No. 680,513. Patented Aug. 13, 1901.

A. WIRTH.

FEED WATER HEATER.

(Application filed Apr. 23, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

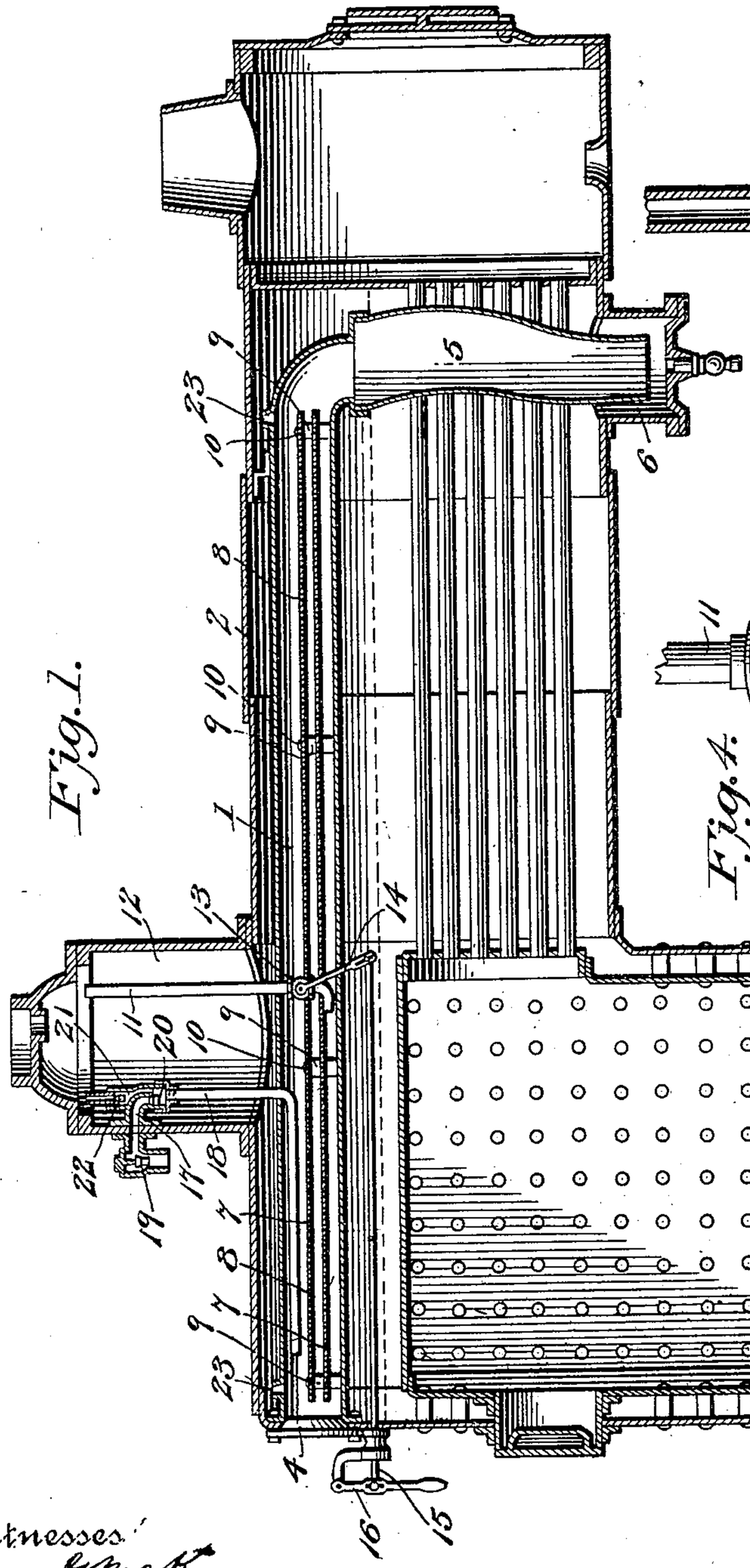


Fig. 5.

