May 5, 1931. E. L. SCHELLENS ET AL 1,803,772

FEED WATER HEATER

Filed March 13, 1926 4 Sheets-Sheet 1

Fig: 1.

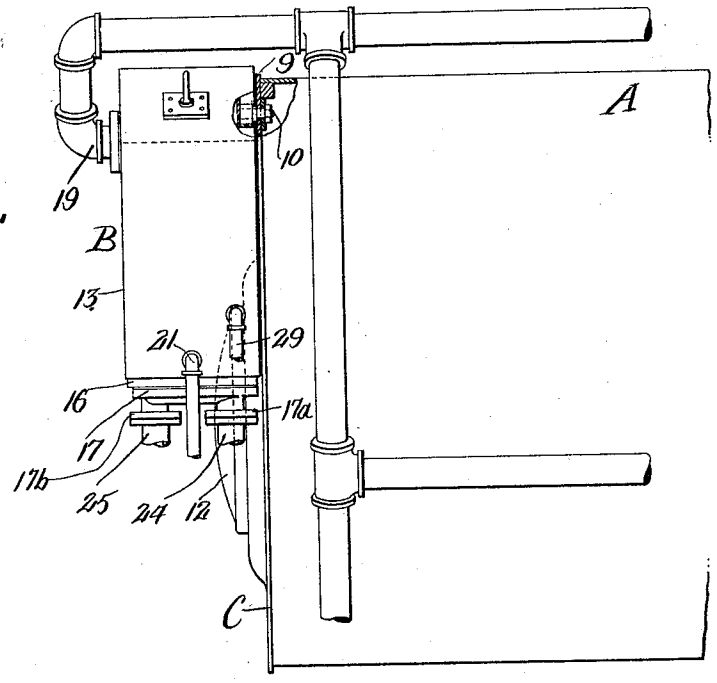
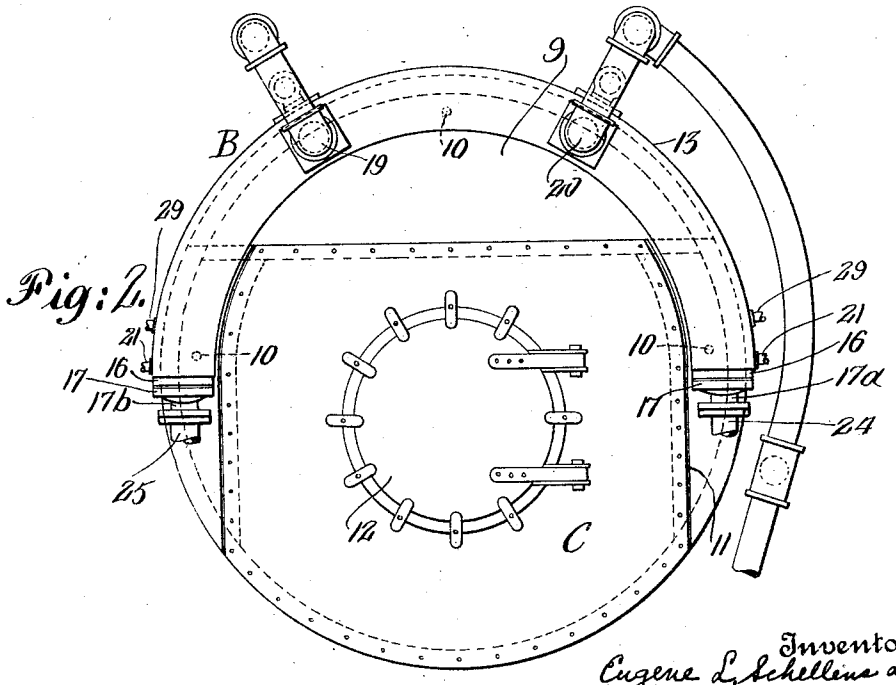


Fig: 2.



