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J. C. CALLERY ET AL

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BOILER WATER CONDITIONING SYSTEM

Filed April 6, 1935

2 Sheets-Sheet 1

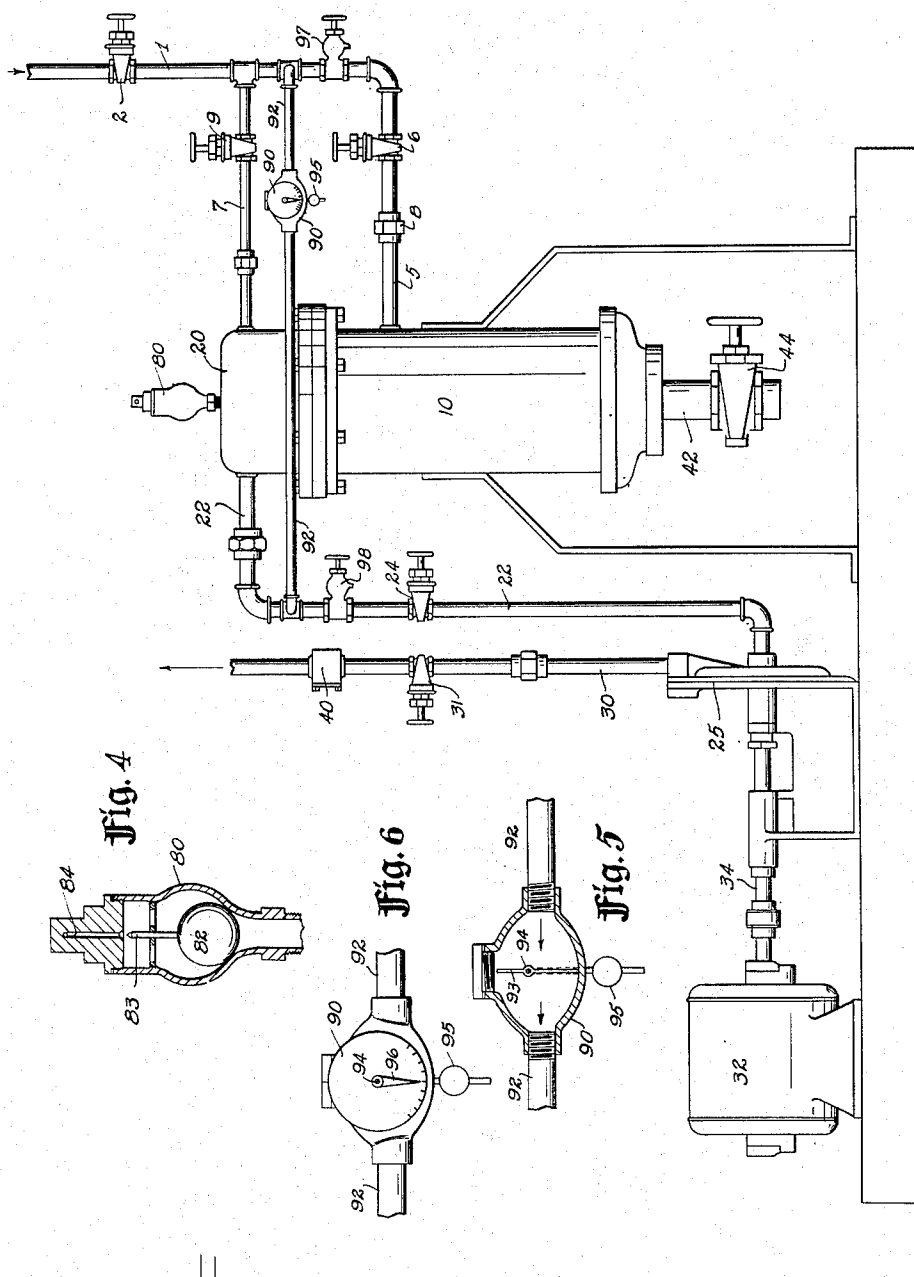


Fig. 1

Fig. 4

Fig. 6

Fig. 5

Fig. 7

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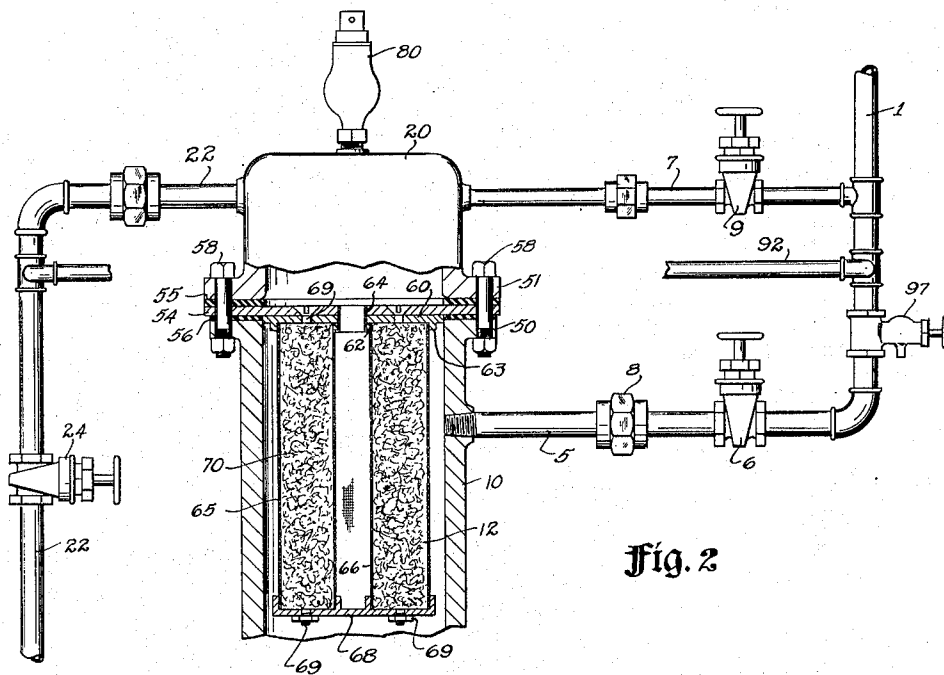


Fig. 2

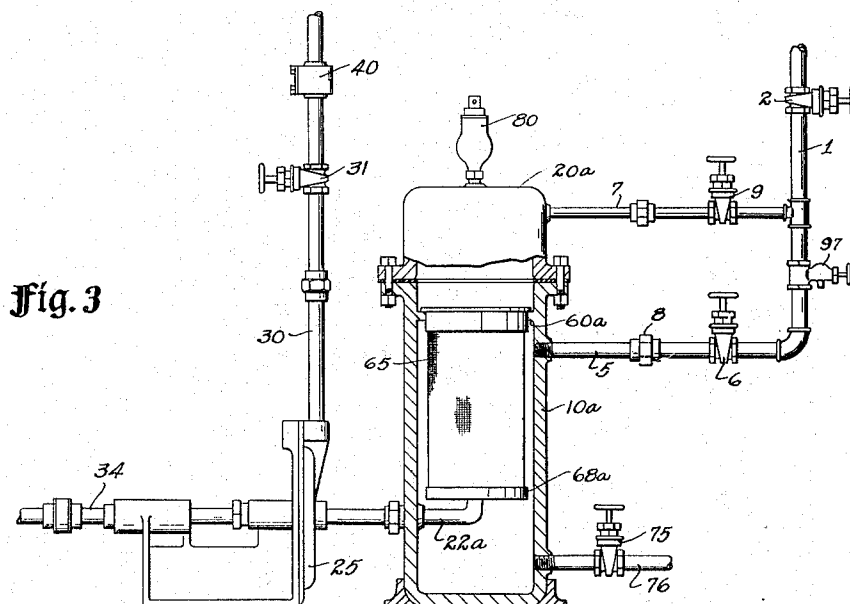


Fig. 3

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BOILER WATER CONDITIONING SYSTEM

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6 Claims. (Cl. 210-16)

This invention relates to systems for removing the suspended solid content in the storage water of boilers. The term "storage water" is used herein to distinguish from the feed water supply.

We have found that to effectively control and to minimize the suspended solid content in the storage water solves the problems incident to boiler operation resulting from excess of such solid content.

Generally the object of the invention is to provide a simple efficient system capable of being carried out by an apparatus which may be cheaply manufactured, easily installed and durable in use and be capable of most economical uses.

