

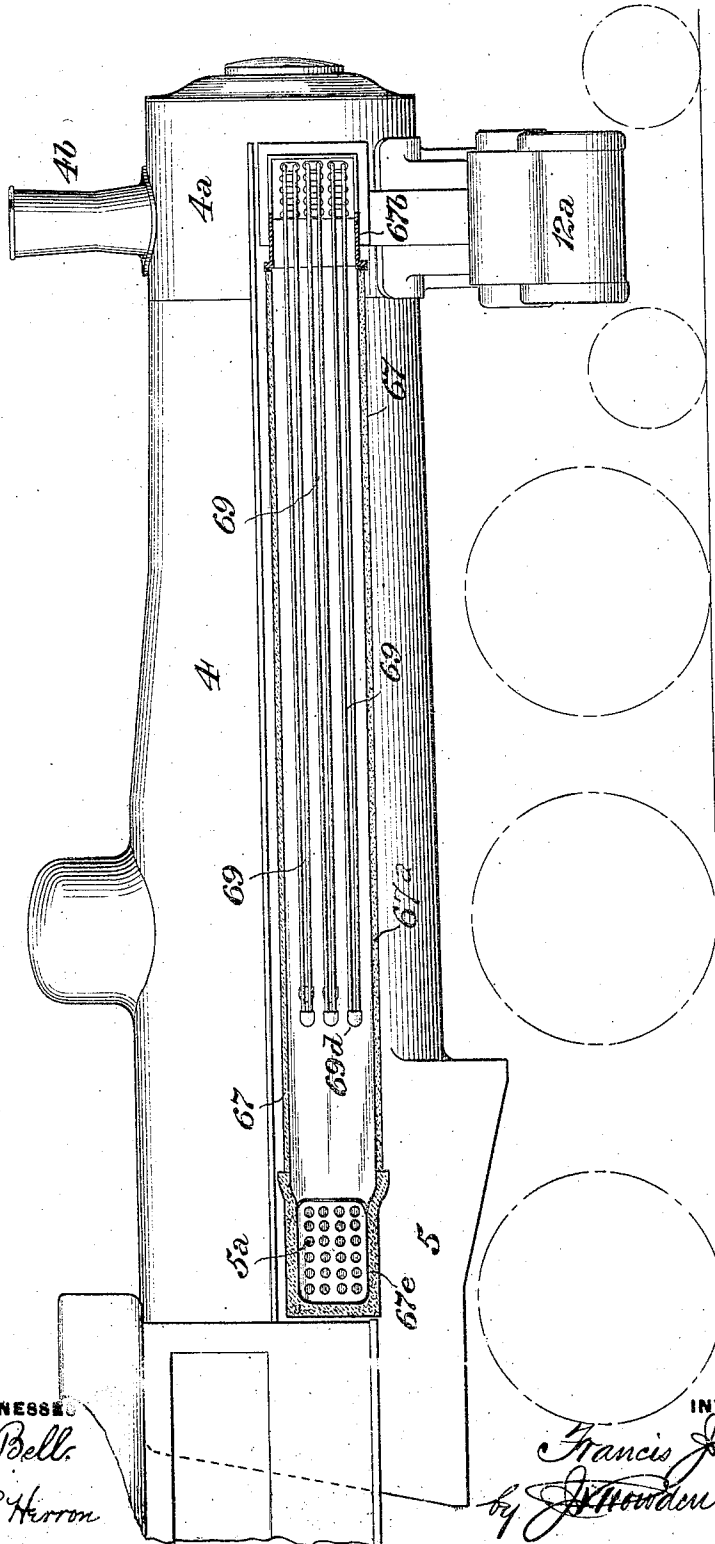
F. J. COLE.  
STEAM BOILER SUPERHEATER.  
APPLICATION FILED APR. 20, 1909.

936,412.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 1.

FIG. 1.



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3 SHEETS—SHEET 2.

