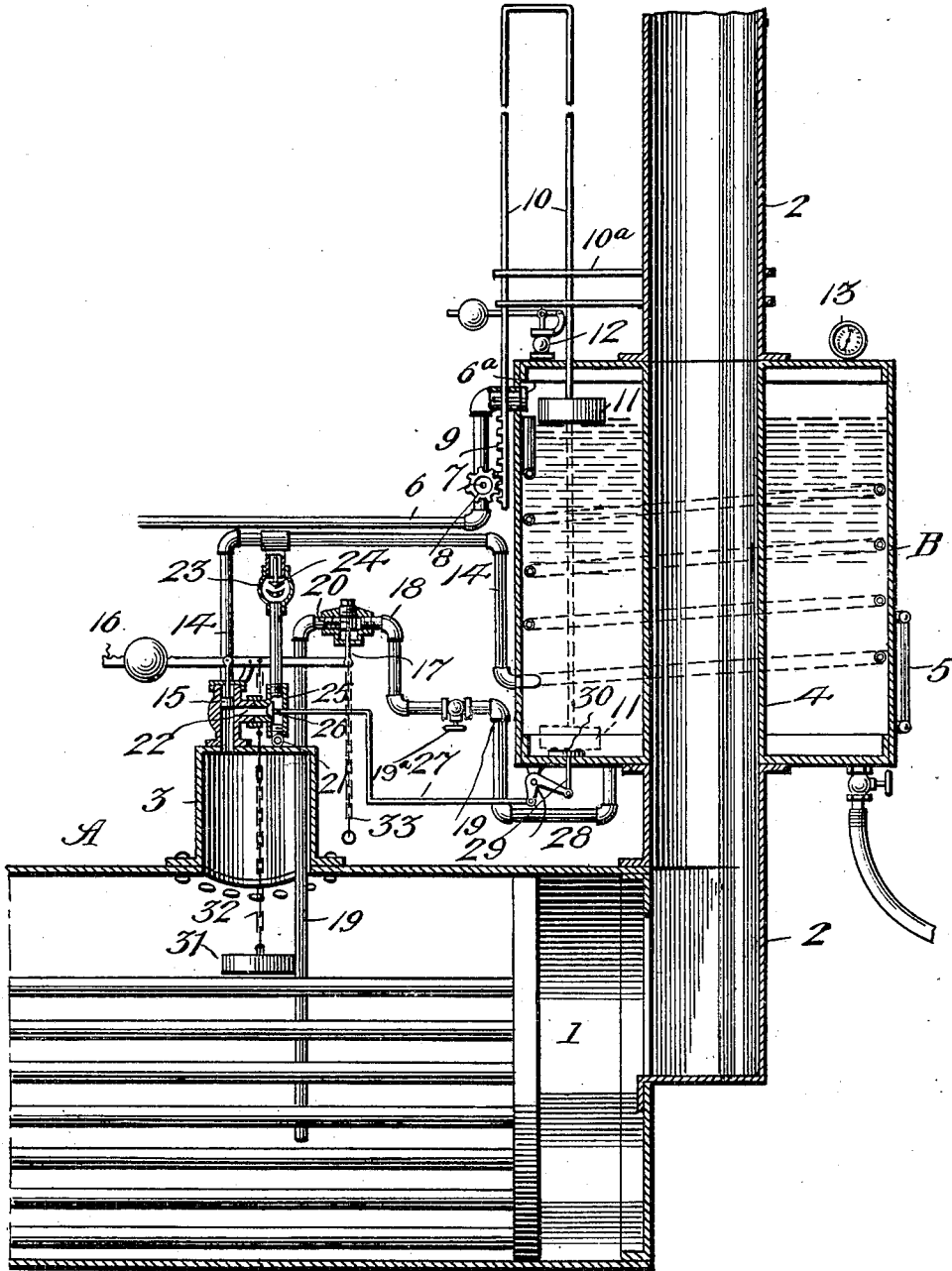


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W. A. MOFFAT.
GRAVITY BOILER FEEDER.

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GRAVITY BOILER-FEEDER.

No. 825,746.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WALTER ANDREW MOFFAT, a citizen of the United States, residing in Denver, in the county of Denver and State of Colorado, have invented new and useful Improvements in Gravity Boiler-Feeders, of which the following is a specification.

My invention relates to improvements in steam-boiler water-feeders; and the primary object thereof is to simplify and improve the existing devices of this character, so as to increase the economy of both heat and steam generated by making provision whereby the waste steam and heat can be utilized in the feed-water receptacle to heat the feed-water and by the pressure of the steam reinforce the gravity feeding of the feed-water.

