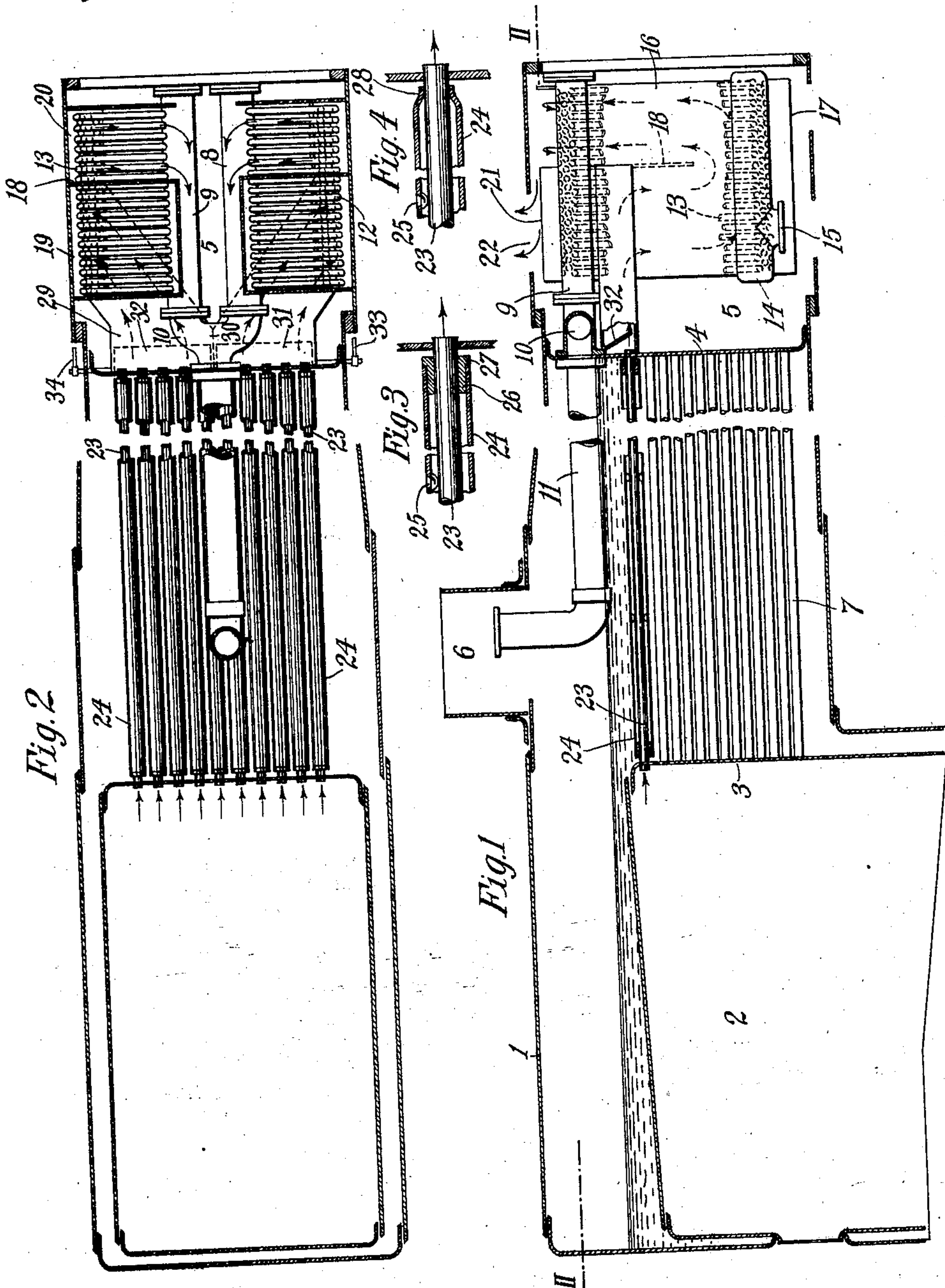


E. H. FOSTER & J. PRIMROSE.
STEAM SUPERHEATER.
APPLICATION FILED JAN. 8, 1906.

Patented Nov. 2, 1909

938,568.



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UNITED STATES PATENT OFFICE.

ERNEST H. FOSTER AND JOHN PRIMROSE, OF NEW YORK, N. Y.

STEAM-SUPERHEATER.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, ERNEST H. FOSTER, a citizen of the United States, residing at New York, in the county of Richmond and State of New York, and JOHN PRIMROSE, a subject of the King of Great Britain, residing at New York, in the county of Queens and State of New York, have invented certain new and useful Improvements in Steam-Superheaters, of which the following is a specification.

