July 30, 1940. H. MELHUISH 2,209,658

STEAM SUPERHEATER

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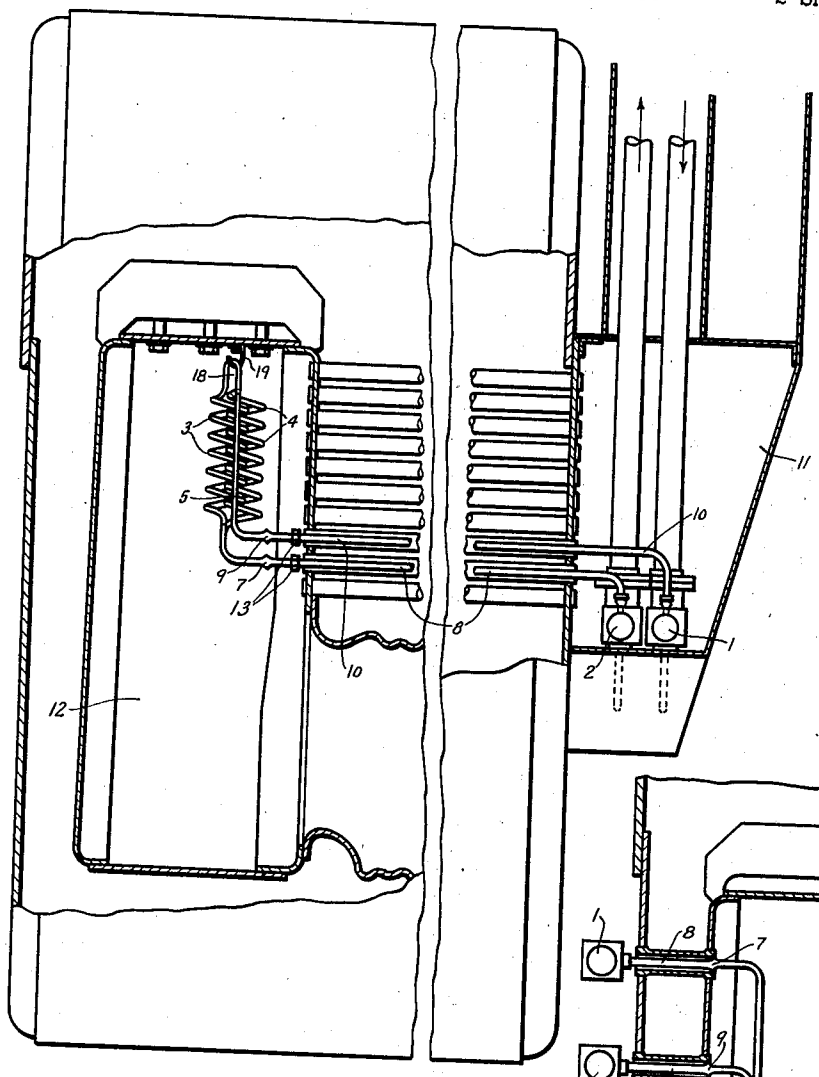


Fig. 1.

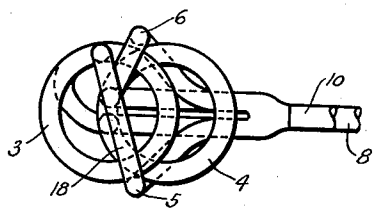


Fig. 2.

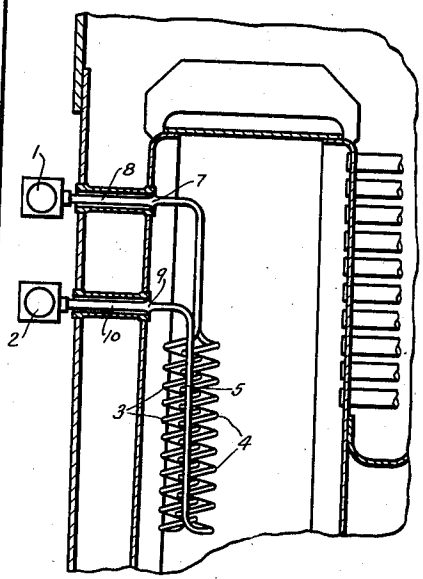


Fig. 3.

