

Feb. 6, 1945.

J. BLIZARD

2,368,632

APPARATUS FOR THE SEPARATION OF FLUIDS

Original Filed Nov. 22, 1939

Fig. 1.

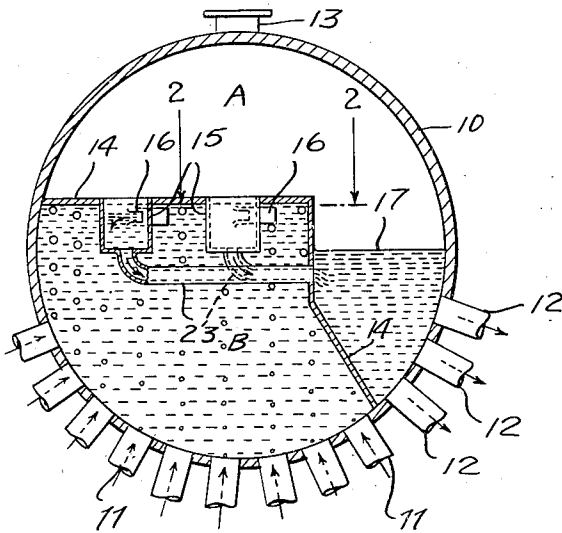


Fig. 2.

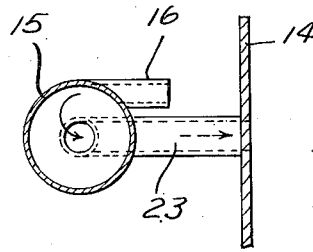


Fig. 3.

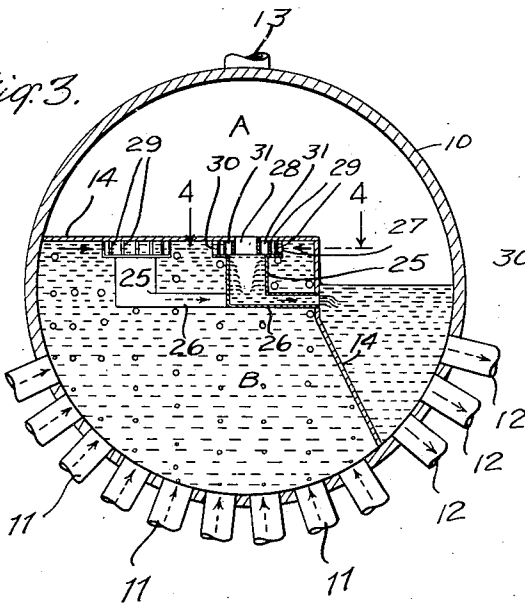
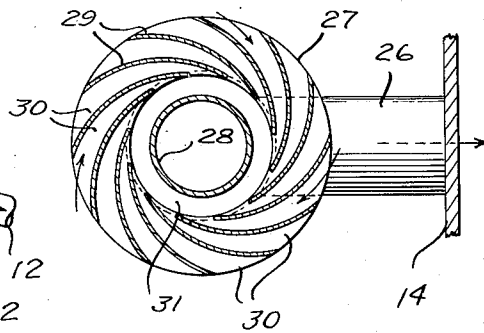


Fig. 4.



INVENTOR  
JOHN BLIZARD  
BY *Levellan J. Green*  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,368,632

APPARATUS FOR THE SEPARATION OF  
FLUIDS

John Blizard, Garden City, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a corporation of New York

Original application November 22, 1939, Serial No. 305,632. Divided and this application October 31, 1942, Serial No. 464,043

8 Claims. (Cl. 122-488)

This invention relates to apparatus for the separation of fluids from mixtures thereof, more particularly the separation of vapor and liquid from mixtures of the same. The invention will be disclosed as applied to the separation of steam and water in a drum of a water tube boiler, but it will be understood that the invention is not limited to this particular application, but it may be utilized generally in the separation of vapors and liquids from mixtures thereof.

This application is a division of application Serial No. 305,632, filed November 22, 1939 and issued June 1, 1943, as U. S. Letters Patent 2,320,345.

In water tube boilers, mixtures of steam and water rise in the heated tubes and discharge into drums wherein the steam separates from the water. The steam leaves the boiler through openings in the upper portion of the drum, and the water remaining in the drum, recirculates through the heated tubes wherein a further portion of the water is evaporated, and the separating process is repeated. In many steam boilers, particularly those which are operated at high specific rates of evaporation, the separation of water and steam is not complete, due to the fact that a portion of the water is carried off with the steam from the drum, and a portion of the steam is carried back with the water to the boiler tubes. This incompleteness of separation is undesirable from the standpoint of superheating equipment, and the steam consuming equipment.

