

July 31, 1945.

M. FRISCH

2,380,424

VAPOR GENERATOR

Filed April 29, 1941

4 Sheets-Sheet 1

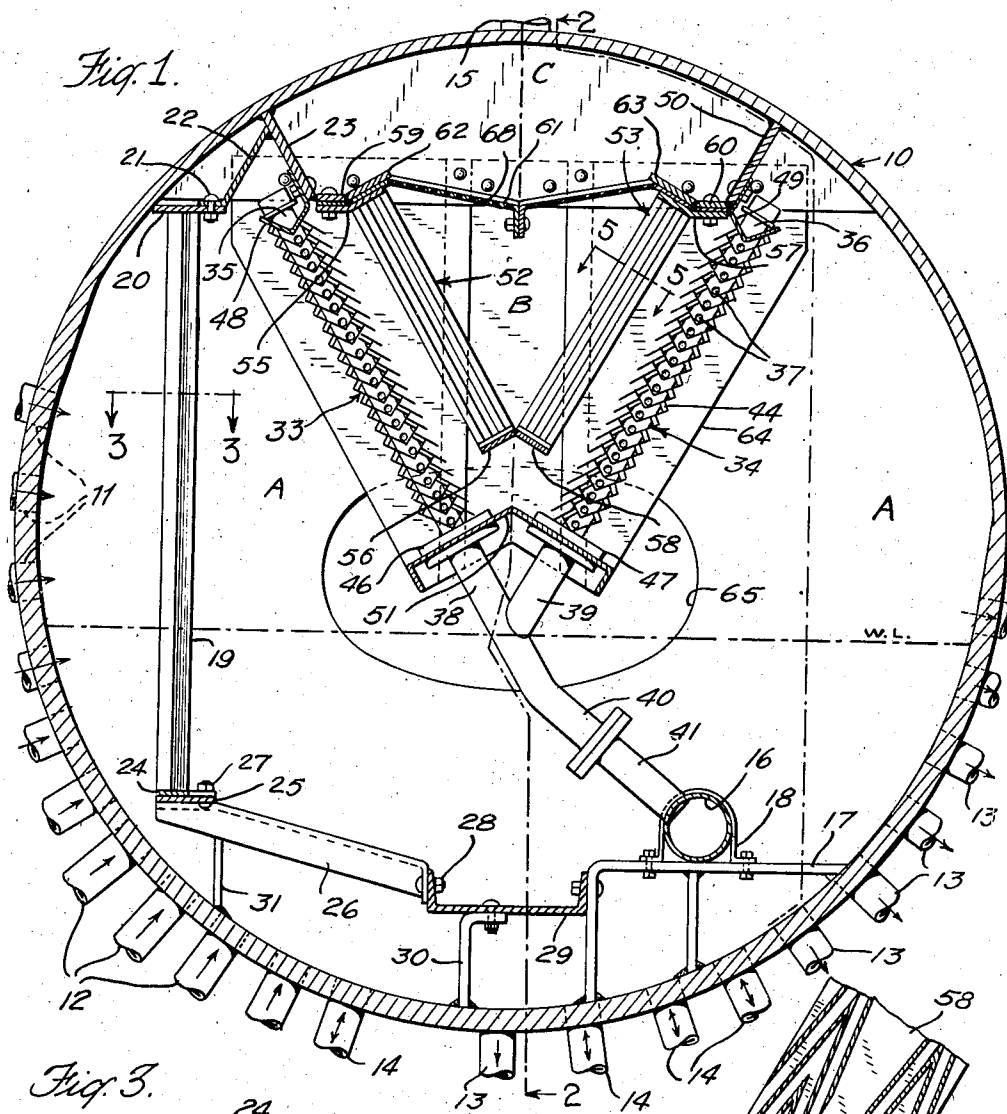


Fig. 3.

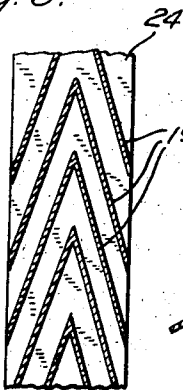


Fig. 4.

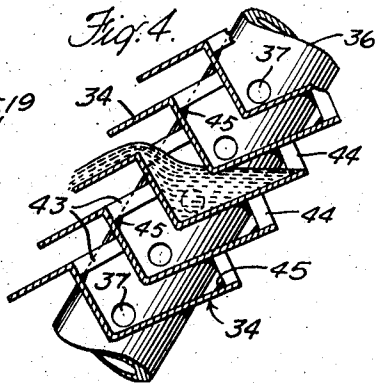
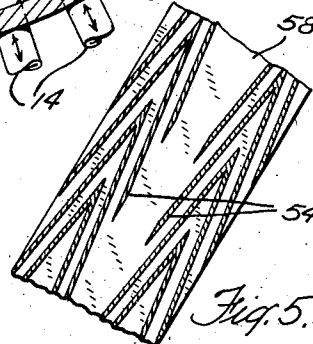


Fig. 5.



INVENTOR
MARTIN FRISCH.

BY *Richard Swann*
ATTORNEY

July 31, 1945.