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STEAM SUPERHEATER

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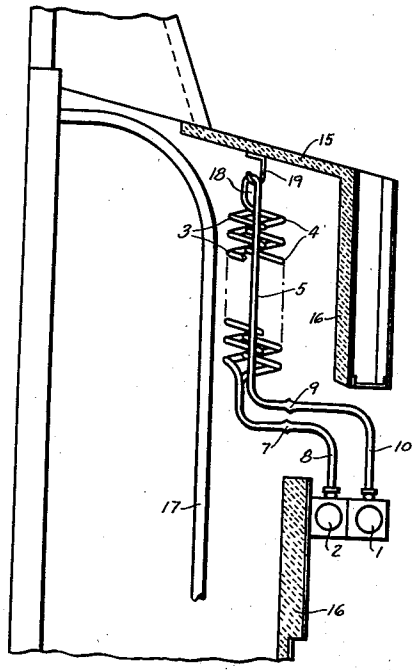


Fig. 4

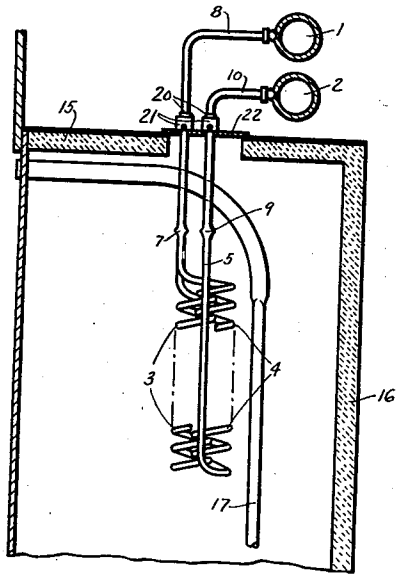


Fig. 5

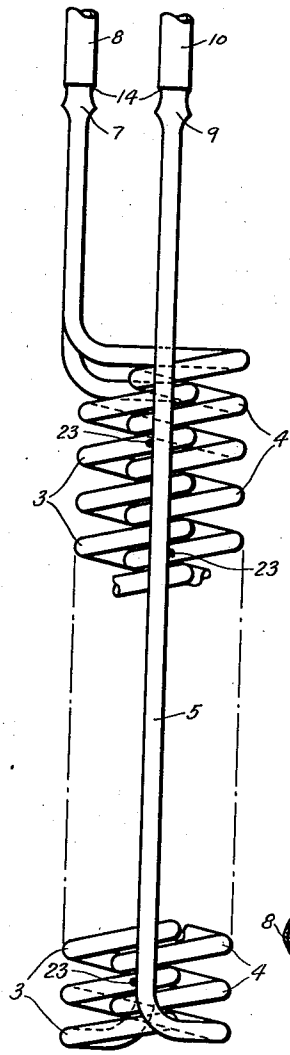


Fig. 6

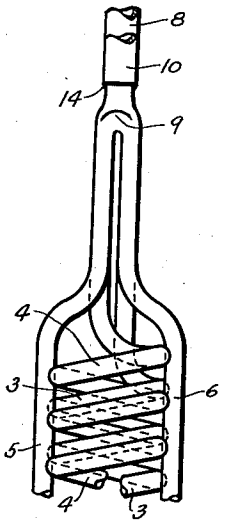


Fig. 7

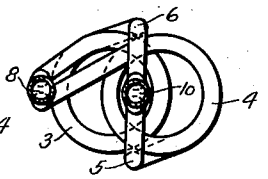


Fig. 8

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2,209,658

STEAM SUPERHEATER

Harold Melhuish, Chingford, England, assignor to The Superheater Company, New York, N. Y.

Application March 7, 1939, Serial No. 261,319
In Great Britain March 7, 1938

2 Claims. (Cl. 257—248)

This invention relates to steam superheaters for Marine, Cornish, Lancashire, Economic and other return smoke tube or return flue boilers, and is concerned particularly with steam superheaters the elements of which are disposed in the combustion or return chambers of such boilers.