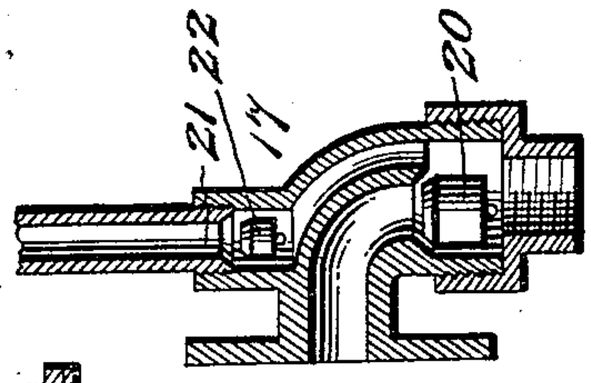
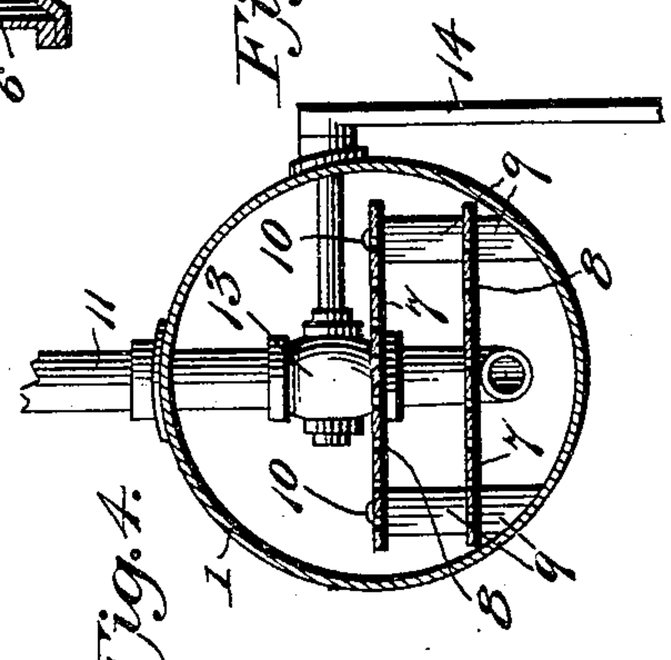


Fig. 4.



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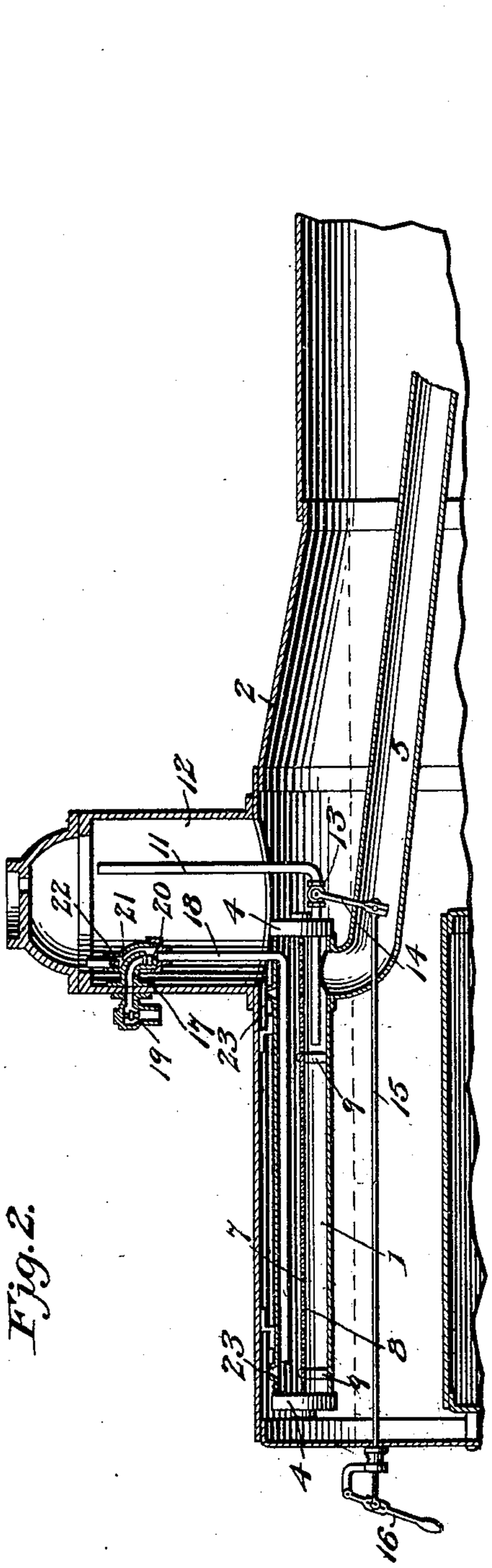

