

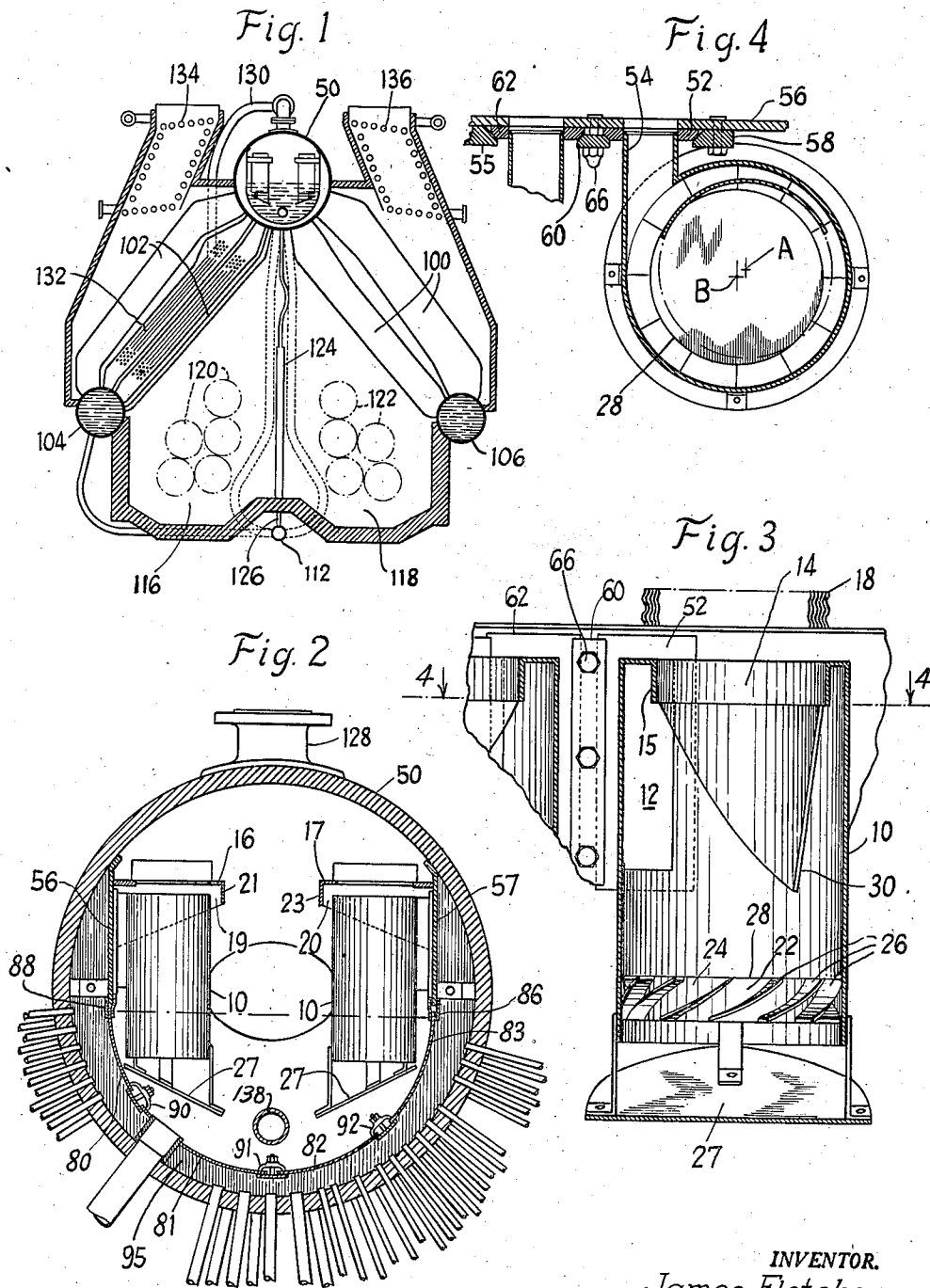
March 5, 1946.

