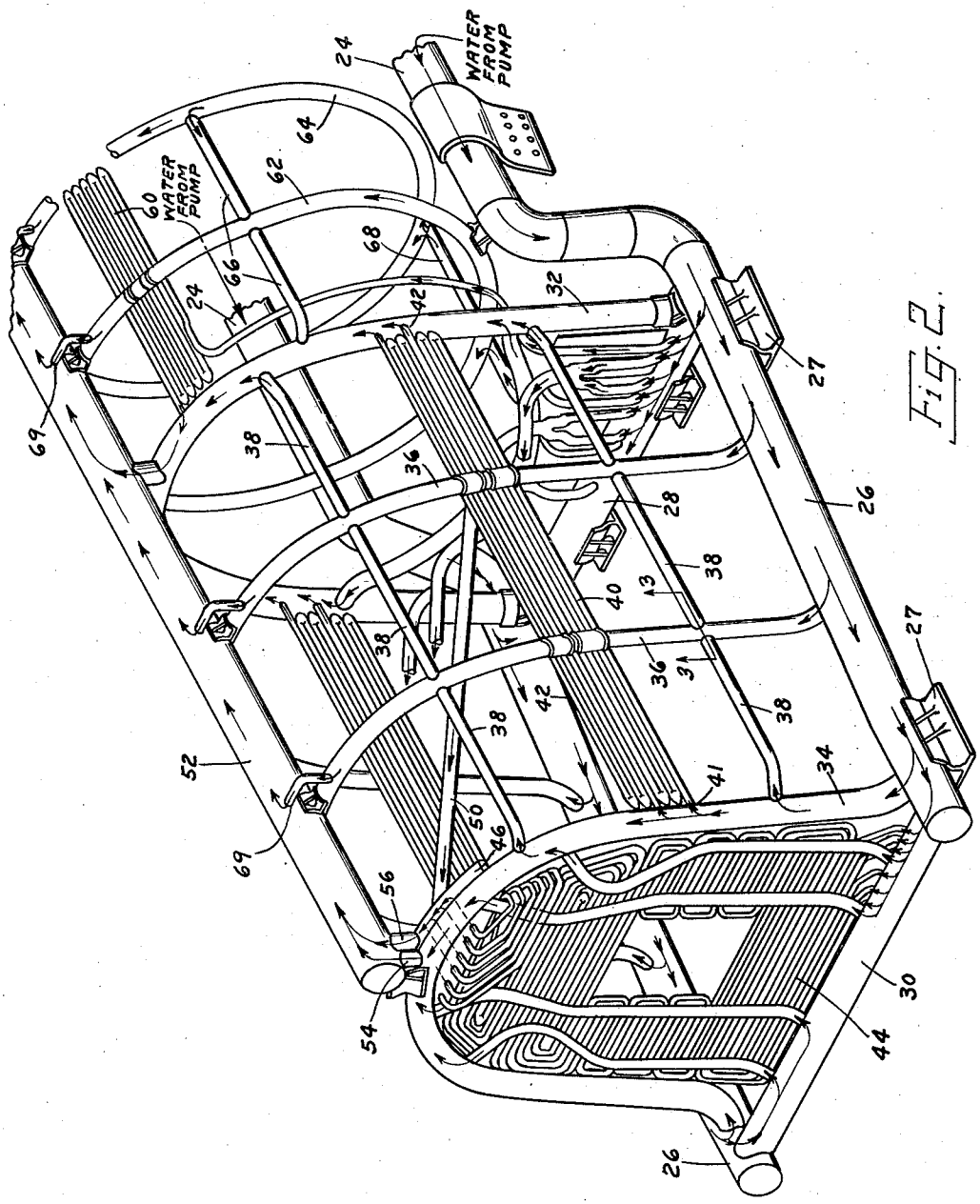


Fig. 2.

