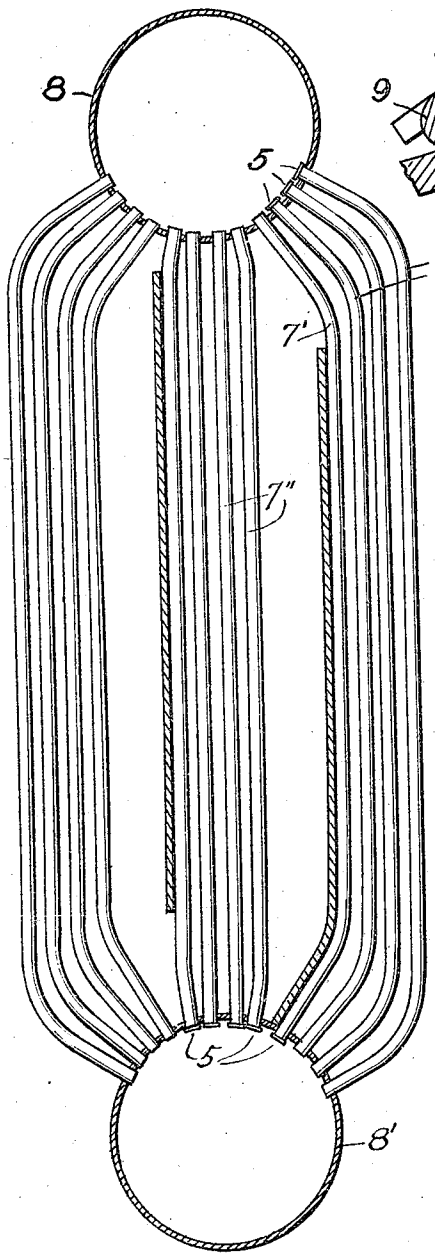
Oct. 2, 1923. 1,469,389

T. H. McGRAW, JR

FLOW CONTROLLING MEANS FOR STEAM BOILERS

Filed Jan. 16, 1920

FIG.1.



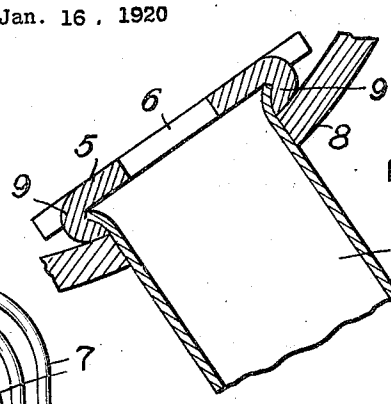
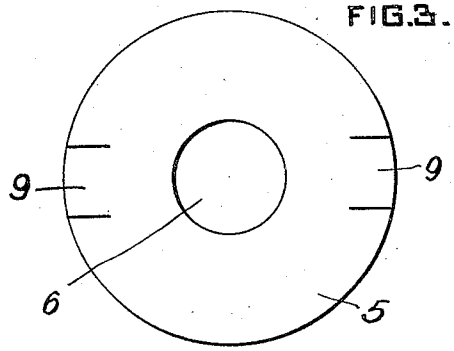


FIG.2.

FIG.3.



WITNESSES

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Patented Oct. 2, 1923. 1,469,389

UNITED STATES PATENT OFFICE.

THOMAS H. McGRAW, JR., OF OAKMONT, PENNSYLVANIA.

FLOW-CONTROLLING MEANS FOR STEAM BOILERS.

Application filed January 16, 1920. Serial No. 351,890.

To all whom it may concern:

Be it known that I, THOMAS H. McGRAW, Jr., a citizen of the United States, and a resident of Oakmont, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Flow-Controlling Means for Steam Boilers, of which the following is a specification.

This invention relates to steam generators or boilers of the water tube type and particularly to means for controlling the flow of water through the tubes of such boilers.

In all water tube boilers there is a more or less clearly defined circulation of water through the tubes. The direction and intensity of flow through each individual tube depends somewhat on the arrangement and the location of the tube and the amount of heat to which the tube is subjected under operating conditions. For example, in a three pass boiler the tubes of the first pass are subjected to the direct heat of the furnace and also the initial flow of hot gases leaving the furnace. Consequently more steam is probably generated in these tubes, and the upward flow or circulation through them is more intense than in other tubes of the boiler. The tubes of the second pass are subjected to hot gases which have only been partially cooled in their passage between the tubes of the first pass and consequently the circulation is probably upward through all the tubes of this pass. It is possible that a downward circulation may be maintained in such tubes of the second pass as are not located in the path of the direct flow of gas. The gases traversing the third pass are so reduced in temperature as to preclude the development of much, if any steam, and the circulation through the tubes of the third pass is unqualifiedly downward, and the rate of flow depends to a large extent on the intensity of upward flow through other tubes of the boiler, since the downward or return flow is induced by the upward flow. Where the boiler is being operated well above normal rating, the heat to which the tubes of the first pass are subjected occasions a violent generation of steam in those tubes and inasmuch as the steam is lighter than water it rises to the top, pushing the water ahead of it. The same condition may exist in certain tubes of the second or middle pass with the result that some of the tubes do not generate steam with maximum efficiency and with the further result that a certain degree of frothing takes place and the boiler has a tendency to deliver wet steam, whereas, under normal conditions of operation it would deliver perfectly dry steam. My invention consists in employing means for controlling circulation or flow through the tubes of the boiler, so that it will be possible to operate the boiler with high efficiency through a wide range of operating conditions and so that the boiler will deliver dry steam even while operating, at for example 400% rating.