Inventors
Eugene L. Schellens and
Christopher A. Schellens
By their Attorneys
Symmestvedt & Lechner

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FEED WATER HEATER

Filed March 13, 1926 4 Sheets-Sheet 2

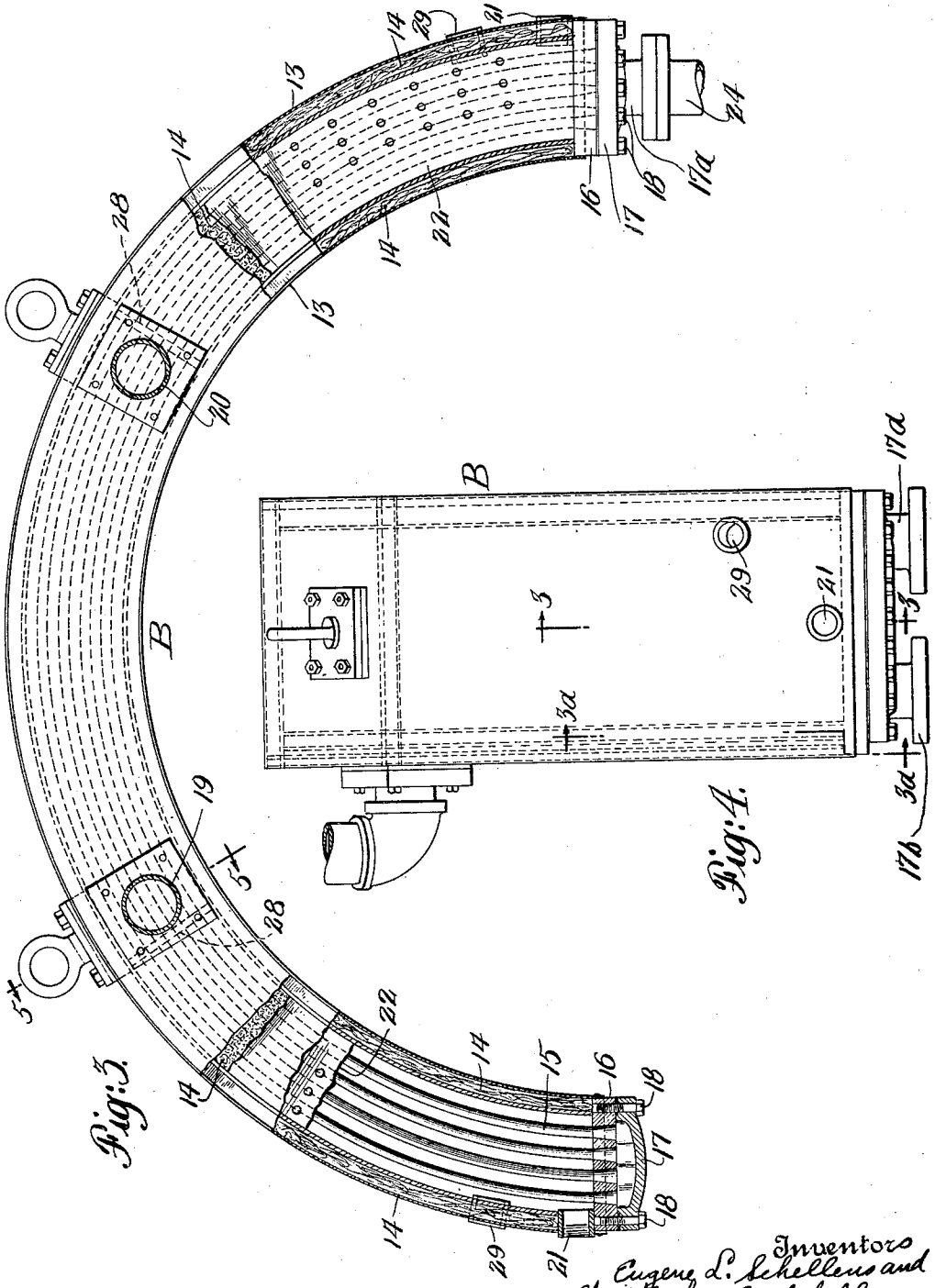


Fig. 4.

Fig. 5.

