

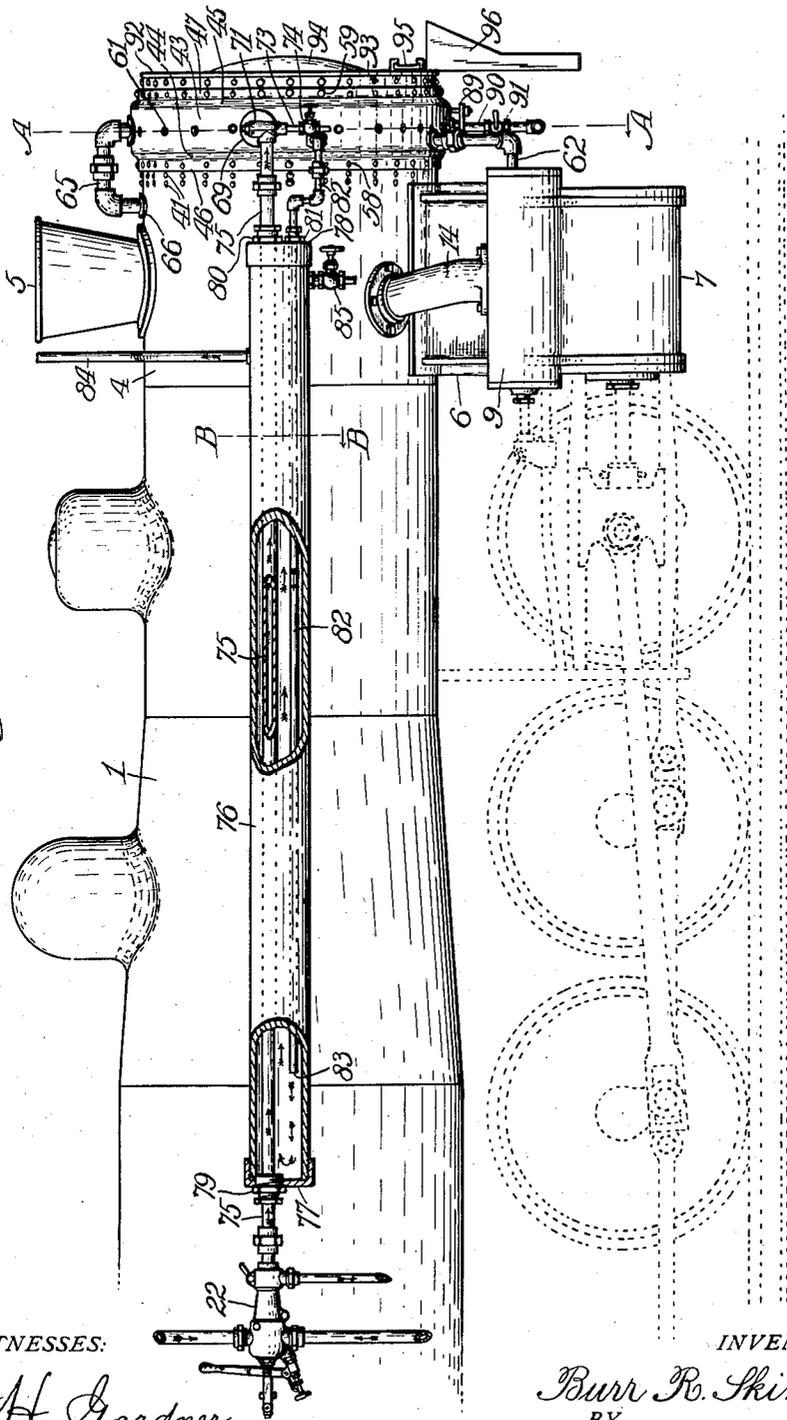
B. R. SKINNER.
 MEANS FOR HEATING BOILER FEED WATER.
 APPLICATION FILED MAY 12, 1913.

1,108,633.

Patented Aug. 25, 1914.

5 SHEETS—SHEET 1.

Fig. 1.



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M. L. Wilhelm.

INVENTOR:

