March 21, 1967 R. MICHEL 3,310,040

ONCE-THROUGH BOILER WITH WELDED TUBE SYSTEM

Filed March 25, 1965 2 Sheets-Sheet 1

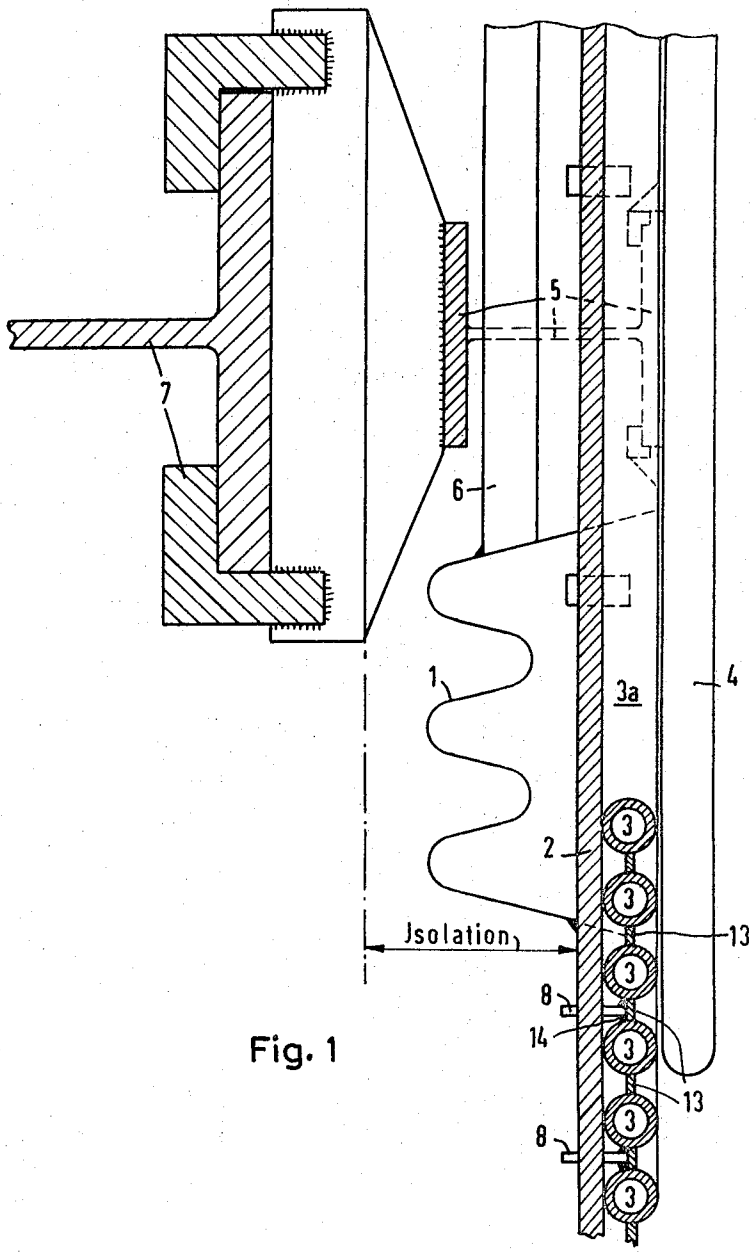

Fig. 1

March 21, 1967 R. MICHEL 3,310,040

ONCE-THROUGH BOILER WITH WELDED TUBE SYSTEM

Filed March 25, 1965 2 Sheets-Sheet 2

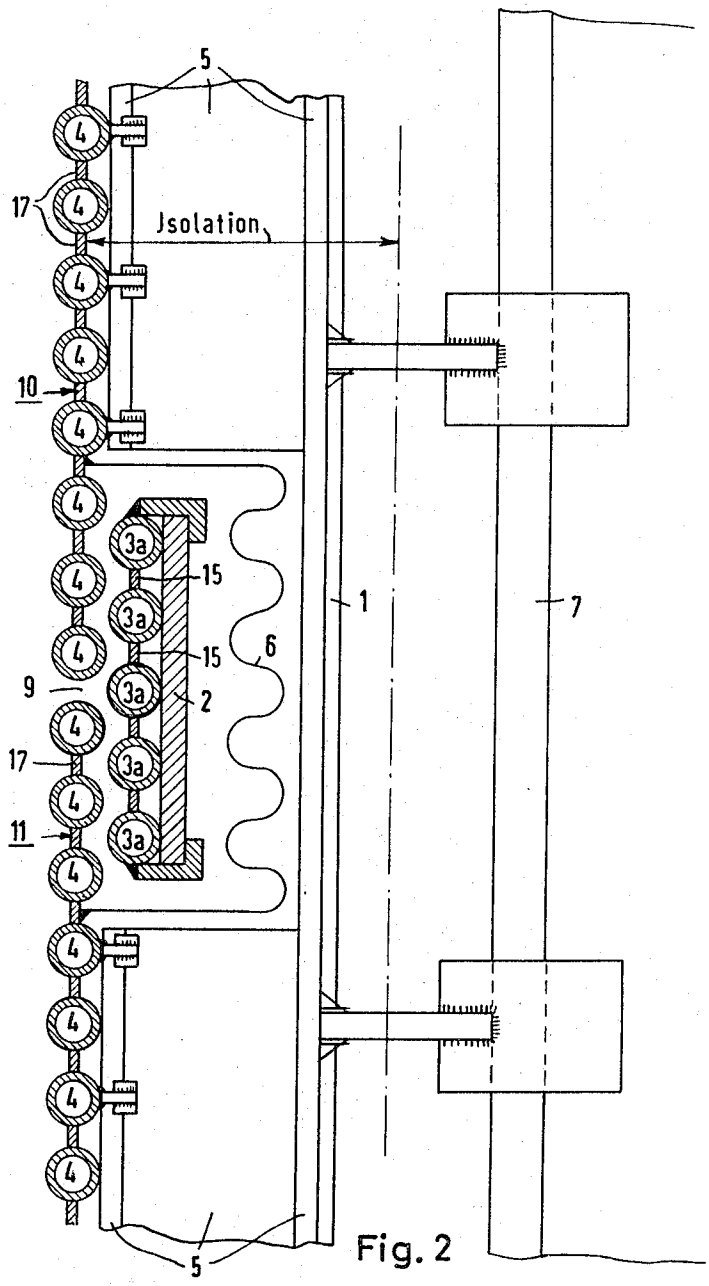

Fig. 2

United States Patent Office 3,310,040 Patented Mar. 21, 1967

3,310,040

ONCE-THROUGH BOILER WITH WELDED TUBE SYSTEM

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Filed Mar. 25, 1965, Ser. No. 442,605
Claims priority, application Germany, Mar. 26, 1964, S 90,244
2 Claims. (Cl. 122—510)

This invention relates to boilers of the once-through type as disclosed in the co-pending application of Rupprecht Michel, Ser. No. 234,484, filed Oct. 31, 1962, for Pressure-Fired Once-Through Boiler, and more particularly to a once-through boiler having superpressure firing, in which the tubes of the evaporator in the lower fire chamber region are wound about the combustion chamber in constant or progressive slope and welded together to form a thick wall. This welded tube system is suitably suspended on vertical flat bars disposed directly therebehind.

According to the earlier suggestion as previously disclosed by me, for a once-through boiler with super-pressure firing, vertically rising outlet tubes carry the radiation superheater located in the upper part of the firing chamber, rising flatly or at a slight incline in the region of the firing chamber; while the flatly rising evaporator tube strips are suspended from carrying brackets suspended from above. In such a once-through boiler the evaporator tubes pass about all sides of the firing chamber, in part horizontally, in part rising flatly, and wind about the combustion chamber, then bend upwardly at a certain height. Such deflection area lies in the upper fire chamber region, at about two thirds of the entire fire chamber height, whence the evaporator outlet tubes are led vertically upward. The outlet tubes end in the region of the fire chamber roof.