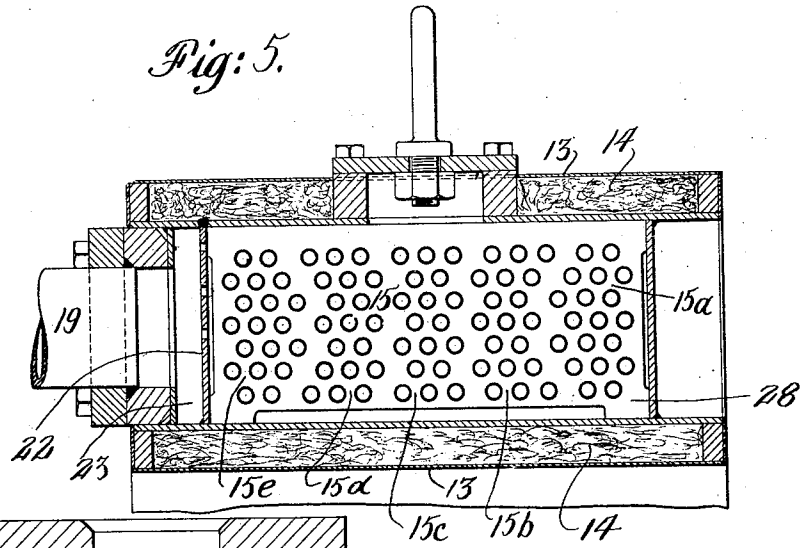
Inventors
Eugene L. Schellens and
Christopher A. Schellens
By their Attorneys
Symmestedt & Lechner

May 5, 1931. E. L. SCHELLENS ET AL 1,803,772

FEED WATER HEATER

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Fig: 5.



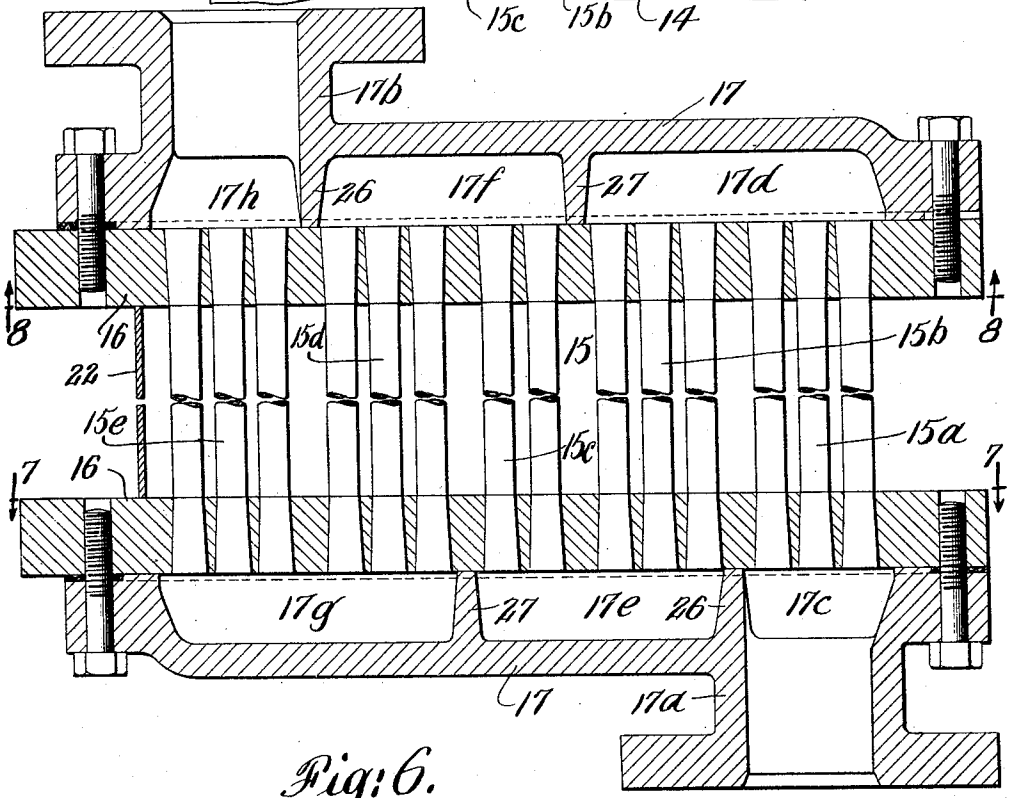


Fig: 6.