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WATER TUBE FIREBOX FOR LOCOMOTIVE BOILERS

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Application February 12, 1946, Serial No. 646,981

8 Claims. (Cl. 122—58)

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The present invention relates to steam locomotives and particularly to an improved water tube fire box for such locomotives.

The present invention contemplates a water-cooled supporting structure for radiantly heated water circulating tubes constituting the walls of a locomotive fire box. The structure is so designed that the fire box structure supports not only its own weight but also that of the grates and the outer protective lagging and sheeting. A further advantage of the improved construction is that it may be manufactured as a unit for use on new locomotives and may readily be removed and replaced and also substituted for the conventional stayed fire box of a locomotive already in service.

The invention will be best understood upon reference to the following detailed description of an illustrative embodiment of the invention when read in conjunction with the accompanying drawings in which:

Figure 1 is an elevational view of a steam locomotive embodying a water tube fire box constructed in accordance with the present invention.

Figure 2 is an enlarged perspective view of the water tube fire box shown in Figure 1.

Figure 3 is a sectional view on the line 3—3 in Figure 2 and shows a detail of construction.

The locomotive illustrated in Figure 1 has a fire tube boiler section or water barrel 10 of conventional construction involving a plurality of fire tubes and flues 12 extending through the water space of the boiler 10 and seated at their ends in the front and rear tube sheets 14, 16 respectively. An exterior conduit 20 connects into the lower side portion of the water barrel 10 and leads to the inlet side of a water pump 22. Although shown in the drawings only on the right hand side of the locomotive, the connection 20 and pump 22 are preferably duplicated on the left side. In the construction shown in Fig. 2 the pumps at either side of the locomotive discharge through conduits 24 into tubular headers 26 that extend along the sides of the fire box at the lower portion thereof and are supported adjacent either end by saddle blocks 27 mounted on the locomotive base 29 (Figure 1). At the forward and rear ends of the fire box the headers 26 are interconnected by cross-headers 28, 30 respectively. Also, at the front and rear ends of the fire box are the U-shaped conduits 32, 34 respectively connected at their ends into the headers 26 and disposed transversely of the locomotive frame. The supporting structure for the

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water wall of the fire box also includes additional U-shaped supporting tubes 36 mounted in spaced relation between the conduits 32, 34 located at the ends of the fire-box. The intermediate supports 36 are joined to the supporting tubes 32, 34 at the ends of the fire box to form a cage-like supporting structure by means of brace pipes 38 extending longitudinally in vertically spaced relation along the sides and roof of the fire-box. As shown in Figure 3 a fluid connection between contiguous brace pipes 38 is obtained by welding the ends of these sections in abutment against the transverse supports 36 which are pierced laterally in alinement with the axes of the pipe sections 38 by tubes 39.

The side walls and roof of the fire box proper are lined by the looped elements 40 each comprising an odd number of parallel tubes interconnected at adjacent ends by integral return bends with the inlet 41 and outlets 42 of the elements located at opposite ends and connected into the main transverse supports 34 and 32 respectively. The tubes constituting the elements 40 are in contact with each other or may be provided with fins in the intertube spaces so that the adjacent elements constitute a complete water cooled wall completely enclosing the fire box at its sides and roof. The tubes of elements 40 are spot welded to the supporting conduits 36 or may be held thereto by suitable clips. The rear wall of the fire box is similarly lined, except for the fire box opening or access door, with looped elements 44 connected at one end into the rear transverse conduit 30 and at the ends near the top of the fire box into an auxiliary header 46. This header also receives the forward ends of arch tubes 50 supplied at their lower forward ends from the transverse header 28. Extending along the top of the firebox is a steam collecting header 52 connected with the mid and highest portion of the rear transverse support 34 by means of a nipple 54 and also with the supplementary header 46 by means of a nipple 56. The mid-points of the intermediate transverse supports 36 which are also located at the top of the fire box are also connected to discharge into the collecting header 52.

