Dec. 10, 1935. W. J. HUGHES 2,023,593

METHOD AND APPARATUS FOR BLOWING DOWN BOILERS

Filed July 31, 1931 2 Sheets-Sheet 1

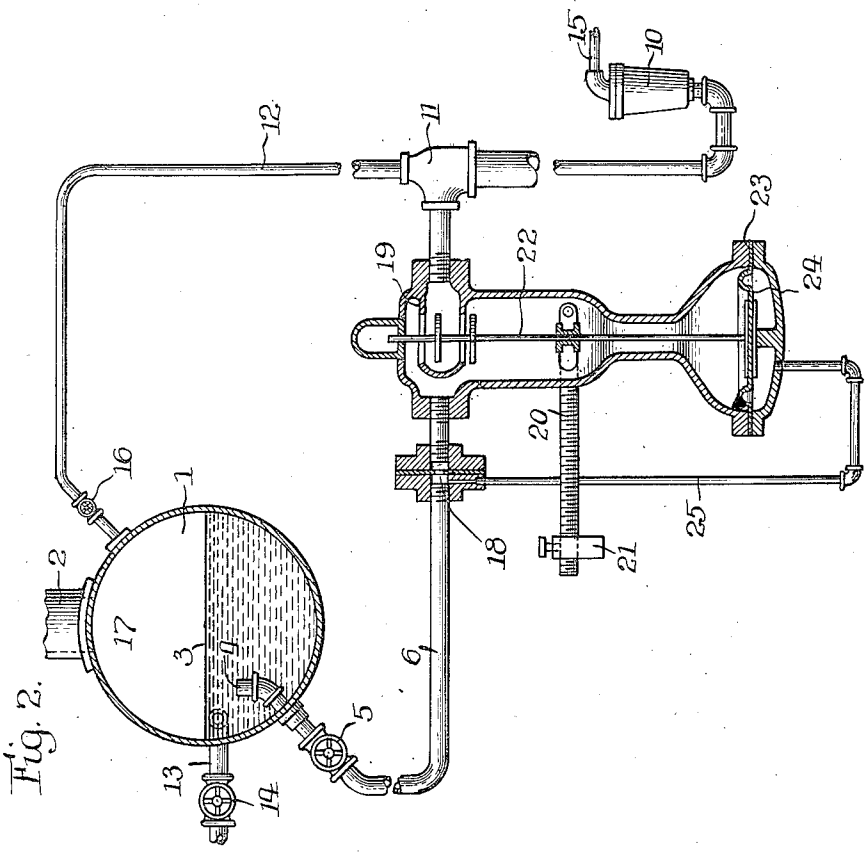

Fig. 2.

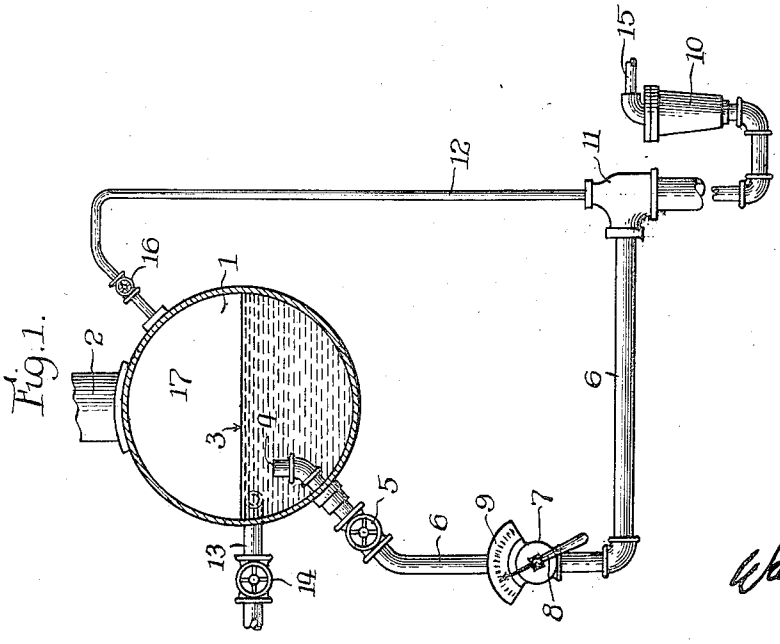

Fig. 1.