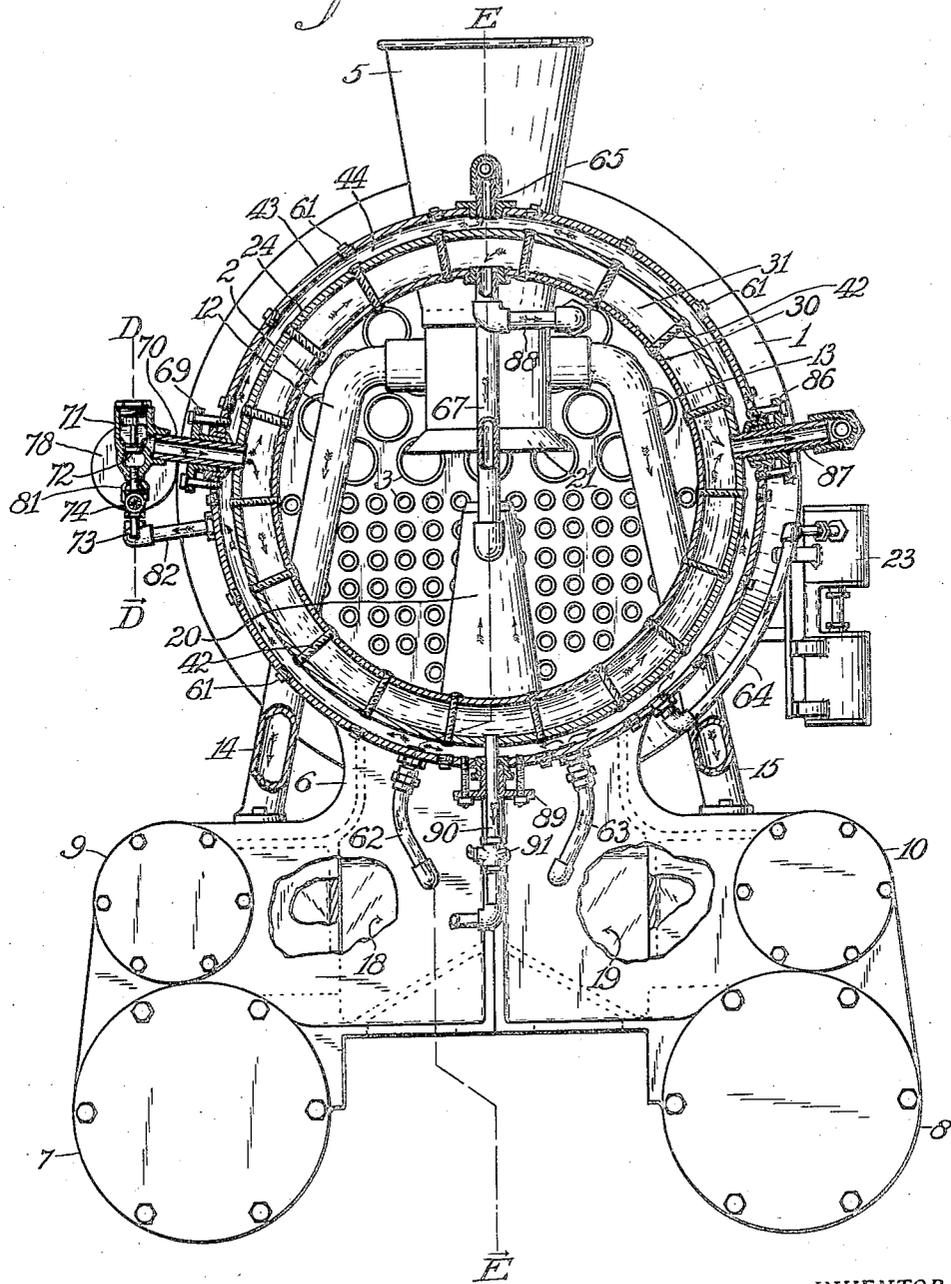
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Fig. 2.



WITNESSES:

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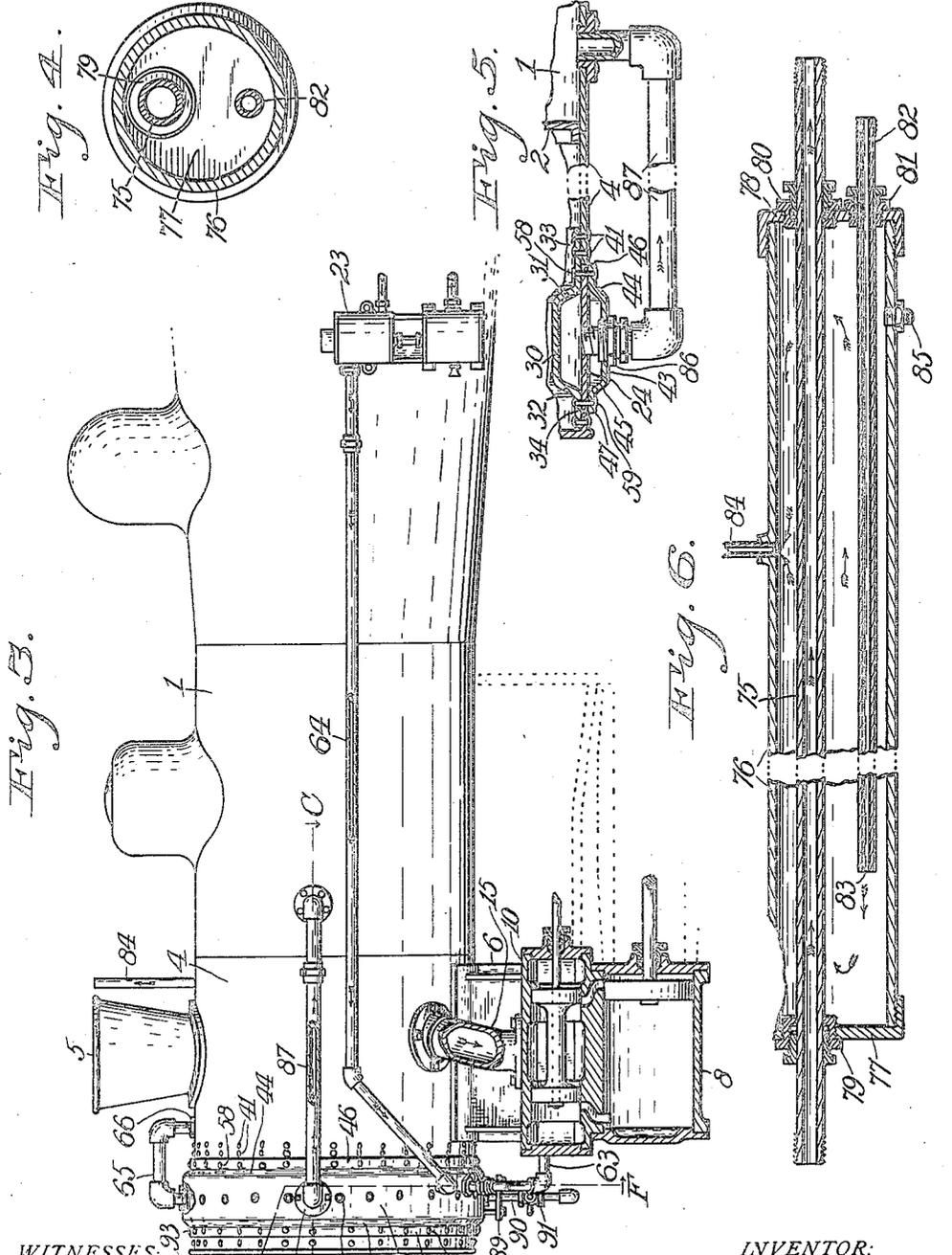
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5 SHEETS—SHEET 3.



