Nov. 1, 1927. 1,647,476

B. R. SKINNER

MEANS FOR HEATING BOILER FEED WATER

Filed June 10, 1922 3 Sheets-Sheet 1

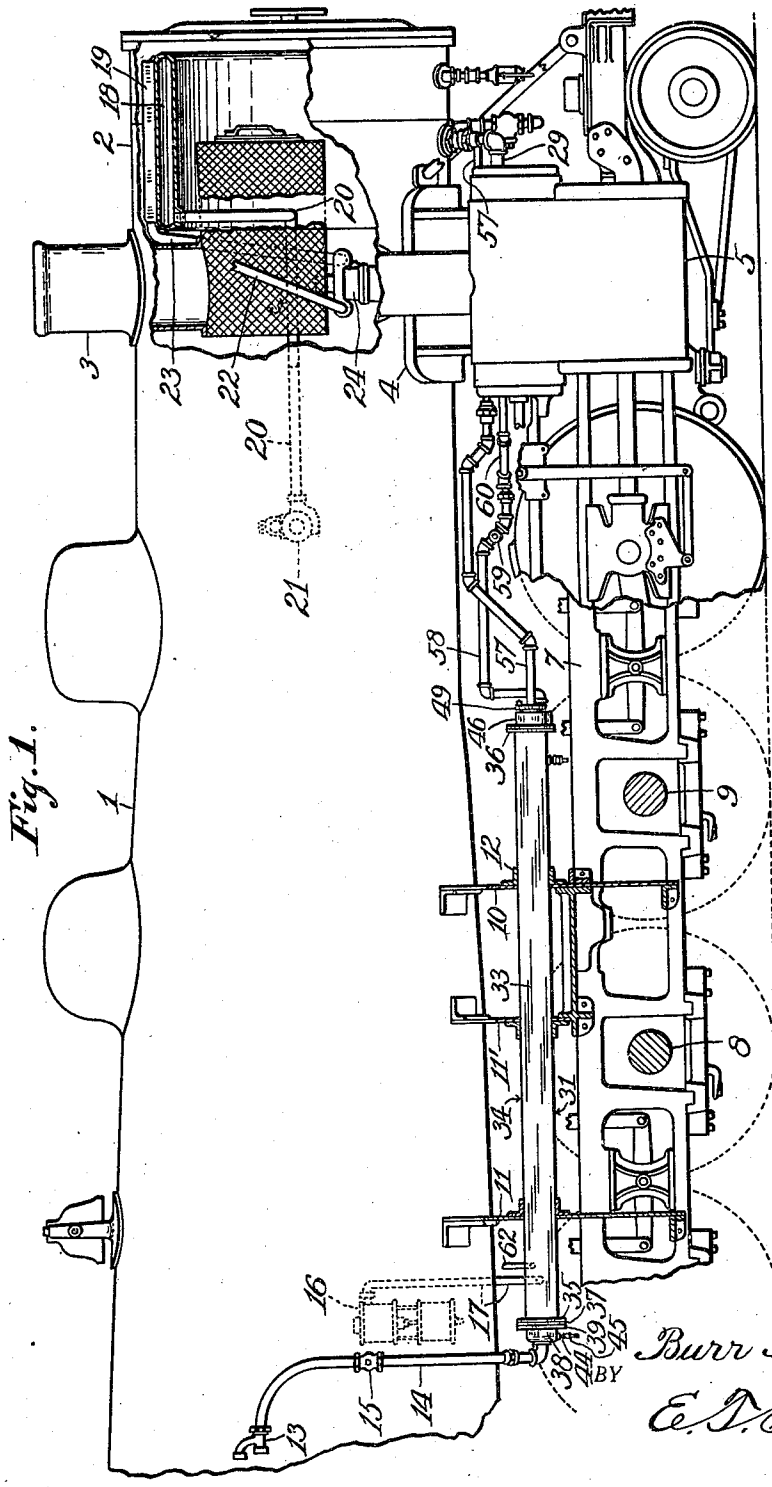


Fig. 1.