Fig. 2.

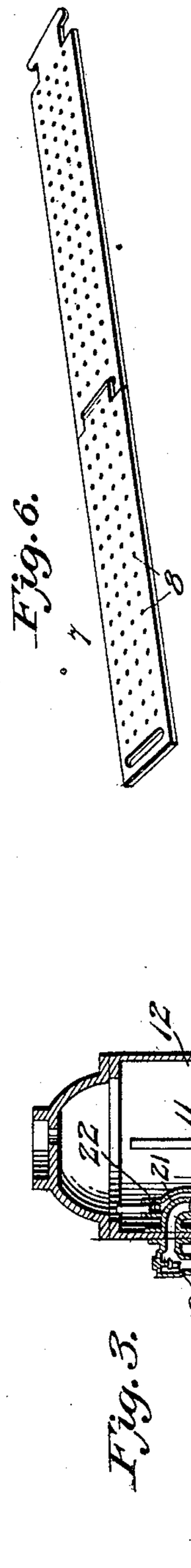

Fig. 6.

Fig. 3.

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UNITED STATES PATENT OFFICE.

ALEXANDER WIRTH, OF PARSONS, KANSAS.

FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 680,513, dated August 13, 1901.

Application filed April 23, 1900. Serial No. 14,013. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER WIRTH, a citizen of the United States, residing at Parsons, in the county of Labette and State of Kansas, have invented certain new and useful Improvements in Feed-Water Heaters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to feed-water heaters for steam-boilers, and more particularly to locomotive feed-water heaters.

In the heating of feed-water for steam-boilers the desideratum is the bringing of the water to the temperature of evaporation freed from all impurities prior to contact with the heating-surface of the boiler. If, as is the case with feed-water heaters heretofore known to the art, the boiler is made to partly heat its feed-water in addition to generating steam, its steaming capacity is rendered less efficient than it would be if the water were heated to the temperature of evaporation before being introduced into the boiler. In high-pressure boilers, such as are used in locomotives, where the pressure is, say, two hundred pounds to the square inch, the temperature at which evaporation takes place under such a pressure is 380° Fahrenheit. Under such conditions the injection of water which is relatively cold necessarily produces an evil effect on the boiler and principally on the steam created when sudden and rapid intermittent circulation takes place, as is the case in locomotive service. This evil effect is manifested in continued breakage of stay-bolts and leaking flues, as well as a fluctuation of the steam-pressure. Under the conditions above named the boiler demands a supply of three to six pounds of water per second, leaving the injector at a velocity of approximately one hundred and seventy feet per second, and as this volume of water must be heated as fast as introduced into the boiler and because feed-water heaters such as now used are incapable of so heating the feed-water the inflowing water constantly cools the boiler and chills the steam, thus limiting the steam capacity.

One object of the present invention is the provision of a feed-water heater especially adapted for locomotive service which will heat the inflowing water to the same temperature as the water in the boiler before being introduced to that water—that is to say, a heater which will bring the water to the temperature of evaporation, whereby the burden of heating its own feed-water after introduction is removed from the boiler and it is left free to act as an exclusive steam-generator and not a partial water-heater.

A further object of my invention is the provision of a heater for the feed-water which will allow a free and unrestricted discharge of the water by its own specific gravity through an outlet of approximately the same size as the heater itself, as I have found that this is necessary to perfect action.