WITNESSES:
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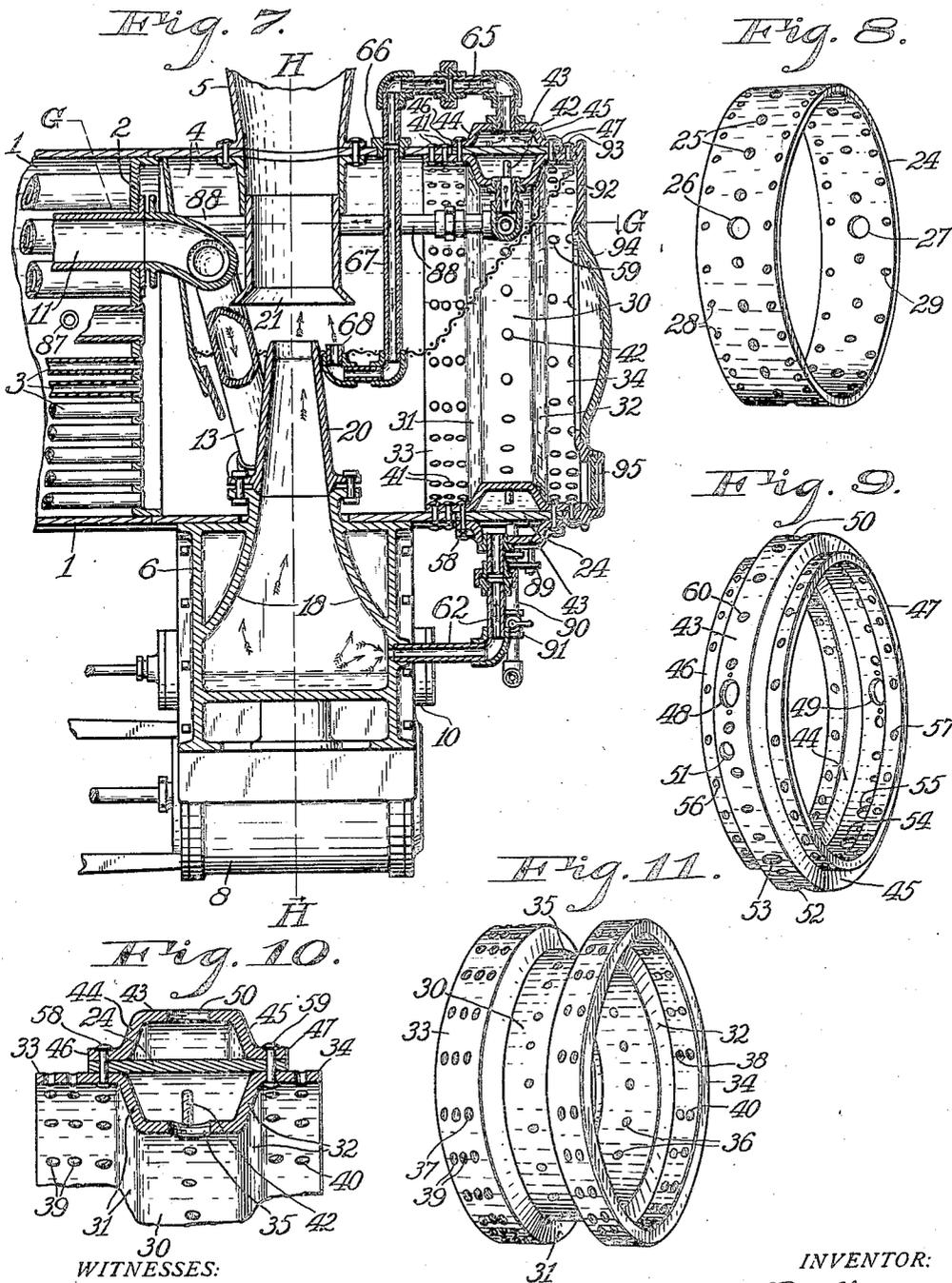
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5 SHEETS—SHEET 4.