The invention contemplates a provision whereby the feed-water is heated by the flue-gases passing from the smoke-stack in addition to the heat of the steam admitted into the feed-water receptacle for the purpose of reinforcing the gravity feed of the water therein and primarily embodies an automatic operating arrangement and aggroupment of the parts involved, comprising a boiler, a feed-water receptacle surrounding the smoke-stack thereof, means to convey water to said receptacle, means to draw the water from said receptacle, and means to convey steam to the steam-space in said receptacle above the surface of the water therein.

The invention also consists in certain other novel features and in the arrangement and construction of parts, all as hereinafter described, and specifically set forth in the appended claims.

In the annexed drawing I have fully and clearly illustrated the improvements in a single figure, principally indicating the parts as in central longitudinal and vertical section, and, reference being had to the illustration, A designates a boiler of the tubular variety having the usual smoke-space 1, which opens into the base of the smoke-stack 2, substantially as shown. On the boiler is mounted the steam-dome 3.

B designates the casing of the water-heater provided with a vertical central sleeve 4, fitted to the smoke-stack and secured thereto by any suitable fastening means.

The water-heater is positioned with its base

in suitable relative disposition to the top of the boiler, substantially as indicated. At a proper point the casing of the water-heater is provided with a gage-glass 5. The heater may be of any desired capacity to suit for the supply of water to be furnished and used. The water is delivered into the heater by a pipe 6, leading from a water source and opening into the upper end of the casing, substantially as shown, a valve 6^a being arranged in the open end of the pipe, which is closed by steam-pressure and opened when the steam-pressure is overcome by the water-pressure, and in the pipe 6 is placed a valve 7, whereby the flow of water may be controlled. On the projecting end of the stem of the valve 7 is mounted a pinion 8, which is engaged by a rack 9 on one of the limbs of an automatically-moving yoke 10, which in its vertical movements controls and operates the valve. The other depending limb of the yoke 10 is slidably arranged through the cover or top of the water-heater tank and has secured to its lower end a float or weight 11, which controls the action of the yoke relatively with the action of the valve 7, according to the elevation of the water in the tank and operating to effect the purpose hereinafter stated in addition to controlling the valve 7.

The rack 9 is made of such length as to turn the pinion 8, fixed on the stem of the valve 7, and thus open and close the valve in its descent or elevation, and when the yoke descends so that the rack escapes the pinion the valve is left open to deliver a supply of water into the feed-water tank. Then as the water rises in the tank and the float is lifted thereby the valve is gradually closed until the high-water line is reached in the tank. Guides 10^a extend from the smoke-stack, through which the limbs of the yoke are slidably disposed to steady them in their movements.

In the top of the water-heater is placed a safety-valve 12 of any approved style, the purpose being the usual one of providing relief for any excess of steam-pressure that may occur in the steam-space above the water-line. A gage 13 is also fixed in the water-tank to show the steam-pressure therein. Steam is let into the steam-space of the heater by means of a steam-pipe 1, leading

from the throat of the steam-dome of the boiler above the safety-valve 15 and opening into the heater near the bottom, where it passes through the wall of the water-heater 5 and continues in upwardly-directed spiral coils, the end of the coil opening above the high-water line in the steam-space in the heater. It will be seen that this arrangement of the steam-pipe in the heater heats 10 the water quickly preliminary to being fed to the boiler.

To the stem of the valve 15 is secured the safety-valve lever 16, which is extended in the direction of the water-heater and is connected to the lower end of a valve-stem 17, 15 which carries a valve 20, disposed in an arch or yoke 18, positioned in the water-pipe 19, opening from the lower end of the heater and extending from the yoke down to a proper distance into the boiler through the steam-dome, substantially as shown in the drawing. This arrangement of elements makes the action of the safety-valve and the water-valve automatic, so that when the safety-valve 25 is lifted above the mouth of the pipe 14 the steam will flow through that pipe and through the coils in the heater into the steam-space therein above the water, and at the same time the safety-valve lever will pull the valve-stem 16 down, carrying the valve 20 in 30 the bridge of the arch 18 with it, and thus open the way through the pipe for the flow of water into the boiler. When the valve 15 is closed, the valve 20 will also be closed and the steam and the water will be shut off. 35

