May 12, 1942. L. O. GUNDERSON ET AL 2,282,775

BOILER WATER CONDITIONER AND BLOW-OFF SYSTEM

Filed Feb. 2, 1939 3 Sheets-Sheet 1

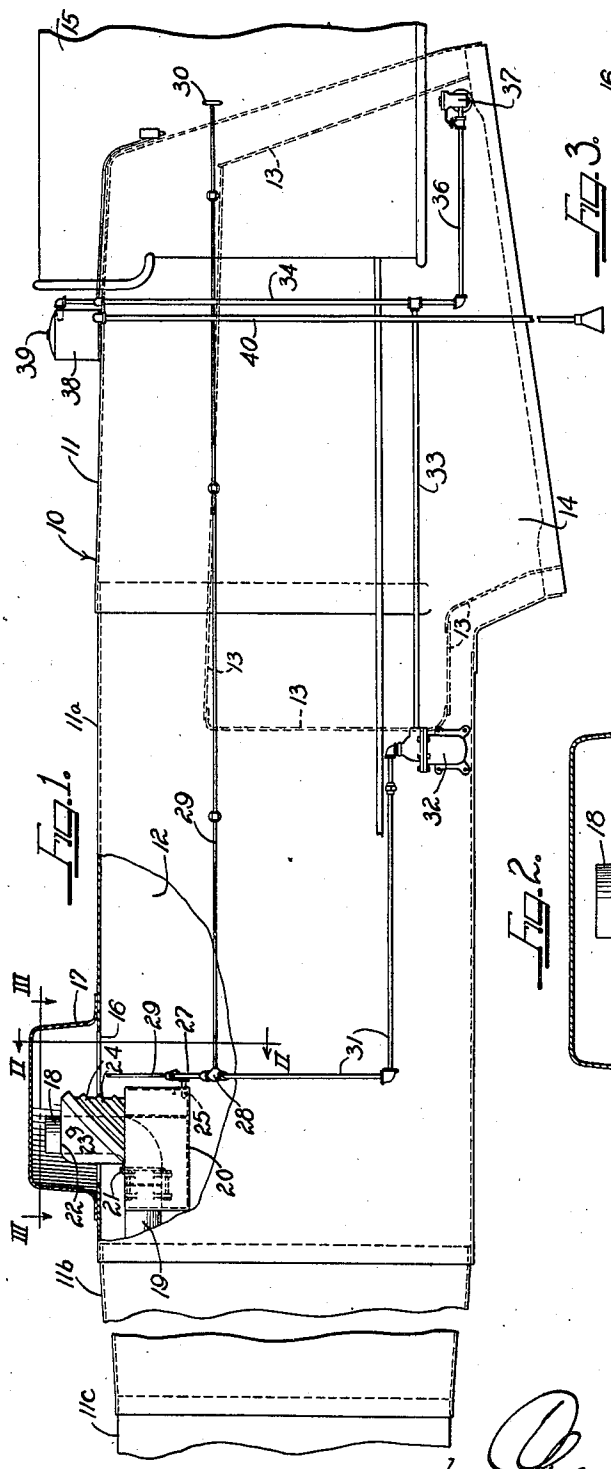

Fig. 1.

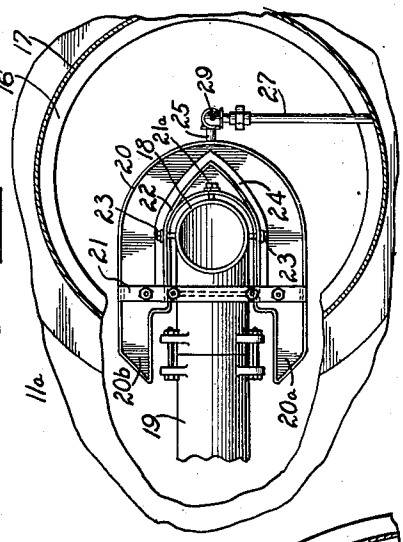

Fig. 3.

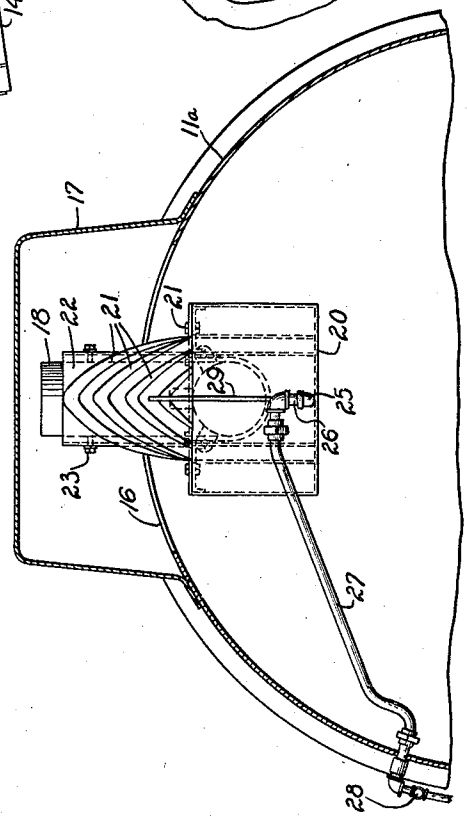

Fig. 2.