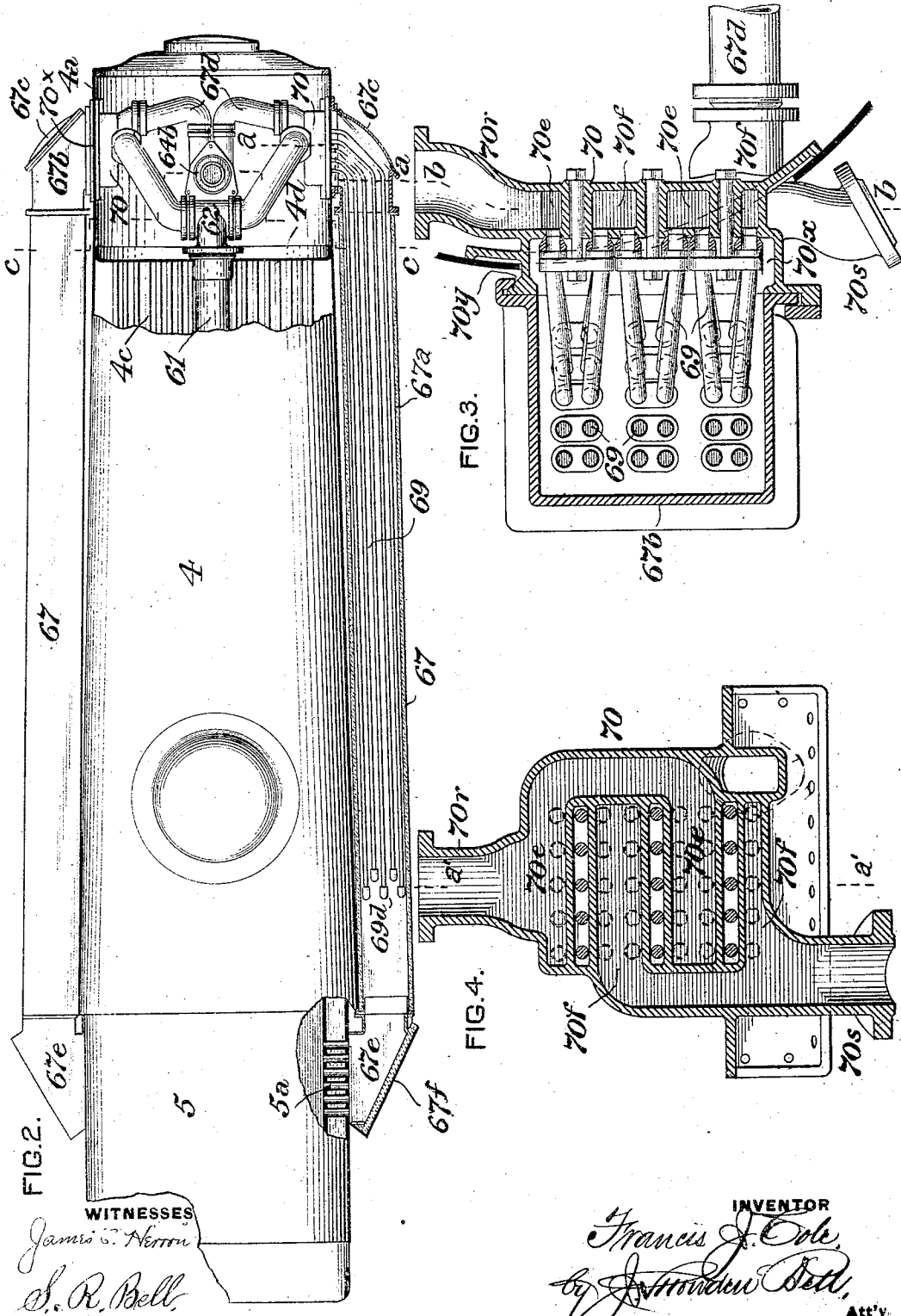


FIG. 2.

FIG. 3.

FIG. 4.

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3 SHEETS—SHEET 3.

FIG. 5.