Our system uses an apparatus for forcibly circulating the storage water from and to the boiler and at such a rate in proportion to the volume of water contained in the boiler as to accomplish most effective results. During such circulation the water is caused to pass through a specially constructed filter comprising part of our invention, and which has certain novel characteristics and features of operation which will hereinafter appear.

The system and apparatus are capable of being so operated as to shut off the flow to the boiler and to reverse the direction of the flow through the filter for washing out or cleaning the filter in a very short time and with a minimum amount of water from the boiler.

In the normal operation of our system the water passing from the boiler first passes through our special novel filtering device to the circulating pump, preferably of the rotary type. A slight differential in pressure is measurable from that on one side of the filtering device to the line on the other side leaving the filtering device.

Another object of the invention is to take advantage of this differential in pressure by a shunt line or passage around the filter in which is interposed an indicating device responsive to the differential in pressure and whereby as the filter reaches a condition which requires it to be cleaned, the slight corresponding increase in pressure required for forcing the storage water therethrough is registered on this indicating device whereby the operator may, by any suitable signal responsive to said device, be notified that the filter should be washed by the back washing as provided in the system.

A more specific object is the provision of a filter which shall comprise cylindrical or equivalent inner and outer spaced apart screen walls, the intervening space filled with a material such

that it will not of itself be easily corroded, which should be effective in its filtering action, and which will be comparatively inexpensive to obtain. For this purpose copper wool or fibre corresponding in physical characteristics to a steel wool, has been found satisfactory.

A further object of the invention is to so mount our filter in a chamber as to provide an air zone or chamber above the same with air space at the top, which is vented by a special venting device for the following purpose. The removal of air reduces the hazard of oxygen and CO₂ in solution in the water, in turn reduces the hazard of corrosion and pitting of the inside surfaces of the boiler metal.

After back washing the filter and draining the chamber, the proper valves being closed, the system is again started in its normal operation. At such time a body of air trapped in the chamber must be disposed of to avoid the difficulties incident thereto and thus with the provision of a dome above the filter, we are enabled to accomplish this object by the use of an air vent valve of a standard commercial construction operable to close when the level of water rises in the body of the valve.

An incidental object or relative effect is that any air, which is admitted in the course of operation of the system, will be most effectively gathered at the dome above the filter and here it has opportunity to escape as described. Thus our system is kept free from air.

Our system lends itself to very conveniently obtaining water samples for chemical analysis at points readily accessible both to test the effectiveness of the filter and for various other purposes. We prefer to install in the line leading to the filter chamber, a suitable valve or pet cock by which water samples of the storage water from the boiler may be easily obtained.

Likewise on the opposite side of the filter, on the line leading to the boiler, a similar valve may be provided for conveniently obtaining a sample of water returning to the boiler after being filtered.

In the accompanying drawings we have shown a simple form of apparatus and installation, and in connection with which our invention is further described. Various modifications of our system may be made without departing from the spirit of our invention as described in the appended claims. For example, one modified form is shown and described as herein claimed.

With our system we prefer to use a device known as a concentration finder, in the nature

of an electrical resistance responsive element being inserted in the water in the system. The nature and operation of such resistance responsive device is the provision of a plug-like member having spaced metallic water contact elements adapted to stand in the body of the water and by suitable wiring connections with any suitable electrical measuring instrument, show the relative or changing conductivity of the boiler water. The said instrument correspondingly indicates in terms of resistance the amount of foreign conducting matter or other substances in the water.

In carrying out our invention we prefer to use a simple type of rotary circulating pump directly driven by a suitable motor. In most installations it is expected that a small, fractional horse power, electric motor will be satisfactory, since the efficiency of our system is high as compared to the power losses of boiler water filter systems now in use. As a matter of fact, for a 500 H. P. boiler the matter of a few cents a day is sufficient to cover the cost of operation. As an actual illustration, in the operation of a 500 H. P. boiler a sixth H. P. motor draws, at commercial rates, current to the amount of about 15 cents a day.

The above and other objects will become more apparent in the following description, which relates to the drawings, it being understood that various modifications and alterations may be made in our system, without departing from the spirit of our invention.

In the drawings:

Fig. 1 is an elevation of the apparatus and piping connections.

Fig. 2 is a partially sectional elevation showing the filter construction and the nature of mounting in the chamber.

Fig. 3 is a sectional elevation showing a modified form of filter mounting and pipe connections.

