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METHOD OF AND APPARATUS FOR WASHING AND REFILLING LOCOMOTIVES.

1,177,220.


To all whom it may concern:

I, DAVID L. WINTERS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Methods of and Apparatus for Washing and Refilling Locomotives, of which the following is a specification.

It is necessary in the operation of locomotives that the boilers thereof be cleaned at intervals of the accumulations therein of mud, or the like from the water used, and according to common practice the boiler is washed after blowing down, with a mixture of blowoff and fresh water at a safe temperature for handling, and is then refilled with a like mixture or with fresh water to which has been added, when possible, the heat units contained in the blowoff steam from the boilers to be washed and refilled. Conditions presented in practice necessitate the blowing down of locomotives without loss of time when the washing of the boiler becomes necessary, with the result that large quantities of the heat units contained in the blowoff steam are wasted, due to the fact that the number of locomotives being blown down often greatly exceeds the number being refilled, this being a well known and recognized condition during the morning hours in all locomotive terminals. In the natural order of events these conditions are of course reversed later in the day, and since an amount of fresh water equal to at least the amount of blowoff water used for washing purposes must be added to the refilling water to return the washed locomotives to service conditions, large quantities of live steam in present practice are used to maintain the temperature of the refilling water at this time. When, in the usual order of events, the number of locomotives being refilled greatly exceeds the number being blown down, and a sufficient quantity of blowoff steam for this purpose is, therefore, not available.

Under normal conditions, the amount of water blown off at any locomotive terminal during each twenty-four hours will be approximately the amount required to refill the same or a like number of other locomotives, and my primary object, as to one of the features of my invention, is to provide, by the exclusive use of this blowoff water to refill locomotive boilers, a novel method of, and a novel, simple and inexpensive apparatus, for refilling locomotive boilers with soft, clarified and superheated water, without the use of any live steam.

In common practice the exhaust steam from the washout and refilling pumps is discharged directly into the mass of refilling water, and this of necessity is totally wasted at all times during which blowoff steam is being supplied in excessive quantities, and partly wasted at all other times, due to heat radiation from the mass of refilling water.

Another and important object of the method and apparatus herein described, is to provide for the immediate and complete utilization of the exhaust steam from the washout and refilling pumps, as follows: First. To heat the washout water, which is obtained from an outside source and re-used, preferably for the same purpose. Second. To superheat the refilling water during the passage of same through the refilling main. Third. To maintain the temperatures in the washout and refilling mains at all times.

The important economies and advantages effected by the use of the method and apparatus herein described are as follows: First. The exclusive use of the blowoff water for refilling locomotive boilers, since it is daily supplied by the locomotives in substantially the amount required, at the temperature required, and accompanied always by more than sufficient steam to compensate for heat lost by radiation during clarification, eliminates the necessity, as encountered in common practice, for the use of fresh water and live steam in refilling boilers, together with the complicated and expensive apparatus required to automatically regulate the use of said live steam. Second. The use of exhaust steam from the washout pump to heat washout water from an outside source, since the proportions of steam and water may be readily changed by increasing or diminishing the pressure in the washout main by means of the pump governor usually employed and since these proportions will remain constant, irrespective of the amount of water used, eliminates the necessity as encountered in common practice for the mixture of blowoff and fresh water for this purpose, together with the complicated and expensive automatic or manually controlled valves to regulate or change the relative supply of hot and cold water. Third. The use of the exhaust steam from the refilling
pumps to superheat the refilling water during the passage of same through the refilling main, since this steam can be introduced into said main irrespective of the temperature of the refilling water, eliminates the total or partial waste of this steam as employed in present practice, and secures to the particular locomotive being restored to service, the greatest amount of heat available from both the blowoff and exhaust steam. Fourth. The still further use of the small amount of exhaust steam available from both the washout and refilling pumps, at intervals during which locomotives are neither being washed nor filled, for the purpose of maintaining the temperatures in the washout and refilling mains, eliminates the necessity as employed in present practice, of continually circulating the water in the mains, and of a comparatively great consumption of live steam to operate the pumps at such times.