Inventors
Eugene L. Schellens and
Christopher A. Schellens
By their Attorneys
Symmestvedt & Leahner

May 5, 1931. E. L. SCHELLENS ET AL 1,803,772

FEED WATER HEATER

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Fig: 7.

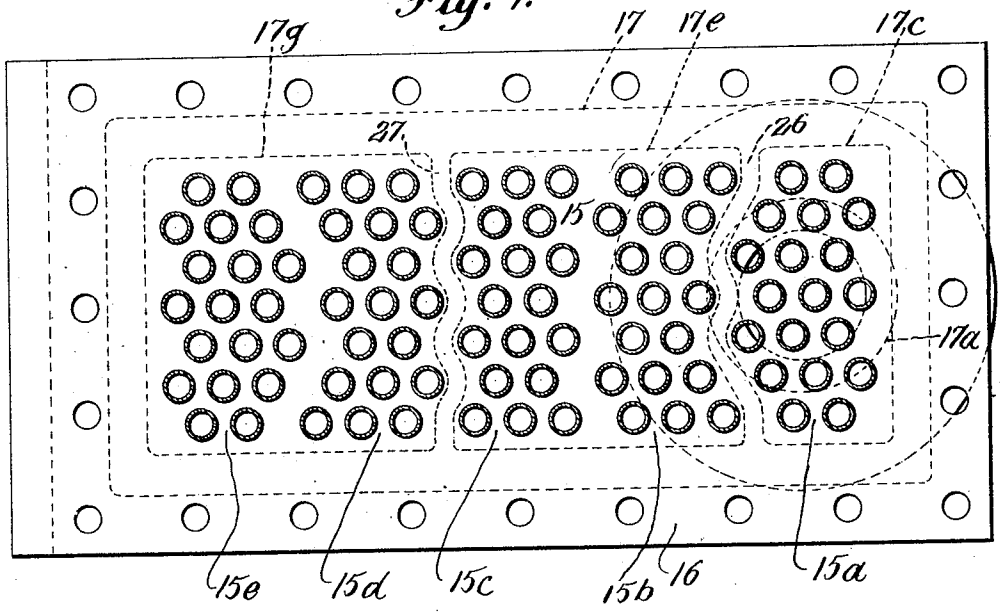
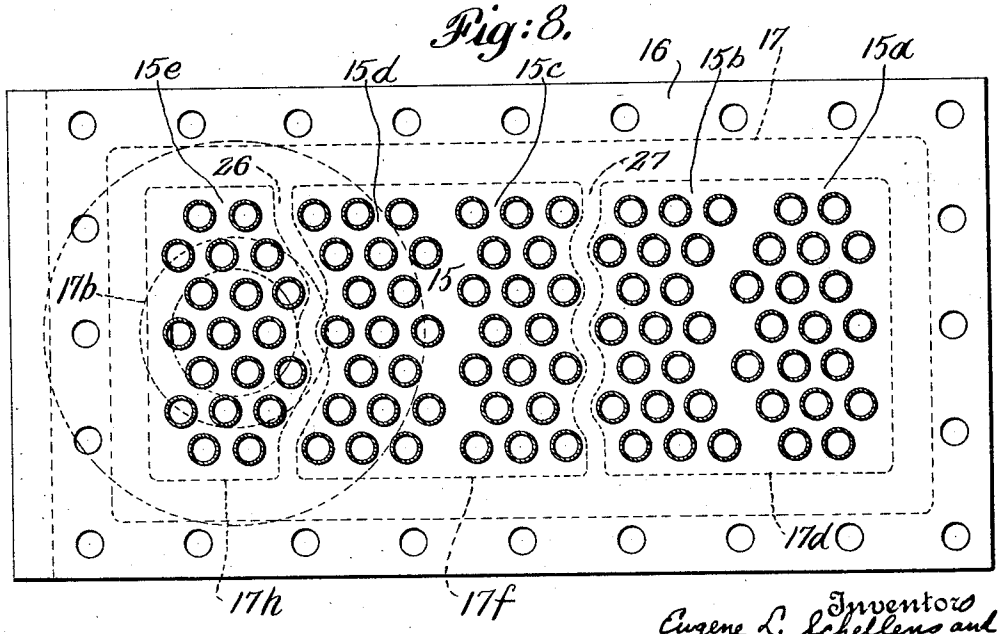