J. FLETCHER

2,395,855

FLUID SEPARATOR

Original Filed July 30, 1940 2 Sheets-Sheet 1



INVENTOR.
James Fletcher
BY
R. M. Holbrook ATTORNEY

March 5, 1946.

J. FLETCHER

2,395,855

FLUID SEPARATOR

Original Filed July 30, 1940

2 Sheets-Sheet 2

Fig. 6

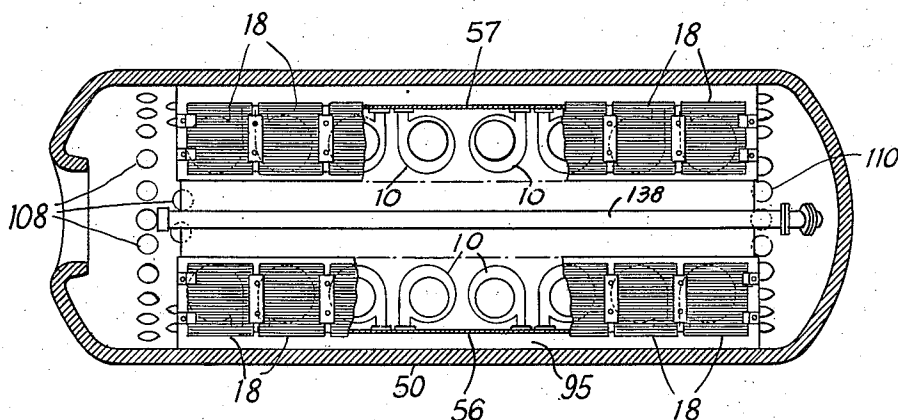
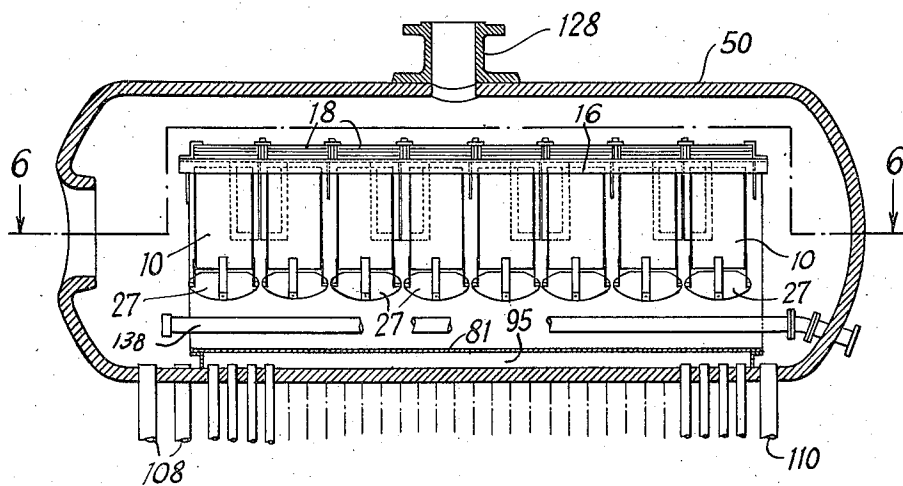


Fig. 5



INVENTOR.

BY James Fletcher

W. M. Holbrook ATTORNEY

UNITED STATES PATENT OFFICE

2,395,855

FLUID SEPARATOR

James Fletcher, Akron, Ohio, assignor to The Babcock & Wilcox Company, Rockleigh, N. J., a corporation of New Jersey

Original application July 30, 1940, Serial No. 348,369. Divided and this application September 28, 1943, Serial No. 504,102

1 Claim. (Cl. 183—80)

This invention relates to steam generators having steam and water drums in which centrifugal separators are employed. The invention is also particularly concerned with a system involving centrifugal means for effecting the separation of fluids of different densities.