Obviously, when blowoff water is used exclusively for refilling boilers, it should be cleansed and clarified to a much greater extent than would be necessary were it to be used for washing purposes only, and another object of the present invention is to provide means to cleanse and clarify this blowoff water far beyond the extent to which this can be accomplished in an ordinary settling tank. For this purpose I partition off sections or compartments in the tank, the contents of which will not be agitated by either the blowoff water or steam from the locomotives, and through which the stored blowoff water will gradually work its way from the place of entrance to the place of use in a prescribed course that will effectually prevent an accumulation of “dead water” in the lower portions of the compartments, the contents of which are not subjected to the agitating action of the blowoff products. In the intermediate compartment, where oil, grease, and other lighter foam-causing impurities will collect on the undisturbed surface of the stored water, I provide a simple skimming device to remove these impurities periodically, and at the same time the heavier impurities are being removed from this, and from the other compartments by means of a valve conduit.

Referring to the accompanying drawings, wherein I have illustrated an apparatus suitable for carrying out my improved method and constructed in accordance with my invention—Figure 1 is a plan view of the apparatus, showing it in connection with the piping, which would be located in the roundhouse; Fig. 2 is a view in elevation of the apparatus, the water receptacles being shown in section; Fig. 3 is a view in elevation, partly sectional, of the terminal of a blow-off pipe, through which blow-off water and steam are discharged into the apparatus; Fig. 4 is a similar view of a device for superheating the refilling water by the exhaust from the refilling pump, a part of the wall of the storage tank being shown in section; Fig. 5 is a view in vertical sectional elevation of a device for skimming the surface of the water discharged from the locomotive; Fig. 6 is a section taken at the line 6 on Fig. 5, and viewed in the direction of the arrow; Fig. 7 is a plan view of the bottom of the tank into which the blowoff water and steam are discharged for storage; and Fig. 8, a view similar to Fig. 2 of a modification of the apparatus of the preceding.

A tank shown to be of generally cylindrical shape in cross-section, with a hopper-shaped bottom 9, this tank being preferably formed of heat non-conducting material, as for example, wood, and containing a removable and replaceable lining 10, also of wood, but not watertight, held out of contact with the outer wall of the tank, by means of spacers 11, whereby additional insulation is provided between the walls 8 and 10 to reduce radiation and to protect the permanent outer walls against damage by steam. The tank 8, in accordance with the preferred embodiment of my invention, is divided into three chambers, 12, 13, and 14, by partitions 15 and 16, composed of heat-conducting material in the tank 8. The partition 15 passes through the center of the tank, thereby causing the chamber 12 to be of substantially one-half the size of the entire tank, and the partition 16 extends at right angles to the partition 15 and divides the remainder of the tank into the two chambers 13 and 14, preferably of the same size and each comprising about one-half the capacity of the chamber 12. The bottom of the tank 8 contains three openings, 17, 18 and 19, which communicate, respectively, with the chambers 12, 13 and 14 and open into a drain-pipe 20, having a valve 21 for a purpose hereinafter stated.

In the operation of the apparatus as hereinafter explained, the blowoff water and steam from the locomotive to be emptied is introduced into the receiving chamber 12, and the water for refilling the locomotive is drawn from the chamber 14, the partition 15 and the partition 16 between the chambers 12, 13 and 14 being perforated at their upper and lower ends respectively, as represented at 22 and 30, whereby water flows by the force of the temperature from the chamber 12 thence into the chamber 13 and from this last-referred-to chamber into the chamber 14.

The blowoff pipe for conducting the steam and water blown off from the locomotive to the apparatus is represented at 22, this pipe representing which is usually...
provided in the roundhouse, and which in practice is provided with the necessary connections for attaching it to a locomotive boiler. This pipe is connected with a pipe 23 which connects with a pipe 24 located in the chamber 12 and opening into a T-coupling 25, into which perforated pipes 26, extending in opposite directions and at angles to this end of the pipe 24, are screwed, and from which the blow-off water and steam from the locomotive boiler is discharged into the lower part of the chamber 12.

In accordance with the preferred embodiment of my invention, the fresh, relatively cold water, which must be supplied to the apparatus under the conditions presented in practice, is supplied to be used for washing out the boiler, and to raise its temperature to that at which it may be safely used. I employ the following described construction:

This construction involves a tank 31, shown as located in the chamber 12, the lower end of this tank being closed by a wall 32, and its upper end being open. A pipe 33 communicates at one end with the bottom of the tank 31 and opens at its opposite end into the suction-end of a pump 34 for furnishing water to the locomotive, as hereinafter described, the pipe 33 containing two T-couplings 35 and 36 and, intermediate therebetween, a valve 37. A pipe 38 connects at one end with the tank 31, near the upper end of the latter, and at its lower end with the T-coupling 36, this pipe containing a valve 39.