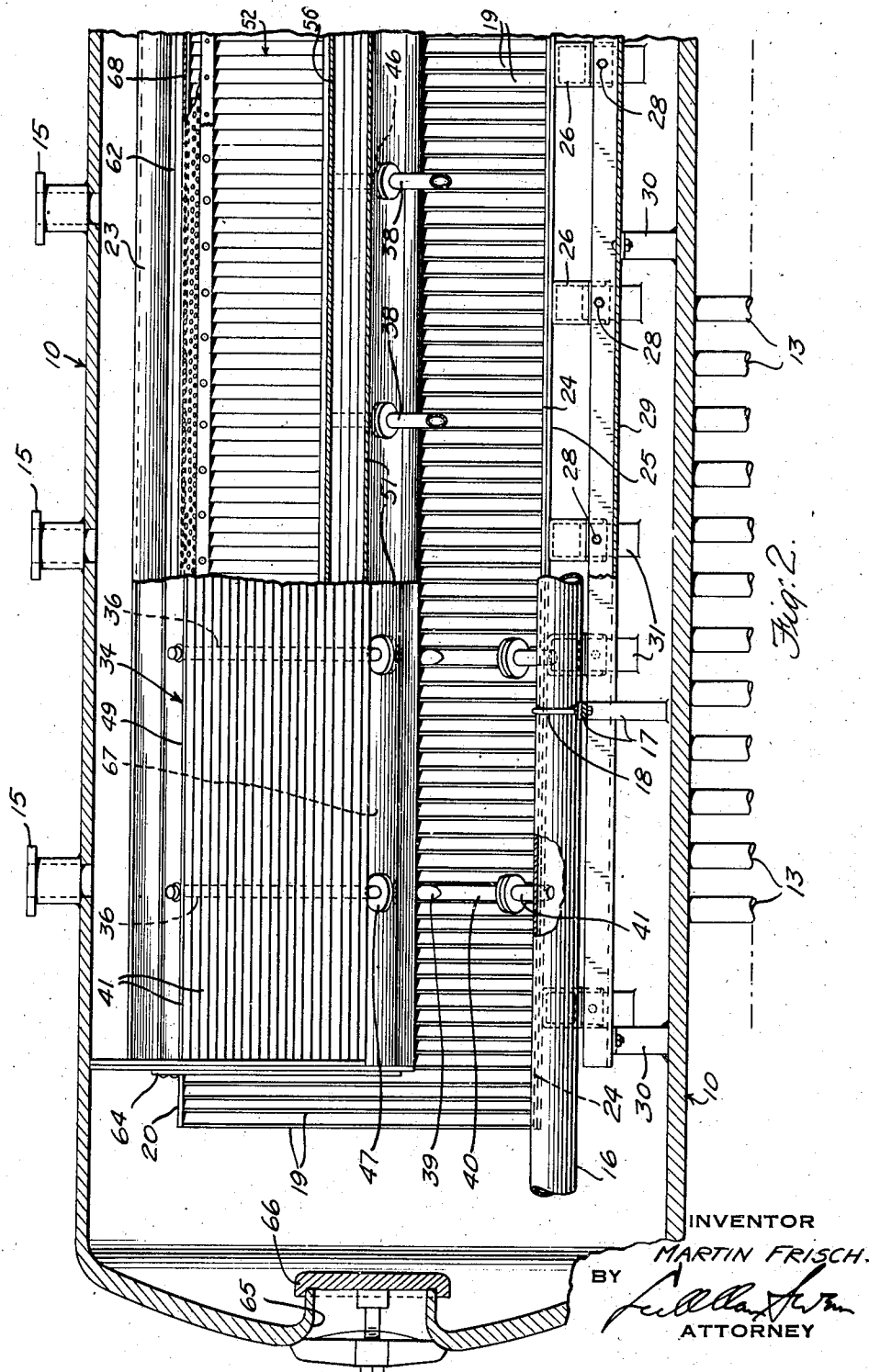
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July 31, 1945.

