Oct. 8, 1935. J. A. POWELL ET AL 2,016,556

DECONCENTRATOR

Filed Dec. 31, 1932 2 Sheets-Sheet 1

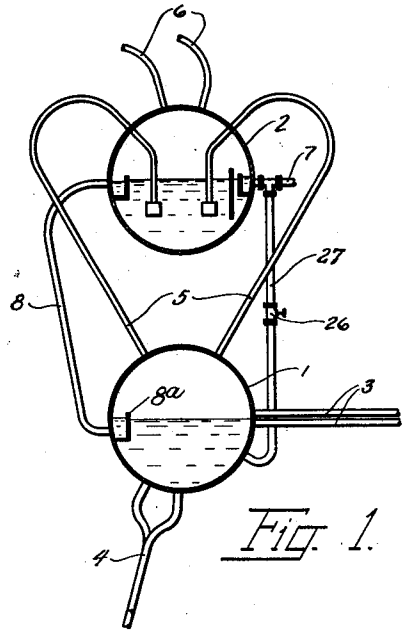

Fig. 1.

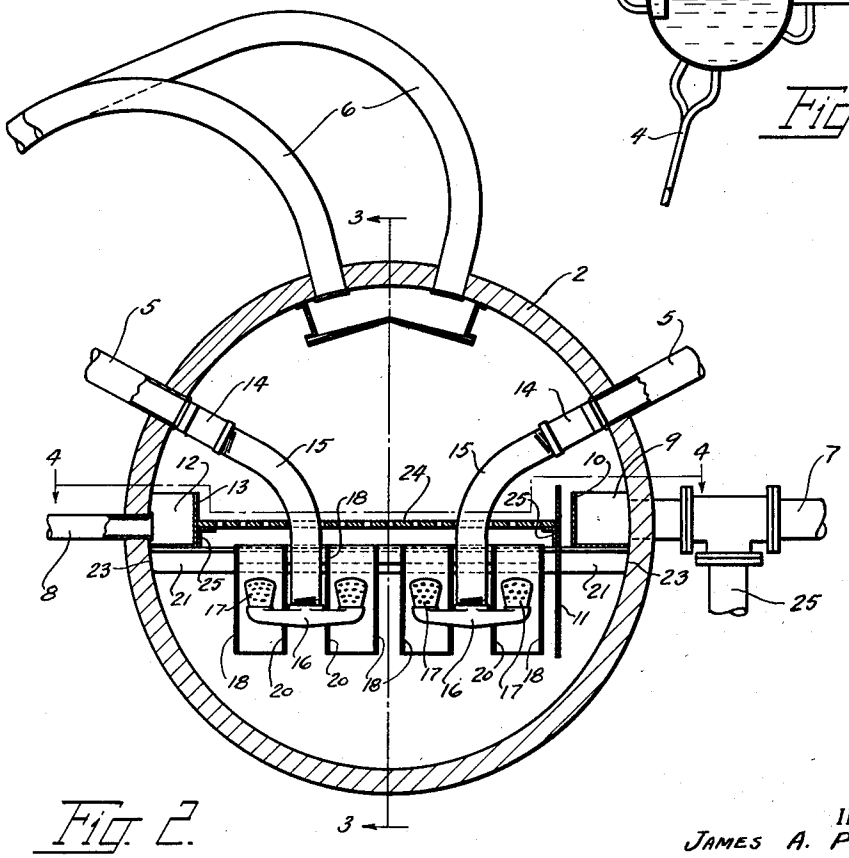

Fig. 2.

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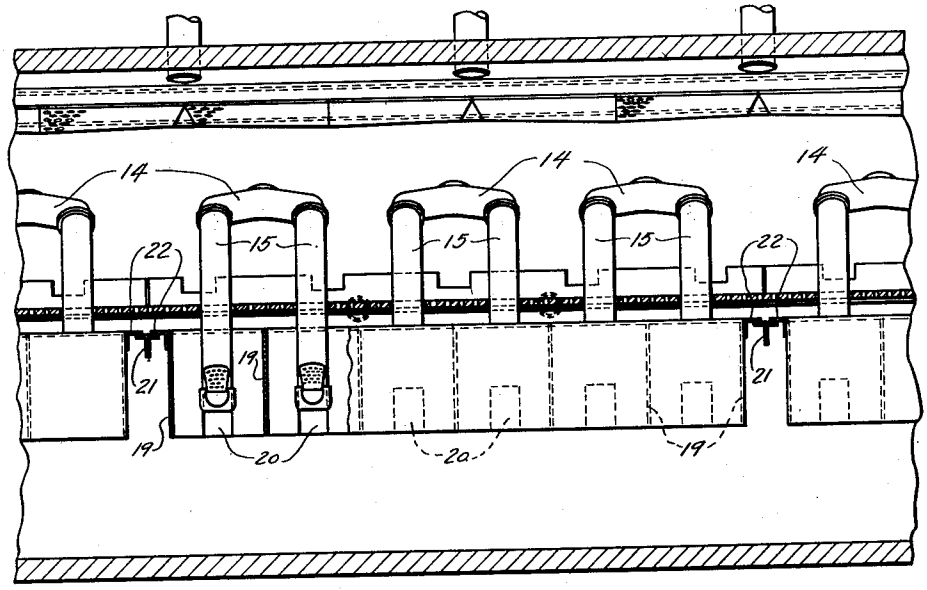

Fig. 3.

