

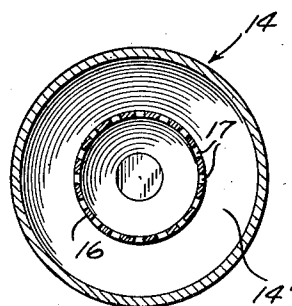
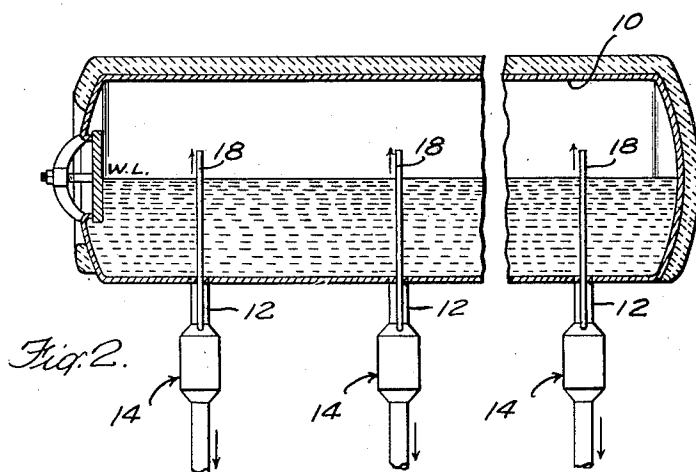
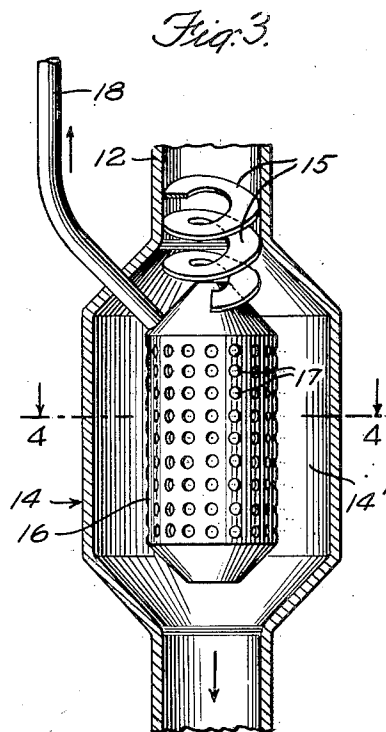
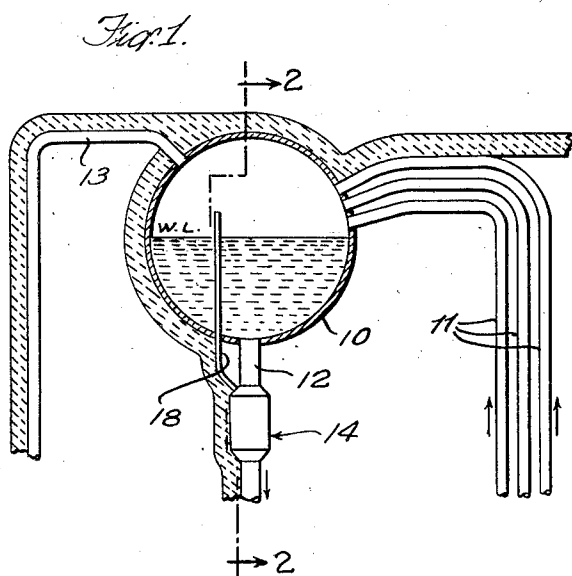
April 15, 1952