M. FRISCH

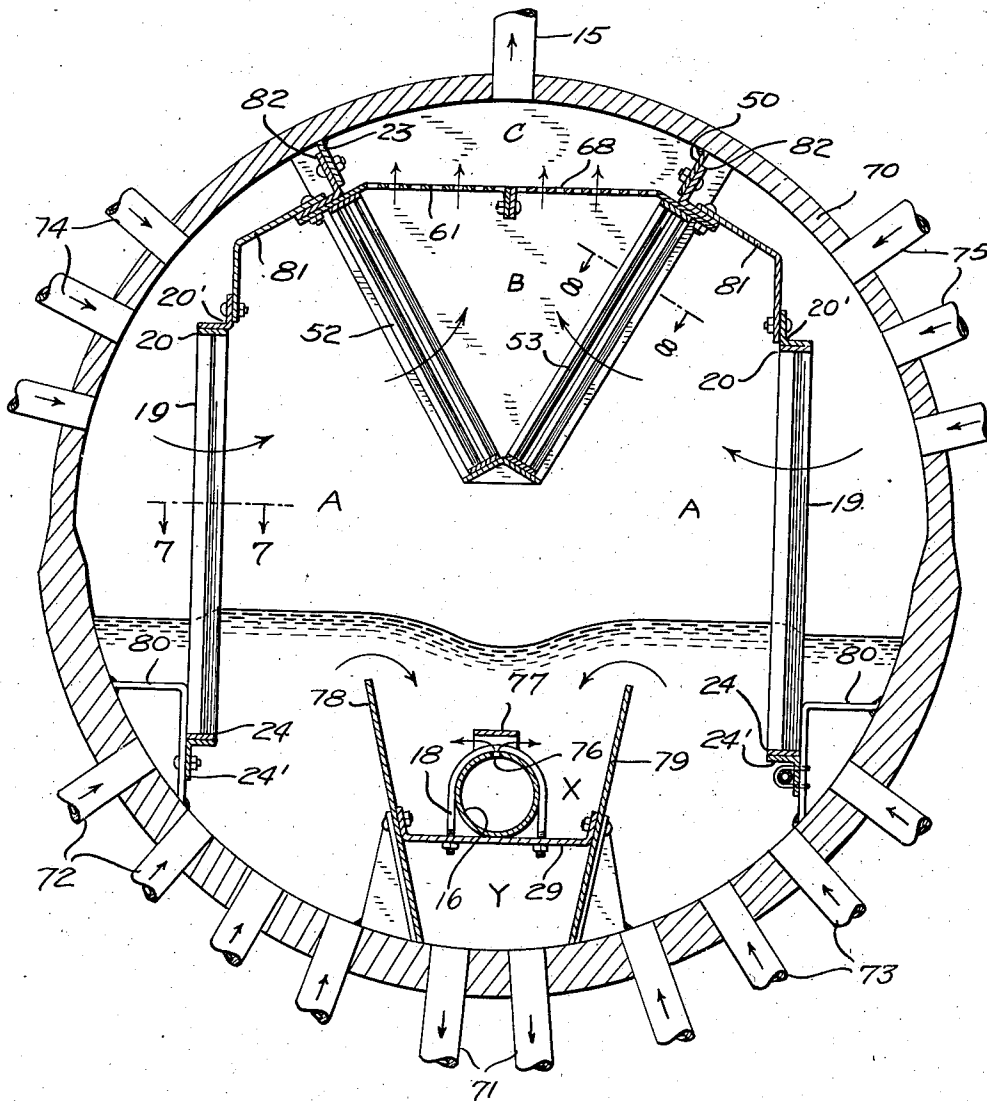
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Fig. 6.



INVENTOR
MARTIN FRISCH.
BY *William H. Swann*
ATTORNEY

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Fig. 7.

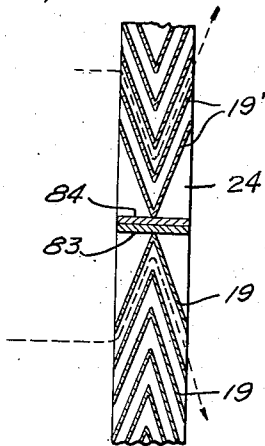


Fig. 8.

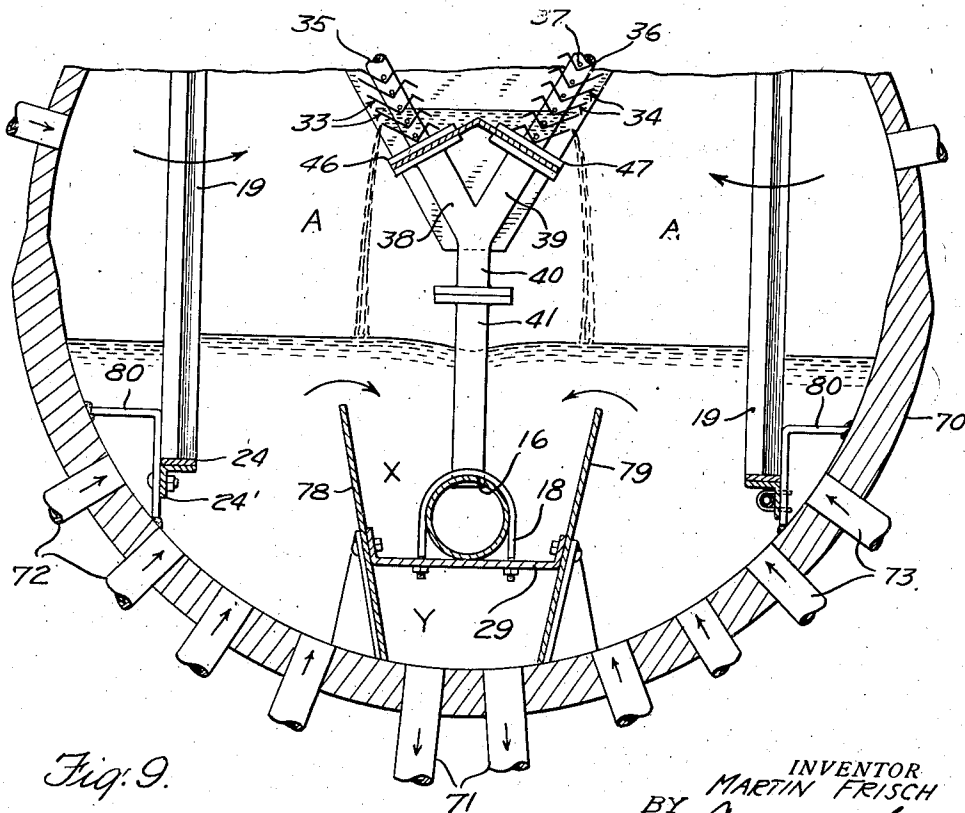
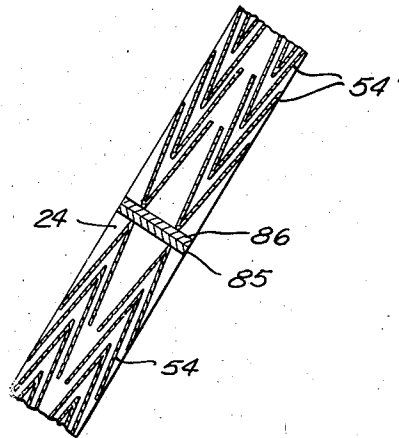