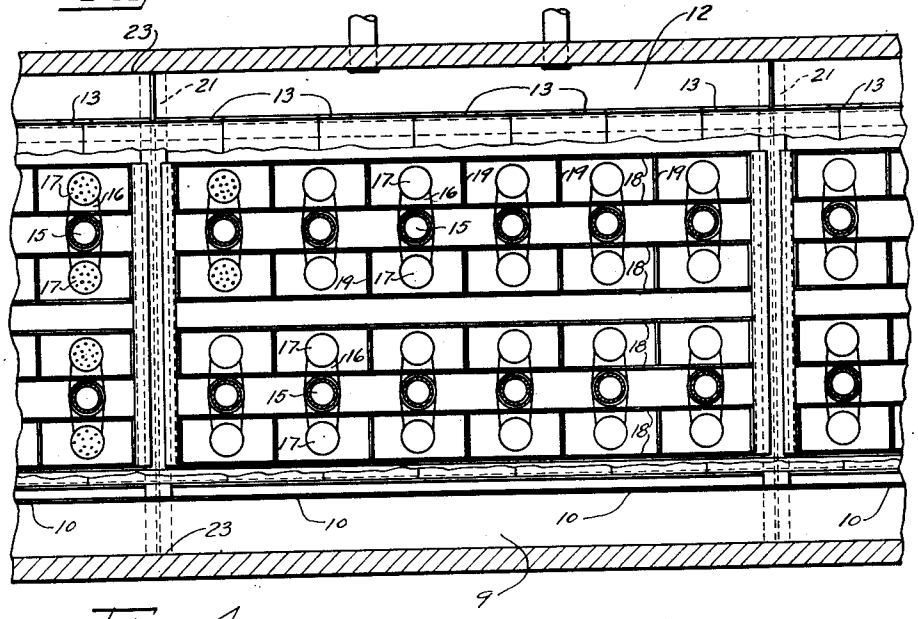

Fig. 4.

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DECONCENTRATOR

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Application December 31, 1932, Serial No. 649,704

8 Claims. (Cl. 122—459)

The present invention relates to boilers and has to do particularly with the purification of the steam generated in the boiler. There has been proposed for this purpose an apparatus which has become known under the name of deconcentrator and is described in typical form in U. S. application 600,864, filed by one of the present applicants. The present invention provides an improved method of operating apparatus of this sort as well as an improvement in the apparatus itself. For the advantages of the apparatus and its operation, reference should be had to the following description. This description itself should be read in connection with the accompanying drawings. In these drawings Fig. 1 is a fragmentary diagrammatic sectional view of a boiler equipped with apparatus according to the present invention. Fig. 2 is a transverse section of a deconcentrator in accordance with the present invention and Figs. 3 and 4 respectively fragmentary sections taken on lines 3—3 and 4—4 of Fig. 2.

In the diagrammatic representation of the apparatus shown in Fig. 1 the boiler drum 1 and the deconcentrator drum 2 are shown in the relative position in which they are preferably placed, i. e. with the deconcentrator drum a certain distance above the boiler drum. The required height will readily be understood by those versed in this art and will moreover be pointed out below. The circulator tubes 3 of the boiler deliver a mixture of steam and water to the drum 1 in the usual way, the steam separating out and collecting in the upper portion of the drum, and the water collecting in the lower part and recirculating back to the boiler through the tubes 4. The steam, instead of being carried from the steam and water drum 1 to the superheater as usual, is, just as in the installation described in said application 600,864, here also carried first to the deconcentrator drum. In the present instance this is done by means of the tubes 5—5. This steam is carried below the level of the water in the deconcentrator drum and there allowed to escape through nozzles presently to be described in more detail. Upon escaping from the nozzles, the steam bubbles through the water in the deconcentrator drum collecting in the upper part and is thence carried off by the pipe 6—6 to the point of use, preferably passing first through a superheater. It will be understood that under some conditions the steam will not all bubble through the water but part of it will be condensed. In so condensing it may either evaporate some of the water already in the drum or may simply raise its temperature.