Another object is the provision of a feed-water heater which will relieve the water of its impurities and carry them off to the mud-drum.

A still further object is to provide a feed-water heater which can be applied to the boiler without difficulty and will be arranged and adapted for easy access thereto, as well as for regulation, and, further, to provide means for equalizing the pressure, so that the water remaining in the heater will be assisted in its discharge therefrom by gravity when the injector or pump is shut off.

Having the foregoing objects and others not specifically mentioned in view, the invention consists of the novel and improved features and coöperating parts fully described hereinafter and set forth in the appended claims.

In the accompanying drawings, Figure 1 is a longitudinal section of the ordinary straight-top locomotive-boiler equipped with the preferred form of my invention. Fig. 2 is a similar view showing the invention as used on a wagon-top locomotive-boiler; Fig. 3, a view showing the invention applied to a wagon-top boiler where there is sufficient steam-space and also showing how it can be used on straight-top boilers; Fig. 4, a cross-section of the heater; Fig. 5, a sectional view of the valve-casing, and Fig. 6 a detail view showing the modified sectional construction of the perforated plate.

Referring now to Fig. 1, the numeral 1 designates a pipe of proper length and diameter, according to the construction of the boiler,

which is secured to the inside of the top of the boiler-shell 2 and which extends along the entire length of the boiler in the steam-space thereof, so that it is completely surrounded by the steam. The rear end of the pipe 1 opens out through the boiler-head 3 and is closed by a cap or head 4, which on being removed permits of access being had to the interior of the pipe or heater. The forward end of the pipe or heater shell 1 is provided with a large water conductor or pipe 5, which extends down below the water-line and into the mud-drum 6. It will be observed that this conductor is of large size, (as large as the heater itself,) and consequently the water is given no back pressure in the heater nor is any resistance offered to its free and unrestricted discharge, and hence the water will discharge from the heater by its own gravity. The provision of a heater having its discharge end of large size—that is to say, a heater which has one end entirely open and adapted to deliver the feed-water below the water-line—is the foundation of the successful operation of my invention and is, so far as I am aware, radically new. That class of feed-water heaters to which my invention relates—namely, those which utilize the live steam in the steam-space—owe their unsuccessful operation largely to the fact that no provision is made for the free and unrestricted discharge of the heated feed-water below the water-level. I desire it to be understood, therefore, that this feature of my invention is entirely novel with me and is the key to the successful operation of live-steam-heated feed-water heaters. The conductor 5 also serves as a sediment conductor and depositor to carry the sediment liberated from the feed-water down into the mud-drum.

Within the heater and extending from end to end thereof, except at the discharge end, are one or more plates 7, arranged horizontally and provided with a large number of small holes or perforations 8. If more than one plate is employed, they are kept separated one above the other by the employment of separating-blocks 9, to which they are fastened by a bolt 10. These plates can be made in a single piece or in connected sections, as shown in Fig. 6. The purpose of the plates is the distribution in an even manner of the overflowing feed-water, so that it can be more readily and rapidly raised to the temperature of evaporation by the heating effect of the live steam both within the heater and surrounding it. As a consequence the water distributed over the heater is instantaneously raised to the point of evaporation.

The numeral 11 designates a steam-pipe extending up vertically into the steam-dome 12 of the boiler with its upper end open to freely admit the live steam, while the lower end of the pipe extends through the shell 1 of the heater and opens into the lower portion of the latter, so as to be in the most advantageous position for the discharge of the steam against the divided portions of the water as it falls through the plates 7. The pipe 11 is provided with a throttle-valve 13, having a crank 14 connected to its stem, and from which there extends a reach-rod 15 through a suitable stuffing-box to a lever 16 outside the boiler-head. By the means thus provided the admission of steam to the interior of the heater can be regulated by the engineer as found desirable to suit the requirements of the occasion. The capacity for regulation of the action of the heater constitutes a valuable feature of my invention.