Fig. 9.

INVENTOR
BY MARTIN FRISCH
Martin Frisch
ATTORNEY

UNITED STATES PATENT OFFICE

2,380,424

VAPOR GENERATOR

Martin Frisch, New York, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a corporation of New York

Application April 29, 1941, Serial No. 390,890

9 Claims. (Cl. 261—119)

This invention relates to steam generators and pertains particularly to the purification of steam generated therein.

The invention provides improved steam washing and drying means associated with an upper drum of a steam generator for purifying the steam released therein before leaving the generator, although the invention is not limited thereto but is capable of application generally to the purification of steam or other vapors.

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 vertical sectional view of the steam drum of a steam generator embodying the invention;

Fig. 2 is a longitudinal sectional view taken substantially on line 2—2 of Fig. 1;

Fig. 3 is an enlarged partial transverse sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is an enlarged partial vertical sectional view of part of the apparatus;

Fig. 5 is an enlarged partial transverse sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a view similar to Fig. 1, showing another form of the invention;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6;

Fig. 8 is a sectional view taken on line 8—8 of Fig. 6, and

Fig. 9 is a partial transverse vertical sectional view showing a further form of the invention.

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

Referring to Figs. 1 to 5 of the drawings, reference character 10 designates a steam drum of a steam generator, to which are connected riser or steam circulator tubes 11 discharging above the water level in the drum, other riser tubes 12 which discharge below the water level, and downcomer tubes 13. Also connected to the drum at the lower portion thereof are tubes 14 which may serve as either downcomer or riser tubes depending on the operating conditions of the generator. Steam leaves the drum through a plurality of outlet nozzles 15. Fresh feed water is supplied to the drum through a horizontal feed pipe 16, which extends through the lower portion of the drum at one side of the vertical center line thereof, and is secured to a supporting bracket 17 by straps 18.

A row of water eliminators 19 is disposed in the zone opposite the outlet ends of the tubes 11 and in the path of the mixture of steam

and water normally entering the steam space of the drum from these tubes. These eliminators 19 comprise a row of separate, vertically extending V-shaped plates which are spaced apart horizontally but are arranged in nested relationship, that is, with the apex edge of one plate within the area bounded by the next adjacent plate. At their upper ends the plates of the eliminators 19 are welded or otherwise secured to a horizontal, longitudinally extending plate 20, secured by bolts 21 to inclined supporting brackets 22 which are welded at their upper ends to a vertically inclined longitudinally extending plate 23 having its upper edge in contact with the inner surface of the drum wall and supported in position at its opposite ends. The lower ends of the plates 19 which are disposed below the water level in the drum, are welded to a horizontal, longitudinally extending plate 24 which is secured to an intermediate horizontal, longitudinally extending plate 25 and to the outer end of each of a plurality of supporting brackets 26 by bolts 27. The inner ends of the brackets 26 are secured by bolts 28 to one side of a channel member 29 which extends longitudinally of the drum, the other side of the channel member being secured to the bracket 17 and being further supported by a plurality of upright bracket members 30 welded to the drum. The outer end portions of the brackets 26 are supported by upright members 31 which are fixed to the brackets, and at their lower ends rest on the drum wall and are welded thereto.

In the form shown, two rows of steam washers 35 are disposed in the drum in the path of the steam flowing to the outlet nozzles 15. These washers are located on opposite sides of a vertical plane passing through the longitudinal axis of the drum, and are oppositely inclined to each other. Each washer comprises a plurality of horizontally extending, substantially N-shaped trough members 33 or 34, which are vertically spaced, with the lower edge at the junction of the intermediate and an outer leg of each trough, and being disposed below the upper edges of the trough next below as shown in Fig. 4. The troughs 34 are the same as the troughs 33 excepting that they are reversed in position, the troughs of both washers being disposed so that steam flows through the washers toward the upper central portion of the drum. The troughs 33 and 34 are supported in spaced relationship on a plurality of spaced, vertically inclined stand pipes 35 and 36 respectively, which pass through openings in the troughs, and which have closed