WITNESSES:
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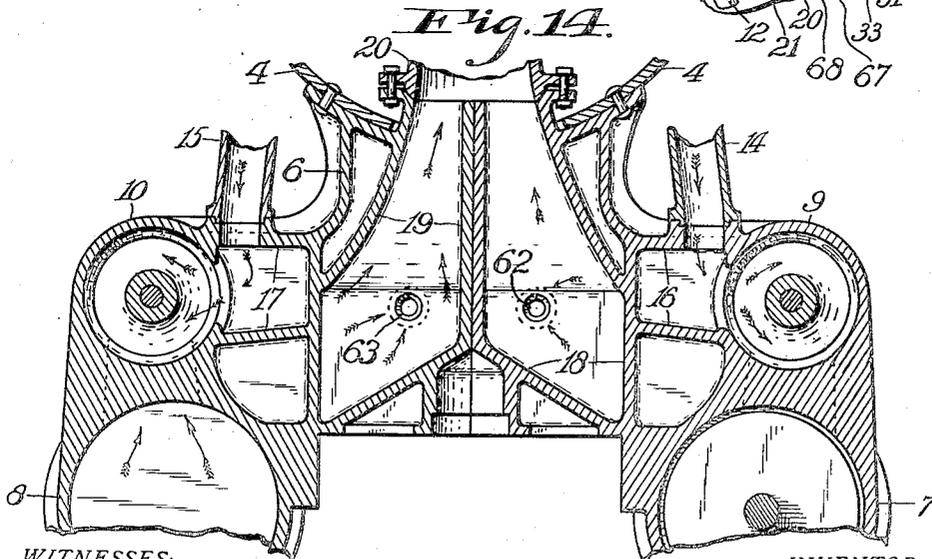
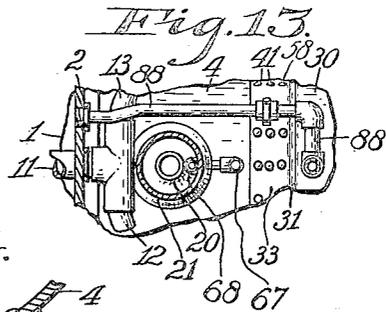
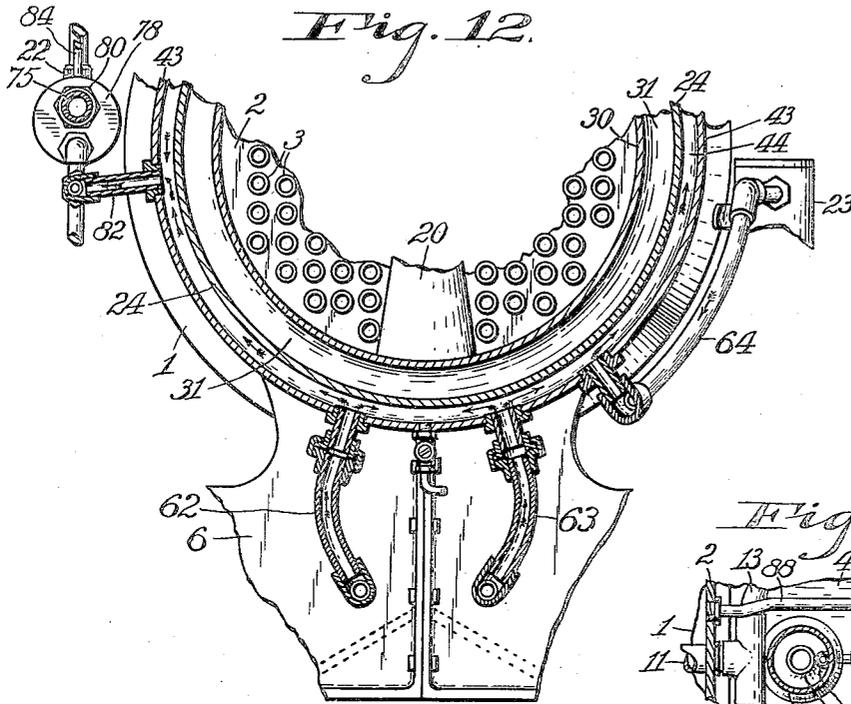
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5 SHEETS-SHEET 5.



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UNITED STATES PATENT OFFICE.

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MEANS FOR HEATING BOILER FEED-WATER.

1,108,633.

Specification of Letters Patent. Patented Aug. 25, 1914.

Application filed May 12, 1913. Serial No. 787,103.

To all whom it may concern:

Be it known that I, BURR R. SKINNER, a citizen of the United States, residing at Aberdeen, in the county of Brown and State of South Dakota, have invented a new and useful Means for Heating Boiler Feed-Water, of which the following is a specification, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon.

This invention relates to means for supplying heat to water entering boilers to be further heated to a high degree or to be converted into steam, the invention having reference more particularly to means for utilizing furnace-draft heat and also spent steam for heating the feed water required by steam boilers, more particularly locomotive boilers.

An object of the invention is to effect a saving of fuel required for heating water or converting water into steam.

A further object is to supply the boiler with warm or hot water in order that the fuel consumed in the fire-box of a boiler of a given size will the more readily convert the water into steam, and therefore in many cases enabling a boiler to make steam freely when it may fail to produce sufficient steam when fed with cold water.

Another object is to provide means for heating feed water for locomotive boilers that shall be so constructed as to directly utilize some of the exhaust steam from the engine cylinders, in order to prevent sharp blasts from the exhaust nozzles and therefore prevent the drawing of unburned fuel from the furnace and filling up the smoke-box therewith, or throwing hot coals out of the smoke-stack and starting fires therewith along the road.

A still further object is to cause the exhaust steam to produce a soft and steady draft on the fire in the fire-box and advantageously utilize the draft heat, so as to obtain the most economical results in operation.