The water service supply pipe for furnishing fresh water to the apparatus and which would lead from any desirable source, is represented at 40, the lower end of this pipe opening into the T-coupling 33 between the tank 31 and the valve 37. The tank 31, near its upper end, is provided with a spout 41, this spout being arranged above the normal water line in the chambers 13, 13 and 14, and provided with a check-valve 42 opening outwardly from the tank 31, for a purpose hereinafter explained.

In the operation of the apparatus as hereinabove described, the wash-water is drawn into the pump 34 from the pipes 33, and 38, thereby drawing water from the tank 31, and to maintain the water in this tank at the desired level above the point at which the pipe 38 communicates with the interior of the tank 31, I provide the pipe 40 with a valve represented diagrammatically at 43, connected with a lever 44 fulcrumed, as indicated at 45, on a bracket 46 carried by the casing of the valve 43, one end of this lever being connected through the medium of a rod 47, with a float 48, and its opposite end carrying a counterweight 49. The parts just described are so proportioned that should the water in the tank 31 lower, the float 48 will descend and open the valve 43, which permits more water to enter the tank 31 by way of the pipe 40 and 33. The tank 31 contains a pipe 50 supported in depending position therein, with its lower end perforated as indicated at 51, this pipe being connected with a pipe 52 containing a valve 53 and connected with the steam-exhaust chamber of the pump 34, the pump being supplied with live steam from any suitable source for operating it, through a pipe 54, it being understood from the foregoing that when the pump 34 is actuated to pump the wash-water to the locomotive, the exhaust steam from the pump will discharge through the perforations 51 in the pipe 50, into the water in the tank 31, thereby heating it.

The discharge end of the pump 34 is connected with a pipe 55 which, in accordance with common practice, is connected with a pipe 56 extending around the roundhouse and provided with taps (not shown) for connection with the usual wash-nozzle employed, which, in accordance with common practice, is constructed.

The pump for pumping refilling water to the locomotive is represented at 26, the suction end of the pump being connected with a pipe 57 which passes through the wall of the tank 8 into a pipe 58 of larger diameter, the latter being perforated, preferably throughout its entire length, as represented, and preferably arranged in an inclined position with its upper end above the normal water level, represented at 39, and its lower end below the minimum water level, represented at 52, the discharge end of the pump 26 being connected with a pipe 59 which connects with a pipe 60 arranged in the roundhouse in accordance with common practice and provided with taps whereby it may be connected with the locomotive boiler to permit the latter to be refilled. A pipe 61 connects with the live steam pipe 54 and with the steam inlet chamber of the pump 56, the exhaust steam chamber of the pump being connected with a pipe 62, having a valve 63 and extending into the chamber 14, the lower end of this pipe, which is perforated, as indicated at 64, extending into the pipe 58 at the upper end of the latter and spaced therefrom as represented, the lower end of the pipe 62 by preference being closed by a cap 65.

It will be understood from the foregoing that when the refilling pump 26 is operated the exhaust steam therefrom will pass through the pipe 62, discharging through the perforations 64 therein into the water which passes into the pipe 58 through the perforations therein, which serves very effectually to superheat the refill-water in its passage to the pump 26.

A description of the operation of the apparatus, in so far as it has been described, is as follows, assuming that the chambers 12, 13, and 14 are filled with hot water to at
least the minimum water line \( y \). The water and steam blowoff pipe of a boiler (not shown) to be emptied, washed and refilled, is connected with the pipe 22, and the hot water and steam in the boiler discharged therethrough and through the pipes 23 and 24, the pipe 24 being preferably of considerably larger diameter than the pipe 23. The steam and water upon entering the pipe 24, losses much of its pressure, and is discharged through the perforations in the pipes 28 into the lower portion of the chamber 12. In the chamber 12, which receives the muddy blowoff water, as stated, the initial operation of settling the mud out of the water takes place, the water in partly clarified condition flowing through the openings 29 in the partition 15 and through the openings 30 in the partition 16 to maintain the same water level in all three of the chambers, the chamber 13, according to the sequence of operation, being a supplemental chamber, and the chamber 14 being what may be termed, a final storage chamber, from which the clarified water is drawn for refilling the locomotives. A portion of the blowoff steam discharged into the chamber 12 after passing upwardly through the water therein and heating it practically to the boiling point, escapes into the chambers 13 and 14 at the water level therein, this being made possible by having these tanks open one into the other at their upper ends, as through the medium of the perforations 29 and opening 26 in the partition 15 between the chamber 12, and the chambers 13 and 14. The steam blown off from the locomotive is of such volume that it is impracticable to trap all of it in the tank 8, and accordingly, a vent 65 is provided, this vent being provided with a pressure check-valve 66 of any suitable construction, which opens outwardly and operates, when the pressure of the steam above the water in the tank 8 exceeds a predetermined degree, to permit the excess steam to discharge therefrom. Steam, however, under pressure, regulated to suit the condition presented, by adjusting the valve 66, remains in the upper portions of the three chambers 12, 13, and 14, and serves to maintain the water therein in heated condition.