Our invention relates to the superheating of steam, more particularly in connection with so-called "fire-tube" boilers.

In generators of this type it is usually most convenient to locate the superheater at the point where the furnace gases leave the fire-tubes or boiler flues, but by the time the gases have reached this point they have given up so much of their heat to the boiler that a very large superheating surface is necessary in order to obtain the desired degree of superheat. Not infrequently the temperature of the gases issuing from the flues is even below this desired temperature and the steam therefore cannot be superheated at all.

To remedy this defect, so that furnace gases sufficiently hot can at all times be supplied to the superheater, is the chief object of our invention.

We have also devised a novel form and arrangement of superheater, for use more especially with boilers of the kind mentioned, which possesses a high degree of efficiency.

In carrying out our invention in its preferred form, we provide a suitable number of flues for conveying hot gases to the superheater, which is located in the smoke-box between the boiler and the stack, and in order to prevent the gases, while flowing through these flues, giving up too large a part of their heat to the contents of the boiler, the flues may be insulated. We prefer to secure the desired insulation by inclosing these flues in some manner which will keep the water in the boiler out of contact with the flues at least for the greater part of their length. A convenient method for this purpose, in the case of flues which are located below the normal water level, is to provide each with a casing of somewhat larger diameter so as to leave an annular space between the two. By preference this

space is not packed, the body of air or steam therein giving sufficient insulation.

The boiler flues discharge their gases into the smoke-box at the end of the boiler, and in the smoke-box is located the superheater. This consists preferably of two parts, one located at each side of the box, each consisting of a plurality of tubes connected to upper and lower headers. The upper headers are connected with a pipe which is open to the steam space or to the steam dome of the boiler and therefore carries steam to these headers. The lower headers are to be connected with an outlet pipe by which the superheated steam may be delivered to the point of utilization. By dividing the superheater into two separated sections a clear space is left between them, affording a free passage for the products of combustion to the stack. At the discharge end of the flue or flues which carry the highly heated gases is one or more chambers or conduits to receive the gases and direct them effectively against the superheater elements. In the conduit or conduits is one or more dampers, whereby the supply of heated gases may be cut off or regulated at will.

In the annexed drawing is illustrated the preferred embodiment of the invention.

Figure 1 is a vertical, longitudinal section showing a fire tube boiler equipped with our invention. Fig. 2 is a longitudinal section on line II—II, Fig. 1. Figs. 3 and 4 are detail views, partly in section, showing the insulating casing around the flue, with two methods of forming the joint between the casing and flue.

The boiler illustrated, indicated at 1, is one of what is commonly known as the locomotive type, having a fire box or furnace 2, tube sheets 3 and 4, smoke box 5 at the front end of the boiler, and steam dome 6. Extending between the tube sheets are the flues or fire tubes, indicated by 7, receiving the products of combustion from the furnace 2 and discharging them into the smoke-box 5.

The superheater is constructed in two parts or sections. More strictly speaking, in the present instance the two parts constitute two superheaters, as will be seen presently. Supported in any suitable manner at the top of the smoke-box are two parallel headers 8, 9, adjacent to each other and extending in line with the axis of the boiler. At the rear

end of the headers is a Y-pipe 10, extending to an opening in tube sheet 4, and there connecting with a supply pipe 11 which extends back and is open to the steam dome 6, so that steam from the dome is carried to the upper headers. 12 and 13 indicate the superheater tubes which are connected to headers 8 and 9 respectively. These tubes extend to right and left from their respective headers; and, bending downward adjacent to the sides of the smoke-box, the tubes extend to the bottom of the box, where they again bend, this time toward the center of the box, and are connected to lower headers preferably arranged directly below their respective upper or inlet headers. One of the lower headers is indicated at 14, in Fig. 1. Each lower header is provided with an outlet, as 15, which may be connected to a common steam main; or, as in the case of a locomotive, each lower header may be connected with the engine on its own side of the boiler. In such case the two parts of the superheater constitute in effect two substantially independent superheaters.