The invention consists in a steam boiler provided with an auxiliary boiler or heater connected therewith and of novel construction and arrangement, so as to receive the benefit of waste heat of combustion, for receiving and primarily heating the feed water, and for separating the sedimentary matter from the water so as to prevent in-

jurious matter from entering the more expensive steam boiler, the auxiliary boiler or heater being relatively cheaper and smaller in structure so that it may be repaired or renewed ultimately at relatively small cost.

The invention further consists in means for conducting exhaust steam to and from the auxiliary boiler or heater, and also novel means for advantageously heating the feed water or keeping it warm in its passage from the boiler feeder to the auxiliary boiler or heater. The invention consists also in the novel parts and 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 side elevation of a railway locomotive having the invention applied thereto as illustrative of one form of structure for practically carrying out the objects of the invention; Fig. 2 is a transverse section on the plane of the line A A in Fig. 1; Fig. 3 is a fragmentary left side elevation of the locomotive to which the invention is applied; Fig. 4 is a transverse section on the line B B in Fig. 1; Fig. 5 is a fragmentary horizontal section approximately on the line C C in Fig. 3; Fig. 6 is a fragmentary section approximately on the line D D in Fig. 2; Fig. 7 is a fragmentary vertical section approximately on the line E E in Fig. 2; Figs. 8 and 9 are perspective views of two of the principal parts of the auxiliary or heating boiler; Fig. 10 is a fragmentary section also on the line E E on an enlarged scale; Fig. 11 is a perspective view of another one of the principal parts of the heating boiler; Fig. 12 is a fragmentary section approximately on the line F F in Fig. 3; Fig. 13 is a fragmentary section approximately on the line G G in Fig. 7; and Fig. 14 is a fragmentary section on the line H H in Fig. 7.

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

A brief description of a well known type of locomotive will suffice for an understanding of the relation of the invention thereto, the numeral 1 indicating the shell of the steam boiler, 2 the front flue sheet, and 3 the tubes or boiler flues, 4 the smoke-box, 5 the smoke-stack, 6 the saddle secured to the

bottom of the smoke-box, 7 and 8 the cylinders provided respectively with valve chests 9 and 10, 11 the dry pipe or steam pipe in the boiler with which the two branch pipes 12 and 13 are connected for supplying steam to the valve chests, in the present case two extensions 14 and 15 being connected respectively with the branch pipes 12 and 13 and also with steam chambers 16 and 17 that supply the valve chests 9 and 10 with steam for distribution to the cylinders. The saddle 6 has suitable exhaust cavities 18 and 19 therein that receive the exhaust steam from the cylinders through suitable ports, as is understood, and discharge the exhaust steam into an exhaust pipe or nozzle 20 from which the steam escapes through a draft pipe 21 into and through the smoke-stack 5. A suitable boiler feeder is provided, in the present case being an injector 22. The locomotive is provided also with an air-pump 23 operated by steam. The foregoing may be of any suitable or desired construction and varied as to details.

It being understood that the products of combustion pass through the boiler tubes or flues into the smoke-box at high temperature, in order to utilize the heat thereof a novel form of heating boiler is provided and attached to or constructed so as to form a forward extension of the smoke box.

As preferably constructed the auxiliary or heating boiler comprises a number of concentrically arranged rings for forming two chambers or compartments, there being a middle partitional ring 24 that is cylindrical and preferably equal in diameter to the diameter of the smoke box 4 so as to practically form a forward extension of the latter. The ring 24 has a suitable number of stay-bolt holes 25 and has also an inlet aperture 26 and an outlet aperture 27 arranged in approximately opposite portions thereof, the ring having also a suitable number of rivet holes 28 and 29 adjacent to the opposite ends thereof. The inner ring comprises a cylindrical portion 30 that is less in diameter than the ring 24 and has end portions 31 and 32 formed thereon that extend outward to the inner side of the ring 24, said end portions having cylindrical extensions 33 and 34 respectively that extend beyond the planes of the ends of the ring 24. The normal upper portion of the inner ring has an outlet aperture 35 therein, being in the cylindrical portion 30 which has also a suitable number of stay-bolt holes 36. The extension 33 has rivet holes 37 therein and the extension 34 has rivet holes 38 therein to receive rivets for securing the inner ring to the partitional ring. The extension 33 has also rivet holes 39 and the extension 34 has rivet holes 40 therein, the rivet holes 39 receiving rivets 41 whereby the extension 33 is secured directly to the

inner side of the forward portion of the smoke box 4. A suitable number of stay-bolts 42 are radially arranged and secured to the ring 24 and the cylindrical portion 30 of the inner ring, so that the chamber or compartment formed by the two rings may safely withstand the pressure to which the steam boiler is subjected. The outer one of the rings comprises a cylindrical portion 43 that is greater in diameter than the ring 24 and has end portions 44 and 45 that extend inward to the ring 24 to form a steam chamber or compartment, said end portions having cylindrical extensions 46 and 47 respectively that embrace the outer side of the ring 24. The cylindrical portion 43 has an aperture 48 in one portion and another aperture 49 in the opposite portion thereof corresponding in position to the apertures 26 and 27 through which inlet and outlet pipes respectively may be inserted. The normal top of the portion 43 has an outlet aperture 50 therein and the cylindrical portion has also an outlet aperture 51 therein in proximity to the aperture 48. The normal bottom of the portion 43 has an aperture 52 therein through which a blow-off pipe is received, and the portion 43 has also two inlet apertures 53 and 54 in the bottom portion thereof and another inlet aperture 55 near the bottom portion. The extensions 46 and 47 have rivet holes 56 and 57 therein respectively that receive rivets 58 and 59 whereby the extensions are directly secured to the outer side of the ring 24, the rivets securing the inner ring also to the partitional ring 24. The cylindrical portion 43 of the outer ring has a suitable number of holes 60 through which to insert or remove, or upset the stay-bolts 42, the holes 60 being closed by plugs 61.