The water is fed into the deconcentrator drum through the pipe 7. Water from the deconcentrator drum is carried to the boiler by means of the pipes 8, which discharge into the trough 8a, this trough forming a seal against the flow of steam from drum 1 to drum 2 through the pipes 8.

While in the drawings only one pipe 5 appears on each side, there will be used in practice a row of such pipes distributed along the length of the drums. Similarly, there is preferably a row of pipes 8 distributed along the length of the drums.

We shall next describe more in detail the parts lying within the deconcentrator drum. The water fed into this drum through pipe 7 is discharged into a trough 9 arranged longitudinally along one side of the drum. This trough has along its upper free edge a plurality of weirs 10—10 over which the water escapes into the drum proper. This water before mingling with the body of the water must pass under the lower edge of plate 11. Parallel to and opposite the trough 9 is another trough 12 which is likewise provided with a series of weirs along its upper free edge, these being designated by the reference numerals 13—13. The pipes 8 which are to carry the water from the deconcentrator drum to the boiler drum open from this trough 12.

The weirs 13—13 in drum 12 are at a slightly lower elevation than are the weirs 10—10 of trough 9. As a result of this arrangement, there will be a constant slow flow of water throughout the length of the drum in a direction transverse to the drum from the trough 9 to the trough 12.

The steam pipes 5—5 which convey steam from the steam and water drum to the deconcentrator drum extend through the wall of the deconcentrator drum at opposite sides as will be seen particularly in Fig. 2, and on the inside have connected to them the branched connecting pieces 14—14. From each branch of the pieces 14—14 extend downwardly into the body of the water the two pipes 15—15. To the lower end of each pipe 15 is connected a transversely extending head 16. The opposite ends of these pieces 16 carry on their upper sides the nozzles 17—17 which are preferably provided with a large number of perforations for the escape of the steam.

The construction is such that all the nozzles 17 lie at substantially the same depth below the level of the water and that they lie in four parallel rows as shown clearly in Fig. 4.

Immersed in the body of the water and the

plates 18—18 which are in a vertical position parallel to the axis of the drum and are arranged in pairs on opposite sides of the rows of nozzles 17. For convenience, the length of these plates is limited so they extend over six nozzles each. Extending transversely between and secured to them are other plates 19—19 which together with the plates 18—18 constitute rectangular casings surrounding the nozzles. Those plates adjacent to the tubes 15 are conveniently cut away at 20 to straddle the horizontal heads 16. Conveniently the structures formed by the plates 18 and 19 are supported on transversely extending T's 21 by means of angles 22 secured to the outside ones of the plates 19. The transverse T's 21 rest against and are preferably secured to the inner wall of the drum 2 at the opposite points 23—23.

At a point slightly below the upper edge of the weirs 13 is arranged in a horizontal position a perforated plate 24. This may be conveniently supported by angles 25—25 secured respectively to the plate 11 and the outside of the trough 12.

By the arrangement described above the steam passing from the drum 1 to the drum 2 is very uniformly distributed throughout the body of water in the drum 2. As a result the liberation of steam from the surface of the water in drum 2 will be very uniform and quiet. In order to avoid that the steam leaving the drum 1 carries a great deal of moisture with it, such quiet liberation from the surface of the water is highly desirable. This quiet action is enhanced by a screen or perforated plate such as 24. This screen is preferably placed slightly below the surface of the water to obtain the best action. The water fed in through pipe 7 will in the usual case come from the hot well and in any event it will be water of a high degree of purity as compared with the water in the boiler. It is well known that bubbles of steam forming in water in which the concentration of impurities is high will not readily coalesce but will pass to the surface as small individual steam bubbles. In water of the degree of purity, however, that exists in the deconcentrator drum, the opposite is true. Bubbles formed in water of this degree of purity will very readily coalesce and form larger bubbles. These larger bubbles will create a correspondingly larger disturbance when they break through the water surface. It is to break up such bubbles that the screen 24 is used and this screen is placed slightly below the surface so that, the bubbles having once been broken up, there will not be enough space above the screen to allow them to coalesce again. The steam will therefore leave the surface of the water in relatively small bubbles and the liberation will be quiet.

The purpose of the box-shaped structures surrounding the nozzles is to create a better circulation upward within these boxes and the consequent rapid interaction between the steam and the water.

It is known to engineers that in boilers the concentration of solids in the scum and foam forming on the surface of the water is very much higher than it is through the body of the water in the boiler. The ordinary blowing down of a boiler does not remove the most impure portion of the water as the water blown off is drawn from some point well below the surface. To remove the most impure water it would be necessary to skim off the impurities from the top. It has in the past been proposed to use skimming devices to remove such impurities from the surface but this has practically proved impossible because of the unavoidable variation in the water level of the boiler. Floating skimmers have been proposed but have in practice been found worthless.