The present invention overcomes this disadvantage and provides separating apparatus in which steam and water or other vapors and fluids in admixture will be more completely separated in the steam drum or other enclosure.

The invention will be understood from the following description when considered in connection with the accompanying drawing forming a part thereof, and in which:

Fig. 1 is a more or less diagrammatic transverse sectional view of a boiler steam and water drum embodying one form of the invention;

Fig. 2 is a horizontal, sectional view taken on line 2-2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1, showing a boiler steam and water drum embodying another form of the invention, and

Fig. 4 is a horizontal sectional view taken on the line 4-4 of Fig. 3.

Like characters of reference refer to the same or to similar parts throughout the several views.

Referring to the drawing, particularly to Fig. 1, reference character 10 designates a steam boiler

drum to which are connected a plurality of heated or steam generating tubes 11, and a plurality of downcomer tubes 12 and having a steam outlet 13. The drum is separated into a steam space 5 A and a compartment B, by a partition or diaphragm 14 which extends longitudinally of the drum throughout its length. As shown, the diaphragm comprises an upper horizontal portion and downwardly extending portion which en- 10 gages the inner wall of the drum just upwardly of the outermost row of boiler tubes 11. The diaphragm extends below the water level in the drum and separates the body of water entering the downcomer tubes 12 from the mixture of 15 steam and water which enters the drum through the generating tubes 11.

In the horizontal portion of the diaphragm are disposed a plurality of short, tubular separating members 15 of the type having a whirl chamber 20 formed by a substantially imperforate outer wall which members are open at their upper ends and are closed at their lower ends except for outlet openings, and have adjacent the upper portion thereof one or more inlet openings extending 25 through the wall thereof. To each of the inlet openings is connected a tangential inlet conduit 16 through which a mixture of steam and water flows from the compartment B into the separating member. A conduit 23 has a vertically extending portion connected to the outlet opening 30 in the bottom of each of the separating members and has a horizontally extending portion projecting through the vertical section of the partition 14 so as to discharge into the water space or residue chamber 17 in the lower portion of the 35 drum 10. The separating members 15 are disposed in the partition 14 with the tangential inlet conduits below the diaphragm, and with the upper open ends approximately flush with the diaphragm, although they may be disposed above 40 the diaphragm, if desired. The separating members extend preferably at spaced intervals throughout the length and width of the horizontal portion of the partition 14.

In operation, the steam and water mixture entering the drum through the tubes 11, moves upwardly in compartment B and enters the one or more tangential inlet conduits 16 of the separating members 15. The steam and water mixture is whirled in a circular path in each separating member, centrifugal force causing the steam and water to become separated, the water moving downwardly along the inner wall of the member, while the steam will take a position radially 45 inwardly of the water and will flow upwardly and

into the space A above the partition 14. The separated water flows from the bottom of each separating member through the conduit 23 into the body of water in the chamber 17 which supplies the downcomer tubes 12. The steam from the separating members enters the space A in the drum 10 and flows through the outlet 13 in the upper portion of the drum to a superheater, or to a point of use not shown. With this arrangement, the steam and water are substantially completely separated, so that dry steam is withdrawn from the drum and steam free water is delivered to the downcomers and to the boiler tubes.

In the form of the invention illustrated in Figs. 3 and 4, the steam and water mixture in compartment B of the steam and water drum 10 enters the upper portion of each separating device 25, and the separated water leaves the device at the lower portion thereof through an outlet conduit 26 which conducts the water to the portion of the space A adjacent the vertical part of the diaphragm 14. The upper portion 27 of the separating device 25 is enlarged to provide a flange on which is mounted a plurality of spaced, curved vanes 29. One of the side edges of the vanes is secured to the enlarged portion 27 while the opposite side edge is secured to the lower surface of the horizontal portion of the partition 14. The vanes 29 are so arranged as to provide a plurality of curved flow paths 30 of gradually diminishing flow area, through which the steam and water mixture flows from the compartment B into the separating device. A tubular member 28 is secured to the horizontal portion 14 and is in communication with the steam space A and central portion of the whirl chamber. The member 28 is of a lesser diameter than the whirl chamber and concentric thereto. The inner ends of the vanes 29 are disposed in a circle in alignment substantially with the cylindrical wall of the lower portion of the separating device, thereby providing an annular space 31 between the inner ends of the vanes and the member 28 in which the steam and water moves in a circular or spiral path, or both, after its discharge from the inner ends of the paths 30.