Each superheater, or section thereof, is inclosed in a heating chamber, preferably in the following manner, considering for convenience only the chamber or casing on the left, shown in Fig. 1 as well as in Fig. 2. This chamber has a vertical wall 16, which at top and bottom has horizontal extensions, not shown, reaching over to the upper and lower headers. The bottom of the chamber, indicated at 17, Fig. 1, extends from the side wall of the smoke-box over to the lower header, and thus covers the lower horizontal portions of the tube 13. Extending about two-thirds of the way down from the top of the chamber is a transverse partition or baffle plate 18, dividing the chamber into two compartments 19, 20. The rear compartment, 19, is closed above the upper horizontal portions of the pipes 13, as indicated at 21, Fig. 1, while the front compartment or conduit, 20, is open. It will therefore be seen that the hot gases, if delivered into the upper part of the closed compartment, 19, will flow downward, bathing the rear tubes, then forward below the partition 18 and up through the front compartment, bathing the tubes therein and escaping from the open top into the smoke box, whence they pass to the stack above the opening 22.

For the purpose of delivering highly heated gases from the furnace to the superheater chamber we provide special flues or fire-tubes, as previously mentioned, preferably located entirely above the body of tubes 7, as shown at 23. These may be of any suitable size and as many may be used as are necessary to deliver the desired amount of hot gases. In the construction illustrated, the special tubes, which for convenience of reference may be spoken of as the super-

heater flues, inasmuch as their purposes is to deliver hot gases to the superheater, are located below the normal water level and hence are insulated, so as to retain the heat of the gases. If the flues are above the water level, in the steam space, the relatively poor heat conductivity of steam would insure retention of sufficient heat. In any case, however, the joints at the ends of the flues should be submerged, to prevent overheating.

A convenient way of securing the desired insulation in the case of submerged flues is to inclose each in a casing, as 24, in the form of a tube of larger diameter. The air or steam in the annular space thus formed effectively retains the heat of the gases and they therefore reach the flue exits at the proper temperature. In order to keep the flues and casings at all times in concentric positions relative to each other, the casing may be provided with inwardly projecting bosses or lugs, which may be made by stamping in the casing wall, as indicated at 25, Figs. 3 and 4. As already stated, the joints at the ends of the flues should be in contact with the water, to prevent overheating. Hence the casings do not extend the full length of the flues, but terminate short of the tube sheets at each end. It is of course desirable that the joints between the flues and casing be substantially liquid-tight. A convenient way of forming these joints is to place on the flue a tightly fitting collar 26, Fig. 3, over which the casing fits closely and abuts against a flange 27 to prevent longitudinal displacement. Another convenient method is to contract the end of the casing around the flue, as indicated at 28, Fig. 4.

For the purpose of conducting the hot gases from the flues to the superheating chambers, without these gases mingling with the cooler products of combustion discharged by the boiler tubes 7, we provide a branched conduit 29, with its larger end over the superheated flues 23, the divergent branches leading to the upper parts of the rear compartments of the right and left superheating chambers respectively. In this way the hot gases are led directly against the superheater tubes, and in the passage of the gases through the chambers they at all times are kept in close confinement around the tubes. When the superheater sections are practically independent, as above described, the conduit is preferably divided by a partition extending from the angle of the branches, as indicated by the dotted line at 30, Fig. 2. Each half of the conduit is provided with a damper, as 31, 32, pivoted at the top and actuated by an arm, as 33, 34, on shafts extending outside the smoke-box. These arms may be connected with the engineer's cab in any convenient way, not shown. By closing one damper or the other the hot gases

can be cut off from either superheater at will.

It will, of course, be understood that the construction herein specifically described is merely the preferred form of the invention, which may be embodied in a considerable variety of forms without departing from its proper scope as defined by the following claims.

10 What we claim as our invention is:

1. The combination with a steam boiler having a fire-box, or furnace, and a smoke-box, of two pairs of companion headers extending lengthwise of the smoke-box, one member of each pair being located in the upper part of the box near the center thereof and the other member of each pair being located near the bottom of the box, superheating tubes connecting the upper and lower headers respectively, inclosing chambers for the superheaters each chamber being provided with a partition depending from its top wall of less length than the height of the chamber, and means for discharging hot gases from the upper row of fire-tubes into the upper portion of the chamber in rear of

said partition, the upper part of the front portion of said chambers being in communication with the smoke outlet.

2. The combination with a steam boiler, 30 having a fire box or furnace, and a smoke box, of two pairs of companion headers extending lengthwise of the smoke box, one member of each pair being located in an upper part of the box near the center thereof 35 and the other member of each pair being located near the bottom of the box, superheating tubes connecting the upper and lower headers respectively, inclosing chambers for the superheaters, means within the chambers 40 for causing the circuitous passage of hot gases therethrough, and means for discharging gases from the upper row of fire tubes into the rear portion of the chambers, the front portion of said chambers being in communication with the smoke outlet. 45

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