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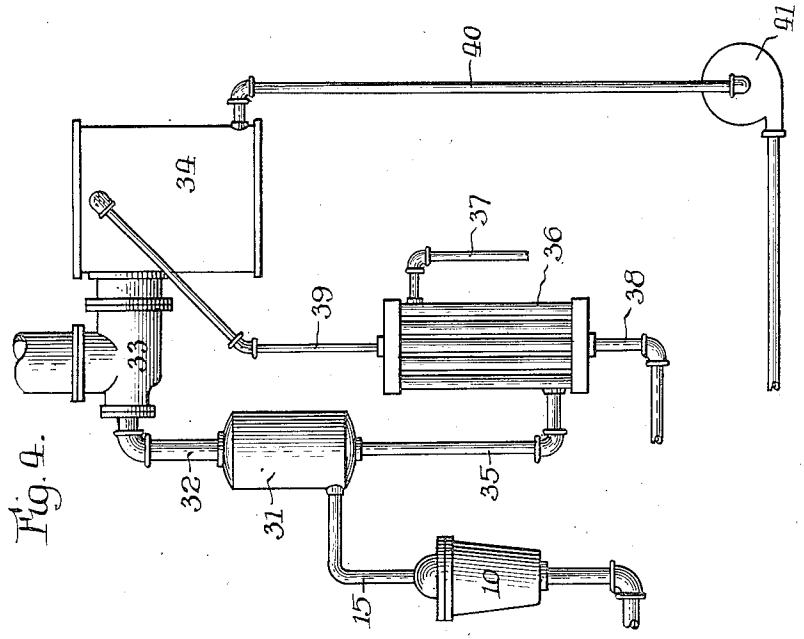

Fig. 4.