Fig: 8.



Inventors
Eugene L. Schellens and
Christopher A. Schellens
By their Attorneys
Symmestvedt & Lechner

Patented May 5, 1931 1,803,772

UNITED STATES PATENT OFFICE

EUGENE L. SCHELLENS, OF MILLBURN, NEW JERSEY, AND CHRISTOPHER A. SCHELLENS, OF MARBLEHEAD, MASSACHUSETTS, ASSIGNORS TO C-S ENGINEERING COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF DELAWARE

FEED WATER HEATER

Application filed March 13, 1926. Serial No. 94,370.

This invention relates to feed water heaters for locomotives and the like, and has for one of its primary objects the provision of an improved arc-shaped heater adapted to be mounted on the smoke box of a locomotive boiler.

Another object of our invention is the provision of a heater in which the steam is so supplied and distributed over the water tubes as to increase the efficiency of the heater.

A further object of our invention is the provision of a heater in which relatively high velocity flow of the steam is produced against the water tubes to increase efficiency.

A more specific object of our invention is the provision of a heater in which the steam is introduced and distributed along the water tubes of the final pass of the heater.

Still another object is to provide a heater of the class described in which the steam flow is crosswise of the tubes.

Other objects and advantages of our invention will be set forth hereinafter as they will be more readily understood in connection with the description of the invention.

How the foregoing, together with such other objects as may be incident to our invention, are realized is illustrated in preferred form in the accompanying drawings, wherein—

Fig. 1 is a side elevational view of the heater applied in front of the smoke box of a locomotive, a certain portion of the heater casing and smoke box casing being broken away to show the manner of securing the heater to the smoke box.

Fig. 2 is a face view of the heater and smoke box.

Fig. 3 is an enlarged front view of the heater, the left hand portion being shown in section substantially on the line 3—3 of Fig. 4, and the right hand portion being shown in section substantially on the line 3*a*—3*a* of Fig. 4.

Fig. 4 is an end view of Fig. 3 looking toward the left.

Fig. 5 is an enlarged cross sectional view taken on the line 5—5 of Fig. 3.

Fig. 6 is a cross section thru the end headers of the heater and thru the tube plates with the tubes and distributing plates in place, the tube plate and header of the left end of the heater being shown above the plate and header of the right end for purposes of illustration, and the tubes being broken out to condense the figure.

Fig. 7 is a section taken on the line 7—7 of Fig. 6, and

Fig. 8 is a section taken on the line 8—8 of Fig. 6.

Referring to the drawings and particularly to Figs. 1, 2 and 3, the front end of a locomotive boiler and smoke box is indicated by the reference letter A, a water heater of arc-shaped form by the reference letter B and a front closure for the smoke box by the reference letter C.

The heater B in this instance is semi-circular and is mounted in front of the smoke box, it being secured to the fixed portion 9 of the closure C in any suitable manner, as by means of the bolts 10. It is pointed out that by reason of the outside diameter of the heater being approximately the same as that of the smoke box, there is no obstruction to the engineer's vision, nor are there any eddies tending to drag the smoke down. In some particular instances, however, it may be desirable to mount the heater as a saddle on top of the boiler, or to build it directly in the boiler casing. The front closure C of the smoke box is provided with a readily detachable portion or plate 11 for giving access to the interior of the smoke box without disturbing the heater. This plate, in turn, is provided with the usual front door 12.