In Figure 1 of the drawing accompanying, forming the part hereof, I have more or less diagrammatically illustrated a water tube boiler of a well known type so equipped that it forms an embodiment of my invention; portions of the boiler are shown in section for convenience of illustration.

Figure 2 is a fragmental sectional view of a drum and boiler tube equipped with a device embodying my invention.

Figure 3 is plan view of the flow restricting device shown in Figure 2.

In carrying out my invention, I control the flow through the individual tubes of the boiler by reducing the effective area of the tubes. This is accomplished in the illustrated embodiment by partially restricting either the inlet or the outlet of each tube. In Figures 2 and 3 I have illustrated an embodiment of the invention which consists of a cap or plug for the tube which is provided with an opening or passage of such area with relation to the area of the tube to which it is attached as to occasion the desired restriction of flow through the tube. For example, those tubes of the first pass which are subjected to the greatest flow of hot gas through the furnace and which are consequently subjected to violent generation of steam while the boiler is being forced or operated materially above normal rating, will preferably be provided with caps at their upper end for the purpose of preventing the steam from causing an undue acceleration of the water passing through the tube and thereby causing excessive agitation in the drum which results in the delivery of wet steam. Likewise, certain of the tubes of the second pass may be equipped with such a flow restricting device to prevent an excessive upward flow through them, and it may be desirable to fit the restricting devices to the lower instead of the upper ends of these tubes.

It will be apparent from the foregoing that my invention makes it possible to modify and thereby control the flow through the tubes under the normal as well as abnormal conditions of operation and that the flow restricting devices may be so proportioned with relation to the areas of their cooperating tubes that the rate of flow may be maintained substantially uniform through all the tubes or through certain groups of tubes by reducing and proportioning the effective area of some or all of the tubes of the boiler or of the group in question.

While it will be apparent that these results may be obtained by locating flow restricting devices at different points in the individual tubes, Figures 2 and 3 illustrate means for capping an end of a tube and in this way restricting the flow through it. As illustrated in Figure 2, the cap consists of a metal disc 5 having a central aperture 6 adapted to be secured to the flared portion of the tube 7, which projects through the shell 8 of the drum. It will be apparent that the size of the aperture 6 will depend upon the diameter of the tube on which the plate 5 is fitted and also upon the desired amount of flow restriction. Any convenient means may be employed for securing the cap to the end of the tube, but as illustrated, the edges of the cap may be cut for the purpose of forming tube engaging fingers 9 which are adapted to be bent and caulked or peened into engagement with that portion of the flared end of the tube which projects beyond the plate of which the drum is formed. It will be apparent that where caps similar to the cap 5 are employed, any convenient means may be employed for securing the disc in place.

In Figure 1, I have shown a water tube boiler of a well known type equipped with caps such as are illustrated in Figures 2 and 3. As illustrated, the upper ends of the tubes 7 of the first pass are equipped with the caps 5, whereas the lower ends of the tubes 7′ are so equipped. The tubes 7″ of the second pass are equipped with caps 5 at their lower ends. While I have shown the tubes of the third pass without the flow restricting devices, it will be apparent that one or more rows of this pass or even certain tubes of this pass may be so equipped, since I contemplate employing the flow restricting devices to the best advantage for the purpose of producing the desired conditions of flow.

From the foregoing, it will be apparent that various changes, modifications, additions and omissions may be made in the apparatus illustrated without departing from the spirit and scope of the invention as set forth by the appended claims.

What I claim is:

1. In combination in a water tube boiler, steam and water drums, water tubes connecting said drums, and a flow restricting device for certain of said tubes, each device consisting of a cap located in the drum and fitted over the end of a tube and having an aperture formed therein of less diameter than the passages through the tube and integrally formed fingers forced into engagement with the end of the tube.

2. In combination in a water tube boiler, steam and water drums, water tubes connecting the drums, and flow restricting devices associated with certain of said tubes, each device comprising a cap located over the end of a tube and positively secured in place by means of integrally formed fingers bent into engagement with the exterior surface of the end of the tube.

In testimony whereof, I have hereunto subscribed my name this 14th day of January, 1920.

THOMAS H. McGRAW, Jr.