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BOILER WATER CONDITIONER AND BLOW-OFF SYSTEM

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Fig. 4.

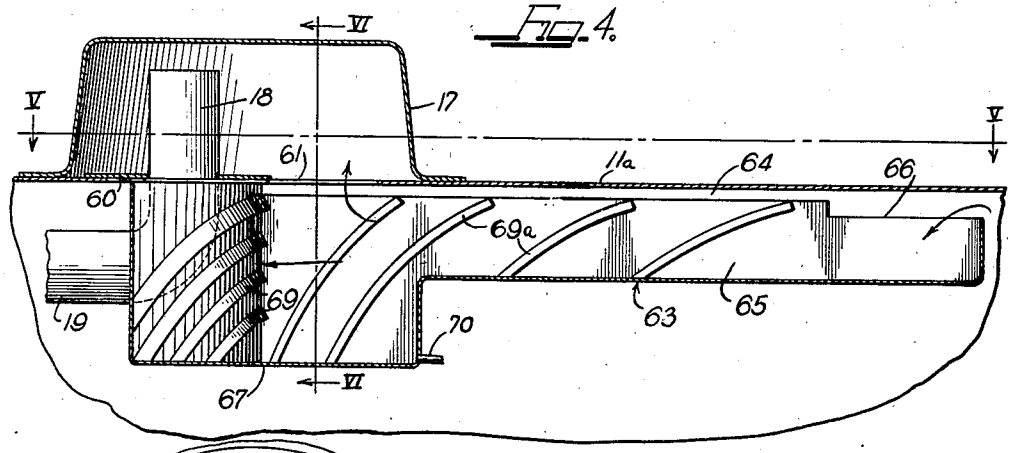


Fig. 5.

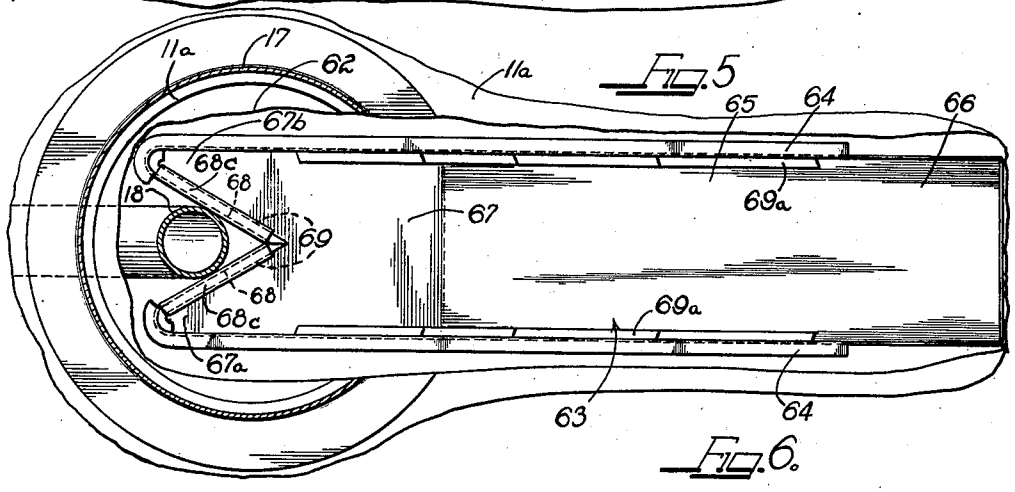
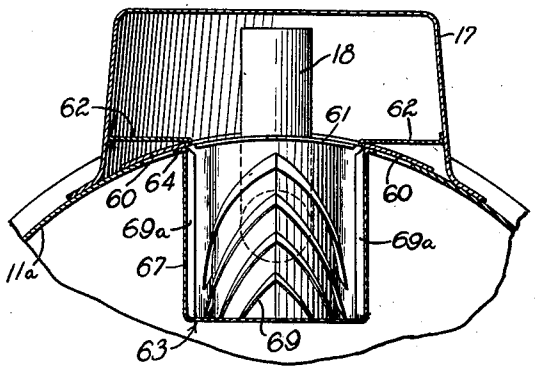


Fig. 6.



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BOILER WATER CONDITIONER AND BLOW-OFF SYSTEM

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Fig. 7.