The heater B comprises the arc-shaped casing 13, the front, top and bottom walls of which are insulated, as indicated at 14 in Figs. 3 and 5, with any suitable insulating material, such as 85% magnesia covering; the nest of water tubes indicated as a whole by the reference numeral 15, said tubes being arranged in a plurality of passes as will further appear; end tube plates 16, 16, into which the water tubes are expanded and which constitute end closures for the arc-shaped casing; and the headers 17, 17 secured to the tube plates 16, 16 as by means

of the bolts 18, said headers being interchangeable.

Steam inlets 19 and 20 are provided in the front side of the casing 13 at the crown or central portion thereof in this instance one being located to each side of the center, whereby steam is introduced to the casing, it being pointed out that the heater condenses all of the steam it can use, the condensate draining out thru the drain outlets 21 located at the bottom of the heater or more specifically stated in the legs of the arc-shaped casing and adjacent the tube plates 16, 16. Thus it will be seen that the steam is introduced in a direction crosswise or transverse of the water tubes.

A perforated distributing or baffle plate 22 is located within the casing between the steam inlets and the water tubes which plate extends along the entire length of the heater whereby a chamber 23 is formed into which the steam initially enters before being distributed over the water tubes. Before explaining in detail the action of the steam, the water flow thru the tubes will be set forth as the relation of the water flow to the steam flow forms an important part of this invention.

Referring now to the construction of the headers 17 and their relation to the water tubes and tube plates, it will be observed that the header of the right hand leg of the heater is connected to the source of feed water supply by means of the pipe 24 and the header flange 17*a* and that the header of the left hand leg is connected to the point of feed water delivery by means of the pipe 25 and the header flange 17*b*. The headers 17 as before mentioned are interchangeable and they are positioned with respect to the tubes and tube plates as clearly shown in Fig. 6, that is, the right-hand header (the lower header in Fig. 6) is positioned with its flange to the rear of the heater and the left-hand header (the upper header in Fig. 6) is positioned with its flange to the front of the heater. The headers 17 are provided with the ribs 26 and 27 whereby chambers are provided at each end of the tubes when the headers are secured as above pointed out to the tube plates 16, 16. These ribs are so spaced as to arrange the water tubes in a plurality of passes as follows.

The feed water introduced at 17*a* enters the single chamber 17*c* in the right-hand header from whence it flows thru the tubes of the first pass 15*a* entering the double chamber 17*d* in the left-hand header, from whence it flows thru the tubes of the second pass 15*b* entering the double chamber 17*e* in the right-hand header, from whence it flows thru the tubes of the third pass 15*c* entering the double chamber 17*f* in the left-hand header, from whence it flows thru the tubes of the fourth pass 15*d* entering the double chamber 17*g* in the right header, from whence it flows thru the tubes of the fifth or final pass 15*e* entering the single chamber 17*h* of the left header and from whence it flows to the point of use thru the medium of the pipe 25 and flange connection 17*b*. Thus it will be seen that five passes are provided for the water in its passage thru the heater.

In this connection it is mentioned that due to the particular shape and diameter of the heater we are enabled to employ very long tubes, in comparison to the lengths of tubes used in other types of locomotive feed water heaters. Where short tubes are used it is necessary to either employ a large number of passes or to employ agitators or retarders. Hence the velocity of flow thru the tubes is cut down whereas by employing long tubes with few passes the flow thru the tubes is at a higher rate which tends to produce greater efficiency in heat transfer. In practice the physical limitations as to space available on locomotives are such that it is impossible to provide a high capacity heater where short tubes and a multiplicity of passes are employed.

Reverting now to the steam flow it will be seen that the distributing plate 22 is located adjacent the final water pass 15*e* so that the steam in its passage over the tubes of the heater engages the tubes of the final pass first, the perforated plate 22 providing an even distribution of steam all along said tubes and producing relatively high velocity flow of the steam thereagainst. Thus every part of the heating surface in the last pass or passes is subjected to violently active steam which blows away the condensate as soon as it forms, and always rapidly circulates over the heating surfaces. The first passes of the heater are never as important, inasmuch as the temperature differences are high even under the worst conditions so that critical conditions are only approached in the final passes. It is further to be noted that the steam is of uniform temperature for the whole length of the final water pass of the heater by virtue of the steam being centrally admitted and then distributed by the plate 22.