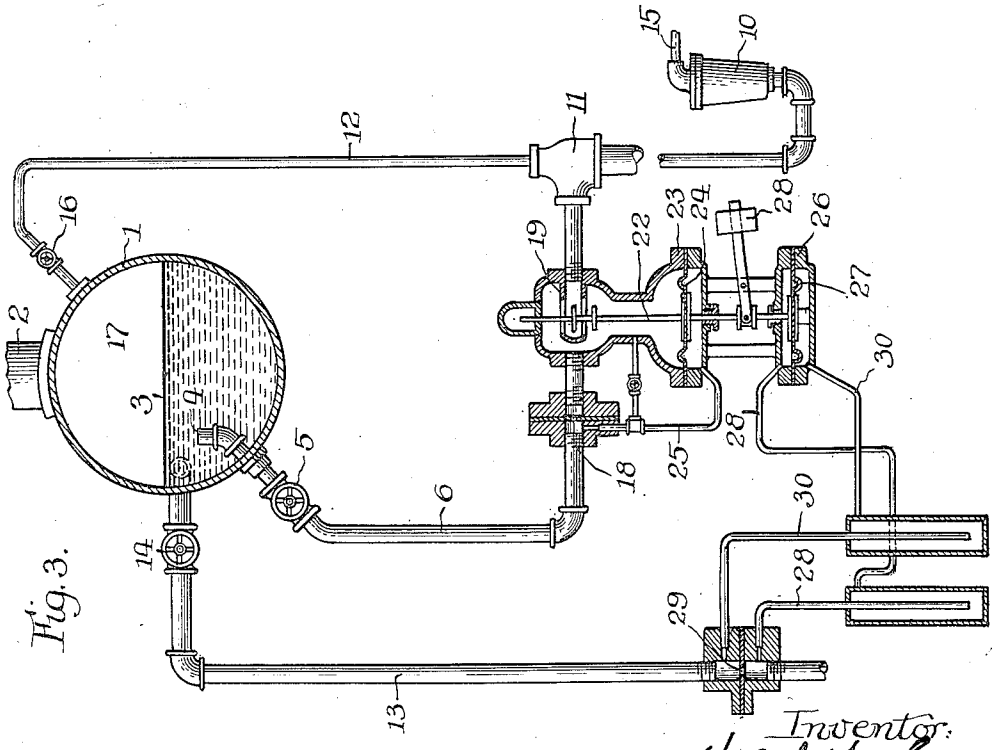

Fig. 3.

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2,023,593

METHOD AND APPARATUS FOR BLOWING DOWN BOILERS

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Application July 31, 1931, Serial No. 554,181

4 Claims. (Cl. 122—379)

This invention relates to the operation of steam boilers or other apparatus working under pressure and has for its purpose an improved method and apparatus whereby the condition of the water or other liquid in the boiler may be regulated by withdrawal of a portion thereof.

In the operation of steam boilers there is ordinarily a continuous generation and removal of steam and a corresponding continuous feed of water to compensate for the loss, so as to maintain the water level and volume in the boiler substantially constant. Since the feed water always carries a certain amount of impurity of non-volatile nature there follows a concentration of such impurities within the boiler. If such concentration were allowed to proceed indefinitely the boiler would become clogged with solid matter but long before such a stage is reached trouble of one kind or another arises. To avoid such difficulties as arise from the presence of these impurities it has been the practice to withdraw water from the boiler, replacing it with fresh water, the concentration within the boiler being correspondingly reduced. The amount of water necessary to be so withdrawn and replaced varies greatly, being dependent chiefly upon the character of the feed water and the rate of boiler operation although other factors enter also.

For many years it was customary to make such withdrawal, or blowdown as it is usually called, periodically, say once per day or once per shift. The operation was manual, by the opening of a valve, the amount of water blown out each time being a matter of judgment of the operator. A very large proportion, probably a majority of boilers are still so operated.

This is far from a satisfactory method, since there is necessarily a considerable variation in the concentration and also because, to be on the safe side, the operator nearly always discharges more water than is necessary.

With increasing severity of operating conditions involving among other things much higher steaming rates, such blowing down at comparatively long intervals became increasingly unsatisfactory or even impossible in some cases and various methods of so-called continuous blowdown have been proposed. In some cases the outflow of concentrated boiler water is really continuous while in others it is intermittent but with discharge of a small volume at such frequent intervals as to be the same in effect as a continuous discharge so far as the boiler operation is concerned. Each of these two methods as heretofore carried out is subject to certain difficulties which it is in part the purpose of the present invention to overcome.

Since the amount of concentrated water to be discharged is always a low percentage of the boiler feed and when expressed in units of volume or weight per minute represents a very small flow, difficulties arise in the control of a continuous flow of this order. In large part these difficulties are caused by the great difference between boiler pressure and atmospheric which necessitates very small orifices. The high velocities generated cause cutting or erosion since the water always carries suspended matter, necessitating the use of special and expensive valves. Regulation and especially automatic regulation of such small orifices or valves is difficult or impossible. Various means have been proposed to dissipate part of this pressure such as using a long pipe of small diameter to cause friction and with some advantages resulting but no method heretofore proposed is adequate.

The alternate method of periodic discharge of relatively small volumes avoids some of these difficulties but is more complicated since it requires some kind of timing and actuating device. Of the two methods the former is preferable but the latter more practical.

My invention has for an object to provide a method and means whereby the discharge from the boiler may be continuous and under small difference in pressure between the two sides of the orifice or aperture, which may in consequence be relatively large and so readily adjustable and free from cutting or erosion.

Another object is to provide means whereby the flow through the orifice may be proportioned in relation to the feed water requirements of the boiler, or the condition of the water in the boiler.