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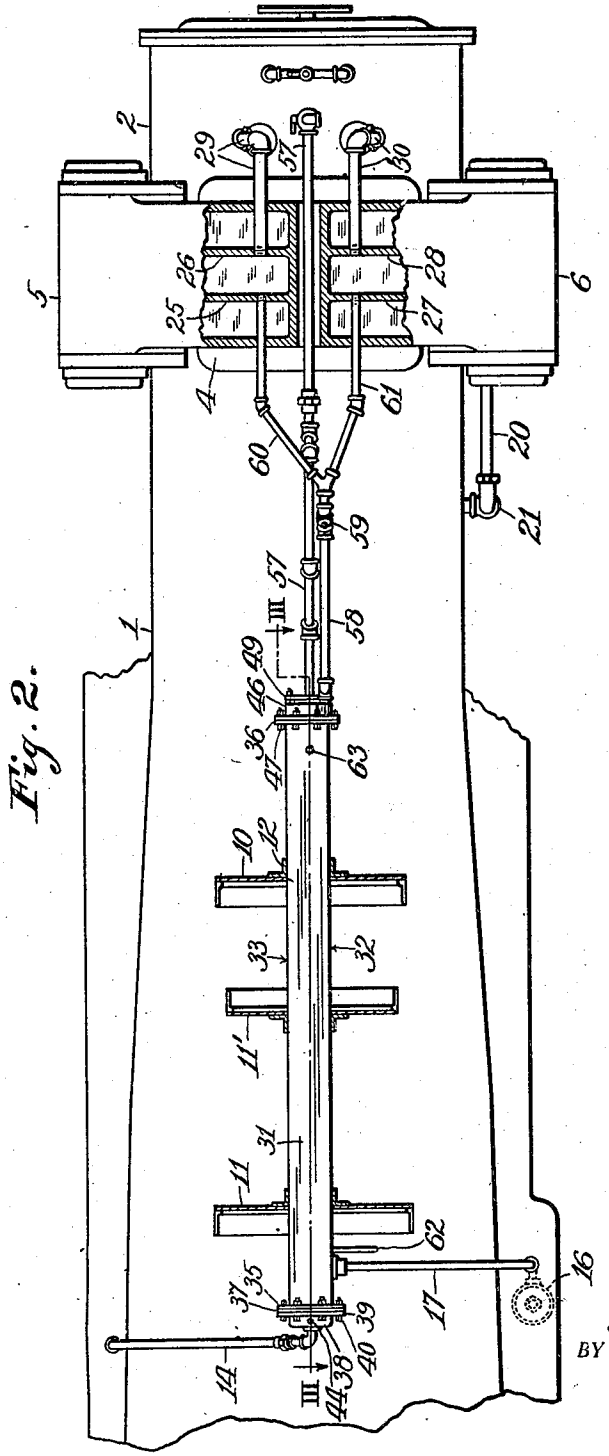


Fig. 2.

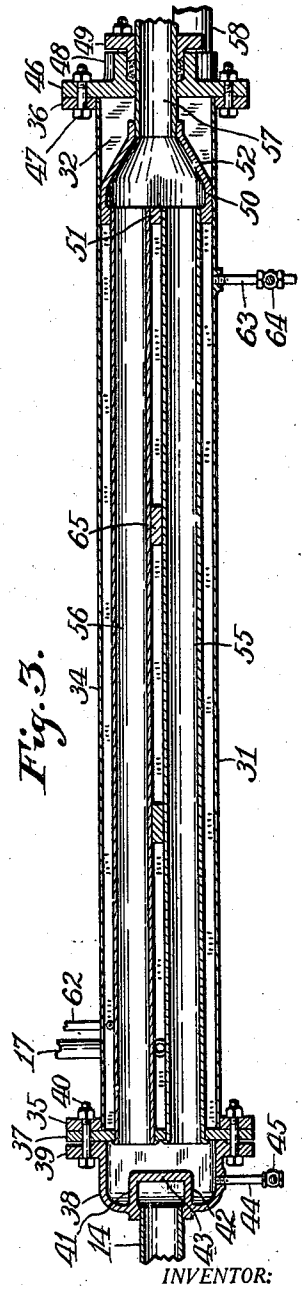


Fig. 3.