It is the general object of the invention to provide an improved element for use in superheaters of the kind with which the invention is concerned, a specific object of the invention being to provide a superheater having elements which in addition to affording a large heating surface and easy paths for steam resulting in a low pressure drop through the superheater, may be supported largely by steam cooled means, whilst avoiding the use on the elements of bands or straps which frequently are formed of relatively expensive heat resisting material.

Another object of the invention is to reduce the number of connections which have to be made between the elements and headers having regard to the extent of the heating surface of the superheater, and where the headers are disposed outside the boiler to correspondingly reduce the number of places at which provision must be made for carrying the inlet and outlet legs of the elements to the outside of the boiler.

The invention also seeks to provide a steam superheater construction which, in addition to achieving the objects already stated, may have its elements arranged to be self-draining.

Various superheaters have been proposed heretofore in which the elements have comprised tube coils, and the superheater elements according to the present invention are of this generic type.

The invention consists in a steam superheater element, for use in boilers of the kind indicated, comprising a plurality of inter-twined tube coils providing fluid paths operating in parallel, each coil having in series with it a longitudinal portion of tubing extending from end to end of the coils parallel to their axes and welded to convolutions of the coils to constitute supporting and spacing means therefor, and the inner-twined coils having a single or common inlet and a single or common outlet for connection to the respective headers of the superheater.

In carrying the invention into practice the coiled tubes of an element may be united at one end of the intertwined coils to provide one common header connection whilst the longitudinal tubes in series with the coils are united to provide the other common header connection, steam thus flowing through the coils in the same direction. Alternatively where the element has two coils, each coil may have one end united to the longitudinal tube in series with the other coil to provide the two common header connections, steam flowing through the coils in opposite directions. The coils may be concentric, or may have their axes spaced apart, rendering one coil eccentric to the other.

Suitable suspension arrangements are provided for the elements. Where the headers are located above the level of the coils of the elements, such arrangements for each element may comprise tapped sleeves adjustable on threaded collars welded to the common inlet and outlet portions of the element and bearing on fixedly positioned overhead supports. Where the headers are disposed below the element coils the suspension arrangements for each element may be constituted by an upwardly directed and, it may be, reinforced loop of the tubing of the element, in series with one of the coils and bridging the intertwined coil portion of the element, and adapted to be engaged with an overhead supporting member or a short sling associated with the latter.

In a superheater comprising elements according to the invention the headers may be arranged at a level above or below the coiled portions of the elements, and the single inlet and outlet end portions of the respective elements may be connected to the appropriate headers by clamped joints or by being expanded into holes in the header walls. Where the latter jointing is adopted it will be understood that access openings would be provided in the header walls and be closed by hand-hole closures of the usual or any convenient form.

In the accompanying drawings:

Fig. 1 is an elevation, largely sectional, of a Scotch marine boiler showing in a combustion chamber of the boiler a steam superheater which comprises elements according to one embodiment of the invention.

Fig. 2 is a plan drawn to a larger scale than Fig. 1 of the superheater element illustrated in that figure.

Fig. 3 is a sectional elevation of a portion of a combustion chamber of a Scotch marine boiler having therein a steam superheater comprising elements according to another embodiment of the invention.

Figs. 4 and 5 are sectional views illustrating steam superheaters having elements according to embodiments of the invention fitted in external combustion chambers of marine boilers with wa-

ter tubes in such chambers between their back walls and the back tube plates of the boilers.

Fig. 6 is an elevation of the superheater element according to the embodiment of the invention shown in Fig. 5 drawn to a larger scale than that in said figure.

Fig. 7 is a fragmentary view showing the upper portion of the element illustrated in Fig. 6 as seen from the right of said figure.

Fig. 8 is a plan of the element shown in Fig. 6.

Referring to the drawings, the steam superheaters shown in Figs. 1, 3, 4, and 6 have inlet and outlet headers 1, 2, respectively, and an appropriate number of elements, each of the latter comprising two coils 3, 4, operating in parallel and inter-twined, with longitudinal portions of tubing 5, 6 in series with, and leading from one end of the respective coils, and extending in a direction vertically of the coils, the tubing of the coils at the other end being united at 7 to form a single inlet or outlet portion to which an inlet or outlet tube 8 is welded or otherwise connected, and the longitudinal tubes 5, 6 being similarly united at 9 and welded or otherwise connected to a single outlet or inlet tube 10, the tubes 8, 10 being suitably jointed to the headers.