In the operation of the apparatus, it is intended that the water for washing out the boiler of the locomotive be drawn in such proportions from the upper end of the tank 31, wherein the water is the hottest, and from the fresh water service pipe 40 in such proportions, depending on circumstances, as to cause the water supplied to the locomotive boiler to be of the desired temperature, as for example, between 120 and 130 degrees F. The wash-out water is supplied to the boiler of a locomotive by operating the pump 34, which draws water from the upper end of the tank 31 through the pipe 38 and directly from the service pipe 40, forcing the water thus drawn from these two sources through the pipe 55 and pipe 56 to the boiler through the connections between the latter and the pipe 56. When the water in the tank 31 lowers the float 48 will descend, thereby opening the valve 43 and permitting fresh water to enter the lower end of the tank 31 through the pipes 49 and 55 sufficient to maintain the desired level in the tank 31.

The water for refilling the locomotive boilers is drawn from the chamber 14 by operating the pump 26. The water flowing through the perforated pipe 58, and thence through the pipe 57 into the pump, where it is forced through the pipe 59 to the refilling main 60, from which it passes into the locomotive boiler. The water in the chamber 14, and which under ordinary conditions would be practically at the boiling point, especially if the chambers contained steam, is superheated in its passage to the pipe 57, by the exhaust steam from the pump 26, which passes through the pipe 62 and discharges into the water as it passes through the pipe 58, thereby raising the temperature of the refilling water if it was not already at the boiling point, and causing, in the normal operation of the apparatus, the water to be mixed with steam, whereby the locomotive boiler is supplied with water at above the boiling point by reason of the placing of the water under high pressure by the action of the pump 56, which produces a very desirable condition, inasmuch as the boilers may be caused very quickly to produce steam of sufficient pressure for running purposes. The chambers 13 and 14 are preferably of such dimensions that they will hold sufficient water to refill the number of locomotive boilers which under normal conditions will be refilled during twenty-four hours, and thus the water which is refilled into the locomotives in the ordinary operations of the apparatus will be given ample time for settling, whereby it will be in properly clarified condition for reentering the boiler.

By providing the three chambers, 12, 13, and 14, and introducing the blowoff water into and steam into the first of the three chambers, agitation of the water which may occur by the discharge of the blowoff water and steam into the apparatus, is confined to the first chamber and thus the water in chambers 13 and 14 is not disturbed, with a manifest advantage. Certain of the difficulties encountered in apparatus provided for this purpose are not due to the deficiency of heat units discharged from the boiler in the blowoff operation, but to the fact that the heat thus furnished is not properly conserved. According to my invention the blowoff steam which, as stated, above, is provided in large quantities, is caused to be...
discharged into a relatively large body of water for refilling purposes, which holds its heat for a relatively long time, not only because of the insulating feature of the tank, 8, but because of its relatively large amount. Furthermore, the heat supplied by the exhaust steam from the washout and refilling pumps is used at such a time and under such conditions that the greatest efficiency is derived therefrom, as distinguished from the discharge of the exhaust steam directly into a large body of storage water at such a point as to be diffused throughout the mass. It may be further stated that when locomotives are blown off, and restored to service, at comparatively short intervals, which is the common practice, the trapping of the steam in the upper part of the chambers 12, 13, and 14 insures the refilling of the locomotive boilers with water at the desired temperature, and under such conditions the introduction into the refilling water as it passes to the locomotive boiler, of exhaust steam from the pump 26, while desirable, is not necessary, this last referred to feature of the apparatus presenting its greatest usefulness where, for example, a number of locomotives are washed and refilled before a locomotive is blown down, which sometimes occurs, as for example, when locomotives are brought from the repair shops and filled, in which case should the water in the chambers drop below the minimum water-level y, water in relatively cool condition, from a source other than the boilers of the locomotives, will be discharged into the tank 8, as hereinafter described.