N. C. ARTSAY
STEAM SEPARATOR

2,592,530

Filed May 24, 1945

2 SHEETS—SHEET 1



INVENTOR
NICHOLAS D. ARTSAY
BY *E. Francis Wentworth Jr.*
ATTORNEY

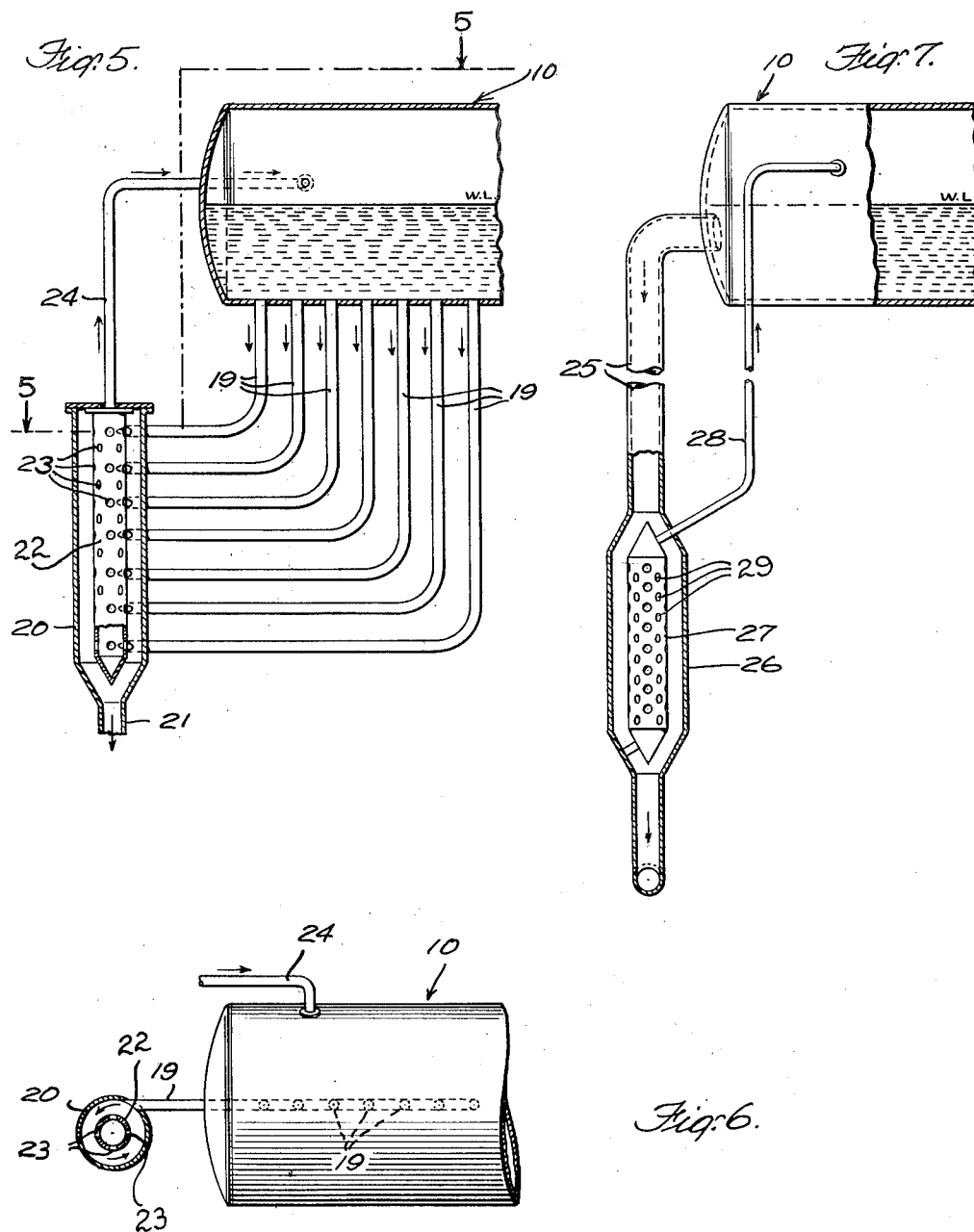
April 15, 1952

N. C. ARTSAY
STEAM SEPARATOR

2,592,530

Filed May 24, 1945

2 SHEETS—SHEET 2



INVENTOR
NICHOLAS D. ARTSAY.
BY *E. Francis Wentworth Jr.*
ATTORNEY

UNITED STATES PATENT OFFICE

2,592,530

STEAM SEPARATOR

Nicholas C. Artsay, Valhalla, N. Y., assignor to
Foster Wheeler Corporation, New York, N. Y.,
a corporation of New York

Application May 24, 1945, Serial No. 595,613

9 Claims. (Cl. 122-488)

1

This invention relates to vapor generators and more particularly to separation of vapor and liquid in said generators.

Vapor generators usually have a plurality of large downcomer tubes through which water from a vapor and liquid drum is conducted to vapor generating tubes of the generator. Normally, vapor is entrained in the liquid passing from the drum through the downcomers. To improve level conditions in the drum and supply liquid of higher density to the circulating system of the generator, vapor and liquid separators have been provided in the drum for separating the vapor and liquid before the liquid is passed to the downcomers. The use of such separators in the drum have not, particularly in high pressure systems, eliminated small vapor bubbles from the liquid before the liquid enters the vapor generating surface of the circulating system.

The present invention provides a vapor and liquid separator in the downcomer tubes of a vapor generator by means of which vapor is separated from the liquid in the downcomers thereby providing liquid of a high density for the circulating system of the generator and also improving liquid level conditions in the drum.

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

Fig. 1 is a transverse sectional view of a portion of a vapor generator embodying the present invention;

Fig. 2 is a view taken on the line 2-2 of Fig. 1;

Fig. 3 is a sectional view of a downcomer of the present invention on a larger scale than Figs. 1 and 2;

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

Fig. 5 is a view similar to Fig. 2 but of another embodiment of the invention;

Fig. 6 is a view taken on the line 5-5 of Fig. 5, and

Fig. 7 is a view similar to Figs. 2 and 5 but of a further embodiment of the invention.