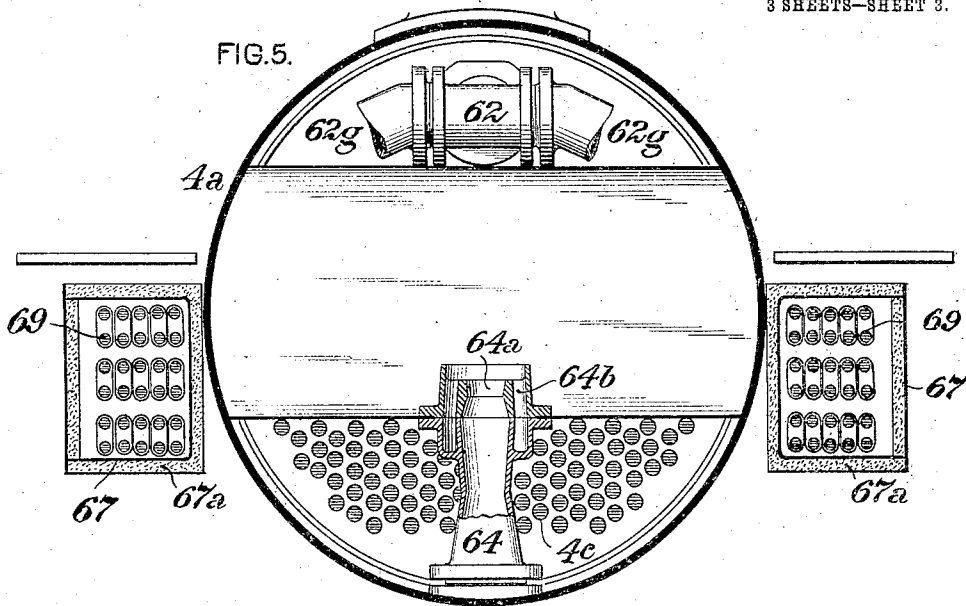
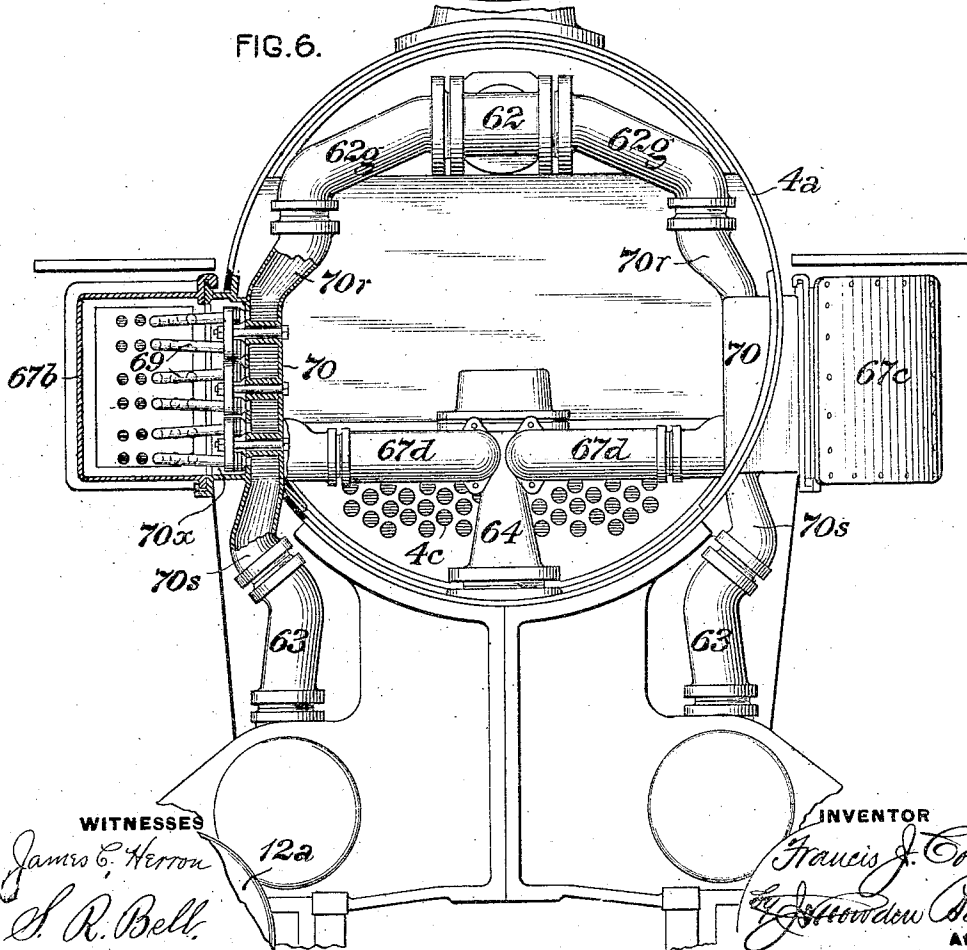


FIG. 6.



WITNESSES

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# UNITED STATES PATENT OFFICE.

FRANCIS J. COLE, OF SCHENECTADY, NEW YORK.

## STEAM-BOILER SUPERHEATER.

936,412.

Specification of Letters Patent.

Patented Oct. 12, 1909.

Application filed April 20, 1909. Serial No. 491,178.

*To all whom it may concern:*

Be it known that I, FRANCIS J. COLE, of Schenectady, in the county of Schenectady and State of New York, have invented a certain new and useful Improvement in Steam-Boiler Superheaters, of which improvement the following is a specification.