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Fig. 4.

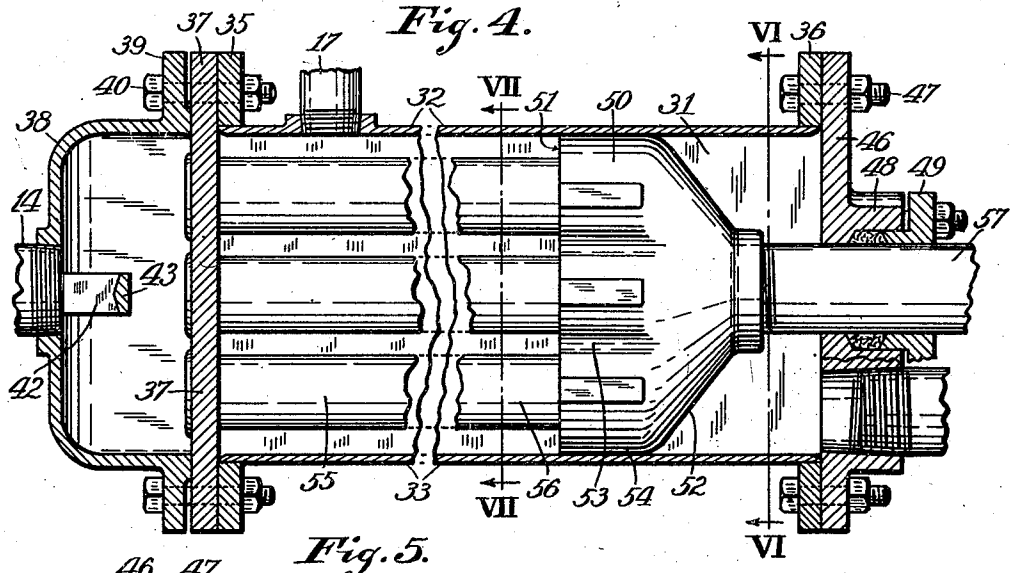


Fig. 5.

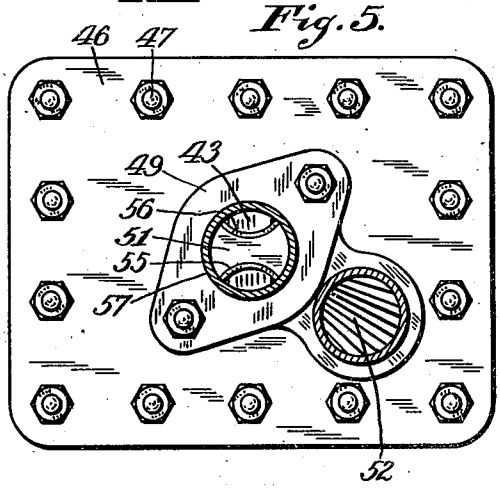


Fig. 6.