Referring more particularly to Figs. 5, 7 and 8 it will be seen that the nest of tubes 15 is of substantially rectangular form of small depth, in cross section, so that the condensate does not have to spill over a great number of rows of tubes before reaching the bottom of the heater casing. This combined with the arc-shape of the heater gives an ideal drainage of condensate which is highly important, it being obvious that the condensate will readily drain along the length of the arc-shaped tubes.

Thru the practice of our invention a feed water heater of high efficiency is produced

as will be substantiated by the fact that a condensate temperature of very high value is reached, it being an accepted fact that high condensate temperatures denote high efficiency.

It has been found that by our novel arrangement of steam introduction as above described the final temperatures of the water were within 2 degress of the steam temperature.

The long tubes (of an average length of 10 feet) which we are enabled to use because of the particular shape of the heater reduces the number of tube joints over other types of heaters, of equal capacity, thus making a less expensive and more dependable construction.

Suitable tube separator plates 28 are provided along the length of the tubes.

In the event of failure of any of the tubes they may readily be removed by detaching the headers 17 and reaming out the ends of the tubes and then sliding them out.

Steam may be supplied to the heater from the engine cylinders and from the stoker and air pump exhaust lines, suitable piping being provided as shown in Figs. 1 and 2.

Suitable air vents are provided in the casing at 29.

We claim:—

1. In a locomotive with its smokebox, a substantially semi-circular feedwater heater removably mounted thereon and co-operating therewith to form with said smokebox a substantially continuous cylindrical surface.

2. In a locomotive with its smoke-box, a multi-tube feed water heater having a substantially semi-circular casing positioned adjacent and external to the smoke-box, and in its outside contour substantially merging with the outside curved contour of the smoke-box.

3. In a locomotive with its smoke-box, a multi-tube feed water heater having a substantially semi-circular casing positioned at the front of the smoke-box and in its outside contour substantially merging with the outside curved contour of the smoke-box.

4. In a locomotive having a smoke-box, a substantially semi-circular feed water heater removably mounted external to the smoke-box at the top of the smoke-box front end wall in the position of an inverted U.

5. In a locomotive having a smoke-box, a substantially semi-circular feed water heater mounted at the top of the smoke-box front end in the position of an inverted U with its upper outside contour substantially merging with the upper outside contour of said smoke-box.

6. In a locomotive having a smoke-box, a substantially semi-circular feed water heater mounted external to the smoke-box at the top of the smoke-box front end wall in the position of an inverted U, with steam admission means adjacent the top thereof and condensate drainage means at the bottom of the legs thereof.

7. In combination, a locomotive having a smoke-box with a front closure therefor, a part of said closure being removable to provide access to the interior, and a feed water heater mounted at the front of the smoke-box between the periphery thereof and the edge of the removable part of said closure and shielded by the smoke-box shell from the cinders and gases therein.

8. A substantially semi-circular feed water heater for locomotives, having water tubes extending from end to end thereof, and spacer plates for the tubes arranged to permit withdrawal of tubes endwise, and having means for permitting condensate drainage beneath the plates.

9. An arc-shaped feed water heater for locomotives adapted to be mounted in the position of an inverted U at the front end of a locomotive, having mounting means at the back and steam admission means at the front.

10. An arc-shaped feed water heater for locomotives adapted to be mounted in the position of an inverted U at the front end of a locomotive, having mounting means at the back and pipe connection means at the bottom of the legs of the heater.

11. An arcuate locomotive feed water heater comprising a casing, water tubes therein, extending from end to end thereof, and arranged in a plurality of passes in the direction of one cross-sectional dimension of the casing, means for directing steam upon and among said tubes from the side adjacent the final pass, and means for drawing off condensate, at the bottom, from the ends of said casing.