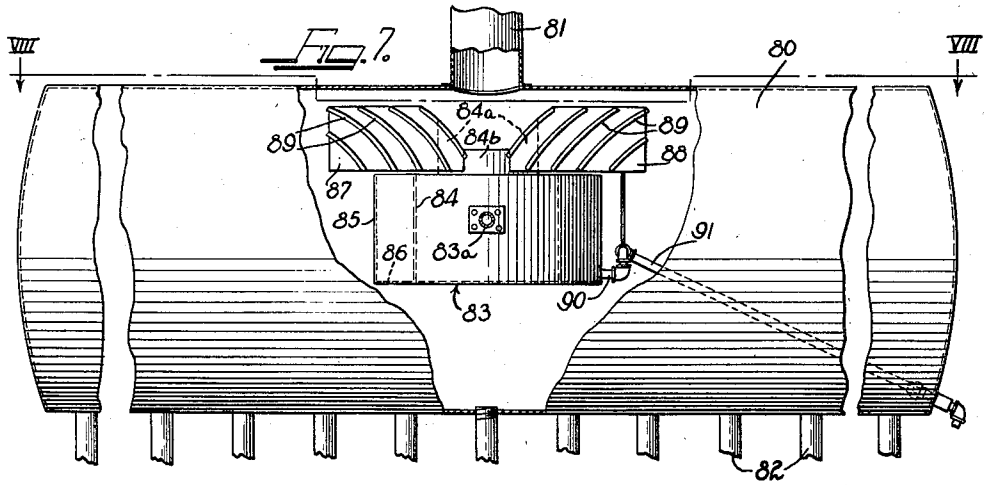


Fig. 8.

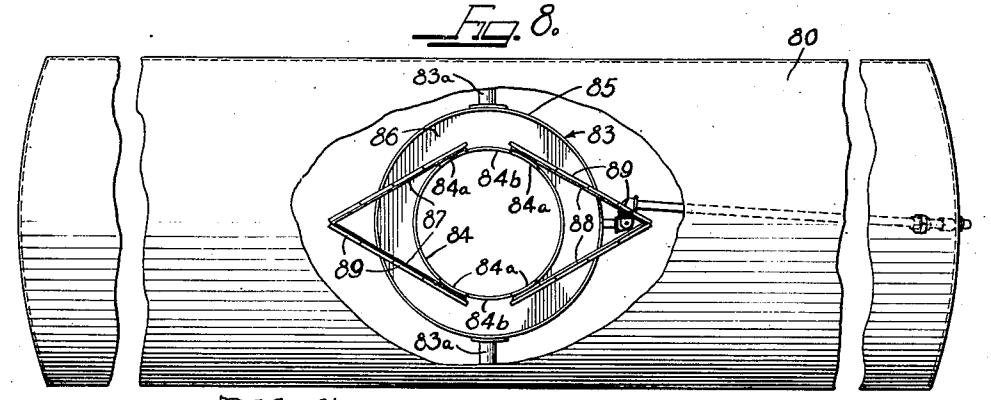
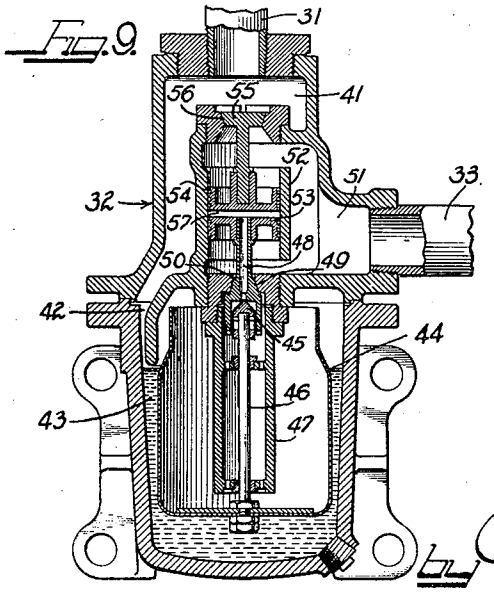


Fig. 9.



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Patented May 12, 1942

2,282,775

UNITED STATES PATENT OFFICE

2,282,775

BOILER WATER CONDITIONER AND BLOWOFF SYSTEM

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Application February 2, 1939, Serial No. 254,176

16 Claims. (Cl. 122—381)

This invention relates to the removal of impurities from boiler water in operating steam boilers at a level above the normal water level in the boilers.

More specifically the invention relates to improvements in collecting troughs or receptacles adapted to be mounted in the boiler adjacent to the steam outlet of the boiler for preventing light water, foam or other impurities from entering into the steam outlet along with the steam.

The troughs or collectors of this invention are adapted to intercept foam or light water before the same reaches the steam outlet pipe of the boiler to insure delivery of a high quality steam. The collected matter in the troughs or collectors can be drained from the boiler into a liquid-actuated valve adapted to open automatically upon accumulation of a predetermined quantity of liquid so as to permit the accumulated liquid to be discharged by boiler pressure. If desired, the discharge from the valve can be utilized to operate a blow-off valve communicating with another part of the boiler so that this part of the boiler will simultaneously be blown down with the discharge from the collecting trough.