The invention involves a circular whirl chamber into which a mixture of steam and water is directed tangentially at a high velocity, this action setting up a whirling motion of the fluid within the chamber. In this chamber, the steam is separated from water, and the former passes from the chamber through an upper circular outlet which is arranged eccentrically with reference to the whirl chamber. The separated water is discharged through another outlet preferably disposed at the bottom of the chamber.

With the whirl chamber inlet near the top of the whirl chamber and a steam outlet arranged at the top of the chamber and eccentrically thereof, there is a maximum annular width or space between the outside edge of the steam outlet and the adjacent whirl chamber wall in the zone of the inlet. With a whirl chamber of a given diameter and with a steam outlet of a given diameter, the eccentric relationship of the steam outlet and the whirl chamber improves fluid separation and increases the capacity of the whirl chamber while at the same time minimizes space requirements in the arrangement of a plurality of the illustrative whirl chambers within a separator chamber. This is particularly important in the steam and water drums of high pressure steam generators, where, on account of the high cost of drums for high pressures, it is necessary that drum space and drum diameters be minimized.

This invention also involves whirl chambers arranged with tangential inlets, a characteristic which combines with the eccentric relationship of the steam outlet and the whirl chamber, to further improve the steam and water separating capacities of boiler drums and thereby minimize the drum space required for a given boiler, by making it possible to arrange a greater number of the illustrative whirl chambers within a steam and water drum.

The invention also involves such an arrangement and mounting of the individual whirl chamber units within a steam and water drum that periodic removal of the individual units to give access to boiler tube ends, is facilitated.

Among other objects, the invention is intended to provide means for maintaining the incoming mixture of steam and water relatively free from

the disturbing influences arising from the impact of the swirling water after it has completed the major part of its first movement about the whirl chamber. An additional object is to effect this result without incurring undesirable reaction due to excessive deflection of the whirling mixture.

Another object is to so construct and arrange the components of the separator that the incoming stream of steam and water is subject to a minimum of flow resistance.

It is also an object of the invention to so arrange the steam outlet with reference to the whirl chamber that an optimum flow of separated steam may take place.

The invention contemplates the use of steam and water separators in a high pressure steam generator to improve circulatory conditions and enable the generator to operate at high water levels and still supply dry steam. The use of the illustrative separators in a steam and water drum of a steam generator is characterized by the fact that the high velocities of the steam and water mixtures are utilized in separating the component parts of these mixtures without subjecting the incoming mixture to excessive flow resistance. Each separator may be arranged to receive the combined discharge of several water heating, or steam generating tubes, and yet, be so arranged and constructed that it may be easily removed from its operative position for inspection of the related boiler parts as well as the separator itself.

Other objects of the invention will appear as the following description proceeds and the invention will be described with reference to an embodiment which is illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a vertical section of a steam generator utilizing the invention;

Fig. 2 is a detail view in the nature of a vertical section through the steam and water drum of the Fig. 1 installation;

Fig. 3 is a vertical section through one of the illustrative separators;

Fig. 4 is a horizontal section on the line 4—4 of Fig. 3;

Fig. 5 is a vertical section through the steam and water drum showing the arrangement of a plurality of separators employed therein; and

Fig. 6 is a horizontal section on the line 6—6 of Fig. 5 of the drum showing the arrangement of the illustrative separators, in plan. This figure is partly broken away to show the arrangement of the inlet nozzles for adjacent whirl chambers.

The illustrative separator includes a plurality

of substantially circular whirl chambers 10 each having an inlet 12 through which a mixture of steam and water is discharged into the whirl chamber at high velocity.

Within each whirl chamber, steam, separated from the water, passes upwardly through a circular steam outlet 14 determined by the downwardly extending flange, or cylindrical structure 15 which is fixed to the top of the whirl chamber. The eccentric relationship of the whirl chamber and the separated steam outlet is indicated in Fig. 4 in which the center of the outlet is indicated at A while the whirl chamber center is indicated at B. Fig. 6 also shows this eccentric relationship.