The object of my invention is to provide a superheating appliance for steam boilers of the locomotive type, which shall be readily applicable, as well to existing boilers as to new constructions, and which shall be located entirely outside of the water and steam spaces of the boiler, thereby reducing the changes in other parts involved in its application to a minimum; avoiding any reduction in heating surface, alteration of flue sheets, or provision of larger diameter tubes; and increasing the capacity of the boiler by the provision of superheating surface additional to that obtainable in the ordinary fire tubes.

The improvement claimed is hereinafter fully set forth.

In the great majority of locomotive boiler superheaters which have heretofore been put in practice, the superheating appliances have been either of the fire tube or of the smoke box type, the superheating pipes being, in the former type, located in enlarged tubes in the upper and central portions of the tube space, taking the place of the ordinary boiler tubes and correspondingly decreasing the amount of evaporating surface. In the latter type, the superheating pipes are located in the smoke box, but on account of the relatively low gas temperature therein, it is not practicable to obtain more than a drying effect, or a very moderate superheat, unless the normal smoke box temperature is increased by the application of one or more flues of greatly increased diameter to deliver the gases of combustion to the superheating pipes at a much higher temperature than normal. Either of these types of superheaters, when applied to an existing locomotive boiler, involves considerable alteration and change of parts, which my present invention is desired to avoid, as well as to avoid reduction of evaporating surface and provide superheating surface additional to and independent thereof.

The leading and characteristic features of my present invention consist in a plurality of superheating pipes inclosed in casings located exterior to the boiler, and extending

longitudinally along the sides thereof, to which casings portions of the gases of combustion are supplied through short tubes passing through the water spaces of the fire box. The superheating pipes are disposed in pairs, connected, in U form, at their rear ends, and connected, at their forward ends, to the saturated and the superheated steam compartments, respectively, of headers located in the smoke box. The traverse of the gases of combustion through the casings and around the superheater pipes therein, is effected by positive draft, the intensity of which can be regulated as desired by varying the proportions of the nozzle or discharge openings, and which is induced by means of an annular exhaust pipe, in which the exhaust from the cylinders is either in the center, as in ordinary locomotive practice, with an annular passage for draft surrounding it, or vice versa. The forward ends of the superheater casings are connected with the draft passage. A partial vacuum can, by this means, be obtained, greater than that through the ordinary tubes, and a positive draft be insured through the superheater casings.

In the accompanying drawings: Figure 1 is a side view, in elevation, of a locomotive boiler, illustrating an application of my invention, the superheater casing being shown in vertical longitudinal section; Fig. 2, a plan view, partly in section of the same, with a superheater casing in horizontal longitudinal section; Fig. 3, a vertical transverse section, on an enlarged scale, on the line *a a* of Fig. 2 and the line *a' a'* of Fig. 4; Fig. 4, a vertical longitudinal section, on the same scale, through a steam header, on the line *b b* of Fig. 3; Fig. 5, a vertical transverse section, on the line *c c* of Fig. 1; and, Fig. 6, a front view, in elevation, with a header and adjoining junction box in section.

My invention is herein exemplified as applied in connection with a locomotive boiler of one of the present standard types, comprising a firebox, 5, at its rear end, having the usual front, rear and side water walls, a waist or body, 4, connected to and extending forwardly from the firebox, and a smoke box, 4<sup>a</sup>, connected to the forward end of the waist. A plurality of fire tubes, 4<sup>c</sup>, extends through the waist, from a rear flue sheet in the firebox to a front flue sheet, in the smoke box, in the ordinary manner. Steam

is supplied from the boiler to the cylinders, 12<sup>a</sup>, through a main steam pipe or dry pipe, 61, passing through the front flue sheet, 4<sup>a</sup>, and connected in front thereof to a transverse T head, 62, from which it is conducted through superheater pipes, 69, which, with their connections and casings will be presently described, and, after being superheated in said pipes, passes to the cylinders through branch steam pipes, 63, located on opposite sides of the smoke box.