By locating bull's eye sight glasses in the top plate of the steam dome on a locomotive in service and by directing light into the interior of the boiler in operation, we have been able to observe the manner in which foam develops inside of a boiler and the manner in which this foam fills the steam space to overflow into the steam outlet pipe. We found that the steam velocity was effective in throwing foam and particles of water against the steam outlet pipe or "dry" pipe and other appurtenances inside of the boiler with such force that it created a spray of water droplets which were entrained by the steam and carried into the steam dry pipe.

We observed that on locomotive boilers with tapered boiler courses, the foam would develop to fill the steam space to the roof sheet in the forward part of the boiler of smaller diameter and would then rise to the forward end of the steam dome until it would overflow into the steam dry pipe.

In order to prevent the discharge of impurities with the steam into the steam dry pipe, we located foam-collecting or collapsing troughs on each side of the dry pipe to intercept the passage of foam and other impurities and to permit the working of the locomotive or boiler to capacity without danger of extraneous matter being entrained with the steam. Our observations have indicated that the location of the foam-collapsing trough so as to extend on each side of the steam dry pipe successfully prevented the foam from rising into the steam dome.

We have now provided a U-shaped collapsing trough with the ends facing the forward end of the locomotive and disposed on each side of the steam dry pipe. This U-shaped trough makes possible the use of a single trough to extend on both sides of the steam dry pipe.

We have also observed that when foam is developed to a relatively high point in the steam space to the rear of the steam dome, the steam generated in the fire box end of the locomotive is restricted in its passage to the steam dome and passes at a higher velocity over the surface of foam in the boiler. This high velocity steam is effective in picking up foam and particles of water similar to the manner in which a high wind throws a water spray from the crests of waves. The picked-up foam and water particles are violently thrown by the steam against the steam dry pipe, causing a considerable spray of fine particles of water that are readily entrained with the steam rising into the steam dome.

In order to prevent water or foam being carried by the high velocity steam from spattering against the dry pipe to cause entrainment with the steam entering the dry pipe, we have provided a special V-shaped baffle which is so constructed that the material picked up by the steam slides along a slanting surface so as to be deflected to either side of the dry pipe without causing any spray. Deflecting vanes are used to direct the material downwardly into the foam-collapsing trough. Our observations have indicated that this structure prevents the formation of fine particles of water capable of being lifted by the steam leaving the boiler.

While the dual arrangement of the U-shaped foam collapsing trough and the V-shaped baffle is preferred, it will be understood that beneficial results will occur through the use of either one of these devices. Thus, the deflecting baffle can be used alone to direct the water back into the boiler instead of into the collapsing trough. Furthermore, the collapsing trough can be used alone without the baffle.

It is, then, an object of this invention to eliminate moisture and foam-entrainment in steam leaving a boiler.

A further object of the invention is to provide foam-collapsing or collecting troughs adjacent the steam outlet of a boiler for removal of light water and foam from the boiler.

A specific object of the invention is to provide a U-shaped foam-collapsing trough around the steam dry pipe of a boiler, such as a locomotive boiler.

Another specific object of the invention is to provide V-shaped baffles adjacent the steam outlet of a boiler for deflecting material entrained with the steam away from the steam outlet.

A further object of the invention is to provide a foam-collapsing trough adjacent the steam outlet of a boiler having baffles cooperating there-

with to deflect moisture and other impurities entrained with the steam into the trough and away from the steam outlet.

A further specific object of the invention is to provide collecting devices in steam boilers having inlets at levels above the normal water level in the boiler and located adjacent the steam outlet of the boiler for receiving light water or foam developed on top of the boiler water as well as moisture entrained with the steam before the steam reaches the outlet pipe from the boiler.

Another object of the invention is to eliminate the water spray against the steam dry pipe projecting into the steam dome of a boiler.

A further object of the invention is to separate moisture entrained in steam before the steam reaches the outlet from the boiler and to utilize this separated moisture for actuating a blow-off device to blow down the boiler.

Another object of the invention is to collapse foam and light water developed to a dangerous level in the boiler, to separate moisture entrained from steam in the boiler and to utilize the combined collapsed foam and separated moisture for effecting a blowing down of the boiler.

Other and further objects of the invention will become apparent to those skilled in the art from the following detailed descriptions of the annexed sheets of drawings which form a part of this specification.

On the drawings:

Figure 1 is a fragmentary, broken diagrammatic side elevational view, with a part broken away and shown in vertical cross-section, of a locomotive boiler equipped with the devices of this invention;

Figure 2 is a vertical cross-sectional view, with parts in elevation, taken along the line II—II of Figure 1;

Figure 3 is a fragmentary horizontal cross-sectional view, with parts shown in elevation, taken along the line III—III of Figure 1;

Figure 4 is a fragmentary vertical cross-sectional view, with parts in elevation, of a locomotive boiler equipped with another form of foam-collapsing trough according to this invention;

Figure 5 is a horizontal cross-sectional view taken along the line V—V of Figure 4 with part of the boiler shell broken away to show the top plan of the collapsing trough;

Figure 6 is a vertical cross-sectional view, with parts in elevation, taken along the line VI—VI of Figure 4;

Figure 7 is a broken, fragmentary side elevational view, with parts broken away and shown in vertical cross section, of a stationary vertical tube, horizontal drum type of boiler equipped with the foam-collapsing trough and baffle devices of this invention;

Figure 8 is a horizontal cross-sectional view, with parts shown in plan, taken along the line VIII—VIII of Figure 7; and

Figure 9 is a vertical cross-sectional view, with parts in elevation, of a liquid-actuated discharge valve controlled by the liquid removed from the collapsing troughs of this invention.