On the side of the steam-dome is a valve-casing 17, through which the feed-water is introduced to the interior of the heater by a pipe 18, which delivers the water in the upper portion of the heater at the closed end thereof. By reason of this position of the discharge the water has to pass over and through the perforated plates and along the entire length of the heater before it can eventually discharge therefrom, and thus the live steam both inside and outside of the heater is given the longest possible time within which to heat the water and raise it to the temperature of evaporation. In its passage through the heater by reason of its contact with the perforated plate or plates the water is relieved of its impurities by the plates and are washed down through the discharge-conductor 5 to the mud-drum. Should the plates become clogged, however, by the sediment taken from the water, the improper or inadequate operation of the heater would notify the engineer that cleaning was necessary, and the cap or head could be removed from the end of the heater and the plates properly cleansed and the impurities washed down into the mud-drum. In the casing 17 is a check-valve 19 and a safety-valve 20.

The valve-casing 17 is provided with a small steam-inlet 21, provided with a valve 22, which opens at its upper end into the steam-dome and at its lower end opens immediately above the safety-valve. The pipe or shell 1 also has the small steam-inlets 23 at its ends and in its upper part, and these inlets, as well as the inlet 21, by admitting the steam to the heater and the water-pipe, equalize the pressure and assist the water contained in the pipe and the heater to discharge therefrom by gravity when the pump or injector is shut off. This equalization of the pressure is, so far as I am aware, a radically-new feature of the present invention and one of the most valuable and important parts thereof.

The form of heater heretofore described is preferable for use in stationary boilers and straight-top locomotive-boilers by reason of the ease with which access can be had from the outside of the boiler to the perforated plates, and is most suitable in locations where the water is full of impurities.

In Fig. 2 I have illustrated a form of the invention which is more particularly adapted for use above the crown-sheet of the wagon-

top boiler. In this form of the invention the caps 4 are placed on both ends of the heater and inside the boiler. One of the caps can be removed in the steam-dome and the other may be taken off through an opening in the boiler-head for the purpose of removing the perforated plates and for cleaning. A large conductor-pipe 5 extends from the forward end of the heater to the front part of the boiler below the water-line, and being inclined and of large diameter is adapted to allow the free and unrestricted discharge of the heated feed-water and the washing off of the impurities freed during the heating of the water.

Fig. 3 illustrates the form the invention will assume when used on a wagon-top boiler having sufficient steam-space forward of the steam-dome. In this form of the invention the cap is removed in the steam-dome and the discharge outlet or conductor 5 is made quite large and reaches down near the flues, giving the water a free exit by its gravity.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A feed-water heater comprising a shell located in the steam-space of the boiler and provided with a large water and sediment conductor or outlet, extending down below the water-line and having its mouth in position to discharge the sediment or impurities into the mud-drum and being of a size relatively to the shell to permit the free and unrestricted discharge therethrough of all the feed-water after heating, by gravity and without back pressure, means for delivering the feed-water to the interior of the shell, and means for delivering steam to the interior of the shell.

2. A feed-water heater comprising a closed shell located in the steam-space of the boiler and provided with a large water-discharging conductor opening below the water-line and of a size to permit the free and unrestricted discharge of the feed-water, after heating, by gravity and without back pressure, means for introducing steam from the steam-space into the lower part of the shell, and independent means for introducing the feed-water into the upper part of the shell.

3. A feed-water heater comprising a shell located in the steam-space of the boiler and provided with a water-discharging conductor or outlet of approximately the same size and water capacity as the shell itself and opening below the water-line, and permitting the free and unrestricted discharge therethrough of all the feed-water after heating, by gravity and without back pressure, means for delivering the feed-water to the interior of the shell, and means for delivering steam to the interior of the shell.

4. A feed-water heater comprising a shell located in the steam-space of the boiler and having one end closed and provided at its other end with a large water conductor or outlet, opening below the water-line and of a size relatively to the shell to permit the free and unrestricted discharge therethrough of all the feed-water, after heating, by gravity and without back pressure, means for delivering feed-water into the shell adjacent the closed end thereof, and means for delivering steam in the shell.