When the whirl chambers 10 are arranged in rows as indicated in Figs. 5 and 6 of the drawings, they are supported so that their steam outlets are spaced downwardly from the horizontal shroud structures 16 and 17. These structures also provide support for a number of multiple plate separators, or scrubbers 18 disposed over the steam outlets of the whirl chambers. It is important that the separated steam be as free from water as possible and this condition is promoted by the provision of the steam discharge openings 19 and 20 between the shroud structures 16 and 17, respectively, and the tops of the whirl chambers. These openings permit communication between the drum steam space and the whirl chamber steam outlets, beneath the shroud flanges 21 and 22. With this construction, pressure drop is reduced and the loading of the multiple plate separators is made more uniform.

In each whirl chamber, the separated water is discharged downwardly through circumferentially arranged outlets such as those indicated at 22 and 24. They are separated by successive vanes 26 arranged in an annular series between a bottom plate 28 and a wall of the whirl chamber. Below the outlets a baffle 27 directs the separated water toward the central portion of the associated drum.

The arrangement of elements is such that the steam and water inlet 12 communicates directly with the circumferential space between the flange 15 and the whirl chamber wall at a point where the flange is at a greater distance from the wall, due to the eccentricity of the whirl chamber and the wall 15 as indicated in Figs. 3 and 4. This arrangement offers a minimum of flow resistance and thus improves the circulation in the fluid system without additional space requirement for the separators. This is particularly important when the separators are utilized in boiler drums.

Means is also provided for preventing the flooding of the space adjacent the steam and water inlet and for minimizing the passage of water through the outlets 14 and the scrubbers 18 along with the steam, and this means is effective to accomplish these results without involving undesirable reaction arising from excessive deflection of the whirling stream within the chamber. This means includes, in each whirl chamber, a curved or segmental plate 30 spaced from the wall of the whirl chamber. It is secured in position by joining it at its upper edge, as by welding or brazing, to the flange 15.

The illustrative separators are preferably arranged in opposite rows within the steam and water drum 50 in the manner indicated in Figs. 1, 2, 5, and 6 of the drawings, and, for this purpose, each whirl chamber is provided at its steam and water inlet nozzle with a heavy flange 52 for securement to upright plates 56 and 57 which

are affixed to the drum in the positions indicated in Fig. 2. As indicated in Fig. 4 of the drawings the flanges 52, rigid with the whirl chamber inlet structures 54 have beveled edges which co-operate with similarly formed edges on the fixed bars 55 and 58 and the removable wedge bars 60 to facilitate the original assembly of a plurality of the illustrative whirl chambers within a drum and likewise facilitate the removal of the whirl chambers when access to the drum ends of the steam generator tubes is desired.

The whirl chambers are arranged in pairs with the tangential fluid inlets of each pair parallel to each other and normal to their supporting plate (either 56 or 57), as indicated in Figs. 4 and 6 of the drawings. In the installation of such a pair of whirl chambers, one of them with its inlet structure 54 is moved upwardly beneath the shelf 15 with the face of the flange against the plate 56 and the right-hand beveled edge (see Fig. 4) disposed within the groove formed by the plate 56 and the beveled edge of the bar 58. Then the adjacent whirl chamber is similarly disposed with its flange 52 facing against the plate 56 and its left-hand beveled edge fitting within the groove formed by the bar 55 and the plate 56. Thereafter, with the adjacent whirl chambers held in the positions indicated, the wedge bar 60 is placed in position with its opposite beveled edges in contact with the remaining beveled edges of the flanges 52 and 62 and the wedge bar is forced into operative position by the tightening of nuts 66 arranged upon bolts secured to the plate 56. Thus the inclined edges with the wedge bar 60 bear upon the inclined faces of adjoining nozzle (or inlet structure) flanges and co-operate with the fixed wedges (formed by the inclined surface of the bars 55 and 58) bearing upon the opposite inclined faces of the nozzle flanges to force the flanges into water-tight relationship with the plate 56 and to maintain it in such relationship.