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

Referring to Figs. 1 to 4 of the drawings, the reference numeral 10 designates a vapor and liquid drum having riser tubes 11 and a plurality of downcomer tubes 12. The drum 10 has a vapor outlet 13 which normally would be connected to a superheater, not shown.

The downcomer tubes 12 have an enlarged portion 14 in which vapor and liquid flowing into

2

the downcomers from the drum 10 is separated. As shown, the means for separating vapor and liquid in the downcomer comprises spiral vanes 15 disposed in the downcomers adjacent the upper part of the enlarged portion, which vanes together with a part of the suction head existing in the downcomer side of the vapor generator's circulatory system impart a whirling or circular motion to the liquid from the drum flowing in the downcomers prior to the entry thereof into the enlarged portion. A tubular body member 16, which is closed at opposite ends and which is of smaller diameter than the enlarged portion of the downcomers, has a plurality of perforations 17 therein. The member 16 is positioned in the central part of the enlarged portion 14 to form a chamber 14' and, as shown, is supported by the vanes 15, but may be supported by any other desirable means. The interior of the body member 16 is in communication with a vent pipe 18 which vent pipe is connected to the drum 10 above the liquid level WL.

In operation, vapor enters the vapor and liquid drum 10 through the riser tubes 11, the major portion thereof flowing outwardly of the drum through the outlet tube 13. Feed liquid for the generator, which liquid has vapor entrained therein, flows downwardly from the drum 10 into the downcomers 12. Liquid in the downcomer flows over the spiral vanes 15 which impart a circular or centrifugal motion to the liquid as the liquid enters the enlarged portion 14. Circular movement of the liquid in the enlarged portion causes the vapor and liquid to be separated by centrifugal force, the liquid flowing downwardly along the inner wall of the enlarged portion into the lower part of the downcomer, while the separated vapor passes inwardly toward the center of the enlarged portion and enters the perforations 17 of the member 16. Vapor entering the member 16 through the perforations 17 passes outwardly of the member 16 through the vent pipe 18 thence into the drum 10, while the separated liquid flows downwardly in the downcomers to the circulatory system of the vapor generator.

In the embodiment of the invention shown in Figs. 5 and 6, the drum 10 has a plurality of downcomers 19 which are connected to the enlarged head 20 of a single downcomer 21. The enlarged head 20, as shown, is circular in cross-section and the downcomers 19 are connected at one side of the head 20 so that liquid passing from the drum 10 through the downcomers 19 will enter said head tangentially thereof. The

3

enlarged head 20 has a body member 22 therein, which is similar to the body member 16, and has perforations 23 therein. A vent pipe 24 connects the body member 22 with the drum 10. Since the downcomers 19 are connected to one side of the enlarged head 20 of the downcomer 21 so that the liquid is discharged into the head 20 tangentially thereof, a circular or centrifugal movement is imparted to the fluid upon entering the head 20. The circular movement in said head causes the vapor and liquid to become separated by centrifugal force, the liquid flowing downwardly along the inner wall of the head to enter downcomer 21 while the steam passes inwardly to enter the perforations 23 of the body member 22. Vapor passes upwardly through the body member 22 into the vent pipe 24, thence into the drum 10.

In the embodiment of the invention disclosed in Fig. 7, one downcomer 25 connected to one end of the drum 10 has an enlarged portion 26 with a body member 27 therein which enlarged portion and which body member are similar to those shown in the form of the invention illustrated in Figs. 1 to 4. The body member 27 has perforations 29 therein and is in communication with the drum 10 through a vent pipe 28. The operation of the embodiment of the invention disclosed in Fig. 7 is similar to that of the embodiment illustrated in Figs. 1 to 4.

Since changes may be made in the form, location and relative arrangement of the several parts of the device disclosed without departing from the principles of the invention, it will be understood that the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, separating means in said downcomer adjacent the inlet end thereof and in the path of flow of a mixture of liquid and vapor passing therethrough for causing the mixture to move in a curved path therein to thereby separate vapor and liquid from the mixture thereof, and means through which separated vapor flows from the separating means and said downcomer.

2. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, a centrifugal separator in said downcomer adjacent the inlet end thereof and in the path of flow of a mixture of liquid and vapor passing therethrough

4

for centrifuging the mixture in said downcomer and thereby separate vapor and liquid from the mixture thereof, and means through which separated vapor flows from said separator and the downcomer.

3. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, an enlarged portion in the downcomer adjacent said inlet thereof, a vapor outlet member disposed in the enlarged portion, said member being of a size to form a chamber between the inner periphery of the enlarged portion and the outer periphery of the member, means in said downcomer and in the path of flow of a mixture of liquid and vapor passing therethrough for causing the mixture to move in a circular path in the enlarged portion to thereby separate vapor and liquid from the mixture thereof, and means through which separated vapor flows from the member to a point outside said downcomer.

4. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, an elongated, substantially annular enlarged portion in the downcomer adjacent said inlet thereof, a vapor outlet member disposed in the enlarged portion, said member being of a lesser diameter than the enlarged portion to form a chamber between the outlet member and the inner periphery of the enlarged portion, means in said downcomer and in the path of flow of a mixture of liquid and vapor passing therethrough for causing the mixture to move in a circular path in the enlarged portion thereby to separate vapor and liquid from the mixture thereof, and means through which separated vapor flows from the member to a point outside said downcomer.

5. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, an elongated, substantially annular enlarged portion in the downcomer adjacent said inlet thereof, a tubular member closed at the opposite ends thereof and disposed within said enlarged portion to extend

5

axially thereof in the central part of the enlarged portion, said tubular member having a plurality of inlet apertures therein, means in said downcomer in the path of flow of a mixture of liquid and vapor passing from the inlet to the outlet of said downcomer for causing said mixture to move in the circular path in the enlarged portion to thereby separate vapor and liquid from the mixture thereof, and conduit means connected to said tubular member to receive vapor therefrom and extending outwardly of said downcomer.

6. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, an elongated, substantially annular enlarged portion in the downcomer adjacent the inlet end thereof, a tubular member closed at the opposite ends thereof and disposed within said enlarged portion to extend axially thereof in the central part of the enlarged portion, said tubular member having a plurality of inlet apertures therein, means in said downcomer in the path of flow of a mixture of liquid and vapor passing from the inlet to the outlet of said downcomer for causing said mixture to move in a circular path in the enlarged portion to thereby separate vapor and liquid from the mixture thereof, and conduit means communicating with the upper part of the tubular member and with a point outside the downcomer and through which conduit separated vapor flows from the downcomer.

7. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an outlet at one end thereof in communication with said generator portion and an enlarged substantially annular portion at the opposite end thereof with a plurality of tangential inlets, a plurality of other downcomer tubes having an inlet in direct communication with the liquid space of the drum and an outlet at opposite ends thereof in communication with said tangential inlets so as to discharge said mixture tangentially of said enlarged portion to thereby separate vapor from the liquid by centrifugal force, and means through which separated vapor flows from the enlarged portion.

8. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator hav-

6

ing vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator to deliver vapor from the generating portion to said vapor space, the downcomer tube having an outlet at one end thereof in communication with said generator portion and an enlarged substantially annular portion at the opposite end thereof with a plurality of tangential inlets, a plurality of other downcomer tubes having an inlet in direct communication with the liquid space of the drum and an outlet at opposite ends thereof in communication with said tangential inlets so as to discharge liquid tangentially of said enlarged portion to thereby separate vapor from the liquid by centrifugal force, a vapor outlet member disposed in the enlarged portion, said member being of a size to form a chamber between the inner periphery of the enlarged portion and the outer periphery of the member, and conduit means through which separated vapor flows from the member.

9. A downcomer tube for conducting liquid from the liquid space of a vapor and liquid drum to the vapor generating portion of a vapor generator, said drum having a vapor space and a liquid space therein, said vapor generator having vapor conducting means in communication with the vapor space of said drum and said vapor generating portion of the vapor generator, the downcomer tube having an inlet in direct communication with the liquid space of the drum and an outlet in communication with said generator portion, means in said downcomer tube adjacent the inlet thereof and operative in conjunction with a part of the suction head existing on the downcomer side of the vapor generator's circulatory system for separating entrained vapor bubbles by centrifugal force of rotary motion of said liquid, and means through which separated vapor flows from the separating means and the downcomer.

NICHOLAS C. ARTSAY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
395,185	Simpson	Dec. 25, 1888
520,884	Hogan	June 5, 1894
669,746	Garrigus	Mar. 12, 1901
1,642,098	Bey	Sept. 13, 1927
1,903,515	Monroe	Apr. 11, 1933
1,904,473	Kerr	Apr. 18, 1933
1,919,521	Lasker	July 25, 1933
2,010,859	Huet	Aug. 13, 1935
2,187,646	Darrieus	Jan. 16, 1940
2,191,671	Kuhner	Feb. 27, 1940
2,240,100	Schmidt	Apr. 29, 1941
2,289,969	Kerr	July 14, 1942
2,320,343	Bailey	June 1, 1943
2,368,632	Blizard	Feb. 6, 1945

FOREIGN PATENTS

Number	Country	Date
512,049	Great Britain	Nov. 24, 1937
757,408	France	June 23, 1933