Fig. 4 is a sectional detail of the conventional air vent.

Fig. 5 is a sectional detail of the pressure responsive indicator across the lines to and from the filter.

Fig. 6 is an elevation of the same.

Fig. 7 is a diagrammatic illustration of a resistance responsive device.

Describing the structures illustrated in the drawings, by the use of reference numerals, 1 indicates a pipe leading from the boiler at any suitable point normally at or below the level of the storage water surface. Regardless of the construction or the nature of the boiler, the intent of course is to draw through the passage line 1, actual condensed water rather than steam. The line 1 is shown as provided with a suitable shutoff valve as at 2, the operation of which, in connection with the system, will hereinafter appear.

Connected with and leading from the line 1, is a branch line 5, shown as provided with a suitable shutoff valve 6, and a disconnecting point or union 8. This line leads to a chamber 10 in which is mounted the filter, designated 12, to be hereinafter more fully described in detail. The chamber is shown as constructed with a dome cap 20, from which leads a pipe line 22 connected with an intake of a pump 25, here shown as a rotary pump. In line 22 is another shutoff valve 24. From the discharge opening of the pump, is shown a line 30 leading to the boiler, constituting the return line for the filtered water. In the line 30 a valve 31 may be inserted. As stated, the pump may be driven by any suitable power, such as an electrical motor. For convenience and efficiency

and for a large majority of installations we find it most satisfactory to use a small fractional horse power motor, indicated at 32, and as having a shaft 34 directly connected through a coupling to the pump.

At 40 is shown a chamber provided in this return line for retaining the material adapted to become oxidized and which may be removed and replaced, and whereby oxidation of the boiler surfaces is inhibited.

In the normal operation of the boiler and of our system, assuming that the pump is in operation, the unfiltered water from the storage body of water in the boiler passes through the line 1, valves 2 and 6 being open, up and through the branch line 5, into the chamber 10, through our specially constructed filtering device, through the line 22, open valve 24 to the pump, and thence to the return line 30 back to the boiler. After a given period of operation, as may be determined, the filter device is washed out by reversing the flow therethrough.

To accomplish this, I provide a branch line 7 with a valve 9 from the pipe 1, to the upper portion of the chamber 10, that is, to the dome portion 20. The lower portion of the chamber 10 is shown as having a large opening shown as provided with a short pipe 42 and normally closed valve 44.

To accomplish the washing back through the filter, the valve 2 is left open. The valve 6 in line 5 is closed. Line 7 is open, having previously closed the valve 24 in the line 22 leading to the pump. It is preferable to also close the valve 31 in the line leading from the pump to the boiler. Thus it will be seen that water tends to reach the chamber 10 from the line 1 at boiler pressure. If now the valve 44 be opened, a rapid flow of hot unfiltered water takes place through the pipes 7 to the dome 20 and thence through the filter in a reverse direction to that of normal operation, washing its accumulated "sludge" or other particles into the chamber and outwardly through the drain or discharge pipe 42 and valve 44. For example, for a filter suitable for 500 H. P. boiler a few gallons, seven or so, of water, being passed through it in this fashion, is sufficient to clean it whereupon the valve 44 is closed. This entraps air in the chamber and the air valve presently becomes effective, as will be described.

Immediately the valve 9 is closed, the valve 6 is then opened, and the valves 24 and 31 may be opened and the motor again started to resume operation.

In boiler installations where oil conditions exist as for example in operation of reciprocating pumps or the like, a dangerous oil condition in the boiler is avoided by our system, by reason of the fact that the filter stops and retains the oil, and the back washing by hot water at the boiler pressure effects a release of pressure and corresponding expansion at the filter, with the result of back washing both by hot water and actual steam.