In order to economically supply the outer one of the chambers with steam for assisting to heat the water in the inner one of the chambers two pipes 62 and 63 are connected to the saddle and also to the cylindrical portion 43 of the outer ring (in the apertures 53 and 54), so as to form communication with the steam chamber and the two exhaust cavities 18 and 19 and permit some of the exhaust steam to be forced by back pressure through the steam chamber. Also in order to utilize the exhaust steam from the air-pump 23 the exhaust pipe 64 of the air-pump has its terminal end connected (in the aperture 55) with the steam chamber. An exhaust pipe 65 is connected (in the aperture 50) to the top of the portion 43 so as to permit the escape of the exhaust steam from the outer chamber, and it continues rearward and thence downward into the smoke box, preferably being secured in a bushing 66 inserted in the top of the smoke box 4, a continuing pipe 67 being secured also in the bushing and supported thereby, the pipe ex-

tending downward and also rearward and being provided with an upturned nozzle 68 that is arranged adjacent to the exhaust pipe or nozzle 20.

6 The outer ring of the heating boiler is provided with a suitable packing box 69 (in the aperture 48) through which extends a nipple 70 that is secured to the partitional ring 24 (in the aperture 26) so as to conduct
10 water to the inner chamber of the heating boiler. A valve casing 71 is connected to the outer end of the nipple and has a suitable check valve 72 therein. Preferably a drain
15 pipe 73 is connected to the casing and provided with a valve 74. A branch pipe 75 is connected with the injector 22 and also with the check valve casing 71. It being desirable to utilize the exhaust steam to the fullest extent, the branch pipe 75 preferably is
20 provided with a tubular casing 76 which has two heads or caps 77 and 78 on its ends, the heads being provided with packing boxes 79 and 80 respectively through which the branch pipe extends. The branch pipe and its casing being approximately horizontal,
25 the arrangement is such that the branch pipe is in the upper portion of the casing. The lower portion of the head 78 is provided with another packing box 81 through which
30 a steam pipe 82 extends, the steam pipe being connected to the outer ring (in the aperture 51) so as to conduct exhaust steam from the steam chamber into the casing 76, the terminal end 83 of the steam pipe extending to the rear portion of the casing in proximity to the head 77, so that steam discharged from the end 83 will fill the casing and cannot escape until it returns nearly through the casing in contact with the branch pipe
40 75. An escape pipe 84 is connected with the casing 76 relatively near the forward end thereof, and it extends upward at the rear of the smoke stack 5. The water of condensation is permitted to escape from the casing
45 76 through a suitable drip-valve 85 connected with the under portion of the casing.

The left hand or opposite portion of the outer ring of the heating boiler is provided with a suitable packing box 86 (in the aperture 49) and a pipe 87 extends therethrough and is secured to the partitional ring 24 (in the aperture 27), the pipe 87 extending rearward and along the outer side of the smoke box and past the plane of the flue sheet 2, and it is connected to the shell 1 of the steam boiler so as to conduct the heated water from the inner chamber to the steam boiler below the level of the water carried therein.

60 Preferably another communication is provided between the upper portion of the inner chamber of the heating boiler and the upper portion of the steam boiler, such communication preferably comprising a pipe 88 that is connected to the cylindrical portion 30 (in
65 the aperture 35) and extends through the in-

terior of the smoke box on one side of the lift pipe 21 and back to the front flue sheet 2 to which the pipe is connected, so that this communication shall be above the water level and insure equalization of pressure in both the boiler and the chamber of the water heater, and also permit steam which may be generated in the water heater to escape into the steam space of the steam boiler.

70 The bottom of the outer ring is provided with a packing box 89 (in the aperture 52) through which a blow-off pipe 90 extends to the under portion of the partitional ring 24 in which the pipe is secured, the pipe being provided with a stop-cock 91, to permit deposits from the feed water to be blown out and therefore prevent it from entering the steam boiler.

A suitable smoke box front 92 is secured to the extension 34 of the inner ring by means of rivets 93 and is provided with a door 94, the lower portion of the front being provided with a gate or valve 95 through which to remove cinders or dead sparks from the smoke box into a suitably supported hopper 96.

85 It will be understood that in the interest of clearness of description the boiler and pipe coverings customarily employed for the prevention of radiation of heat are omitted in the drawings, it being obvious that suitable coverings will be provided wherever found desirable.