As shown on the drawings:

In Figure 1 the reference numeral **10** designates generally a locomotive having the usual boiler shells **11**, **11***a*, **11***b* and **11***c* defining a tapered boiler course **12**. Plates **13** define a fire box **14** in the boiler at the rear end thereof. The usual engineer's cab **15** is mounted around the rear end of the boiler.

The boiler shell **11***a* has an opening **16** in the top thereof communicating with the usual steam dome **17** mounted on top of the boiler. A steam outlet pipe or dry pipe **18** extends upwardly into the steam dome **17** and has the open end thereof spaced beneath the top of the dome as shown.

The dry pipe **18** is connected to a horizontal pipe **19** extending to the operating cylinders of the locomotive for supplying steam thereto.

As shown in Figures 1 to 3, a U-shaped foam collapsing trough or collector **20** is mounted on the dry pipe **18** by means of a mounting bracket **21** and bolts such as **21***a* (Figure 3). This trough or collector **20** has the legs **20** and **20***a* thereof disposed on each side of the pipe **18**, while the base of the U faces the rear end of the boiler and extends behind the pipe **18**.

The open top of the trough or collector is preferably spaced below the steam dome **17** but communicates with the steam space of the boiler at a level above the normal boiler water level.

A substantially V-shaped baffle plate **22** has the sides thereof bolted to the pipe **18** by means of bolts **23**. The plate **22** extends above the top of the trough or collector **20** and almost to the top of the pipe **18**. The base or point of the plate **22** faces the rear of the boiler. As best shown in Figure 3, the baffle plate **22** is aligned with the interior of the trough or collector **20** so that material draining downwardly from the plate will be collected in the trough or collector.

Deflecting vanes **24** are mounted on the plate **22** and slope downwardly in spaced relation from the point or base of the plate to the top of the collecting trough.

A drain pipe **25** extends into the bottom portion of the collecting trough **20** at the rear end thereof as shown. This pipe **25** is coupled to a short vertical pipe **26** extending upwardly therefrom. The pipe **26** in turn is coupled to a pipe **27** extending through the boiler shell and communicating with a manually operated valve **28** mounted on the outside of the boiler.

A vent pipe or tube **29** communicates with the vertical pipe **26** so as to prevent a siphon discharge out of the collapsing trough **20**. Since the discharge pipe **27** communicates with the drain pipe **25** at a level above the bottom of the collapsing trough the pipe **25** must always be below the level of liquid in the trough before the liquid can flow into the pipe **27**.

As shown in Figure 1, the valve **28** is operated through a rod **29** extending alongside of the locomotive and into the engineer's cab **15**. This rod **29** can be turned by a handle **30** in the engineer's cab.

The valve **28** discharges into a pipe line **31** communicating with a liquid-actuated valve **32**. The valve **32** discharges into a pipe **33** connected to a pipe **34**. The pipe **34** communicates at one end with a pipe **36** connected to a blow-off valve **37** which communicates with the bottom portion of the boiler. The other end of the pipe **34** is connected to a steam separator **38** mounted on top of the boiler. The steam separator **38** may be of the centrifugal type and has a steam discharge outlet **39** at the top thereof and a water drain line **40** extending below the bottom of the boiler.

When the liquid-actuated valve **32** is opened to permit water from the drain line **31** to be blown through the valve into the pipe **33**, the pressure of this liquid will act on the blow-off

valve 37 through the pipe line 36 to open the valve. The combined discharge from the blow-off valve 37 and from the liquid-actuated valve 32 will then enter the steam separator 38 through the pipe 34. Steam is separated from the combined liquids and discharges from the separator at 39 while the liquids are drained with harmless force through the drain line 40.

The liquid-actuated valve 32 is best shown in Figure 9. As shown in Figure 9, the drain line 31 from the collapsing trough 20 communicates with a chamber 41 in the top of the valve. The chamber 41 is connected through a passageway 42 with a float chamber 43 in the bottom of the valve. A float bucket 44 is mounted in the chamber 43 and is adapted to float in the liquid collected in the chamber until the liquid level rises above the top of the bucket. Liquid will then enter the bucket to sink the same. The bucket carries a pilot valve 45 on a rod 46 extending through a tube 47 which communicates with the interior of the bucket. The pilot valve 45 controls a passageway 48 in an auxiliary valve 49 adapted to seat on a valve seat 50 establishing communication between the float chamber 43 and a discharge chamber 51. An open-ended cylinder 52 is mounted in the discharge chamber 51. This cylinder slidably receives a piston 53 secured to the valve 49 for controlling the valve. A second piston 54 likewise is slidable in the cylinder 52 and controls a valve 55 adapted to be seated on a seat 56 which establishes communication between the inlet chamber 41 and the discharge chamber 51.