Other objects and advantages will be apparent from the following description and pointed out in the claims.

While my invention is contemplated to be chiefly useful in connection with the operation of steam boilers and for purposes of illustration will be so described, it will be apparent that it is adapted to other purposes also.

In the accompanying drawings Fig. 1 shows my invention in very simple form, the control being entirely manual.

Fig. 2 shows an apparatus similar to Fig. 1 but with the addition of a device for automatically maintaining constant discharge.

Fig. 3 is similar to Fig. 2 but with the addition of means for automatically governing the discharge from the boiler feed.

Fig. 4 illustrates auxiliary equipment useful in conjunction with blowoff by any of the previously illustrated devices.

In the various figures the same number is used to designate the same or like parts.

Referring now to Fig. 1 the numeral 1 designates a boiler or the drum of a boiler, 2 the steam outlet, 3 the normal water level, 4 the blowoff outlet, and 5 a shutoff valve in the blowoff line 6, which leads to trap 10 having the discharge line 15. The regulating valve 7 in line 6 is provided with pointer handle 8 and scale 9.

Trap 10 may be of any of the well known types of steam traps which automatically discharge entering water while preventing the escape of steam, although preferably it is of the kind to allow a continuous discharge of water therefrom. Intermediate valve 7 and trap 10 the pipe 6 is shown connected at fitting 11 by equalizing pipe 12, provided with valve 16, to the steam space 17 of the boiler 1. In some cases, depending on the construction of the trap used, pipe 12 may lead directly to the trap instead of being connected to line 6. Thus where the trap is of the common type where the water to be discharged collects in the lower portion and there is a steam space over the water, the pipe 12 may be led to this steam space. At 13 is indicated a supply line for the boiler feed water, containing valve 14.

Assuming valves 5 and 16 open and valve 7 closed it is apparent that there will be transmitted to the lower side of valve 7 the pressure existing in steam space 17 while on the upper side will be applied this same pressure plus a head due to the difference in level between the valve and the water level in the boiler, trap 10 being effective to prevent escape of steam. If now valve 7 be opened the same condition will obtain and a flow will take place through the valve that is independent of the boiler pressure and determined by the water head referred to and the amount of valve opening.

The above assumes the pipe 6 is of such size, as it may be, that with the maximum flow through 7 the pipe 6 is not completely filled with water between 11 and 7, so that steam can get back from 12 to the underside of 7. If pipe 6 is smaller or is so placed that it runs full of water, the effective head will not be that between the levels of 3 and 7 but between that of 3 and some other point which may be that of the fitting 11 where 12 is joined to 6 or that of the water level in trap 10, or some other level, depending on the exact arrangement. In all such cases, however, the flow through 7 will be that due to a difference of water level between two points in the system and independent of the boiler pressure.

In the preferred form and as illustrated in the drawings valve 7 will be positioned in some place in line 6 convenient of access and sufficiently below the water level in 1 to provide head for the maximum discharge of water required, with the valve wide open. Trap 10 is preferably located at a lower level than valve 7, since if the trap is set at a level above that of valve 7 the head effective on the latter is correspondingly diminished.

In the form shown in Fig. 2 the flow regulating valve 7 is replaced by the orifice 18 and means are provided whereby the head effective on the orifice to produce flow therethrough may be adjusted as desired and maintained constant at any given setting. For this there is provided the balanced valve 19 to the stem 22 of which there is connected the graduated lever 20 carrying the weight 21, the moment of the weight tending to open the valve. Stem 22 extends into diaphragm chamber 23 and is there attached to diaphragm 24. The side of chamber 23 below the diaphragm is connected by pipe 25 to the boiler or upstream side of orifice 18. The downstream side of orifice 18 is open to the side of chamber 23 above the diaphragm.

With this arrangement the differential pressure across 18 is available on diaphregm 24 to oppose the moment of weight 21 and with valves 5 and 16 open a flow will be created and maintained of such amount as will establish a state of equilibrium. Of the total head available to cause flow a portion will be dissipated at orifice 18 and the balance by valve 19. Thus by the setting of weight 21 any desired flow may be maintained.