In the operation of the form of the invention shown in Figs. 3 and 4, the steam and water mixture flows from compartment B into all of the flow paths 30 simultaneously wherein the water will separate from the steam and will flow along the concave surfaces of the vanes 29, while the steam will flow in other portions of the path. The steam and water in separated, or in partly separated condition, will be discharged into the annular space 31 and will move in this space in a circular or spiral direction, or both; to complete the separation of the steam and water. The separated water will flow along the outer peripheral portion of the annular space 31, while the separated steam will tend to flow in the other portions of this space. The water will fall by gravity to the lower part of the separating device and will be conducted to chamber 17 through conduit 26, while the steam will flow downwardly and make an abrupt turn and flow upwardly through the member 28 into steam space A. With this arrangement, the separated steam and water do not flow across the path of the other separated component of the mixture, and the abrupt turn of about 180° made by the steam prior to flowing from the separating device will separate out any entrained moisture which may re-

main in the steam after flowing from the annular space 31.

In accordance with the invention, it will be perceived that the component parts of the vapor liquid mixture are completely separated readily and efficiently and without the necessity of utilizing cumbersome arrangements. The operation is such that dry vapor is obtained and vapor free liquid is delivered to the vaporizing tubes of the generator.

It will be understood that changes may be made in the form, location and arrangement of the several parts of the apparatus illustrated without departing from the principles of the invention, which is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, the upper part of the portion of said separator within the compartment having an inlet opening therein through which a mixture of steam and water flows into the separator from said compartment, and residue outlet means communicating with the lower part of the separator and the residue chamber.

2. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator having a substantially cylindrically-shaped whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, the upper part of the portion of said separator within the compartment having an inlet opening therein through which a mixture of steam and water flows into the separator from said compartment, and residue outlet means communicating with the lower part of the separator and the residue chamber.

3. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum having a substantially horizontal portion and a substantially vertically extending portion located to divide the interior of the drum into a space for steam in the upper portion thereof above the horizontally extending portion, a compartment in the lower part

of the drum for a steam and water mixture in a space formed between said portions and the inner wall of the drum, and a residue chamber for water in the lower portion of the drum adjacent said compartment, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, the upper part of the portion of said separator within the compartment having an inlet opening therein through which a mixture of steam and water flows into the separator from said compartment, and residue outlet means communicating with the lower part of the separator and the residue chamber.

4. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, the upper part of the portion of said separator within the compartment having an inlet opening therein through which a mixture of steam and water flows into the separator from said compartment, and a residue outlet conduit in communication through one end thereof with the bottom of the whirl chamber and in communication through the opposite end with the residue chamber.

5. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, the upper part of the portion of said separator within the compartment having an inlet opening therein, an inlet conduit in communication at one end with the inlet opening of the separator and at the other end with said compartment, said inlet conduit being arranged and disposed to discharge the mixture of steam and water at a tangent to the inner wall of the whirl chamber, and residue outlet means communicating with the lower part of the separator and the residue chamber.

6. A steam and water drum for a steam generator having steam generating and downcomer

tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, means at the upper portion of the separating member and within the compartment, said means extending circumferentially of the whirl chamber and providing a plurality of curved flow paths through which a mixture of steam and water flows into the whirl chamber from the compartment, and residue outlet means communicating with the lower part of the separator and the residue chamber.

7. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being arranged to extend into the compartment with its axis substantially vertical and with its steam outlet opening into said space, flow directing means at the upper portion of the separating member and within the compartment, said flow directing means extending circumferentially of the whirl chamber and including a plurality of curved vanes spaced from one another to form a plurality of curved flow paths having a flow area which gradually diminishes toward the whirl chamber and through which paths a mixture of steam and water flows from the compartment into the whirl chamber, and residue outlet means communicating with the lower part of the separator and the residue chamber.

8. A steam and water drum for a steam generator having steam generating and downcomer tubes connected to the drum, a longitudinally extending partition in the drum located to divide the interior of the drum into a space for steam in the upper portion thereof, a compartment for a steam and water mixture, and a residue chamber for water in the lower portion thereof, said steam generating tubes connecting with the compartment, said downcomer tubes connecting with the lower portion of the residue chamber, means forming a centrifugal steam and water separator of the type having a whirl chamber formed by a substantially imperforate outer wall, said separator being disposed in said compartment with its axis substantially vertical, a tubular member through which steam flows from the whirl chamber to the steam space, said tubular member extending downwardly into the whirl chamber and being of lesser diameter than said whirl chamber, flow directing means at the upper portion of the

separating member and within the compartment, said flow directing means extending circumferentially of the whirl chamber and including a plurality of curved vanes the inner end of which is disposed in substantial alignment with the inner periphery of the wall of the whirl chamber, said vanes being spaced from one another to form a plurality of curved flow paths having a flow

area which gradually diminishes toward the whirl chamber and through which paths a mixture of steam and water flows from the compartment into the whirl chamber, and residue outlet means communicating with the lower part of the separator and the residue chamber.

JOHN BLIZARD.