In Fig. 1 the headers 1, 2 are arranged at the front of the boiler in the uptake 11, and the tubes 8, 10 extend from said headers through two boiler smoke tubes to the combustion chamber 12 where they are connected to the single tube or union portions of the coils 3, 4 and tubes 5, 6 respectively, by per se known or other appropriate screwed unions 13. Figs. 3 to 5 show arrangements in which the headers 1, 2 are located at the back of the boiler, and in these figures and in Figs. 6 to 8 the tubes 8, 10 are connected to the union portions of the elements by welding, as at 14, Figs. 6 and 7. In Fig. 3 the inlet and outlet tubes or legs 8 and 10 of the elements extend through hollow stay tubes in the back water space of the boiler as in certain previously proposed combustion chamber superheaters.

The boilers of which fragments are shown in Figs. 4 and 5 are of the kind in which the combustion chamber is arranged exteriorly of the boiler body, the upper wall 15 and a portion or portions of the back wall 16 of the combustion chamber being shown in each case. Water circulating tubes 17 are arranged in such combustion chambers, and serve to protect the walls of such chambers from becoming overheated as well as assisting in promoting water circulation in the boilers. In Fig. 5 the water tubes 17 are bifurcated, the heat absorbing portions of the superheater elements lying between such tubes and the boiler back plate with the inlet and outlet tubes 8, 10 extending through the spaces between the single tube portions of such bifurcated tubes.

In the construction illustrated in Fig. 4, the heat absorbing portions of the superheater elements lie between the water tubes 17 and the back wall 16 of the combustion chamber.

The headers 1, 2 may be arranged below the level of the coiled portions of the elements, as in the embodiments of the invention shown in Figs. 1, 2 and 4, or they may be disposed above the level of the coils as in the embodiments illustrated by Figs. 3 and 5. To support elements which extend downwardly to their headers as in Figs. 1 and 2 a portion of the tubing at the top of each element is formed to provide an integral upwardly directed loop 18 in series with one of the coils (as shown the coil 3) and with one of the longitudinal tubes 5, 6 (as shown the tube 5), such loop bridging the top of the inter-twined coil portion. Said loops 18 are engaged with hook like portions 19 of a bar of appropriate section secured to the top of the combustion chamber, or with short slings suspended from an overhead support. Alternatively a suitably supported bar may extend through the loops. At the inner side of the bend or bight of a loop 18 on an element a reinforcing pad may be welded to prevent friction setting up wear of the tube itself. It will be seen that the element shown in Fig. 4 is supported in the manner described with reference to Fig. 1, but in Fig. 4 the loop 18 is in series with the coil 4 and the tube 5.

With headers disposed above the level of element coils the inlet and outlet legs 8, 10 of the elements may be employed to suspend the depending portions, including the coils, of the elements, whilst at the same time means are provided to relieve the joints of the elements with the headers of all strains except those arising from the internal steam pressure. For example, and as shown in Fig. 5 there may be welded on each inlet and outlet leg a threaded collar 20 and tapped sleeves or long nuts 21 be vertically adjustable on said collars, the lower ends of said sleeves or nuts bearing on suitably supported members 22, which may be straps or plates bearing at their ends on girders at or adjacent the roof of the combustion or return chamber. The lower end surfaces of the tapped sleeves or nuts 21 may be spherically shaped and engage in spherically shaped or coned seats in said straps or plates 22.

A superheater embodying the invention lends itself to various dispositions of the headers, as will have been appreciated. In Figs. 1 and 4 the headers 1 and 2 are arranged close together in the same horizontal plane, whilst in Figs. 3 and 5 the headers lie in the same vertical plane. Where a superheater according to the invention is fitted in a boiler having an external combustion chamber and the coiled portions of the elements lie in the space between the water circulating tubes and the back wall of the combustion chamber, as shown in Fig. 4, but with the headers located above the elements as in Fig. 5 the headers may lie in the same horizontal plane and be spaced apart sufficiently to permit the elements to be withdrawn in an upward direction between them. In such case the jointing surfaces on the headers may face upwardly or towards one another, and, as is the case where the headers are arranged as shown in Figs. 1, 4, and 5, be easily accessible for inspection and regrinding when necessary. As will be understood, the inlet and outlet legs 8, 10 of the elements will be bent as required for connection of their ends to the headers.