Referring now to the filter construction, as stated the chamber 10 is divided, being provided with flanges at 50 and 51 on the body 10 and dome member 20. Between these flanges is gripped a disk like plate 54 with gaskets 55 and 56 above and below the same, while bolts 58 pass through the flanges, disks and gaskets, as shown, to firmly hold the parts together in a steam tight position. On the disk 54 as shown, is secured a disk 60 having concentric flanges 62 and 63, the inner one of which surrounds an opening 64

through the disk. This opening affords communication between the divisions of the chamber 10 and air dome 20. Concentric screens of suitable fine mesh are secured to the flanges 60 and 61 and are designated 65 and 66 respectively. The lower ends of these screens, each of which is preferably a cylinder, are fitted to concentric flanges formed on a disk 68. The screens are clamped between the disks 60 and 68 by bolts 69. The space between the two concentric cylindrical screens, for the purpose of our system, particularly when used in the treatment of boiler storage water, is filled with closely packed copper wool, indicated at 70. It will be seen that the water passing from the lower chamber 10 to the air dome 20, through the opening 64 must first pass through the outer screen, the copper wool, the inner screen 66 and thence through the opening 64. It will also be noted that the filter is thus capable of being removed and cleaned or parts replaced by removing the bolts 58 and separating the parts of the chamber, then the filter may be taken apart by removing the bolts 69.

A modified form of the filter and its chamber is shown in Fig. 3. The chamber 10a and air dome being slightly modified as follows: The screens of the filter with the copper wool or like material therebetween are, as before, held between flanged disks 60a and 68a, the former being tightly fitted and held in any suitable fashion in the wall of the chamber 10a. The pipe 1 and its branch 5 lead to a point outside of the filter as before, and the branch 7 leads from the pipe 1 to the dome 20a as before. The discharge of the filter however, is through the disk 68a and pipe 22a to the intake side of the pump, whence the water passes through the pipe 30 as before.

To backwash to clean the filter, the valves 6 and 31 are closed. As heretofore described, the valve 9 in the branch 7 and a discharge valve 75 in a pipe 76 leading from the bottom of a chamber 10a are opened. The boiler pressure now forces the storage water through the line 7, through the opening 64 and from the inside of the filter outwardly to the out-side of the filter and thence out of discharge pipe 76. After a few gallons have passed in this reversed direction, the filter will be sufficiently cleaned to warrant resuming the normal operation, whereupon the valves 9 and 75 are closed and the valves 6 and 31 are opened and the pump is started.

It will be noted that even though the opening 64 is in constant communication with dome 20a in this form, there is no circulation upwardly through the dome, while the valve 9 is closed, but the air vent valve 80 at the top of the dome functions at all times.

Into an opening in the upper portion of the air dome is fitted an air vent valve of standard construction, the operation of which is apparent in Fig. 4, where the conventional float 82 is shown as acting to close a needle valve member 83, the valve acting to close discharge opening 84 when the water level rises in the body of the valve. After flushing or back washing the filter, a body of air may be entrapped and it is however, permitted to escape from the air dome without being permitted to pass through the pump. To assure this, a momentary interval after the closing of the valves 44 or 75, and 9, and opening valve 6 may be allowed before opening the valve 31 and starting the pump.

It is understood this air vent control may be any suitable control responsive to the presence of water at a level above the opening in the air

dome, such for example as thermo responsive valves.

The device shown, particularly in Figs. 1, 5 and 6 constituting the pressure responsive indicator for disclosing to the operator the condition of the filter, is designated, generally 90, and is mounted in a pipe line 92 connected across, that is bypassed around, the filter from the pipe 1 to the pipe 22. In the illustration given it may comprise a leaf or damper like valve member 93, pivoted at 94 above its center, thus presenting below the pivot, a larger area to the flow, tending to pass through the casing from the pipe 1 to the pipe 22. On the pivot member may be mounted a suitable adjustable weight 95, which as shown acts to hold the leaf valve normally in an upright position. Also on the pivot member may be mounted any suitable indicator member or hand, such as at 96. As the pressure of the water, tending to flow in the direction of the arrows of Fig. 5, moves the valve and its weight, the indicator is correspondingly moved and from its position may be judged, the resistance offered by the filter due to its more or less clogged or "filled" condition. Thus at a time determined from experience, the filter may be back washed at such intervals as its condition may require.

This indicator device is illustrative of any of several types of mechanisms or devices which may be connected across the filter to indicate relative difference in pressure and by which the condition of the filter may be judged.

In the use of such systems it is frequently desirable to procure or take samples of the water at opposite sides of the filter. In the present installations this is frequently difficult or at least an awkward thing to do. In our system pet cocks or valves, such as indicated at 97 and 98 in the pipes 1 and 22 respectively, afford a convenient means for taking such samples of water for test or analysis, whenever desired.