upper ends. Wash water is supplied to the troughs through the stand pipes and openings 37 therein which are located just above the bottom of each trough at opposite sides of each stand pipe. The stand pipes 35 and 36 are connected at their lower ends respectively to branches 38 and 39 of spaced pipes 40 which are connected to nozzles 41 on the feed pipe 16. The trough members are supported intermediate the stand pipes by supports 43 and 44. Supports 43 are tack-welded at 45 at their lower ends to the upper end portion of the intermediate leg, and supports 44 are tack-welded at 45 at their lower ends to the upwardly extending outer leg, of the trough members. The washer assemblies 33 and 34 are supported on the flanges 46 and 47 respectively, at the lower ends of the stand pipes 35 and 36. Brackets 48 and 49 each having V-shaped portions like the V-shaped portions of the trough members 33 and 34 and an upwardly inclined flange, are secured respectively, through their upwardly inclined flanges to the outer sides of the inclined plates 23 and 50, and are maintained in proper spaced relationship with the uppermost trough members by supports 43 and 44. These brackets serve to prevent upward movement or warping of the trough members and to maintain them in their desired spaced relationship with respect to the orifices 37 in the stand pipes, and further serve to provide a seal against the short-circuiting of steam past the washer. A splash plate 51 which is secured between the pipe flanges 46 and 47 at the lower ends of the stand pipes 35 and 36 respectively, and the flanges of the branch pipes 38 and 39, extends longitudinally of the drum as shown in Fig. 2.

Steam driers 52 and 53 are located respectively adjacent and parallel to the outlet side of the washers 33 and 34. As shown in Fig. 5, these driers comprise two adjacent but spaced, parallel rows of separate, vertically inclined V-shaped plates 54 disposed in horizontally spaced relationship, which are similar to the water eliminators 19 excepting that the acute angle included between the legs of the plates 54 is smaller than the corresponding angle of the plates 19. The upper and lower ends of the plates of the drier 52 are welded to plates 55 and 56 respectively, and the upper and lower ends of the plates of the driers 53 are welded to plates 57 and 58 respectively. The plates 55 and 57 are bolted to sealing plates 59 and 60 respectively, which are welded along their outer edges to the lower ends of the inclined plates 23 and 50 respectively. The plates 56 and 58 at the lower ends of the driers are in contact with each other to prevent the short-circuiting of steam between the driers. A perforated distributing plate 61 extends between the upper ends of the driers 52 and 53, the side portions of the plate 61 being disposed between the plates 55 and 57 at the upper ends of the driers and plates 62 and 63 respectively, which are welded to the sealing plates 59 and 60 respectively.

Adjacent both ends of the drum, the washer and drier assembly is enclosed at its opposite ends by plates 64 which are generally triangular in shape and extend from the inner surface of the wall of the drum in the upper portion thereof to a point adjacent the lower ends of the stand pipes. In the ends of the drum are the usual manhole openings 65 and closure devices 66 therefor.

In operation, steam normally will enter the

drum in jets through the riser or circulator tubes 11 and will impinge against the row of water eliminators 19. A substantial amount of the entrained water carried by this steam will be eliminated both by impingement on the eliminator plates and by centrifugal force due to the abrupt changes in direction of flow the steam is required to make as it flows through the narrow V-shaped passages between the plates. The water thus removed from the steam will drain down the surfaces of the plates by gravity to the water space in the drum, while the relatively moisture-free steam will enter the main steam space A at a considerably reduced velocity. None of the steam entering through the tubes 11 can pass below the eliminators 19 since their lower ends extend well below the drum water level. The steam which enters the drum through the tubes 12 will rise in bubbles through the water to the surface thereof. If desired, a horizontal perforated plate or other means, not shown, may be disposed just below the water level in the drum to assist the steam bubbles to disengage themselves from the surface of the water before entering the steam space. Obviously any steam from the tubes 12 which is released from the water at the inlet side of the eliminators 19 must pass through the passages therebetween.

Fresh feed water from the pipe 16 is supplied through the pipe connections 40 and 41 to the stand pipes 35 and 36, and flows through the orifices 37 therein into the trough members 33 and 34, filling the troughs. Steam from the space A will flow through the spaces between the trough members 33 and 34 and the water in the troughs and into the spaces between the washers and the driers 52 and 53. The submerged apex of each trough member will force the steam from the space A to flow downwardly into the water in the troughs below. The fresh feed water delivered to the washer troughs through the apertures 37 in the stand pipes is discharged from these apertures at a relatively high velocity with the result that the water in the washer troughs normally is not quiescent. Due to the fact that the washers extend substantially for the height of the steam space A and for at least the greater part of the length of the drum, a large flow area is provided over which the steam may enter the washer troughs, so that the velocity of flow of the steam through the washers will be relatively low. Thus the time of contact of the steam with the fresh feed water will be relatively long, and the normal agitation of the water in the troughs which is increased by the entrance of the steam into the water and the somewhat higher velocity of the steam in passing through the troughs as compared with its velocity in the steam space A, will provide thorough contact between the steam and water and an adequate washing of the steam. The flow of steam through the washers will cause the water to flow from the washers over the upper edges of the intermediate legs of the troughs and the inner, downwardly extending legs thereof and to fall onto the splash plate 51 whence the water will drain through open spaces 67 between the stand pipes and the lowermost trays of the washers into the body of water in the drum, and will be introduced into the circulation of the steam generator through the downcomers 13. The steam leaving the water in the troughs will impinge against the inner downwardly extending legs thereof and will be forced to change its direction of flow abruptly from an upwardly inclined

to a downwardly inclined direction, thus eliminating a substantial quantity of the water entrained in the steam. This eliminated water will flow downwardly onto the splash plate 51 and into the water in the bottom of the drum. As the steam enters the spaces between the washers and the driers 52 and 53, the velocity of the steam is reduced due to the increase in the area available for the passage of the steam, and entrained water will drop out of the steam by gravity in these spaces before the steam enters the driers.