The present invention starts from this principle of the suspended boiler and has its concept residing in that the vertical evaporator outlet tubes in a once-through boiler are preferably welded together and combined in groups; and that these welded together tube groups are arranged in such a way that they thermally protect carrying brackets for the tube strips of the evaporator wound about the firing chamber.

According to the present invention, thus, the flat plates carrying the welded together evaporator tube system are protected in the upper region of the radiation superheater by the here vertically rising and welded together evaporator outlet tubes against undesirable thermal radiation. Here in the region of the radiation superheater, the U-shaped tubes are suitably welded together into strips of two to three m. in width. The expansion joints between these bands should in each case be at the points where the evaporator tubes are led up vertically so that there is present an overlap for prevention of fire chamber radiation. The sealing of the independently suspended heating surfaces of the evaporator system opposite the radiation superheater takes place, for instance, through a horizontal diaphragm running about the entire firing chamber. The vertical separation joints in the region of the radiation superheater are then packed by means of vertical diaphragms.

In the region of the radiation superheater horizontal, hot wrappings lying immediately behind the tubes, for instance in double T-form, are suitably placed about the firing chamber and welded together in the firing chamber corners. At all the points where the vertical bearing construction passes through, suitable cutaways are provided in the horizontal wrappings. In the region of the evaporator such horizontal wrappings are not necessary because the forces are taken up by the horizontally lying

or only slightly rising, welded together groups of tubes themselves.

The boiler may have its tubes for its horizontal pass and the second pass constructed of welded together tube walls inserted between the evaporator and the radiation superheater in the working medium flow. The sealing of the fire chamber roof may be effected in a conventional manner, for instance through a plate cover and packing insulation for the thrust-through superheater heating surfaces, with an air chamber laid over the entire fire chamber, the air chamber being kept at a suitable excess pressure with respect to the firing chamber pressure.

Once-through boilers with welded tube systems have already been constructed for very large boiler outputs. With a choice of very small tube diameters as for example, 10 mm. internal diameter, it was possible there, for system yields of 1,500 t./h., for the tubes in all firing chamber walls to be connected in parallel in one rise. The present invention is based on the knowledge that in boilers with smaller steam outputs up to 1,500 t./h., the arrangement of vertical tubes and parallel connection of all walls is not possible. This is so because with diminishing steam yields, the size of the combustion chamber decreases more slowly than the boiler output. This could very well be counteracted by choosing even smaller tube diameters; however, with the selection of internal tube diameters below 10 mm., the danger of clogging by foreign bodies and excess metal will be too great.

The concepts of the present invention features an evaporator system for a once-through superpresure-fired steam boiler having a combustion chamber. The evaporator system includes a plurality of evaporator tubes upwardly sloping at a slight incline and extending around said combustion chamber. Vertically extending supports are disposed in spaced relationship to the combustion chamber, and a plurality of strips are disposed between and welded to adjacent of said tubes so that the tubes and the strips form a tube wall. Brackets are secured to the supports and welded to the strips for supporting said tube wall on the supports with the evaporator tubes terminating in vertically extending outlet tubes, disposed between said chamber and said supports. The superheater is also similarly constructed, independently suspended and disposed between the combustion chamber and the evaporator tubes.

Still further objects and features of this invention reside in the provision of an evaporator system for a once-through superpressure-fired steam boiler that is extremely safe and self protective and which is substantially trouble free.

These, together with the various ancillary objects and features of this invention, which will become apparent as the following description proceeds, are attained by this evaporator system, a preferred embodiment being illustrated in the accompanying drawings by way of example only, wherein:

FIG. 1 is a vertical sectional view illustrating the evaporator system constructed in accordance with the concepts of the present invention; and

FIG. 2 is a horizontal sectional view through the boiler illustrating the evaporation section in detail.