Forwardly of the fire box the combustion chamber is also lined with longitudinally extending looped elements 60 which at the rear ends partly circle the combustion chamber and then extend downwardly into the transverse header 28 at the front end of the fire box. The discharge ends of the elements 60 are connected into the forward transverse support 32 which also defines the rear

end of the combustion chamber. Like the firebox elements 40 the elements 60 on the walls of the combustion chamber are supported by connection to longitudinally spaced transverse supports 62, 64 which in this case are of circular form but interconnected like the firebox transverse supports by longitudinally extending brace tubes 66 spaced at intervals around the combustion chamber. These circular supporting members are supplied near their bottom parts from transverse header 28 through tubes 68 and then discharge at their upper parts through nipples 69 into header 52. This header discharges into the steam space of boiler 10 (Fig. 1) through a tangential separator the water from which is led off through a pipe 71.

In the form described above the water tube firebox does not rely for support upon special structural frames, nor upon being hung from a surrounding casing structurally as is frequently the case with locomotive boilers. The supporting structure, consisting of the headers 26, along opposite sides of the firebox at the base thereof and the bowed conduits 32, 34, 36 interconnecting the latter together with the longitudinal tubes 38 that join adjacent bowed tubes, constitutes a water cooled supporting structure for the walls of the firebox which is not directly exposed to radiant heat. The entire firebox unit is a rigid unitary construction maintained without external support since the bowed conduits 32, 34 and 36 have sufficient strength to maintain themselves as well as to hold the side wall tubes 40 in proper relation.

Inasmuch as the water tube fireboxes described above each constitute a forced circulation steam generator, their various circuits need not be of exactly the same length since appropriate orifices may be used at the entrance of each particular circuit in accordance with its needs; such orifices may also compensate for unequal heat absorption by different circuits of equal length.

What I claim is:

1. In a locomotive having a boiler and a firebox space therefor; the combination therewith of headers extending along opposite sides of the firebox space at the base thereof; inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of horizontal tubes spaced around the firebox space on the sides thereof attached to and interconnecting said U-shaped tubes to form a rigid cage-like supporting structure disposed over the firebox space; a steam collecting header extending centrally along the top of the firebox space and connecting at its forward end into the steam space of said boiler; connections between said steam collecting header and said inverted U-shaped conduits at substantially the tops thereof; and steam generating tubes connected at opposite ends to the U-shaped conduits at the rear and the front of the firebox space and disposed in parallel longitudinally of the firebox space in contacting relation inwardly of said intermediate U-shaped conduits to form a water wall for the sides and top of the firebox space.

2. In a locomotive having a boiler and a firebox space therefor; the combination therewith of headers extending along opposite sides of the firebox space at the base thereof; inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of horizontal tubes spaced around the firebox space on the sides thereof attached to and interconnecting said U-shaped tubes to form a rigid cage-like supporting structure disposed over the firebox space; a steam collecting header extending centrally along the top of the firebox space and connecting at its forward end into the steam space of said boiler; connections between said steam collecting header and said inverted U-shaped conduits at substantially the tops thereof; steam generating tubes connected at opposite ends to the U-shaped conduits at the rear and front of the firebox space and disposed in parallel longitudinally of the firebox space in contacting relation inwardly of said intermediate U-shaped conduits to form a water wall for the sides and top of the firebox space; and means supporting said generating tubes from said intermediate U-shaped conduits.

3. In a locomotive having a boiler and a firebox space therefor; the combination therewith of headers extending along opposite sides of the firebox space at the base thereof; inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of horizontal tubes spaced around the firebox space on the sides thereof attached to and interconnecting said U-shaped tubes to form a rigid cage-like supporting structure disposed over the firebox space; and water circulating tubes lining the sides and top of said firebox space and supported by connection with said U-shaped conduits.