In practical use the greater proportion of exhaust steam passes out the smoke stack and as usual produces the requisite draft for the fire whereby to convert the water into steam in the boiler, the product of combustion being drawn into the smoke box and consequently into contact with the inner ring of the water heating boiler, the degree of heat, however, being less when the engines are not in operation. The exhaust steam passing through the pipes 62 and 63 and also through the pipe 64 heats the partitional ring 24 and therefore assists in heating the water in the water-chamber. The steam escaping from the nozzle 68 produces a continuous draft on the fire, acting as a blower so that the intermittent blasts from the pipe 20 may be softened and therefore not be liable to tear up the fire as often occurs when excessively small exhaust nozzles are used. In case the locomotive is at rest the air-pump may be working so that the exhaust steam therefrom contributes toward heating the feed water in case the injector is working. When the locomotive is in operation and the injector is working as is customary the heating process of the feed water begins in the branch pipe 75, or under some conditions at least is prevented from being cooled as it comes from the injector. The water enters the inner chamber, as will be seen, below the level of the water in the

boiler and passes through the lower portion of the water-chamber to become heated by the exhaust steam in the steam chamber and also by the heat in the smoke box, the water
 5 passing out through the pipe 87 to the steam boiler. In case the heat becomes excessive so that steam is generated in the water-chamber it will be understood that the steam escapes through the pipe 88 into the steam
 10 boiler.

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

1. Means for heating feed water including a heating boiler comprising three concentrically arranged rings secured together to form two annular chambers, and stay-bolts secured to the two inner ones of the rings.

2. Means for heating feed water including a heating boiler comprising a partitional ring, an inner ring having two end portions secured to the inner side of the partitional ring, and an outer ring having two end portions secured to the outer side of the partitional ring.

3. A steam-boiler provided with an annular heating boiler having two concentrically arranged chambers, the outer one of the chambers having an inlet and also an outlet, and two conduits connected with the inner chamber and also with the steam-boiler on opposite sides respectively of a horizontal plane.

4. Means for heating feed water including a water-chamber, a steam-chamber having an inlet and an outlet, a casing, a feed pipe extending through the casing to the water-chamber, and a steam-pipe connected with the steam-chamber and extending into the casing through one end and nearly to the opposite end thereof.

5. Means for heating feed water including a smoke-box to receive heat and having a water-heating extension thereon provided with two chambers, one chamber being encircled by the other to receive the feed water, an inlet for conducting steam into the encircling chamber, a front mounted on the water-heating extension, and a door mounted
 50 on the front.

6. A steam-boiler provided with a smoke-box having an annular heating boiler thereon, the heating boiler having an inner chamber and also an outer chamber extending
 55 about the inner chamber, a conduit connected with the inner chamber and also with the steam-boiler and extending through the outer chamber, and a steam-inlet pipe connected with the outer chamber.

7. A steam-boiler provided with a smoke-box having an annular heating boiler on its normally forward end, the heating boiler having an inner chamber and also an outer chamber extending about the inner chamber,
 65 the inner chamber having communication

with the steam-boiler both below and above the normal water level of the steam-boiler, and a steam-inlet pipe connected with the outer chamber.

8. Means for heating feed water including a water-heating boiler having two annular chambers therein, one of the chambers extending about the other, an inlet conduit extending through the outer one and having communication with the inner one of the chambers, an outlet conduit having communication with the inner one of the chambers,
 75 an inlet conduit having communication with the outer one of the chambers, and an outlet conduit having communication with the outer one of the chambers.

9. In means for heating feed water, the combination of a plurality of rings connected together to form two concentrically arranged chambers, the outer ring having two packing boxes therein, an inlet pipe and an outlet pipe connected with the inner one of the two chambers and extending respectively through the two packing boxes, and an inlet pipe and an outlet conduit connected with
 90 the outer chamber.

10. In means for heating boiler feed water, the combination with a steam-boiler, of a smoke-box having an extension on its end provided on its inner side with a water-chamber and on its outer side with a steam-chamber, an inlet pipe extending through the steam-chamber to the water-chamber, a conduit connected with the water-chamber and the steam-boiler, and an exhaust pipe
 95 connected with the steam-chamber and extending into the smoke-box.

11. In means for heating boiler feed water, the combination of a smoke-box having a water-chamber in its interior and a steam-chamber on its exterior, a casing, a feed-pipe extending through the casing and also through the steam-chamber to the water-chamber, a steam-pipe connected with the steam-chamber and extending into the casing, an outlet pipe connected with the water-chamber, a supply pipe connected with the steam-chamber, and an exhaust pipe connected with the steam-chamber.

12. In means for heating boiler feed water, a heating boiler comprising three concentrically arranged rings, the inner and the outer ones of the rings having end portions that extend to and are secured to the middle one of the rings whereby two concentrically arranged annular chambers are formed, a supply pipe extending through the outer one to the inner one of the chambers, means for heating the supply pipe, an outlet pipe connected with the inner one of the chambers, a supply pipe connected with the lower portion of the outer one of the chambers, and an exhaust pipe connected with the upper portion of the outer one of the chambers.

13. In means for heating boiler feed water, the combination with a steam-boiler, a boiler feeder, and a steam-operated pump, of an annular water-heating boiler having a water-chamber and also a steam-chamber extending about the water-chamber, a branch pipe connected with the boiler-feeder and the water-chamber, an exhaust steam-pipe connected with the pump and the steam-chamber, an outlet pipe connected with the steam-chamber, and a conduit connected with the water-chamber and the steam-boiler.

14. In means for heating feed water, a heating boiler comprising three concentrically arranged rings, each one excepting the middle one of the rings having end portions thereon that extend to the middle one of the rings, each one of the end portions having a cylindrical extension thereon that is secured to said middle ring, the outer one of the rings having a series of apertures therein, a series of stay-bolts extending radially from the inner one to the middle one of the rings and secured thereto in alignment with the apertures respectively, and a series of plugs inserted in the apertures respectively.