The provision of the valves 53, 63, and the valved pipe connections 66 between the pipes 52 and 63, permit of the passage of the exhaust steam from either of the pumps 34 and 26 to either the chamber 14 or 31, as desired, should conditions in the apparatus render it advisable at any time to discharge the exhaust steam from both of these pumps into one chamber only.

In connection with the washout and refill mains I prefer to employ means whereby the water standing in these mains when the apparatus is not being operated, will be maintained at a desirable temperature, in order that the water first entering the locomotive boiler in either the washout or refilling operation will not injure the boiler.

This is effected by stringing a pipe 67 of relatively small diameter and in communication with the exhaust pipe 52, through the pipe 55 and pipe 56, and the pipe 68 of relatively small diameter and connected with the pipe 62, through the pipes 59 and 60, these pipes, which are provided with valves 70 and 71 respectively, being connected at their ends with pipes 73, which open into the opposite ends of the blowoff pipe 22. The pipes 67 and 68 may be supplied with steam from any suitable source. It is preferred, however, that exhaust steam be used and that this be provided from the exhaust chambers of the pumps 34 and 26. This is a desirable arrangement, inasmuch as it is highly desirable that the pumps 34 and 26, which are automatically started and stopped by the drop of pressure in the respective mains 55 and 59, caused by opening one or the other to supply water to the locomotive and the reestablishment of back pressure in these mains by shutting them off, are allowed to slowly operate to avoid accumulation of condensed steam in the cylinders. To insure this "creeping" action of the pumps I provide by-passes 73 between the suction and discharge-water chambers of the pumps, and thus a supply of exhaust steam continually passes from these pumps through the pipes 52 and 62 respectively, to the pipes 67 and 68, thereby maintaining the water in these pipes and the roundhouse pipes 56 and 60 connected therewith, at a desirable temperature, the condensed steam returning through pipe 22 and pipe 23, and passing into the chamber 13, this being the course of the exhaust steam from the pumps 34 and 26 during the "creeping" operation thereof, inasmuch as the pressure of this steam is insufficient to displace the water which would fill the lower ends of the pipes 52 and 62, where they extend into the tank 31 and chamber 14 respectively. When, however, these pumps are operating to furnish water to a boiler, and the exhaust from these pumps is therefore, under relatively great pressure, practically all of the steam will discharge into the tank 31 and chamber 14 respectively, inasmuch as the diameter of the pipes 67 and 68 is very small compared with the diameter of the pipes 52 and 62.

As hereinafter stated, the water level in the tank 8 may drop below the minimum level y where a number of locomotives are refilled in succession and which have not previously been blown off into the storage tank, and in such case water from a source other than a locomotive boiler is introduced into the tank. In the particular arrangement shown, this is effected by means of a float 74, which also forms a part of the skimming mechanism hereinafter referred to, this float being connected by a cable 74 running over pulleys 75 and 76, with a weight 77 connected by a cable 78 with the lever 44, the weight 77 being sufficiently heavy to partly counterbalance the float 74, and the float 74 being heavier than the weights 49 and 77. Thus, when the water-level in the tank 8 drops below that indicated at y, the float 74 will lift the weight 77 and rock the lever 44 on its fulcrum, which automatically opens the valve 43. This allows water from the pipe 40 to rise in the tank 31, forcing its way past the check 42.
42, and overflowing into the chamber 12, until the water level in this chamber rises to the line y, whereupon the valve 43 automatically closes.

5 The float 74 is preferably provided with diametrically extending openings 74a, which communicate with the central pipe 175, sliding in an upright stationary pipe 176 secured in the chamber 13 and extending below the tank 8, where it is provided with a valve 177, accessible to the operator, the pipe 176 communicating between its ends with a pipe 178, which has a downturned end opening through the bottom 9 of the tank and into the pipe 20. The holes 74a are so disposed that the water in which the float 73 is partially submerged, will extend at its upper surface substantially central of these openings, and thus when the valve 21 is opened, for a purpose hereinafter explained, the surface water and floating impurities will flow into the float 74, passing down through the pipes 175, 176 and 78, and discharging into the pipe 20, thus skimming the upper surface of the water of oil, grease, or other floating impurities on the surface of the water, the valve 177 being provided for the purpose of permitting the operator to determine whether or not the float 74 maintains the necessary position in the water for skimming the surface thereof.