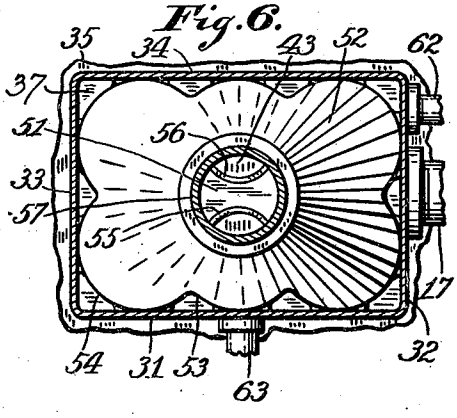
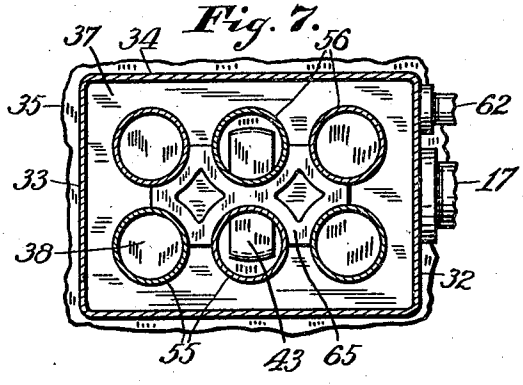


Fig. 7.



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UNITED STATES PATENT OFFICE.

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MEANS FOR HEATING BOILER FEED WATER.

Application filed June 10, 1922. Serial No. 567,298.

This invention relates to means for heating or raising the temperature of water before entering boilers to be further heated, the invention having reference more particularly to means for utilizing exhaust or waste steam for heating the feed-water required by steam-boilers, and to advantageously use the heat of locomotive boilers in raising the temperature of the feed-water; this invention relating generally to the class of means for heating boiler feed-water described in Letters Patent #1,341,443 granted to me on May 25, 1920.

An object of the invention is to effect the utmost saving in the consumption of fuel required for heating water or for converting water into steam, more particularly in locomotive boilers.

Another object is to provide improved means for supplying a locomotive boiler with water at the highest temperature possible under the existing conditions of operation, in order that the water temperature may be raised in the boiler by the furnace heat to the required degree with the minimum consumption of fuel, and so that steam may be rapidly and constantly generated freely, and without over-taxing the steam-producing ability of the boiler and its fire-box with consequent waste of fuel due to the common evil of drawing unconsumed fuel from the fire-box and ejecting it from the smoke-stack.

A further object is to provide improved means for utilizing exhaust steam to heat locomotive boiler feed-water, which shall be so constructed and arranged as to tend to effect steady draft through the fire-box and the boiler without sharp blasts from the engine exhaust nozzle.

A still further object is to provide an improved primary heater and of such construction as to be adapted to be located and carried in an advantageous position where its operation may be favorably influenced by close association with a locomotive boiler and also be protected by reason of its position from the cooling effects of severely cold winds which adversely affect feed-water heaters; which primary heater shall be of simple and efficient construction and adapted to be easily cleaned and repaired, and which may be readily connected advantageously with a main heater which may be arranged in the smoke-box of the locomotive boiler.

With the above-mentioned and other objects in view, the invention consists in an improved primary heater and in the novel arrangement thereof in association with a locomotive and in connection with a main heater; and, the invention consists also further in various novel parts and features, and in the combinations and arrangements of parts, as hereinafter particularly described and further defined in the accompanying claims.

Referring to the drawings,—Figure 1 is a fragmentary right-hand side sectional elevation of a railway locomotive, partially broken away, to which the invention is applied and illustrating the preferred arrangement of the primary heater and its connection with its various other features or elements of the structure; Fig. 2 is an inverted plan of the locomotive boiler and the improved primary heater and arrangement thereof, portions of the locomotive being in section; Fig. 3 is a vertical longitudinal section of the main structure of the primary heater approximately on the line III—III in Fig. 2, on an enlarged scale; Fig. 4 is a fragmentary horizontal section, on a further enlarged scale, of the main structure of the primary heater, approximately centrally thereof; Fig. 5 is an enlarged elevation of the primary heater, pipes connected therewith being in section; Fig. 6 is a transverse section, approximately on the line VI—VI in Fig. 4; and, Fig. 7 is a transverse section approximately on the line VII—VII in Fig. 4.

Similar reference characters in the different figures of the drawings indicate corresponding or like elements or features of construction herein referred to in detail.