In our arrangement where the steam which is to be used is liberated from the surface in the deconcentrator, a generally similar effect to that in boilers would prevail were it not for the provision which we present by the present invention. Were it not for this provision there would here also be a layer of scum on the surface of much greater concentration than the body of water in the deconcentrator and the steam bursting through this layer would carry with it moisture of much greater concentration than the body of the water has and moreover a concentration which could not easily be checked or controlled. By the arrangement described above, this surface of the water in the deconcentrator is constantly skimmed off by the transverse current from one set of weirs to the opposite set and the surface is therefore left clean. The layer of concentrated contaminated water flows to the boiler where of course the concentration is many times higher anyway and where the impurities do no harm. As a result the steam leaving the deconcentrator entrains moisture with an extremely low degree of concentration.

As a matter of fact, the water in the boiler plant may actually be too pure for certain purposes. A modern plant for example often has difficulty with corrosion in the apparatus between the hot well and the boiler, i. e., the pumps, economizers, etc. This corrosion is caused by the fact that the water is too pure and seems to have an excessive affinity for the metallic walls of the chambers it passes through. The situation has in the past at times been remedied by purposely polluting this pure water to the desired extent by adding impurities. One method of doing this has been to mix a certain amount of the impure boiler water with such pure feed water from the hot well.

In order to avoid this objectionable possibility at least as far as the desuperheater and the parts within it and its connections to the boiler are concerned, we provide a by-pass 27 for the feed water around the deconcentrator. This may conveniently extend from the inlet pipe 7 to the water space of the boiler as indicated in Fig. 1. This pipe is equipped with a regulating valve 26. Any desired fraction of the feed water can by this arrangement be by-passed around the deconcentrator drum. By a proper setting of the valve 26 the water in the deconcentrator drum can be kept of any desired degree of impurity or concentration. In a modern boiler plant, the concentration of the boiler is constantly checked and the same check can be kept on the water in the deconcentrator drum. By keeping the degree of concentration at the proper point the water in the deconcentrator will be of such a concentration that it will not readily attack the walls of the deconcentrator and the parts within it or the pipes connecting it to the boiler and yet the steam from the deconcentrator drum will be so pure that it will not deposit objectionable amounts of impurities in the superheater nor cause difficulties in the turbine or other apparatus where the steam is used.

What we claim is:

1. In apparatus of the class described and comprising a boiler having a steam space and a water space and a deconcentrator drum through which feed water on its way to the boiler flows, the steam being caused to pass through said feed

water in the deconcentrator drum, the combination of means to cause the water entering the deconcentrator drum to enter at a plurality of points distributed along the length of the drum adjacent to one side of it and means to cause the water leaving the drum for the boiler to do so at a plurality of points distributed along the length of the drum adjacent to the opposite side of the drum, whereby a transverse surface current is created across the drum carrying with it to the boiler material floating on the surface.

2. Apparatus as claimed in claim 1, the means through which the water enters the deconcentrator drum comprising a trough having a plurality of horizontally alined weirs adapted to let the water spill out of the trough into the drum.

3. Apparatus as claimed in claim 1, the means through which the water enters the deconcentrator drum comprising a trough having a plurality of horizontally alined weirs adapted to let the water spill out of the trough into the drum, and the means causing the water to leave the drum comprising a second trough having a plurality of horizontally alined weirs adapted to let water spill out of the drum into the trough, the weirs of said second trough being at a lower elevation than those of the first trough.

4. In apparatus of the class described, the combination of a drum, means to keep it normally filled with water to a substantially constant level, a plurality of steam injecting devices all arranged at substantially the same depth below the water level, means to supply steam to the steam injecting devices, and means spaced from and separately surrounding each of said steam injecting devices and defining vertical open-ended channels terminating short of the bottom and short of the surface of the water.

5. Apparatus in accordance with claim 4 and further comprising a horizontal screen between the steam injecting devices and the surface of the water.

6. In apparatus of the class described, the combination of a boiler, a drum, means to convey boiler feed water to the drum and from the drum to the boiler, means to maintain a minimum water level in the drum, means to convey steam from the boiler to the drum and to discharge it below the water level in the drum, means to convey steam away from the drum, additional means to convey boiler feed water directly to the boiler, and means to regulate the amount of feed water passing to the drum, whereby the concentration of impurities in the drum can be controlled.

7. The method of controlling the concentration of impurities in a deconcentrator drum comprising forcing boiler feed water to the boiler by way of a deconcentrator drum, discharging the boiler steam into the water while in the drum, and controlling the concentration of impurities in the water in the drum by by-passing a controlled portion of the feed water directly to the boiler.

8. Apparatus as claimed in claim 1, the means through which the water leaves the deconcentrator drum being provided with a water seal to prevent steam flow from the steam drum to the deconcentrator drum through such means.

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