From time to time, it is necessary that the chambers 12, 13, and 14 be cleared of the accumulations of mud or other particles which have settled from the blowoff water in its passage through these chambers, this being effected by opening the valve 21, which permits the accumulations in the bottom of these chambers to be flushed therefrom through the openings 17, 18, and 19, and the material skimmed from the upper surface of the water to pass through the pipe 20 and discharge into any suitable drain. Thus the material, such as mud, which gravitates to the bottom of the chambers, and the floating impurities skimmed from the upper surface of the water therein, are caused to discharge from the apparatus by the single operation of opening the valve 21.

50 Another reason why it is advantageous to use, in the normal operation of the apparatus, fresh water only for washout purposes, as distinguished from introducing fresh water into the water to be refilled into the locomotive, arises from the fact that chemical treatment of the water where the supply of fresh water available for use in connection with the apparatus is of a kind that, before it can be used in the generation of steam in a boiler, must be chemically treated, at relatively great expense, is not necessary. While, on the other hand, such water may, with perfect safety, be used as washwater.

65 It will be understood from the foregoing that the scope of my invention is not limited to the combining of the washout and refilling units as shown in this, my preferred construction, and that the washout unit can be operated entirely separate from the refilling unit as described. The advantages derived from the present location of tank 31 being a partial use of the superheat contained in the blowoff water and steam upon the entrance thereof into chamber 12, and a wider range in the temperature of the washout water, without the necessity of changing either the pressure or volume of this water at the point of use. It will also be readily understood that while I purposely omit the separation of the blowoff steam from the blowoff water in the usual manner and the use of this steam in chamber 14, it is because the normal temperature of this water, due to contact with heat conducting partition 15 and with surplus steam, will remain at or near the boiling point, and that it is clearly within the scope of my invention to utilize this, or any other well known and common form of heater in chambers 13 and 14 where unusual conditions warrant the additional cost thereof.

The tank 31 is by preference located in a position, as for example, that stated, wherein it will be subjected by radiation to the heat of the blowoff water and steam which under some conditions may be found to be desirable, as for example, should the exhaust from the pump 34 be insufficient to heat the washout water to the desired temperature, though it is within my invention, where conditions are such that the exhaust steam is sufficient alone to heat the washout water to the desired temperature, or whether other heat is available to supplement the exhaust steam, to position the tank 31 where its contents will not be heated by radiation, from the blowoff water and steam. Such a modification of the apparatus is illustrated in Fig. 8, wherein the elements of the apparatus are the same as in the preceding figures and bear the same numerals, excepting that the tank 31 and the float-controlled valve are located outside of the housing and the pipe 40 instead of connecting with the heater 31 at a point between the latter and the pump 34 connects with a coupling 40 which opens into the pipe communicating with the lower end of the heater 31 and opening into the coupling 36. Furthermore, other suitable forms of apparatus may be employed in carrying out my invention, and in so far as the apparatus is concerned other modifications or additions may be made therein within the spirit of my invention, and within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is

The method of washing and refilling locomotive boilers which consists in storing 120
the water blown off from the boilers, washing the boilers with water other than the blowoff water, tempered to the desired degree, and utilizing the stored blowoff water for this purpose only.

2. The method of washing and refilling locomotive boilers which consists in storing water blown off from the boilers, washing the boilers with water other than the blowoff water tempered to the desired degree, refilling the boilers with water, utilizing the stored blowoff water for this purpose only, and introducing into the blowoff water in its passage to the boilers, steam for superheating the water.

3. The method of washing and refilling locomotive boilers which consists in storing the water blown off from the boilers, washing the boilers with tempered water other than the blowoff water, and refilling the boilers with the blowoff water first introduced into the storage tank.

4. In apparatus of the character set forth, the combination of a plurality of water-chambers, including an intermediate chamber, means for causing the first one of the chambers of said series to communicate with the intermediate chamber near the top of the last referred to chamber, means for causing the intermediate chamber to communicate with the last one of the chambers of said series near the bottom of said last referred to chamber, means for introducing blowoff water from a boiler being emptied, into the first one of the chambers of said series, and means for conducting water from the last one of the chambers of said series to a boiler for refilling purposes.