When the bucket 44 sinks, the pilot valve 45 is pulled away from the mouth of the passageway 48 to vent the space 57 between the pistons 53 and 54 to the pressure existing in the float chamber. This pressure will force the pistons apart to open the valves 49 and 55 thereby directly venting the pipe 31 with the pipe 33 so that liquid will rapidly flow through the valve. As soon as the liquid level in the float chamber 43 reaches a level below the top of the bucket, the bucket will again float in the chamber to move the pilot valve 45 against the mouth of the passageway 48 and the boiler pressure existing in the inlet side of the valve will close the auxiliary valves 49 and 55.

This type of valve, therefore, will only permit passage of liquid therethrough and the steam in the boiler is not vented to the discharge line 33.

The device shown in Figures 1 to 3 operates by collecting foam, light water or other impurities on top of the boiler water into the collapsing trough 20 and by simultaneously collecting moisture entrained with the steam entering the steam dome. The collected material is accumulated in the trough or collector 20 until a sufficient amount is received therein for flowing out through the pipe 31 into the valve 32 for opening the valve. The valve will then automatically open and the collected liquid will be discharged through the steam separator where any steam flashed from the hot liquid is removed at 30 while the liquid is drained through 40 to the road bed. The liquid is propelled through the valve under the boiler pressure existing in the boiler and, if desired, can be utilized to operate the blow-off valve 37 so that the lower portion of the boiler will simultaneously be blown down with an emptying of the collapsing trough 20. If it is desired to prevent a drainage of the collecting trough 20, the valve 28 can be closed by manipulation of the valve wheel 30 in the engineer's cab.

In the modification shown in Figures 4 to 6, a closure plate 60 is secured to the boiler shell 11a in the steam dome portion 17. This plate 60 extends snugly around the dry pipe 18 as shown in Figure 4 and has a smaller opening 61 than the opening 16 described in Figures 1 to 3. As shown in Figures 4 and 6 the plate 60 can be welded to the boiler shell 11a and can be reinforced by means of flanges 62 (Figure 6) connected with the steam dome 17.

A foam collapsing trough 63 has side flanges 64 secured as by welding, riveting or the like to the inside of the boiler shell 11a and to the bottom face of the plate 60.

The collapsing trough 63 has an elongated channel portion 65 extending rearwardly from the steam dome 17 and communicating at its rear end with the steam space of the boiler through an open top portion 66. This open top portion 66 is spaced below the top of the boiler shell 11a and steam can enter into the passage 65 as indicated by the arrow in Figure 4.

The forward end of the collapsing trough 63 has a sump portion 67 directly under the steam dome 17. The forward walls of the sump portion 67 are V- or U-shaped as at 68 to provide legs 67a and 67b on each side of the dry pipe 18 beneath the plate 60. The tops of the walls 68 have flanges 68c thereon (Fig. 4) secured to the plate 60 to close the forward end of the sump 67. As shown in Figure 5 the forward ends of the legs 67a and 67b are rounded.

Deflecting vanes 69 are mounted in the sump 67 on the U-shaped or V-shaped end walls 68 thereof. These vanes slope downwardly from the top portion of the sump for directing liquid to the bottom of the sump. The vanes 69 can be curved at their outer end if desired to conform with the rounded end walls of the legs 67a and 67b as shown in Figure 5.

Additional vanes 69a can be secured on the side walls of the collapsing trough 63 as shown in Figures 4 to 6 for directing moisture to the bottom of the trough. The vanes 69 and 69a provide pockets or channels to intercept the moisture.

The sump 67 is drained through a drain outlet 70 which can be connected to a liquid-actuated valve and steam separator as described in Figures 1 to 3.

In the modification shown in Figures 4 to 6, the steam will be fed to the dry pipe 18 through the inlet 66 of the trough 63. The steam from the inlet 66 will flow forwardly along the passage 65 of the collapsing trough 63 and will impinge against the walls 68 at the forward end of the trough. Any moisture entrained with the steam will be deflected downwardly into the sump 67, while the clean steam can enter the steam dome through the opening 61 of the plate 60. This trough prevents moisture from entering the dry pipe 18 and is effective not only in removing entrained moisture from the already formed steam but also in removing foam from the boiler when it reaches a level above the top of the inlet 66.

In the modification shown in Figures 7 and 8, the reference numeral 80 designates a horizontal drum of a stationary type of boiler. The drum 80 has a steam outlet 81 at the top thereof and water tubes 82 communicating with the lower portion thereof.