From the steam-pipe 14 at the proper point is coupled the steam-pipe 21, leading to the engine in the usual manner. Extending laterally from the chamber of the safety-valve 15 is a short steam-pipe 22, which 40 opens into the engine-pipe 21, and above this pipe 22 in the engine-pipe is a valve-chamber 23, wherein is disposed a valve 24, which when the steam is let through the pipe 22 rises and shuts off the steam from entering the pipe 14 at its junction with the engine-pipe, and thus the steam is directed with certainty through the engine-pipe toward the engine. When the safety-valve is forced up 45 to open the port to the pipe 14, a portion of the steam will be deflected through that pipe and thence through the coils to the steam-space in the water-heater. The short steam-pipe 22 opens into a valve-chamber 25, interposed in the engine-pipe 21, flow of steam 50 therethrough being controlled by a valve 26 in the chamber and the rod or stem 27 of which is extended to adjacent the water-heater and the end pivotally connected to an arm of a pivotally-supported bell-crank lever 28, constituting a trip, the other arm of the lever being pivotally connected to a vertical rod 29, slidably let through the bottom of the heater and carrying on its upper end 55 within the heater a disk or plate 30, posi-

tioned in the path of the float or weight 11, as indicated in the drawing by the dotted lines. The rods 27 and 29 are jointed, as shown, to compensate for the direction in movements. It will thus be seen that when 70 the valve 26 is open the bell-crank lever raises the plate 30 and the valve 26 will remain open, with the steam coursing to the engine. Now should the feed-water tank become depleted of its contents the float will 75 descend into contact with the plate 30 and push it down, operating the lever, which through its connection to the valve 26 pushes that into closed position and shuts off the steam to the engine. Then as the feed- 80 water tank begins to fill the float rises, releasing the plate 30, and the steam-pressure again opens the valve 26.

31 designates a float within the boiler, carried by a chain 32, which is extended by a rod 85 up through the roof of the steam-dome and connected to the lever of the safety-valve. It will be seen that should the water in the boiler go down so as to leave the weight or float suspended the safety-valve lever will 90 tilt by the weight, so as to open the valves 15 and 20 to let the steam out and the water in simultaneously.

The apparatus may also be operated by manipulation. To the rear end of the 95 safety-valve lever is connected a chain 33, which being pulled downward will actuate the safety-valve lever connected to that element and also open the water-valve in the arch of the pipe 14, so that steam will be injected into the water-heater and the water 100 flow therefrom, as specified. In the boiler-pipe 19 is arranged a turning plug or valve 19^a, by which the water may be regulated. The height of the arch in the water-pipe will 105 regulate the low-water line in the heater under well-known principles.

It will be readily perceived that the heat given out by the smoke-stack will speedily impart heat to the water contained in the 110 heater and that the injected steam will lend pressure on the water-surface to force the water through the water-pipe and at the same time the steam in the steam-coils will materially contribute to heating the water 115 within the heater.

The action of the apparatus may be rehearsed as follows: The boiler having on a full head of steam and it becoming necessary to supply the water-heating tank, the valve 120 19^a being closed, the water passing through the valve 7, which has been previously opened, and steam-trap pipe 6^a opening into the feed-water tank rapidly fills the tank. When the high-water line is reached, the 125 float or weight 11 will close valve 7, thus stopping further entrance of water. If the flue-gases from the furnace and the escaping steam have not given the required temperature to the feed-water at this time, the chain 130

33, hanging at the side of the boiler, may be pulled down, thus allowing a portion of the steam to escape through the safety-valve 15 to the steam-pipe 14, thence through the coils into the tank, and make a cushion above the surface of the water in the water-heater. It will be seen that all overpressure of steam which may occur from the fuel burned will by this method be utilized, except that it will not be necessary to give the valves any attention other than to place the safety-valve weight at any given point desired, when excess pressure will raise the valve and permit the steam to pass to the feed-water tank.