The washed steam flows into and through the passages between the plates 54 of the driers 52 and 53, and in its flow through these passages, it is forced to change its direction of flow abruptly upon entering these passages and also in the zone between the apices of the plates. The entrained water will impinge upon and be deposited on the plates 54 of the driers 52 and 53 in the areas adjoining the zones where the abrupt changes in direction of flow occur, and this water will drain down the plates without being re-entrained in the steam, due to the relatively low velocity of the steam flowing through the driers, and to the cohesive properties of the water, and its adherence to the surfaces of the plates. The steam leaving the passages between the first row of plates of each drier, flows into the spaces between the two rows of plates and in these spaces, water will drop out of the steam by gravity. Thereafter the steam flows into and through the passages between the second row of plates 54 of each drier, and into the steam space B between the driers. Entrained water will be eliminated by the second row of drier plates in the same manner as described in connection with the first row of plates. It will be perceived that the flow of steam is substantially at right angles to the flow of the water on the plates, the steam flowing substantially horizontally and the water draining downwardly on the plates to the water in the bottom of the drum. From the second row of drier plates the dried steam flows into steam space B and thence through the orifices 68 in the distributing plate 61 into the dry steam space C. In flowing through the plate 61, entrained moisture will impinge against the plate and will be removed from the steam. The distributing plate 61 causes the steam to be withdrawn from the steam space B substantially uniformly throughout the length of this space, and insures that the steam leaving the washers 33 and 34 will be distributed substantially uniformly over all the drier plates. From the steam space C, the steam is withdrawn from the drum through the outlet nozzles or superheater connections 15.

With steam washers and driers embodying the invention, the velocity of the steam through and between these devices will be of the order of magnitude of from one to three feet per second. A satisfactory washer for the purpose will be composed of troughs having an overall width of $3\frac{3}{4}$ inches and an overall height of $1\frac{1}{4}$ inches with the intermediate leg being $1\frac{1}{4}$ inches long, the outer or upwardly extending leg $2\frac{1}{4}$ inches long, and the inner or downwardly extending leg $\frac{3}{4}$ of an inch long, and with the troughs spaced on a vertical pitch of one inch. The eliminator plates 19 may have a width of two inches between the outer edges of the legs, and a depth (horizontal distance from apex to base line) of three inches and spaced on a pitch of $1\frac{1}{2}$ inches. The drier plates 54 may be the same as the plates 19 excepting that their depth will be one inch. It will be understood that these dimensions are given

by way of example and are not to be construed as limiting the invention because other sizes of washer troughs and eliminator and drier plates may be employed.

In the form of the invention shown in Figs. 6 to 8, the upper steam and water drum of a steam generator is designated by the reference character 70. This form of the invention differs from that disclosed in Figs. 1 to 5, in the omission of the steam washing troughs, in the provision of an additional row of water eliminators positioned on opposite sides of the drum, and in means employed for supplying the downcomer tubes of the generator with relatively solid, steam-free water.

Referring to Fig. 6, it will be seen that downcomer tubes 71 are connected to the bottom of the drum on opposite sides of a vertical plane passing through the longitudinal center line of the drum. The tubes 71 extend in a longitudinal row in the drum which row terminates short of both ends of the drum. On opposite sides of the downcomer tubes and adjacent thereto are groups of riser tubes 72 and 73 respectively. Connected to the upper portion of the drum on opposite sides thereof, are other groups of riser tubes 74 and 75. The horizontal feed pipe 16, in this form of the invention, extends longitudinally through the lower portion of the drum directly above the inlet ends of the downcomer tubes and below the normal water level in the drum. The pipe 16 is secured by straps 18 to channel member 29, which member extends longitudinally of the drum. The channel member 29 is positioned above the inlet ends of the downcomer tubes 71 in spaced relationship thereto. In the upper portion of the feed pipe is a plurality of spaced outlet orifices 76. Mounted on the feed pipe 16 a slight distance above the orifices, is a splash plate or baffle 77 which extends throughout the length of the feed pipe parallel thereto. Extending longitudinally along the opposite sides of the channel member 29 and welded thereto are weirs 78 and 79. These weirs are vertically inclined in opposite directions and are so disposed that the lower edge of the weir 78 contacts the drum wall between the downcomer tubes and the groups of riser tubes 72 and separates these two groups of tubes, while the lower edge of the weir 79 contacts the drum wall separating the downcomer tubes from the group of riser tubes 73. The lower portion of the weirs 78 and 79 are attached to supports secured to the drum wall. The upper edge of each weir extends to a point substantially above the feed pipe but below the normal operating water level in the drum.

A submerged trough-like water space X is formed above the angle member 29 between the upper portions of the two weirs, and another water space Y, which is enclosed except at its ends, is formed below the angle member between the lower portions of the weirs enclosing the inlet ends of the downcomer tubes 71. Steam-free water flows directly from the space Y to the downcomer tubes.