According to this invention, a foam-collapsing

trough 83 is mounted in the drum 80 on supports 83a secured to the drum wall. The top of the trough is below the steam outlet 81. The collapsing trough 83 has concentric inner and outer side walls 84 and 85 joined by a base 86 so as to define an annular open top chamber. The inner wall 84 has four spaced leg portions 84a extending above the wall 85 as shown in Figure 8. These legs 84a have V-shaped baffle plates 87 and 88 secured thereon and disposed above the top of the walls 85. Shorter legs 84b connect two adjoining legs 84a between the divergent ends of each baffle plate 87 and 88 at a level above the top of the wall 85. The tops of the baffle plates are cut away above the legs 84b to provide side passages to the steam outlet 81.

The points or converging ends of the baffles 87 and 88 face the ends of the drum 80. Deflecting vanes 89 are mounted on each baffle 87 and 88 on the outer faces thereof and slope downwardly from the tops of the baffles as indicated.

The top ends of the walls 85 of the collapsing trough 83 are at a level in the drum 80 that is above the normal water level therein so that foam or light water developed on top of the boiler water can spill into the trough whenever it reaches a level above the walls 85. Since the walls 85 are below the steam outlet 81, this foam will never reach the level of the steam outlet.

The deflecting vanes and the baffle plates will direct moisture entrained with the steam either into the collapsing trough or back toward the boiler water so that the steam entering the outlet 81 is substantially pure.

The collapsing trough 83 has a drain 90 communicating with the bottom thereof and connected to a discharge pipe 91 extending through the end of the drum 80. This discharge pipe may be connected to a water-actuated valve such as 32 for effecting the automatic removal of water from the collapsing trough without, however, permitting the discharge of steam from the drum.

From the above descriptions, it should be understood that this invention now provides improved foam-collapsing troughs or collectors in boiler constructions. The invention also provides deflecting means or baffles to separate entrained moisture from the steam before the steam leaves the boiler. The collapsing trough communicates with the steam space of a boiler at levels above the normal water level in the boiler so that good boiler water is not discharged through the collapsing trough. At the same time the inlet levels of the collapsing trough are arranged so that the foam or light water will be intercepted before it reaches the steam outlet from the boiler.

We are aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and we, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

We claim as our invention:

1. A collecting device for boilers comprising an elongated open top pan having flanges extending from the side walls adapted to be secured to the inner face of a boiler shell at the top of a boiler, said pan having an inlet opening at one end thereof and a sump portion at the other end thereof, and the end wall of said sump portion being substantially U-shaped to define spaced legs along the sides of the sump.

2. In a locomotive boiler having a steam dome, a steam outlet pipe extending from the forward end of the boiler and an upturned leg on the end of the steam pipe extending into the steam dome, the improvement which comprises a foam collapsing trough in said boiler defining a substantially U-shaped chamber around said upturned end of the outlet pipe, a drain for said chamber and a baffle having divergent vertical side walls communicating with the interior of said trough and extending above said trough on each side of said upturned end, said side walls of the baffle converging toward the rear of the boiler to provide a deflecting surface for moisture and steam that would normally impinge against the upward end of the outlet pipe whereby the moisture can slide along the deflecting surface and into the trough without creating a spray.

3. In a locomotive boiler having a steam dome at the top thereof, and a steam throttle pipe extending through said boiler from the front end thereof into said steam dome, the improvement which comprises a foam collapsing trough in said boiler mounted on said steam throttle pipe and defining a substantially U-shaped open topped chamber around said pipe with the connecting portion of the chamber facing the rear end of the boiler, a drain for said chamber and converging vertical baffle plates communicating with the interior of said trough extending above said trough having converged ends facing the rear of the boiler whereby impurities entrained in steam passing to the steam dome can slide along said baffle plates without creating a spray and be collected in said trough.

4. In a locomotive boiler having a steam dome in the top thereof and a throttle pipe extending from the interior of said boiler upwardly into said steam dome, the improvement which comprises a plate member across the bottom of the steam dome having an aperture receiving the throttle pipe therethrough and a second aperture in spaced relation from the throttle pipe permitting flow of steam into the steam dome, a foam collapsing trough secured to the inner face of the boiler and having a sump portion beneath the aperture in said plate, said trough having a steam inlet opening remote from the steam dome, whereby steam entering the throttle pipe will flow through the trough to the sump end thereof and thence upwardly through the aperture in said plate into the steam dome.

5. In a locomotive boiler having a steam dome in the top thereof and a throttle pipe having an upturned end extending into said steam dome, the improvement which comprises a foam collapsing trough having a sump portion in the boiler beneath the steam dome and an elongated chamber extending rearwardly in the boiler from said sump, the rear end of said chamber having a steam inlet opening between the top thereof and the top of the boiler, said sump portion of the trough having spaced legs extending on each side of the throttle pipe beneath the steam dome and a plate receiving the upturned end of the throttle pipe therethrough, said plate sealing the tops of said legs.

6. A collecting device for boilers comprising a pan having concentric inner and outer walls joined by a bottom to define an annular open topped chamber, said inner wall having portions extending above the outer wall and a V-shaped baffle above said outer wall secured to said portions of the inner wall.