In the practice of my invention, I support, outside of the boiler shell, adjacent to each side thereof, and preferably with its top adjacent to the horizontal central plane of the boiler, a superheater casing, 67, of sheet metal, which is most conveniently made of rectangular transverse section, and is clothed with a covering or lagging, 67<sup>a</sup>, of suitable non-conducting material, to prevent the radiation of heat to the atmosphere. The superheater casings extend from about the middle portion of the length of the firebox, 5, to about the middle portion of the smoke box, 4<sup>a</sup>; and communicate, at their rear ends, with the interior or fire chamber of the firebox, by a plurality of short tubes, 5<sup>a</sup>, passing through the side water walls of the firebox. For convenience of connection to the firebox, the rear end portions of the superheater casings are preferably made in the form of separate junction boxes, 67<sup>b</sup>, into which the tubes, 5<sup>a</sup>, open, and which are provided with removable plates or bonnets, 67<sup>c</sup>, to afford access to the latter. The front ends of the superheater casings are connected to and open into, junction boxes, 67<sup>b</sup>, which are provided with removable plates or bonnets, 67<sup>c</sup>, to permit access to the interior of the casings, and are bolted to flanges on the outer sides of steam headers, 70, secured to the inside of the shell of the smoke box. The junction boxes, 67<sup>b</sup>, open into draft chambers, 70<sup>s</sup>, on the outer sides of the headers, and said chambers are connected by draft pipes, 67<sup>a</sup>, with an annular draft discharge passage, 64<sup>b</sup>, which surrounds the steam discharge opening or nozzle, 64<sup>a</sup>, of the exhaust pipe, 64.

It will be seen that when the locomotive is running, gases of combustion are drawn from the firebox, by the exhaust blast from the nozzle, 64<sup>a</sup>, through the short tubes, 5<sup>a</sup>, and the superheater casings, 67, and thence through the connected junction boxes, 67<sup>b</sup>, draft chambers, 70<sup>s</sup>, and draft pipes, 67<sup>a</sup>, to and out of the draft discharge passage, 64<sup>b</sup>. It will also be seen that the draft through the passages, 64<sup>b</sup>, induced by the exhaust blast, will be substantially greater than the draft in the smoke box through the fire tubes, 4<sup>a</sup>, so that positive draft will be maintained through the superheater casings. The junction boxes, 67<sup>b</sup>, are fitted to slide longitudinally on inclined faces, 70<sup>r</sup>, on the

outer flanges of the headers to which they are connected, so as to admit of the longitudinal expansion and contraction of the superheater casings. The weight of the junction boxes, acting on the inclined faces, maintains the surfaces in contact and insures tight joints.

Each of the superheater casings, 67, serves as an inclosing receptacle for a plurality of pairs of superheater pipes, 69, which are disposed in vertical rows, and extend longitudinally within it, from planes a short distance from its rear end, into the connected front junction box, and also constitutes a conduit for the traverse of gases of combustion from the firebox, around said superheater pipes, to the smoke box, 4<sup>a</sup>, and stack 4<sup>b</sup>. The superheater pipes of each pair are connected, in U form, at their rear ends, as by a return bend or elbow, 69<sup>a</sup>, and are held up in normal position in the casings, 67, by supports of any suitable and preferred form. The forward ends of the superheater pipes communicate, through the saturated and the superheated steam compartments of the headers, 70, as hereinafter more fully described, with the main steam supply pipe, 61, and the delivery steam pipes, 63, respectively, so as to constitute continuous avenues or channels, throughout the length of which the steam passes, and within which it is superheated, in its traverse from the boiler to the cylinders.

The T head, 62, corresponds substantially in construction and relation to the steam headers, 70, with that set forth in Letters Patent of the United States No. 875,895, granted and issued to me under date of January 7, 1908, and, except as to being provided with the draft chambers, 70<sup>s</sup>, for the reception of the gases passing out of the superheater casings through the junction boxes, 67<sup>b</sup>, the steam headers, 70, are not different, in any substantial particular, from those of said Letters Patent. These members, which are not, in and of themselves, claimed as of my present invention, will be herein only briefly and generally described.

Each of the steam headers, 70, is divided, by horizontal walls or partitions, into a plurality of saturated steam chambers or compartments, 70<sup>c</sup>, which communicate, through a chamber at one end of the header, with a flanged nozzle or supply passage, 70<sup>r</sup>, thereon, which is connected to one of a pair of branch saturated steam pipes, 62<sup>s</sup>, leading from the T head, 62, and a plurality of superheated steam chambers or compartments, 70<sup>s</sup>, which communicate, through a chamber at the opposite end of the header, with a flanged nozzle or delivery passage, 70<sup>s</sup>, thereon, which is connected to one of the delivery steam pipes, 63, leading to the engine cylinders, 12<sup>a</sup>.