In addition to the row of vertical water eliminators 19 which is disposed in the zone opposite the outlet ends of the riser tubes 74 and in the path of the mixture of steam and water normally entering the steam space of the drum from these tubes, another similar row of eliminators 19 is disposed in the zone opposite the ends of the riser tubes 75. At their lower ends the eliminators are welded or otherwise secured to horizontal, longitudinally extending plates 24 mounted on longitudinally extending brackets 24' which

are secured at the opposite ends thereof to brackets 80 on the wall of the drum. The upper end of each of the eliminators is attached to a longitudinally extending plate 20 attached to a longitudinally extending bracket 20' which in turn is secured to a vertical side of longitudinally extending bracket 81, the adjoining side of which is inclined and secured adjacent the end thereof to one side of L-shaped sealing brackets 82, the other side of which are fastened to the inclined plates 23 and 50 respectively, forming the sides of the dry steam space C.

The water eliminators in the form of the invention illustrated in Figs. 6 to 9 inclusive, comprise a row of separate vertically extending V-shaped plates spaced apart horizontally and arranged in nested relationship with the apex edge of one plate within the area bounded by the next adjacent plate. However, the eliminators 19 comprising substantially one-half of the length of the row are disposed so that their apices point toward one end of the drum and the eliminators 19' which comprise substantially the remaining half of the row are positioned so that their apices point toward the opposite end of the drum. The eliminators 19 and 19' are separated at the adjacent ends of each half row of plates by means of vertically extending separating plates 83 and 84, the apex of an eliminator 19 being secured to the plate 83 and the apex of an eliminator 19' being fastened to the plate 84. The plates 83 and 84 are fastened together.

The eliminators are arranged in the manner above described so that the jets of steam which flow through the passages between the eliminator plates will not all be directed towards the same end of the drum which might tend to cause a higher water level at one end of the drum than at the other. With this arrangement the jets of steam passing through the passages between the eliminators 19 will be directed toward one end of the drum while the jets passing through the passages between the eliminators 19' will be directed toward the opposite end. This corrects the undesirable result obtained from the standpoint of circulation when all the steam is directed toward one end of the drum.

As shown in Fig. 8, the plates 54 and 54' of the driers 52 and 53 are similarly arranged so that the steam will likewise be directed in the passages between these plates. The eliminators 54 and 54' are separated at the adjacent ends of each half row by plates 85 and 86.

In operation, steam bubbles which are mixed with the water entering the drum through the groups of riser tubes 72 and 73 tend to be separated from the water by the upper edges of weirs 78 and 79 as the water flows past these edges downwardly into the space X. There will also be a tendency for any steam bubbles which pass over the top of the weirs to be condensed on or near the surface of the feed water pipe 16. In the form of the invention shown in Fig. 6 of the drawings, the water as it passes downwardly into the space X mixes with incoming fresh feed water, the feed water having entered the space X through apertures 16 in the feed pipe and having been directed horizontally toward the weirs 78 and 79 by means of the splash plate or baffle 77. The water from the riser tubes after mixing with the feed water in the space X enters the space Y at opposite ends thereof, and from the space Y passes into the downcomers 71. In this manner relatively solid steam-free water

is supplied to the downcomer tubes from the space Y.

The passage of the steam and water mixture through both rows of eliminators will be the same as previously described, that is, the mixture passing through the eliminators 19 will be directed into the space A toward one end of the drum and the mixture entering the space A through the eliminators 18' will be directed to the opposite ends. Likewise, the steam from the steam space A will pass through the plates 54 and 54' of the driers 52 and 53, and be directed toward opposite ends of the space B, thereafter pass through the perforated plate 61 into the space C, and then leave the drum from the dry steam space C through the outlet nozzles 15.

In the form of the invention shown in Fig. 9, the steam washing troughs 33 and 34 illustrated in Fig. 1, are added to the form of the invention shown in Fig. 6, the apertures 16 in the feed pipe 16 and the baffle 77 being eliminated. The troughs 33 and 34 are respectively connected to the feed pipe through the stand pipes 35 and 36, branch pipes 38 and 39, pipes 40 and nozzles 41. As in the form of the invention shown in Fig. 1 of the drawings, the feed water passes from the pipe 16 through the trough members 33 and 34 downwardly, onto the splash plate 51 and into the water in the bottom of the drum. The steam bubbles in the water entering the drum through the groups or riser tubes 72 and 73 tend to be separated from the water by the upper edges of the weirs 78 and 79, as described in the operation of the form of the invention shown in Fig. 6. The water flows over the top edges of the weirs 78 and 79 and downwardly into the space X becoming mixed with the water in the bottom of the drum and thence passing into the space Y from opposite ends thereof from where it enters the downcomer tubes 71. The steam separated from the water rises and passes through the steam washers as described in connection with the operation of the form of the invention shown in Fig. 1, then through the driers into the space B, from where it passes into the space C through the orifices 68 in the plate 61 to the outlet nozzles 15.