15. In means for heating feed water, the combination with a steam-boiler, of a smoke-box on the front end of the boiler having an extension thereon provided with an annular water-chamber and also a steam-chamber extending about the water-chamber, the inner wall of the water-chamber partaking of the heat in the smoke-box, a front closure connected to the end of the extension, a water-inlet conduit connected with the water-chamber, a casing for the conduit, a steam-pipe connected with the steam-chamber and the casing, a conduit connected with the water-chamber and the steam-boiler, and inlet and outlet pipes connected with the steam-chamber.

16. In means for heating boiler feed water, the combination with a steam-boiler, and a smoke-box on the front end of the steam-boiler, of an annular water-heating boiler on the front end of the smoke-box and having a water-chamber and also a steam-chamber extending about the water-chamber, a front closure mounted on the front end of the water-heating boiler, a door mounted on the front closure, a water-supply pipe connected with the water-chamber, a conduit connected with the water-chamber and the steam-boiler, a steam-supply pipe connected with the steam-chamber, and an exhaust pipe connected with the steam-chamber and extending into the smoke-box.

17. In means for heating feed water, the combination with a steam-boiler, and a smoke-box on the front end of the steam-boiler, of a water-heating boiler on the

front end of the smoke-box and having two concentrically arranged annular chambers therein, one of the chambers extending about the other, a water-inlet pipe connected with the inner one of the chambers, a steam-inlet pipe and also an escape pipe connected with the outer one of the chambers, a water-pipe connected with the inner one of the chambers and extending through the outer one of the chambers and past the exterior of the smoke-box to the steam-boiler and connected with the latter, and an equalizing pipe connected with the inner one of the chambers and also with the steam-boiler.

18. In means for heating feed water, a heating boiler comprising three upright and concentrically arranged rings connected together to form two annular chambers, one chamber extending about the other, an inlet pipe and an outlet pipe connected to approximately opposite portions respectively of the middle one of the rings and extending through the outer chamber and the outer one of the rings, a steam-inlet pipe connected to the under portion of the outer one of the rings, an escape pipe connected to the upper portion of the outer one of the rings, a packing box secured in the under portion of the outer one of the rings, and a blow-off pipe connected to the middle one of the rings and extending through the outer one of the chambers and also through the packing box.

19. In means for heating feed water, a water-heating boiler comprising an annular structure having two chambers therein extending about a horizontal axis, one of the chambers extending about the other, an inlet pipe and an outlet pipe extending through the outer one and forming communication with the inner one of the chambers above the plane of the horizontal axis, a plurality of steam-inlets forming communication with the lower portion of the outer one of the chambers, an escape pipe forming communication with the upper portion of the outer one of the chambers, an outlet pipe forming communication with the upper portion of the inner one of the chambers, and a blow-off pipe forming communication with the lower portion of the inner one and extending through the outer one of the chambers.

20. In means for heating boiler feed water, the combination with a steam-boiler, a boiler feeder, a steam-operated pump, a smoke-box on the boiler, and a saddle secured to the smoke-box and having exhaust-steam cavities therein, of a water-heating boiler on the front end of the smoke-box and having a water-chamber and also a steam-chamber therein, conduits connected with the exhaust cavities respectively and also with the steam-chamber, an escape pipe connected with the steam-chamber and

extending into the smoke-box and upward therein, a pipe connected with the pump and the steam-chamber, a branch pipe connected with the boiler feeder and the water-chamber and provided with a casing, a pipe
5 connected with the steam-chamber and the casing, a pipe connected with the water-chamber and the steam-boiler, and an equalizing pipe connected with the upper portions of the water-chamber and the steam-boiler.
10

21. In means for heating feed water, the combination with a steam-boiler, a smoke-box on the front end of the steam-boiler, a
15 saddle secured to the lower portion of the smoke-box and having two exhaust-steam cavities therein, and an exhaust pipe secured uprightly on the saddle and having communication with the two exhaust cavities,
20 of a water heating boiler secured to the front end of the smoke-box and having two concentrically arranged annular chambers therein, one of the chambers extending
25 about the other, two pipes connected respectively with the two exhaust cavities and also with the lower portion of the outer one of the chambers, an escape pipe connected with
the upper portion of the outer one of the chambers and extending into the smoke-box
30 to the exhaust pipe, the end of the escape pipe being turned upward, an inlet pipe connected with the inner one of the chambers, and an outlet pipe connected with the

inner one of the chambers and also with the steam-boiler.

22. In means for heating feed water, the
35 combination with a steam-boiler, a smoke-box on the front end of the steam-boiler, a saddle secured to the lower portion of the smoke-box and having an exhaust-steam
40 passage therein, and a water heating boiler on the front of the smoke box and having two concentrically arranged annular chambers therein extending about the horizontal
45 axis of the smoke-box, one of the chambers extending about the other, of a conduit forming communication with the exhaust-steam passage and the lower portion of the
50 outer one of the chambers, an escape pipe forming communication with the upper portion of the outer one of the chambers, an inlet pipe and an outlet pipe forming
communication with the inner one of the chambers approximately on the plane of
55 said axis, the outlet pipe forming communication with the steam-boiler, and a pipe extending through the smoke-box and connected with the upper portions of the steam-boiler and the inner one of the chambers.

In testimony whereof, I affix my signature
60 in presence of two witnesses.

BURR R. SKINNER.

Witnesses:

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