Portions of a modern locomotive with which the invention is advantageously applied are described as being sufficient to an understanding of the invention and its practical application, the numeral 1 indicating the steam-boiler having a smoke-box 2 provided with a smoke-stack 3, a saddle 4 being secured to the smoke-box and supporting the engine cylinders 5 and 6, an engine frame 7 being connected to the saddle and being supported on driving axles 8 and 9 and usually other axles, brace plates 10 and 11, and in some cases another brace plate 11′ being secured to the frame and to the lower portion of the boiler. For the purpose of the present invention the brace plates have each a suitable opening therein and a flange or col-

lar 12 extending about the opening. The locomotive, as will be understood, is provided with injectors or pumps discharging into a Y 13 to which a branch-pipe or feed-pipe 14 is connected through which to conduct the feed-water, being in some cases provided with a stop-cock 15. The locomotive is provided also with an air-pump 16 which has an exhaust-pipe 17, the exhaust steam from the air-pump preferably being utilized in the improved primary heater.

In accordance with approved practice the smoke-box 2 has a main heater therein comprising a water-chamber 18 and a steam-chamber 19, or preferably a pair of steam-chambers, on the outside of the water-chamber, generally similar to the main heater shown in said patent, a branch-pipe 20 being connected with the water-chamber and with a check valve 21 connected to the boiler. The steam-chambers of the main heater when two are provided have exhaust-pipes 22 and 23 connected thereto and leading to the engine exhaust-pipe 24, as is understood, being arranged so as to direct the exhaust steam into the smoke-stack with continuous flow during operation of the locomotive to assist in creating a draft through the boiler. Without superfluous illustration and description it will be understood that the saddle 4 has two walls 25 and 26 to form an exhaust-channel to conduct exhaust steam from one cylinder to the engine exhaust pipe and two walls 27 and 28 to form another exhaust-channel to conduct steam from the opposite cylinder to the exhaust pipe. According to the approved practice a steam-pipe 29 is connected with the forward wall 26 of one of the exhaust-channels to conduct exhaust steam to one of the steam-chambers of the main heater, and another steam-pipe 30 is connected with the forward wall 28 of the opposite exhaust-channel to conduct exhaust steam to the opposite steam-chamber of the main heater, so that the stem-chambers of the main heater may be supplied from the exhaust-channels in which during operation of the locomotive there is sufficient back pressure caused by the exhaust pipe 24 to cause exhaust steam to enter the pipes.

Details of the connections of the pipes 29 and 30 with the steam-chambers of the main heater are not shown, any suitable connection being permissible. The exhaust-pipe 24 obviously is of the tapered type commonly provided for a well-known purpose.

The improved primary heater has a shell or enclosing wall to which the exhaust pipe 17 is connected, and the shell preferably is rectangular in cross-section and comprises a flat bottom 31 on which are side walls 32 and 33 to which a flat top 34 is connected. The shell is arranged in and extends through the collars 12 and is supported thereby so as to permit longitudinal expansion and contraction of the shell. One end of the shell has a flange 35 and the opposite end a similar flange 36 fixed thereto. The rearward or inlet end of the heater is provided with a distributing-chest which preferably comprises a header 37 arranged against the flange 35 to constitute the inner end of the distributing-chest which mainly comprises a cap 38 having a flange 39 arranged against the header 37, the header being secured to the flanges by means of bolts 40. The feed-pipe 14 is connected to the cap, and the inner side of the cap has arms 41 and 42 thereon that support a baffle-plate 43 opposite to the end of the feed-pipe to deflect and spread out the feed-water in the distributing-chest. Preferably a drain pipe 44 is connected to the cap through which water may be drawn from the distributing-chest and preferably is provided with a stop-cock 45. The opposite end of the shell is provided with an apertured head 46 that is secured to the flange 36 by means of bolts 47, the head having a packing-box 48 thereon which has a suitable packing-gland 49. The shell has a combining-chamber arranged therein adjacent to the head 46 and comprising a body portion 50 having an inner apertured head 51 therein and a tapered end portion 52 extending towards the head 46. The body portion 50 is of suitable dimensions to be steadied against the side walls of the shell while resting on the bottom thereof, and has suitable channels 53 in its bottom and its top and also in its sides and has also rounded corners 54 providing ample passages for steam and water of condensation to circulate in the shell and past the combining-chamber. A suitable number of heater tubes are arranged in the shell which constitutes a heating-chamber, there being preferably a lower series of heater tubes 55 and an upper series of tubes 56, one end of each of the tubes being secured in the header 37 so as to receive water from the distributing-chest, the opposite end of each tube being secured in the apertures in the head 51 of the combining-chamber wall so as to discharge the water into the combining-chamber. An extension feed-pipe 57 is connected to the smaller end of the combining-chamber and extends through the packing-box 48 and also through a suitable opening in the saddle and is connected with the water-chamber of the main heater, as will be understood. When the main heater is arranged as a complete unit within the smoke-box the pipes 29, 30, and 57 extend thereto through suitable openings in the lower portion of the smoke-box wall. An exhaust steam-pipe 58 is suitably connected with the heating-chamber, being preferably secured in the head 46 and it preferably has a stop-cock 59 connected thereto which is always open when the heater