4. In a locomotive having a boiler and a firebox space therefor; the combination therewith of longitudinal headers extending along opposite sides of the firebox space at the base thereof; inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of horizontal tubes spaced around the firebox space on the sides thereof attached to and interconnecting said U-shaped tubes to form a rigid cage-like supporting structure disposed over the firebox space; a conduit extending centrally along the top of the firebox space and attached to said U-shaped conduits; transverse headers at the base of the firebox space interconnecting said longitudinal headers at the front and rear of the firebox space; arch tubes connected at their forward ends to the transverse header at the front of the firebox space; and an auxiliary steam collecting header connected to the rear ends of said arch tubes.

5. In a locomotive having a boiler and a firebox space therefor; the combination therewith of longitudinal headers extending along opposite sides of the firebox space at the base thereof; inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of horizontal tubes spaced around the firebox space on the sides thereof attached to and interconnecting said U-shaped tubes to form a rigid cage-like supporting structure disposed

over the firebox space; a conduit extending centrally along the top of the firebox space and attached to said U-shaped conduits; transverse headers at the base of the firebox space interconnecting said longitudinal headers at the front and rear of the firebox space; arch tubes connected at their forward ends to the transverse header at the front of the firebox space; an auxiliary steam collecting header connected to the rear ends of said arch tubes; and steam generating tubes connected at one end to said transverse water header at the rear of the firebox space and at their other ends to said auxiliary steam collecting header and arranged to form a water wall at the rear end of the firebox space.

6. In a locomotive having a boiler, a firebox space therefor and headers extending along opposite sides of the firebox space at the base thereof; the combination therewith of inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of groups of horizontal tubes each group comprising a plurality of axially alined tubes attached to and interconnecting said U-shaped tubes with the groups spaced around the firebox space on the sides to form a rigid cage-like supporting structure disposed over the firebox space, the horizontal tubes attached to the U-shaped conduits at front and rear of the firebox space being in fluid circulation therewith; and auxiliary tubes extending through the intermediate U-shaped conduits in alinement with the axes of the alined horizontal tubes attached to intermediate conduits for placing said horizontal tubes in fluid communication to establish fluid paths from the rear conduit to the forward conduit.

7. In a locomotive having a boiler, a firebox space therefor and headers extending along opposite sides of the firebox space at the base thereof; the combination therewith of inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of groups of horizontal tubes, each group comprising a plurality of axially alined tubes attached to and interconnecting said U-shaped tubes with the groups spaced around the firebox space on the sides to form a rigid cage-like supporting structure disposed over the firebox space; a steam collecting header extending centrally along the top of the firebox space and connecting at its forward end into the steam space of said boiler; connections between said steam collecting header and said inverted U-shaped conduits at substantially the tops thereof; and other parallel tubes extending longitudinally of the firebox space and connected for fluid circulation between said rear and forward U-shaped conduits and arranged in contacting relation to form water cooled side walls and roof for said firebox space.

8. In a locomotive having a boiler, a firebox space therefor and headers extending along opposite sides of the firebox space at the base thereof; the combination therewith of inverted substantially U-shaped conduits in fluid communication with and interconnecting said headers at the front and rear of the firebox space and at a number of intermediate points spaced at intervals equal to several times their diameter; a plurality of groups of horizontal tubes, each group comprising a plurality of axially alined tubes attached to and interconnecting said U-shaped tubes with the groups spaced around the firebox space on the sides to form a rigid cage-like supporting structure disposed over the firebox space; a steam collecting header extending centrally along the top of the firebox space and connecting at its forward end into the steam space of said boiler; connections between said steam collecting header and said inverted U-shaped conduits at substantially the tops thereof; other parallel tubes extending longitudinally of the firebox space and connected for fluid circulation between said rear and forward U-shaped conduits and arranged in contacting relation to form water cooled side walls and roof for said firebox space; and substantially continuous circular conduits surrounding the combustion chamber forwardly of said firebox space and connected at their top portions with said steam header.

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