5. In apparatus of the character set forth, the combination of a tank provided with metal partitions dividing it into a plurality of water-chambers in successive communication with each other, means for introducing blowoff water from the boiler of a locomotive to be emptied, into the first chamber of said series, and means for conducting water from the last one of the chambers of said series to a boiler for refilling purposes, said metal partitions serving to conduct heat from the boiler-water introduced into said first chamber, to the water in said other chambers.

6. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler, means for pumping water from said chamber into a locomotive boiler to fill it, and means for introducing steam into the refill-water during its passage to the boiler.

7. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler, means for pumping water from said chamber into a locomotive boiler to fill it, and means for subjecting the refill-water in its passage to the boiler, to the exhaust steam from said pumping means.

8. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from the boiler of a locomotive, a pipe in communication with the storage water closely adjacent to the level of the water, means for discharging the stored blowoff water into a boiler to be filled, and means for introducing steam into the portion of the water into which the said pipe opens.

9. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a locomotive boiler, a perforated pipe extending into said chamber with its perforations closely adjacent to the level of the water, means connected with said pipe for discharging water from said chamber into a boiler to be filled, a pipe extending into said first named pipe and submerged in the water therein, and means for introducing steam through said last-named pipe into the water in said first-named pipe.

10. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, means for supplying water, other than blowoff water from the boiler, to a 95 boiler to be washed, means for heating the washwater, and means for refilling a boiler with blowoff water from said chamber.

11. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, means for supplying to a locomotive boiler washwater, other than said blowoff water, means for subjecting to blowoff product heat the water to be used for 105 washing, and means for filling a boiler with water from said storage-chamber.

12. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, a conduit exposed to blowoff product heat, means for supply water other than the blowoff water to said conduit, means for discharging water from said conduit into a boiler for washing it, and means for filling a boiler with water from said storage chamber.

13. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, a conduit supplied with water other than the blowoff water, means for discharging water from said conduit into a locomotive boiler to wash it, a steam-pipe opening into said conduit, and means for 125 discharging steam through said pipe into said conduit.

14. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, a conduit supplied with water other than the blowoff water, means for discharging water from said conduit into a locomotive boiler to wash it, a steam-pipe opening into said conduit, and means for discharging steam through said pipe into said conduit.
comotive, a tank positioned to be subjected to blow-off-product heat, means for supplying said tank with water other than the blowoff water, means for discharging water from said tank into a locomotive boiler to wash it, a pipe extending into, and opening into said tank, means for supplying steam to said pipe for discharging into said tank, and means for refilling a locomotive-boiler with water from said storage-chamber.

15. In apparatus of the character set forth, the combination of a pipe for conducting heated water to a locomotive boiler, a steam-operated pump connected with said pipe for forcing heated water therethrough, means for maintaining the pump in continuous operation, and a pipe connected with the exhaust-steam chamber of the pump and positioned to maintain the water in said first-named pipe in heated condition.

16. In apparatus of the character set forth, the combination of a blow-off pipe for receiving the blowoff contents of a boiler to be washed and refilled, a tank for receiving the blowoff water, a conduit connected with a water supply, a steam-operated pump for discharging water through said conduit into the boiler of a locomotive, said conduit being filled with water at all times, means for continuously operating said pump, means in communication with the exhaust-steam-chamber of the pump for heating the water confined in said conduit, and means for conveying into said tank the surplus steam which is not condensed in the heating of the water in the said conduit.

17. In apparatus of the character set forth, the combination of a chamber for storing blowoff water from a boiler of a locomotive, a tank adapted to be supplied with water other than the blowoff water, a steam-pump for pumping wash-water to a locomotive boiler, from said tank, means for discharging the exhaust-steam from said pump during the washing operation, into the water in said tank, a refill steam-operated pump for pumping the upper portion of the water in said chamber, into a locomotive boiler to refill the latter, and means for conducting the exhaust steam from said refill pump during the refilling operation into the upper portion of the water in said tank.

18. In apparatus of the character described, the combination of a steam operated pump to supply washing water to a locomotive boiler, a water main leading from a source of supply to said pump and from said pump to said boiler, a water-pressure governor to regulate the pressure of water and thereby the consumption of steam, constricting means at the point of use to increase the velocity and diminish the volume of water consumed, and means in said water main to utilize the heat units in the exhaust steam from said pump to heat said washing water during the use thereof.

19. In apparatus of the character set forth, the combination of a pipe for conducting heated water to a locomotive boiler, and a pipe in said first-named pipe of smaller external diameter than the internal diameter of the latter, and means for supplying steam to said second-named pipe whereby the water in said water-pipe is maintained at all times in heated condition.

20. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from boilers, means for pumping water from the upper portion of the body of water in said chamber into locomotive boilers to fill them, and means for subjecting the refill water in its passage to the boilers to the exhaust steam from said pumping means.

21. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from boilers, means for pumping wash-water, other than the blow-off water, into boilers to wash them, and means for subjecting the wash-water to blow-off-product heat and exhaust steam from said pumping means, and means for refilling the boilers with water from said chamber.

22. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from boilers, means for washing boilers with tempered water other than the blow-off water, and means for refilling the boilers with the blow-off water first introduced into said chamber.

23. In apparatus of the character set forth, the combination of means for forcing wash-water to boilers to be cleaned, and means for subjecting the wash-water in its passage to the boilers, to the heat in the exhaust steam from said forcing means.

24. In apparatus of the character set forth, the combination of a series of water-chambers, in successive communication with each other at different elevations in alternate arrangement, whereby a sinusous course for the water passing through said chambers is provided, means for introducing blow-off water from a boiler, to be emptied, into the first one of said series of chambers, and means for conducting water from the last one of said series of chambers to a boiler for refilling purposes.

25. In apparatus of the character set forth, the combination of a series of communicating water-chambers, a means for introducing blow-off water from a boiler, to be emptied, into one of said chambers, means for conducting blow-off water from one of the other of said chambers to a boiler for refilling purposes, and means for causing
steam from a boiler being emptied to enter the upper portions of the chambers, above the water therein.

26. In apparatus of the character set forth, the combination of a series of water-chambers in successive communication with each other at different elevations in alternate arrangement, whereby a sinuous course for the water passing through said chambers is provided, means for introducing blow-off water from a boiler to enter, into the first one of said series of chambers, to said boiler for refilling purposes, and means for causing steam from a boiler being emptied to enter the upper portions of said chambers beyond the first one of the series thereof, above the water therein.

27. In apparatus of the character set forth, the combination of a series of water-chambers in successive communication with each other at different elevations in alternate arrangement, whereby a sinuous course for the water passing through said chambers is provided, means for introducing the blow-off-products from a boiler to be emptied, into the first one of said series of chambers, means for conducting the water from the last one of said series of chambers to a boiler for refilling purposes, and means for causing the excess steam in the first chamber of said series to enter the other of said chambers above the water levels therein.

28. In apparatus of the character set forth, the combination of a tank provided with metal partitions dividing it into a plurality of water-chambers in successive communication with each other, means for introducing the blow-off-products from a boiler, to be emptied, into the first chamber of said series, means for conducting water from the last one of the chambers of said series to a boiler for refilling purposes, said metal partitions serving to conduct heat from the blow-off products introduced into said first chamber to the water in said other chambers, and means providing communication between said first chamber and the others thereof above the water levels therein, whereby excess steam in the blow-off water rising from the latter in said first chamber spreads into the top portions of all of the other chambers.

29. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from the boiler of a locomotive, means for supplying water, other than blow-off water, from the boiler, to a boiler to be washed, means for heating the wash-water, means for refilling a boiler with blow-off water from said chamber, and means for skimming the accumulations on the upper surface of the stored boiler-water.

30. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from the boiler of a locomotive, means for supplying water, other than blow-off water from the boiler, to a boiler to be washed, means for heating the wash-water, means for refilling the boiler with blow-off water from said chamber, and means for simultaneously effecting discharge of accumulations from the upper and lower portions of the stored water.

31. In apparatus of the character set forth, the combination of a chamber for storing blow-off water from the boiler of a locomotive, means for supplying water, other than blow-off water from the boiler, to the boiler to be washed, means for heating the wash-water, means for refilling the boiler with blow-off water from said chamber, and means for maintaining a minimum water level in said chamber.

32. In apparatus of the character set forth, the combination of a plurality of water-chambers, including an intermediate chamber, means for causing the first one of the chambers of said series to communicate with the intermediate chamber near the top of the last referred to chamber, means for causing the intermediate chamber to communicate with the last one of the chambers of said series near the bottom of said last referred to chamber, means for introducing blow-off water from a boiler being emptied, into the first one of the chambers of said series, means for conducting water from the last one of the chambers of said series to a boiler for refilling purposes, and means for maintaining a minimum water level in said first chamber.

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In presence of—

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."