is in operation, and beyond the stop-cock two branch pipes 60 and 61 are connected with the exhaust steam-pipe 58 and are connected to the walls 25 and 27 respectively so as to receive exhaust steam from the exhaust-channels.

The heating-chamber has a small vent with which a vent-pipe 62 preferably is connected, to permit circulation of steam in the heating-chamber. The bottom of the shell has a drain-pipe 63 connected thereto for the escape of water resulting from condensation of steam, and the drain-pipe preferably is provided with a suitable drain controller, as a valve 64. Preferably a brace plate 65 is arranged between the several heater tubes to prevent vibration of the tubes, in some cases another brace plate being similarly used if desired.

The coverings with which heaters and pipes are commonly provided are of such character as to be well known and may be applied in accordance with approved practice.

In practical use the primary heater and the pipes connected therewith are protected in a measure from cold winds, the saddle acting as a wind-break when the locomotive is running, and the atmospheric air is tempered below the boiler by radiation of heat therefrom; so that rapid condensation of steam in the primary heater is in a measure prevented with proportionate advantage to the heater. When water is fed through the branch or feed-pipe 14, it is projected against the baffle-plate 43 and thereby spread out, the water passing through the heater tubes and into the combining-chamber and thence out through the pipe 57 in a highly heated state, and thence into the water-chamber of the main heater where the water is further heated and flows therefrom and into the boiler. When the locomotive is not running or is "drifting" the air-pump 16 may be operating intermittently, and the exhaust steam therefrom supplies the heating-chamber with steam through the exhaust-pipe 17, the steam passing out through the pipe 58 and into the exhaust-channels in the saddle, and finally out through the smoke-stack. When the locomotive is running the exhaust steam escapes through the engine exhaust-pipe and its exhaust-nozzle and out through the smoke-stack, but because of back pressure in the steam-channels sufficient quantities pass through the pipes 29 and 30 to the main heater while smaller volumes pass through the pipes 60 and 61 and the pipe 58 and into the heating-chamber in which the water passing through the heater tubes is heated to a higher degree before entering the main heater. Because of the continuous or nearly continuous escape of exhaust steam, a blower effect is obtained, obviating the necessity of using a choking nozzle in the exhaust pipe for the exhaust steam, with the result that a steady fire for generating steam is maintained with consequent improved results, especially in the saving of fuel.

Having thus described the invention, what is claimed as new is,—

1. Means for heating boiler feed-water including a primary heater chamber having a packing box on one end and a distributing-chamber on the opposite end thereof, two steam-supply pipes connected to the heater chamber at a point adjacent to the distributing-chamber and at a point distant therefrom respectively, a combining-chamber movably arranged in the heater chamber in proximity to the packing box and having an extension feed-pipe fixed thereto and extending movably through the packing box, a plurality of water-conducting tubes fixedly connected with the distributing-chamber and the combining-chamber, and a water-feed pipe connected with the distributing-chamber.