The pipes of all the pairs of superheater

pipes, 69, in each of the superheater casings, 67, are each bent inwardly to a connection with the adjacent steam header, 70, and the opposite ends of the steam superheating channel formed by each pair of superheater pipes are connected to a saturated steam compartment, 70<sup>a</sup>, and a superheated steam compartment, 70<sup>b</sup>, respectively, of said header. The connection of the superheater pipes to the headers may be made in any suitable and preferred manner, as, for example, by fitting collars on the ends of the pipes, which abut against ball joints fitting in openings in the adjacent walls of the steam headers, and securing them in place by glands or followers, connected to the headers by bolts passing through the glands and headers, and made fast by nuts engaging screw threads on the outer ends of the bolts, substantially as set forth in Letters Patent No. 875,895 aforesaid. The joints between the superheater pipes and headers can be readily examined for the detection of leaks; by removing the bonnets, 67<sup>a</sup>, of the junction boxes, and can be made tight by the adjustment, from the outside of the smoke box, of the nuts of the connecting bolts, which are conveniently accessible through the junction boxes.

In operation, saturated steam from the boiler passes through the dry pipe, 61, T head, 62, and communicating branch steam supply pipes, 62<sup>a</sup>, into each of the saturated steam compartments, 70<sup>a</sup>, of the steam headers, 70, from which it passes, first rearwardly and then forwardly, through the pairs of superheater pipes, 69, into the superheated steam compartments, 70<sup>b</sup>, of the headers, being, in its traverse through the superheater pipes, thoroughly superheated by the hot products of combustion which pass through the superheater casings, 67, inclosing the superheater pipes. The superheated steam passes from the superheated steam compartments, 70<sup>b</sup>, of the headers, into the communicating branch delivery steam pipes, 63, and through the latter to the engine cylinders, 12<sup>a</sup>, for utilization therein.

I claim as my invention and desire to secure by Letters Patent:

1. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its opposite ends, with the firebox and the smoke box thereof, respectively, a steam header supported in the smoke box, and superheater pipes located in the superheater casing and connected at their forward ends to the steam header.

2. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its opposite ends, with the firebox and the smoke box thereof, respectively, means for inducing positive draft through said casing, a steam header

supported in the smoke box, and superheater pipes located in the superheater casing and connected at their forward ends to the steam header.

3. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its rear end, with the firebox, an annular exhaust pipe having a draft discharge passage communicating with the forward end of said casing, a steam header supported in the smoke box, and superheater pipes located in the superheater casing and connected at their forward ends to the steam header.

4. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its forward end, with the smoke box, a junction box connected to a side water wall of the firebox and communicating with the rear end of said casing, draft tubes passing through the water wall and opening into the junction box, a steam header supported in the smoke box, and a plurality of pairs of superheater pipes extending, in U form, in the superheater casing and connected, at their forward ends, to the steam header.

5. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its rear end, with the firebox, a steam header supported in the smoke box and having a draft chamber communicating with the forward end of the casing and with a draft discharge passage in the smoke box, and a plurality of pairs of superheater pipes extending, in U form, in the superheater casing, and connected, at their forward ends, to saturated and superheated steam compartments in the steam header.

6. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler, and communicating, at its rear end, with the firebox, a steam header supported in the smoke box and having a draft chamber communicating with the forward end of the casing; an annular exhaust pipe having separate steam and draft discharge passages, a pipe connecting the draft chamber of the header with the draft discharge passage of the exhaust pipe, and a plurality of pairs of superheater pipes extending, in U form, in the superheater casing, and connected, at their forward ends, to saturated and superheated steam compartments in the steam header.

7. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating, at its rear end, with the firebox, a steam header supported in the

smoke box and having a draft chamber on its outer side and a communication from said draft chamber to a draft discharge passage in the smoke box, a junction box connecting the forward end of the casing with the draft chamber, a removable plate closing an opening in the junction box, and a plurality of pairs of superheater pipes extending, in U form, in the superheater casing, and connected, at their forward ends, to saturated and superheated compartments in the steam header.

8. In a steam boiler superheater, the combination of a superheater casing extending longitudinally adjacent to a steam boiler and communicating at its rear end with the fire-box, an annular exhaust pipe having separate steam and draft discharge passages, a

pipe establishing communication between the forward end of the casing and the draft discharge passage of the exhaust pipe, a steam header supported in the smoke box and divided into saturated and superheated steam compartments, a steam supply pipe leading into the saturated steam compartments, a steam delivery pipe leading out of the superheated steam compartments, and a plurality of pairs of superheater pipes extending, in U form, in the superheater casing, and having their forward ends connected to the saturated and the superheated steam compartments, respectively.

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