It will be appreciated that where the headers are arranged below the level of the lowermost convolutions of the elements the inlet and outlet portions may be so bent to the headers that the elements are self-draining, this being the case with the superheaters shown in Figs. 1 and 4.

The coiled portions of an element may be circular in plan, as in the case of the elements shown in Figs. 2, 6, 7 and 8, or they may be elliptical in plan; they may, however, be of hour-glass or any other desired shape in plan. There are shown in the drawings elements each comprising two inter-twined coils, but the invention is not restricted in this respect, as if desired, more than two inter-twined coils may be com-

prised in each element; for example, there may be three coils. The coils comprised in each element may be concentrically disposed, or each coil may have its axes spaced from the axis or axes of the other coil or coils so that when seen in plan the convolutions of a coil cross those of the other coil or coils. As a further alternative one coil of an element may be circular in plan and the other more or less of hour-glass shape in plan.

Preferably the element is constructed so that steam flows in the same direction through the component coils and also preferably each element is so arranged that steam flows through the coils in a general direction counter to that of the gases of combustion flowing over their surfaces. If desired, however, each element may be such that steam may flow in opposite directions in different coils of such element.

Assuming the element to comprise two inter-twined coils, as shown in the drawings, the straight tubes **5**, **6** preferably lie outside of the coils, as shown, and are welded to selected convolutions, as indicated at **23**, Fig. 6, or to each convolution as may be desired. In the case of an element having its coils concentrically disposed, the tubes **5** and **6** may be arranged to lie against the inner side of the convolutions, and be welded to appropriate convolutions.

Reference has been made to an element in which steam flows in opposite directions in different coils of the element. Assuming such element to comprise two coils, the common inlet portion **8** would be connected, for example, as shown in the drawings, directly to one end of one coil and by a tube extending longitudinally of the coils, similarly to the tubes **5** and **6**, to the opposite end of the other coil, the common outlet portion **10** being similarly connected with the other ends of the coils.

In elements in which the coils are eccentrically disposed, so that the convolutions of the respective coils cross one another when seen in plan, as do the coils of the elements shown in Figs. 1 to 8, the straight tubes **5**, **6** preferably lie in the angles of intersection of the convolutions, as shown in Figs. 2 and 8, and by being welded to the convolutions of both coils maintain the spacing of the axes of the coils.

Where the constituent coils of an element are concentric the superposed convolutions may be closely spaced at the lower or gas inlet ends of the coils and more widely spaced at the upper or gas outlet ends thereof, to permit the combustion gases to flow out freely between the convolutions. In addition or alternatively, assuming the coils to be of circular shape in plan, selected or alternate convolutions at the gas outlet ends of the coils of an element may be pressed inwardly to an approximately hour-glass shape in plan to provide for the free passage of the combustion gases between the turns of the coils at the gas outlet end of the coiled portions of the element.

Whilst some modifications of the constructional details shown in the drawings have been described or referred to herein, other variations might be made without departing from the invention.

What I claim is:

1. A steam superheater element, for use in boilers of the kind indicated, comprising a plurality of inter-twined helicoidal tube coils providing fluid paths operating in parallel, each coil having in series with it a longitudinal portion of tubing extending from end to end of the coils parallel to their axes and welded to convolutions of the coils to constitute supporting and spacing means therefor, and the inter-twined coils having a single or common inlet and a single or common outlet for connection to the respective headers of the superheater.

2. A superheater element as claimed in claim 1, wherein the inter-twined coils are disposed eccentrically of one another, the longitudinal tubes of the element which are welded to convolutions of the coils lying in the angles of intersection of the respective convolutions and by their welded attachment to convolutions of the coils serving to maintain the spacing of the axes of the coils in addition to supporting the latter and spacing the convolutions of the individual coils.

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