In the above described action, it is to be noted that no access is necessary to the spaces between the plates 56 and 57 and the adjacent walls of the drum 50. It is only necessary to insert a socket wrench in the space between adjacent whirl chambers, this socket wrench engaging the nuts 66 to operate them and thus secure the whirl chambers in their operative positions. This manner of mounting the whirl chambers permits a close spacing of those chambers throughout the length of the drum and thus increases the steam and water separating capacity of the drum, per unit of drum length. The eccentric relationship of the steam outlets and the whirl chambers permits the tangential arrangement of the inlet nozzles or structures 54 which, in turn, permits such a closely spaced arrangement of the whirl chambers in pairs as indicated in Figs. 4 and 6, thus, these co-acting structural relationships combining to provide increased steam and water separating capacity for a given drum length, and to afford an improved manner of assembling and disassembling the illustrative separators within a steam and water drum.

The plates 56 and 57 combine with the drum wall and the segmental plates 80-83 to form a compartment which receives the steam and water discharged into the drum by the steam generating tubes. These plates are preferably of such width that they may be passed through a drum manway, and the upper edges of the plates 80 and 83 are arranged with vapor-tight slip joint connections 86 and 88 with the lower edges of the plates

56 and 57, the adjoining edges of the plates 80—83 being united by the spanner clamps 90—92. This entire assembly is one which increases accessibility of the drum ends of the steam generating tubes, and this is of particular importance in connection with marine boilers where the internal drum chamber connecting with the whirl chambers must embrace almost the entire lower half of the drum due to the extent of drum connections of the steam generating tubes.

Steam and water mixtures are discharged into the internal drum chamber 95 by the steam generating tubes of two upwardly converging banks of tubes 100 and 102 which are in communication at their lower ends with the water drums 104 and 106, and, in the natural circulation boiler shown, the downcomers 108 and 110 connect the water space of the drum 50 with the drums 104 and 106.

The banks of tubes 100 and 102 are disposed above furnaces 116 and 118, respectively, the latter being fired by the sets of burners 120 and 122.

In the steam generator shown in Fig. 1 of the drawings, the furnaces are separated by a wall 124 which may include tubes 126 directly connecting the drum 50 with the header 112 which is connected into the boiler circulation.

Steam and water passes from the drum chamber 95 through the illustrative separators and the separated steam discharged from the separators, passes through the steam off-take 128, and through the superheater supply conduit 130 to a superheater 132, some of the tubes of which are preferably arranged between some of the tubes of the bank 102.

The feed water pipe 138 in the water space of the drum, is provided for adding water to replace that removed by the steam generated.

Furnace gases and other combustion products, after passing through the banks of the tubes 100 and 102 pass over the heat exchange surfaces of the economizers 134 and 136 and thence to one or more flues or stacks.

This application is a divisional application of the parent application 348,369 entitled Fluid separator, and filed on July 30, 1940. (Abandoned for lack of prosecution May 31, 1944.)

What is claimed is:

In a fluid system of the type having an inlet, and an outlet chamber with fluid flowing from the former to the latter, and means supplying the inlet chamber with a mixture of fluids of different densities at a pressure higher than the pressure in the outlet chamber; the combination therewith of several tangential inlet whirl chamber fluid separators alternately constructed with right and left tangential inlets by which the whirl chambers are secured in alternation to a wall of the inlet chamber, the arrangement being such that there are a plurality of pairs of separators with the right and left tangential inlets of the separators of each pair disposed in parallelism and closely adjacent each other, the pairs of inlets being relatively widely spaced along the wall of the inlet chamber, and securing devices each including releasable means common to the closely adjacent inlets of a pair for releasably securing those inlets and their separators to the wall of the inlet chamber with the inlets in communication with the inlet chamber, the separators of each pair being independently movable upon release of their associated releasable means.

JAMES FLETCHER.