From the foregoing, it will be perceived that with steam purifying apparatus embodying the invention, the steam and water flow in the same general direction between the trough of the washers, at relatively low velocities as compared with prior types of washers, due to the fact that the entire washer area is available to receive the steam therein, excepting for the area occupied by the edges of the washer plates. With the present invention, overflow pipes for draining the water from the washer are not required, thereby simplifying the design. Moreover, complete accessibility to the interior of the drum and to the washer and drier elements is provided, so that the washer elements may be cleaned with a hose to eliminate sludge deposits periodically without the necessity for dismantling the washer or any part thereof.

Although the invention is disclosed as embodied in a steam and water drum of a steam generator, it will be understood that it is not limited thereto, but that it may be employed generally in the washing, or drying, or both, of steam or other vapors in other environments. Moreover, changes may be made in the form, location, proportions and relative arrangement of the several parts of the apparatus disclosed without departing from the principles of the invention.

For example, the water eliminators 19 may be omitted if desired. More than one row of water eliminator plates 19 may be utilized, and one row, or two rows or more, of drier plates 54 may be employed. Or the size and the included angle between the legs of the water eliminator and the drier plates may be varied in accordance with changes in operating or other conditions. In the event more than one row of water eliminators 19 is used, the second row of plates may have the same, or a larger or smaller included angle than the plates of the first row. Likewise, the second or other rows of drier plates 54 may have a smaller or larger included angle than the plates in the first row. In view thereof, 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. In steam treating apparatus comprising a steam and water drum and tubes connected with said drum through which steam and water are delivered to the drum, means for washing the steam delivered to the drum comprising opposed rows of N-shaped trough members inclined toward each other, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, and means for supplying wash water to said trough members.

2. Steam washing apparatus comprising opposed rows of N-shaped trough members vertically inclined toward each other, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, at least one vertically inclined tubular member for supporting each row of trough members, and means for supplying wash water to said trough members.

3. Steam washing apparatus comprising oppositely inclined rows of N-shaped trough members, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, at least one vertically inclined tubular member for supporting each row of trough members, the tubular members having discharge outlets in communication with the trough members between adjacent members, and means for supplying wash water to said tubular members.

4. Steam washing apparatus comprising horizontally spaced tubular supports vertically inclined, other horizontally spaced tubular supports adjacent the first-mentioned supports and vertically inclined in a direction opposite to that of the first-mentioned supports, rows of N-shaped trough members, one row extending between and supported by the first-mentioned support and another row extending between and supported by said other supports, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member

at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, and means for supplying wash water to said supports, the supports having discharge outlets in communication with the trough members between adjacent members.

5. Steam washing apparatus comprising horizontally spaced tubular supports vertically inclined, other horizontally spaced tubular supports vertically inclined in a direction opposite to that of the first-mentioned support, said first-mentioned and other supports being connected adjacent one end thereof, rows of N-shaped trough members, one row extending between and supported by the first-mentioned support and another row extending between and supported by said other supports, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, and means for supplying wash water to said supports, the supports having discharge outlets in communication with the trough members between adjacent members.

6. In steam treating apparatus comprising a steam and water drum having a steam space and a water space, tubes connected with said drum through which a mixture of steam and water is introduced into the steam space, means in the steam space for washing the steam comprising adjacent, oppositely inclined rows of N-shaped trough members forming a chamber therebetween, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, means extending along said rows at the top and the bottom thereof and between said rows at opposite ends thereof to prevent steam from entering the chamber between said rows except between adjacent trough members, steam outlet means in communication with said chamber, and means for supplying wash water to said trough members.

7. In steam treating apparatus comprising a steam and water drum having a steam space and a water space, tubes connected with said drum through which a mixture of steam and water is introduced into the steam space, means in the steam space for washing the steam comprising adjacent, oppositely inclined rows of N-shaped trough members forming a chamber therebetween, each row comprising a plurality of horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, at least one vertically inclined tubular member for supporting each row of trough members, the tubular members having discharge outlets in communication with the trough members between adjacent members, means for supplying wash water to the tubular members, means extending along said rows at the top and the bottom thereof and between said rows at

opposite ends thereof to prevent steam from entering the chamber between said rows except between adjacent trough members, and steam outlet means in communication with said chamber.

8. In steam treating apparatus comprising a steam and water drum having a steam space and a water space, tubes connected with said drum through which a mixture of steam and water is introduced into the steam space, a substantially horizontal feed water conduit extending longitudinally in said drum, means in the steam space for washing the steam comprising horizontally spaced tubular supports vertically inclined, other horizontally spaced tubular supports adjacent the first-mentioned supports and vertically inclined in a direction opposite to that of the first-mentioned supports, said supports being connected to and supported by said feed water conduit, rows of N-shaped trough members, one row extending between and supported by the first-mentioned support and another row extending between and supported by said other supports, each row comprising a plurality of

horizontally extending, vertically spaced members in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, and discharge means in said supports in communication with the trough members between adjacent members.

9. Steam washing apparatus comprising a plurality of horizontally extending, N-shaped trough members, vertically spaced in nested relationship with the edge of one trough member at the junction of the lower end of the intermediate leg and an outer leg thereof in the area included between the corresponding legs of the trough member immediately below, and means for separately supplying wash water to each trough member, the flow of water into and from the trough members being such that water flows through each member without flowing into another member.

MARTIN FRISCH.