12. A substantially semi-circular feed water heater for locomotives, having water tubes extending from end to end arranged in a plurality of passes, with counterpart invertible inlet and outlet heads at the ends providing means for directing the water serially through the passes.

13. An arcuate locomotive feed water heater comprising a casing, water tubes therein, extending from end to end thereof, means cooperating with walls of the casing to form an arcuate steam chamber from end to end thereof, means for admitting steam to said chamber, and a plurality of jet openings from said chamber directed toward said tubes, said tubes being arranged in a plurality of passes with the final pass adjacent said jet openings.

14. A substantially semi-circular feed water heater having water tubes therein extending from end to end, steam admission means adjacent the middle of the heater, and drainage means adjacent the ends of the heater.

15. A substantially semi-circular feed water heater having water tubes therein extending from end to end, steam admission means

adjacent the middle of the heater, and drainage and vent means adjacent the ends of the heater.

16. A substantially semi-circular feed water heater having water tubes therein extending from end to end, steam admission means adjacent the middle of the heater, and drainage and vent means adjacent the ends of the heater, together with means preventing short-circuiting of the steam from the admission means to the drainage and vent means.

17. A substantially semi-circular feed water heater having water tubes therein extending from end to end, steam admission means adjacent the middle of the heater, and drainage and vent means adjacent the ends of the heater, together with means preventing short-circuiting of the steam from the admission means to the drainage and vent means, comprising a perforated plate between them.

18. A substantially semi-circular feed water heater having water tubes therein extending from end to end, steam admission means adjacent the middle of the heater, and drainage and vent means adjacent the ends of the heater, together with means preventing short-circuiting of the steam from the admission means to the drainage and vent means, comprising a perforated plate between them which also serves to agitate the steam, distribute it from end to end of the heater and direct it in jets upon said tubes.

19. An arcuate feed water heater for mounting at the front end of a locomotive, comprising an arcuate casing drawn on a circle substantially to merge, in its outside contour, with the outside contour of a locomotive front end, arcuate water tubes extending from end to end of the casing, means for admitting steam adjacent the middle of the casing, and means for taking off condensate at the two ends thereof.

20. An arcuate feed water heater for mounting adjacent the front end of a locomotive, comprising an arcuate casing drawn on a circle substantially to merge, in its outside contour, with the outside contour of a locomotive front end, arcuate water tubes extending from end to end of the casing, means for admitting steam adjacent the middle of the casing, and means for taking off condensate at the two ends thereof, together with air port means in the outside peripheral wall of the casing.

21. An arcuate feed water heater for mounting at the front end of a locomotive, comprising an arcuate casing drawn on a circle substantially to merge, in its outside contour, with the outside contour of the locomotive front end, arcuate water tubes extending from end to end of the casing, means for admitting steam adjacent the middle of the casing, and means for taking off condensate at the two ends thereof, together with air port means in the casing also positioned adjacent said ends.

22. An arcuate locomotive feed water heater comprising a casing, water tubes therein, extending from end to end thereof, means cooperating with walls of the casing to form an arcuate steam chamber from end to end thereof, means for admitting steam to said chamber, and a plurality of jet openings from said chamber directed toward said tubes.

23. An arcuate locomotive feed water heater comprising a casing, water tubes therein, extending from end to end thereof, means cooperating with walls of the casing to form an arcuate steam chamber from end to end thereof, means for admitting steam to said chamber adjacent the middle of the arc, and a plurality of jet openings from said chamber directed toward said tubes.

24. An arcuate locomotive feed water heater comprising a casing, water tubes therein, extending from end to end thereof, means cooperating with walls of the casing to form an arcuate steam chamber from end to end thereof, means for admitting steam to said chamber adjacent the middle of the arc, and a plurality of jet openings from said chamber directed toward said tubes, together with condensate drains at the ends of the casing.

In testimony whereof, we have hereunto signed our names.

EUGENE L. SCHELLENS.
CHRISTOPHER A. SCHELLENS.