When the feed-water is of the desired temperature, open this valve 19^a. (This valve can be left open after the first filling, as the feed-water will always be hot.) This being done, the first overpressure of steam will force up the weight of the safety-valve lever 16, and thus open the water-valve 20. The live steam from the boiler will pass through pipe 14 to feed-water tank and quickly force the feed-water through valve 20 and pipe 19 to boiler. At this time weight or float 11 is dropped to its lowest position in the feed-water tank and in the movement has opened valve 7 and closed the steam-trap 6^a, thus shutting off the engine from the main boiler-supply at a time when it needs relief—that is, when taking water—and allowing the dry steam from the heater, or for the time being from the steam-dome, to close the trap or valve 6^a in the upper end of the influent water-pipe, leaving the only escape down through the pipe 14, from whence it proceeded, then passing through check-valve 24, which closes with an upward pressure. When the pressure of steam within the water-feeding receptacle is equal to or in excess of the pressure in the boiler, the engine-pipe 21 will take its steam direct from the feed-water receptacle until such time as the pressure within the boiler becomes greater than that in said receptacle, thus allowing for a reserve of steam-pressure which can be drawn upon by the engine for a period sufficient to continue its operation when the pressure in the boiler falls below the requisite degree of pressure by reason of the introduction of feed-water. When the engine is taking steam direct from the feed-water receptacle, as above, the valve 26 has closed communication between the engine-pipe and the boiler.

Should the water in the boiler get below a certain established line, (determined by the length of the chain 32, attached to float 31 in the boiler,) the automatic feeding of the boiler will occur as the result of low water.

If automatic action is not required, chain 33 may be pulled. When the steam-pressure in the feed-water tank has been exhausted, the water-pressure from pipe 6 will open the trap or valve 6^a, thus allowing the tank to fill with water again, when the float 11

rising will permit the steam-trap 30 to open, causing the steam from the boiler to close check-valve 20 to go back again to engine-pipe. Float or weight 11 upon reaching the top again closes valve 7, and everything is in readiness for automatic repetition.

The invention may be readily adapted to use on locomotive-boilers, as well as on stationary engines, in both instances the surplus steam being utilized for heating the feed-water and for forcing it into the boiler, and in both cases the casing of the feed-water tank should be of the same strength as that of the boiler. Under the pressure attained in the tank the feed-water may be used as a fire-extinguisher, and to adapt the apparatus for that purpose a stop-cock *a* is positioned in the bottom of the casing of the heater, to which is connected a line of hose *b*, so that by closing the valve in the pipe leading to the boiler and opening the valve *a* the full force of the steam-pressure can be utilized for driving the water from the tank.

It may be stated that in the construction of the smoke-stack for stationary engines the stack may not extend lower than the top of the feed-water heater, whereby the cylindrical passage through the feed-water heater acts as a part of the smoke-stack, thus cheapening the construction of the smoke-stack and insuring direct impact of the ascending heat to the heater. Because of these adjunctive applications and relative adaptations I do not desire to be limited to the precise arrangement and particular aggroupment of the parts shown in the drawing, since any proper disposition in operative combinations not radical to the invention may be the equivalent thereto.

Having thus described my invention, what I claim is—

1. In a steam-boiler water-feed, the combination with the boiler, of a feed-water receptacle, a feed-water pipe connecting said receptacle and boiler and having a valve, a steam-pipe leading from the boiler into the feed-water receptacle and opening above the water-line therein, a valve for said steam-pipe, and means whereby said valves are simultaneously operated.

2. In a steam-boiler water-feed, the combination with the boiler and its safety-valve of a feed-water receptacle, a feed-water pipe connecting the water-space of said receptacle with the water-space of the boiler, a steam-pipe leading from the safety-valve into said feed-water receptacle and opening above the high-water line therein, a valve in said feed-water pipe, and means operated by the safety-valve to actuate the valve in the feed-water pipe.

3. In a steam-boiler water-feed, the combination with the boiler, of a feed-water receptacle, a feed-pipe connecting the water-space of the said receptacle with the water-

space of the boiler, a steam-pipe leading from the boiler into the feed-water receptacle, a heating-coil within the water-space of said receptacle forming a continuation of said steam-pipe and opening above the high-water line therein, and valves for controlling the said steam-pipe and feed-pipe.

4. In a steam-boiler water-feed, the combination with the boiler and its smoke-stack, of a feed-water receptacle surrounding the smoke-stack, a feed-pipe connecting the water-space of said receptacle with the water-space of the boiler, a steam-pipe leading from the boiler into the feed-water receptacle, a heating-coil within the water-space of said receptacle forming a continuation of said steam-pipe and opening above the high-water line therein, and valves for controlling said steam-pipe and feed-pipe.

5. In a steam-boiler water-feed, the combination with the boiler and its stack, of a feed-water receptacle having a flue-passage therethrough and adapted to form an intermediate section of the stack, a feed-water pipe connecting said receptacle and boiler, a steam-pipe leading from the boiler into the feed-water receptacle, a heating-coil within the water-space of said receptacle surrounding the flue-passage thereof and opening above the high-water line therein, the said coil forming a continuation of said steam-pipe, valves for controlling the steam-pipe and feed-pipe, and means whereby said valves are operated by the steam-pressure within the boiler.