With continuing reference to the accompanying drawings, wherein like reference numerals designate similar parts throughout the various views, FIG. 1 shows a vertical section in the region of about two thirds of the height of the combustion chamber of the boiler where the evaporator tubes 3 winding about the combustion chamber at first still rising at a slight incline there, double back and then terminate in evaporator outlet tubes 3*a* which rise vertically up to the combustion chamber ceiling. The radiation superheater 4 is independently suspended and extends substantially the full height of the evaporator.

The combustion chamber is located to the right of the

representation of FIG. 1. The still slightly inclined or substantially horizontally disposed evaporator tubes 3 are formed of cast iron and they are welded together into a tight tube wall by means of suitable strips 13. The strips 13 are alternately disposed between and welded to adjacent tubes 3. This tube wall is suspended from above on the boiler frame structure by means of carrier supports 2 which may be in the form of plates. Suitable brackets 8 are provided at intervals of about 10 to 15 cm. by means of which the tube wall made up of the evaporator tubes 3 is welded to the supports 2. The brackets are secured to the supports 2 and then welded, as at 14, to the strips 13.

The evaporator outlet tubes 3*a*, as is especially evident from FIG. 2, are welded together into separate groups so that they thermally protect the supports 2 against the heat radiating from the combustion chamber located to the left in FIG. 2. The evaporator outlet tubes 3*a* form a vertically extending wall through the use of strips 15 which are welded to adjacent tubes 3*a*.

The tubes of the radiation superheater 4 are U-shaped and are suspended independently of the evaporator system. The tubes may likewise be formed of cast iron or other suitable material and are welded together into tight wall sections with band-shaped intermediate straps 17. The parting line 9 between the two wall sections 10 and 11 of the radiation superheater 4 lies parallel to the suspension structure 2 for the evaporator tubes 3.

The tube walls 10 and 11 of the radiation superheater 4 may for example have a width of two to three meters. The vertical spaces between these walls 10 and 11 are covered and closed by a diaphragm sheeting 6 to make the superheater gastight. The differential expansion of the radiation superheater heating surface in the upper part of the combustion chamber with respect to the evaporator heating surfaces is taken up by a diaphragm system surrounding the entire combustion chamber. While in the region of the evaporator horizontal supports or wrappings are not required in the hot areas, such horizontal supports 5 in the form of double T-irons are provided in the region of the radiation superheater 4 on account of the vertical separating spaces. These T-irons may be welded at the corners of the combustion chamber. At all points where the vertical through-beam construction of the evaporator system extends, these supports are shown in cutaway section. At 7, are designated the cold, outlying supports which are necessary in the region of the evaporator as well as of the radiation superheater.

If need be, measures may be taken to counteract the danger of the incineration of the diaphragms 1 and 6 possibly arising with coal dust firings. These diaphragms should, for instance, be connected to the fresh air compressor in order to prevent the penetration of ashes.

A latitude of modification, change and substitution is intended in the foregoing disclosure, and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

I claim:

1. A once-through superpressure-fired steam boiler comprising a combustion chamber, an evaporator system including a plurality of evaporator tubes upwardly sloping at a slight incline and extending around said combustion chamber, vertically extending supports disposed in spaced relationship to said combustion chamber, a plurality of strips disposed between and welded to adjacent of said tubes so that said tubes and said strips form a tube wall, brackets secured to said supports and welded to said strips for supporting said tube wall on said supports, said evaporator tubes terminating in vertically extending outlet tubes, said outlet tubes being disposed between said chamber and said supports, a superheater disposed between said combustion chamber and said evaporator tubes and independently suspended from said evaporator system, said superheater including a plurality of U-shaped tubes, a plurality of strips welded to and spaced adjacent of said U-shaped tubes to form superheater wall sections spaced from one another in a common plane, the spaces between said superheater wall sections lying in said common plane and parallel to the supports for said evaporator system, and vertical diaphragm sheeting sealing said spaces against said combustion chamber.

2. A boiler according to claim 1, including a horizontally extending diaphragm disposed about the entire combustion chamber and welded to said vertical diaphragm sheeting adjacent said superheater.

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