2. Means for heating boiler feed-water including a primary heater chamber, a distributing-chamber on one end of the heater chamber, a packing box on the opposite end of the heater chamber, a combining-chamber movably supported in the heater chamber and having an extension feed-pipe thereon extending movably through the packing box, a plurality of tubes fixedly connected with the distributing-chamber and the combining-chamber, a water feed-pipe connected with the distributing-chamber, a drain-pipe connected with the lower portion of the distributing-chamber, a steam-supply pipe and an open vent pipe connected with the heater chamber adjacent to the distributing-chamber, and a steam-supply pipe connected with the heater chamber adjacent to the packing box and having two exhaust steam supply branches connected thereto.

3. In means for heating boiler feed-water, a primary heater comprising a rectangular shell, a header secured to one end of the shell, a cap secured to the header, a head secured to the opposite end of the shell, a transversely rectangular combining-chamber slidably arranged in the shell adjacent to said head, a plurality of heater tubes secured in the header and connected with the combining-chamber, a feed-pipe connected to the cap, an open vent pipe connected to the top of said shell adjacent to the header, an extension feed-pipe connected with the combining-chamber and extending through said head, and a branched steam-pipe secured in said head.

4. The combination, with the main bars of a locomotive frame, braces secured to the bars of said frame, and a locomotive boiler arranged above and secured to the braces, of a primary heater shell arranged closely adjacent to the boiler and extending through

and supported by the braces and having a distributing-chest on the rearward end and also a combining-chamber slidable within the shell adjacent to the opposite forward end thereof, the combining-chamber having external longitudinal channels which with the shell form passages for leading steam past the combining-chamber, a head secured to the forward end of the shell, a feed-pipe connected with the distributing-chest, a plurality of heater tubes fixedly connected with the distributing-chest and the combining-chamber, an extension feed-pipe connected with the combining-chamber and extending through said head and having connection with the boiler, and a branched steam-supplying pipe connected with said head.

5. The combination, with the boiler and the saddle of the locomotive, the saddle having two exhaust-channels therein, of a transversely rectangular heater shell supported under the boiler adjacent thereto behind the saddle and having a distributing-chest on the rearward end thereof, a head secured to the opposite forward end of the shell, a steam-pipe connected with said head and having branches connected each with an exhaust-channel, a combining-chamber movably guided in the shell in proximity to said head and having external longitudinal channels which with the shell form passages to lead steam from the steam-pipe past the combining-chamber, a feed-pipe connected with the distributing-chest, a plurality of heater tubes fixedly connected with the distributing-chest and the combining-chamber, and a conduit connected with the combining-chamber and extending through the saddle and having connection with the boiler.

6. In means for heating boiler feed-water, the combination of a transversely rectangular heater shell, a rectangular head secured to one end of the shell and having a packing box, a rectangular header secured to the opposite end of the shell, an exhaust steam-pipe connected to said head adjacent to said packing box, a combining-chamber slidably arranged in the shell in proximity to said head and having longitudinal channels in the outer portions thereof which with the wall of the shell form passages to lead steam from the steam-pipe to the space between the header and the combining-chamber, the combining-chamber having an apertured inner end and a tapered outer end, the outer end extending toward said head, a plurality of heater tubes in the shell and secured at one end thereof in the header, the opposite ends of the tubes being secured in the apertures of the inner end of the combining-chamber, a brace plate arranged between said tubes, an extension feed-pipe connected to the tapered end of said combining-chamber and extending through said packing box, two branch steam-pipes connected to said exhaust steam-pipe, a cap secured to said header, and a feed-pipe connected to the cap.

In testimony whereof, I affix my signature.

BURR R. SKINNER.