6. In a steam-boiler water-feed, the combination with the boiler, its safety-valve and lever controlling the same, of a feed-water receptacle, a feed-water pipe connecting said receptacle with the boiler, a steam-pipe leading from the safety-valve into the feed-water receptacle and opening above the high-water line therein, a valve in the feed-water pipe connected to the lever of the safety-valve, a float within the boiler connected to said lever and adapted when not sustained by the water within the boiler to actuate said lever by gravity and open the feed-valve.

7. In a steam-boiler water-feed, the combination with the boiler, its safety-valve and lever for controlling the same, of a feed-water receptacle, a feed-water pipe connecting said receptacle with the boiler, a steam-pipe leading from the safety-valve into the feed-water receptacle and opening above the high-water line therein, a valve in the feed-water pipe connected to the lever of the safety-valve, and means for operating said lever manually.

8. In a steam-boiler water-feed, the combination with the boiler and its safety-valve, of a feed-water receptacle having a feed-water pipe connecting the same and the boiler, a steam-pipe leading from the safety-valve into the feed-water receptacle above the high-water line therein, and a safety-valve for con-

trolling the steam-pressure within said receptacle.

9. In a steam-boiler water-feed, the combination with the boiler, of a feed-water receptacle, a feed-water pipe connecting said receptacle and said boiler, a steam-pipe leading from the boiler into the feed-water receptacle and opening above the high-water line therein, a valve for said steam-pipe, an engine steam-pipe communicating with the boiler and with said steam-pipe, means for alternately cutting off said communications, whereby steam for the engine may be taken from the water-feed receptacle when the pressure therein is equal to or greater than that in the boiler.

10. In a steam-boiler water-feed, the combination with the boiler and its safety-valve, of a feed-water receptacle, a feed-water pipe connecting said receptacle and boiler, a steam-pipe leading from the safety-valve into the feed-water receptacle and opening therein above the high-water line thereof, an engine steam-pipe having communication with said steam-pipe and with the boiler, a check-valve for closing said communication with the steam-pipe under the pressure direct from the boiler, a valve for closing communication between the engine steam-pipe and the boiler, a float within the feed-water receptacle, and means actuated by said float and connected to the latter valve to close the same.

11. In a steam-boiler water-feed, the combination with the boiler and its safety-valve, of a feed-water receptacle wholly located above the boiler, a feed-water pipe connecting said receptacle and boiler and having a valve, a steam-pipe leading from the safety-valve into the feed-water receptacle and opening above the water-line therein, and a heating-coil within the water-space of said receptacle and forming a continuation of the said steam-pipe.

12. In a steam-boiler water-feed, the combination with the boiler and the smoke-stack, of a feed-water receptacle through which the smoke-stack passes, a feed-water pipe connecting said receptacle with the boiler, a valve in the feed-water pipe, a steam-pipe connecting the boiler with said receptacle and opening above the high-water line therein, a heating-coil forming a part of said steam-pipe, a valve in the steam-pipe, and means to operate both valves simultaneously and automatically.

13. In a steam-boiler water-feed, the combination with the boiler, of a feed-water receptacle, a feed-water pipe connecting said receptacle and boiler, a steam-pipe leading from the boiler and opening into said receptacle above the high-water line therein, a heating-coil within said receptacle forming a continuation of said steam-pipe, a water-supply pipe opening into said receptacle, a valve in said supply-pipe, a float within said

receptacle, and means operated by said float to open and close the valve of the water-supply-pipe.

14. The combination with the feed-water
5 receptacle, of a water-supply pipe, a valve therein, a pinion mounted on the stem of the valve, a vertically-movable yoke having one limb outside the receptacle and having a rack
10 to engage the pinion, and the other limb slidably projected into said receptacle, and a float on the latter limb within the receptacle.

15. In a steam-boiler water-feed, the combination with the boiler, of a feed-water receptacle, a feed-water pipe connecting said
15 receptacle and boiler, a steam-pipe leading

from the boiler into the feed-water receptacle and opening above the high-water line therein, a supply-pipe having a valve adapted to close the same by steam-pressure within said receptacle, a second valve in said supply-pipe, 20 means for opening and closing said valve, and a float within the receptacle for actuating said valve-operating means.

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

WALTER ANDREW MOFFAT.

Witnesses:

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LUCIE A. GRAHAM.