We have spoken above of an electrical resistance indicator, which may be applied to the water in any part of our system. The nature of such a device is apparent from Fig. 7 in which a suitable plug or cap like member 100 is shown as carrying spaced apart metallic members 101 and 102 connected by an insulating and spacing block 103, at their opposite ends and connected through wires 105 with any suitable electrical measuring instrument 106. The resistance offered by the water into which the members 101 and 102 are projected, through a suitable opening, closed by the cap member 100, being indicated by the electrical measuring instrument, afford a means of judging the amount of conducting and non-conducting substance in the water and thereby determining, to some extent the condition thereof, from a standpoint of its suitability for boiler use.

From the foregoing description it will be seen that our system effectively and economically carries out the objects above set forth. It comprises simple and for the most part standard equipment parts and it may be cheaply constructed and be effective and economical in operation. An advantage not specifically mentioned arises from the fact that we use the water from the boiler at the boiler pressure and the corresponding temperature of the water, due to the pressure, permits us to be sure that the chamber and associated portions of the chamber will be subjected to a minimum of stresses and strains, due to changes in temperature. In other words, if cold water were to be suddenly admitted into the chamber

which just previously had been operating at a high temperature, many uneven stresses and strains would be set up which would tend to weaken the materials of which it is composed.

5 It is also apparent that many modifications and alterations may be made while still attaining the objects and advantages. We desire it to be understood that our invention is not limited, except as defined by the scope of the appended claims.

10 Having thus described our invention, we claim:

1. In a system for filtering storage boiler water and for washing the filter by reverse flow under boiler pressure, a pipe connection from the boiler to the filter and another pipe connection from the filter through a pump to the boiler, a further outlet from the filter, said reverse flow being from said boiler outlet through the filter and said further outlet, a by-pass connecting the inlet and outlet conduits and normally open during the filtering operation, means in said connection responsive to the differential pressure tending to resist flow therethrough, and an indicator actuated by said pressure-responsive means to determine the amount of contamination of the filter.

2. A filter for use in a system of the character described comprising a plate adapted to be held between two elements of a chamber, concentric flanges on said plate concentrically spaced apart radially, cylindrical walls of screen material fitted to said flanges, a corresponding plate provided with flanges fitted to the opposite end of said walls, means for securing said plates and walls in assembled position and copper wool packed between said walls, said securing means comprising bolt members extending from said one plate to the other plate, permitting ease of replacement of the copper wool, there being an opening in the first-mentioned plate communicating with the space in the inner cylindrical wall, and passages to the chamber at opposite sides of said plate, and a passage leading from the chamber at the side of the plate opposite the cylindrical walls.

3. A system for purifying the storage water of boilers including a pump and filter chamber and passages connecting them whereby the pump may circulate water through the filter from and to

the boiler, a branch passage connected with passages at opposite sides of the filter and having a movable pressure responsive element therein and an indicator actuated by said element, whereby the amount of contamination of the filter may be determined, said pressure responsive element comprising a pivot member, a wing carried thereby, means tending to hold it in normal position and urging it against the pressure, the indicator being connected to the pivot.

4. In a system for removing solids from boiler storage water using a pump for removing the water from and returning it to the boiler and a filter for filtering the water between the boiler and pump, a single means responsive to the pressure at opposite sides of the filter to indicate the amount of contamination in the filter, said means comprising a conduit connected to opposite sides of the filter, a vane normally blocking the conduit and pivoted therein to expose different areas at opposite sides of the pivotal axis and movable about the axis to vary the effective size of the passage through the conduit, means yieldably urging the vane to blocking position, and an indicator actuated by said vane.

5. A water filtering and purifying apparatus for steam boilers comprising a receptacle, means for connecting the receptacle to a boiler, means for circulating water through the receptacle and back into the boiler, a filter within the receptacle consisting of a mass of copper wool, means for binding the mass together, and means constraining the water circulated through the receptacle to pass through the filter.

6. A water filtering and purifying apparatus for steam boilers comprising a receptacle, means for connecting the receptacle to a boiler, means for circulating water through the receptacle and back into the boiler, a filter within the receptacle consisting of a mass of copper wool, means for binding the mass together, means constraining the water circulated through the receptacle to pass through the filter, a valve controlled drain on said receptacle, and means for reversing the flow of water through the filter and into the drain.

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