5. A feed-water heater comprising a closed water-heating shell located in the steam-space of the boiler and adapted for the free discharge of the water therefrom, of a water-pipe adapted to deliver feed-water to the interior of the shell, a steam-pipe extending from the steam-space into the shell and adapted to deliver steam thereinto, a valve in said pipe for regulating or cutting off the flow of the steam to the shell and means for controlling said valve from the exterior of the boiler.

6. A feed-water heater comprising a closed water-heating shell located in the steam-space of the boiler and adapted for the free discharge of the water therefrom, of a water-pipe adapted to deliver feed-water to the interior of the shell, a steam-pipe extending from the steam-space into the shell and adapted to deliver the steam thereto, a valve in said pipe for regulating or cutting off the flow of the steam to the interior of the shell, a crank for turning the valve, a lever on the boiler-head, and a reach-rod connecting the lever with the crank, whereby the valve can be controlled from the exterior of the boiler.

7. The combination with a steam-boiler, of an inclosed feed-water heater located in the steam-space of the boiler and having a large discharge-outlet permitting the free and unrestricted discharge of the heated water, and a plate extending along the heater inside the same and above its bottom, which is provided with perforations adapted to divide the feed-water into sprays or streams to facilitate the heating thereof.

8. The combination with a steam-boiler, of an inclosed feed-water heater located in the steam-space of the boiler and having a free discharge-outlet, a perforated plate extending along the heater, inside the same, and means for initially introducing the feed-water on the perforated plate at the end farthest away from the outlet, whereby the water will be broken up into sprays or streams and given the greatest possible time for heating before discharging through the outlet.

9. The combination with a steam-boiler, of an inclosed feed-water heater located in the steam-space of the boiler and having a large discharge-outlet permitting the free and unrestricted discharge of the heated water, of a perforated plate extending along the heater inside the same, means for introducing steam into the heater below said plate, and means for introducing feed-water into the heater, above the plate.

10. A feed-water heater comprising a closed shell located in the steam-space of the boiler above the water-line, said shell being provided with a delivery-mouth opening below

the water-line, a feed-water pipe for delivering water to the interior of the shell, which extends up into the steam-dome, a vent in the shell of the heater and a vent in the feed-water pipe in the dome, said vents being adapted to admit the steam to the interior of the heater and feed-water pipe for the purpose of equalizing the steam-pressure in the heater and permit the exit, by gravity, of the water from the heater.

11. The combination with a steam-boiler, of a feed-water heater located in the steam-space thereof and provided with a free and unrestricted outlet at one end which extends below the water-line, a removable cap at the other end of the heater, a perforated plate extending along the heater and inside the same, a steam-supply pipe entering the heater and extending into the steam-dome, a water-supply pipe entering the heater, and a vent in the heater.

12. A feed-water heater comprising a closed shell located in the steam-space of the boiler and having one end opening out through the boiler-head and its other end provided with a large water conductor or outlet, opening below the water-line and of a size relatively to the shell to permit the free and unrestricted discharge therethrough of all the feed-water, after heating, by gravity and without back pressure, and a removable cap closing the open end of the shell on the boiler-head, the same permitting access to the interior of the shell when removed therefrom.

13. The combination with a steam-boiler, of a feed-water heater located in the steam-space of the boiler and which has one end opening out through the boiler-head and its other end provided with a large water discharge or conductor inside the boiler which permits the free and unrestricted discharge of the heated water, and a removable cap closing the end which opens out through the boiler-head which permits of access to the interior of the heater.

14. A feed-water heater comprising a shell located in the steam-space of the boiler and provided with a water discharge conductor or outlet leading from the extreme lowest portion of the shell and of a size relatively to the shell to permit the free and unrestricted discharge therethrough of all the feed-water after heating, by gravity and without back pressure, whereby the water in the shell is compelled to pass out through said conductor, means for delivering the feed-water to the interior of the shell, and means for delivering steam to the interior of the shell.

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

ALEXANDER WIRTH.

Witnesses:

JAMES SHORE,

A. BUCKLEY.