7. The method of operating steam boilers to

produce high quality steam which comprises collecting impurities in the boiler directly from the boiler water at a level below the steam outlet but above the normal water level, deflecting moisture in steam leaving the boiler away from the steam outlet along diverging paths without creating a spray, collecting deflected moisture, and discharging the collected impurities and moisture from the boiler.

8. The method of operating steam boilers to produce high quality steam which comprises collecting impurities in the boiler directly from the boiler water at a level below the steam outlet but above the normal water level, deflecting moisture in steam leaving the boiler away from the steam outlet, collecting the deflected moisture and discharging the collected impurities and moisture without substantial loss of steam only when a predetermined amount has been collected.

9. The method of producing high quality steam in a locomotive type boiler having a steam dome and a steam outlet pipe extending upwardly from the boiler into the steam dome which comprises downwardly and laterally deflecting steam that would normally impinge against the pipe away from the mouth of the pipe to free the steam entering the pipe from moisture, collecting released moisture from said deflected steam, simultaneously collecting light water and foam from the boiler water at a level above the normal water level but below the mouth of the pipe, and discharging the collected material from the boiler without discharge of steam therewith.

10. The method of purifying steam in an operating steam boiler which comprises impinging steam in the boiler flowing to the steam outlet of the boiler against a baffle sloping laterally outward from the direction of flow of the steam, trapping impurities released by said impingement on said baffle against upward flow to the steam outlet, draining the trapped impurities downwardly and outwardly from said steam outlet, collecting said impurities in the boiler, and flowing the purified steam upwardly to said steam outlet.

11. In a steam boiler having a water space, a steam space above the water space and a steam outlet at the top of the steam space, the improvements which comprise an open topped collecting pan in said steam space under said outlet with the open top at a level above the normal boiler water level in the water space but below said steam outlet, a generally V-shaped vertical baffle carried by said pan and extending above the open top thereof, said baffle having a vertical leading edge in the path of steam flow to said steam outlet and having side walls diverging from said leading edge into laterally spaced relation from said steam outlet, moisture trapping vanes on said baffle communicating with the pan for directing moisture from steam impinging against the baffle into said pan, and a drain for said pan to discharge collected moisture out of the boiler.

12. In a locomotive boiler having a steam dome at the top thereof, a throttle pipe extending through the boiler from the front end thereof and an elbow pipe secured on the end of the throttle pipe and extending into the steam dome, the improvement which comprises a substantially U-shaped open topped pan mounted on said elbow below the steam dome and having the side legs thereof extending on both sides of the elbow, a drain for said pan, a baffle having convergent vertical side walls on each side of the elbow communicating with the interior of the pan and extending above the pan, the converged ends of said side walls facing the rear of the boiler, and downwardly sloping moisture deflecting vanes on said side walls of the baffle whereby steam and moisture flowing toward said elbow pipe will slide along the side walls of the baffle without creating a spray and whereby said vanes will deflect the sliding moisture into the pan.

13. In a steam boiler having a steam dome and a steam outlet pipe extending upwardly into said dome, the improvement which comprises an open topped pan mounted in said boiler below the upper end of said pipe, a baffle extending on each side of said pipe in the path of steam flow to the upper end of the pipe, said baffle communicating with said pan and so positioned that steam in flowing to the pipe will impinge against the baffle for deflection of moisture entrained therein into the pan.

14. In a steam boiler having a steam outlet in the upper portion thereof, the improvement which comprises an open topped pan mounted in said boiler below said steam outlet but having the open top thereof above the normal water level of the boiler at a level to receive directly from the boiler water the foam and light water on the boiler water, a baffle communicating with said pan having a converged end in the path of steam flow to the outlet and having divergent ends on each side of the steam outlet, and said baffle so positioned that moisture in steam flowing to the outlet will impinge against the baffle and be deflected into the pan.

15. In a steam boiler including a water space, a steam space, a steam outlet communicating with the steam space, and a fire box in longitudinally spaced relation from the steam outlet, the improvements of an elongated trough mounted in the boiler to extend beneath the steam outlet and in a longitudinal direction therefrom toward the fire box, said trough having side and end walls projecting into the steam space above the normal water level in the boiler and providing an inlet to the trough at a level below the steam outlet and above the normal water level to intercept into the trough foam and light water direct from the boiler water before the foam and light water reach the steam outlet, said trough defining an elongated localized non-steam-generating clear steam channel to the steam outlet, and a drain for discharging collapsed foam and light water out of the trough to maintain the clear steam channel.

16. The method of operating steam boilers to produce high quality steam which comprises forming a localized boiler course beneath the steam outlet of the boiler and extending toward the hottest portion of the boiler, collecting impurities directly from the boiler water into said localized course at a level below the steam outlet but above the normal water level, and discharging the collected impurities to maintain a non-steam-generating clear steam channel along the length of the course to the steam outlet.

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