In Fig. 3 is shown a modification wherein the discharge flow instead of being manually set or maintained constant as in Figs. 1 and 2 is proportioned to the feed water supply to the boiler. To accomplish this the stem 22 of valve 19 is extended beyond diaphragm 24 into a second diaphragm chamber 26 and therein attached to diaphragm 27. With this construction weight 28 serves to counterbalance the weight of the moving parts and not for flow adjustment.

The upper side of diaphragm chamber 26 is connected by pipe 28, which may lead through a settling chamber, with the inlet side of an orifice 29 located in the feed water line 13. The lower side of chamber 26 is similarly connected by pipe 30 with the discharge side of orifice 29.

With this construction a flow of feed water through pipe 13 creates a corresponding differential on diaphragm 27 tending to pull down rod 22 and so open valve 19. When valve 19 opens a flow takes place through pipe 6 and orifice 18 creating a differential on diaphragm 24 that tends to close valve 19. Obviously a state of equilibrium is reached when the flow through 18 is such that the thrust of diaphragm 24 equals that of diaphragm 27 and valve 19 will be held at such a degree of opening as to maintain this balance. Variations in the flow through 13 to correspond with boiler requirements will upset the equibrium and valve 19 will be moved until the flow through 6 again corresponds. In this way the discharge from the boiler is maintained at a constant ratio to the feed and so the concentration in the boiler kept uniform. If it is desired to change the ratio of discharge to feed this may be done in various ways as by inserting a different orifice at either 18 or 29 or one of these may be made adjustable.

The water discharged as above described is at boiler temperature and so carries an amount of heat which it is many times desirable to conserve. Means to accomplish this are shown in Fig. 4. The discharge pipe 15 from trap 10 leads to a flash tank 31. The steam separating in this tank is lead through pipe 32 into exhaust main 33 and so to heater 34 which is indicated to be of the open type. The hot water from the bottom of 31 flows through pipe 35 to heat interchanger 36 and discharges thence to waste through pipe 37. The cold feed water enters interchanger 36 through pipe 38 and after absorbing heat from the blowoff water flows through pipe 39 to heater 34 and from thence through pipe 40 to boiler feed pump 41. Instead of separating the steam and water as in flash tank 31 the pipe 15 may be lead directly to interchanger 36.

From the above description and accompanying drawings the principle of my invention and the mode of application will be readily understood and various modifications in the manner of ap-

plication and in the uses to which it may be put will occur to those skilled in the art. All such modifications and applications are contemplated by me and the scope of my invention is not to be limited as to those matters otherwise than as the prior art and the appended claims may require.

What I claim is:

1. The method of controlling boiler blowdown which comprises continuously flowing water from the boiler by gravity through an orifice while neutralizing the effect of the boiler steam pressure to cause flow therethrough, accumulating under boiler steam pressure the water delivered through the orifice and discharging the water by steam pressure to a zone of lower pressure at substantially the rate of accumulation.

2. The method of blowing down a boiler which comprises continuously transferring water from the boiler to a level below that of the water in the boiler by a gravity flow while neutralizing the effect of the steam pressure in the boiler on said flow, and then discharging the water from the lower level under the influence of the steam pressure in the boiler.

3. The method of blowing down a boiler which comprises maintaining a gravity head on a measuring orifice, equalizing the steam pressure on the two sides of said orifice so that the flow therethrough will be independent of the steam pressure, and subsequently discharging the measured flow by boiler pressure.

4. The method of blowing down a boiler which comprises utilizing the head due to differences in water level within the system to secure a flow through a measuring orifice and neutralizing the effect of the boiler pressure on said flow so that said flow is independent of the steam pressure in the boiler and subsequently utilizing the boiler pressure to effect discharge from the system.

WALTER J. HUGHES.