No. 877,355. PATENTED JAN. 21, 1908.

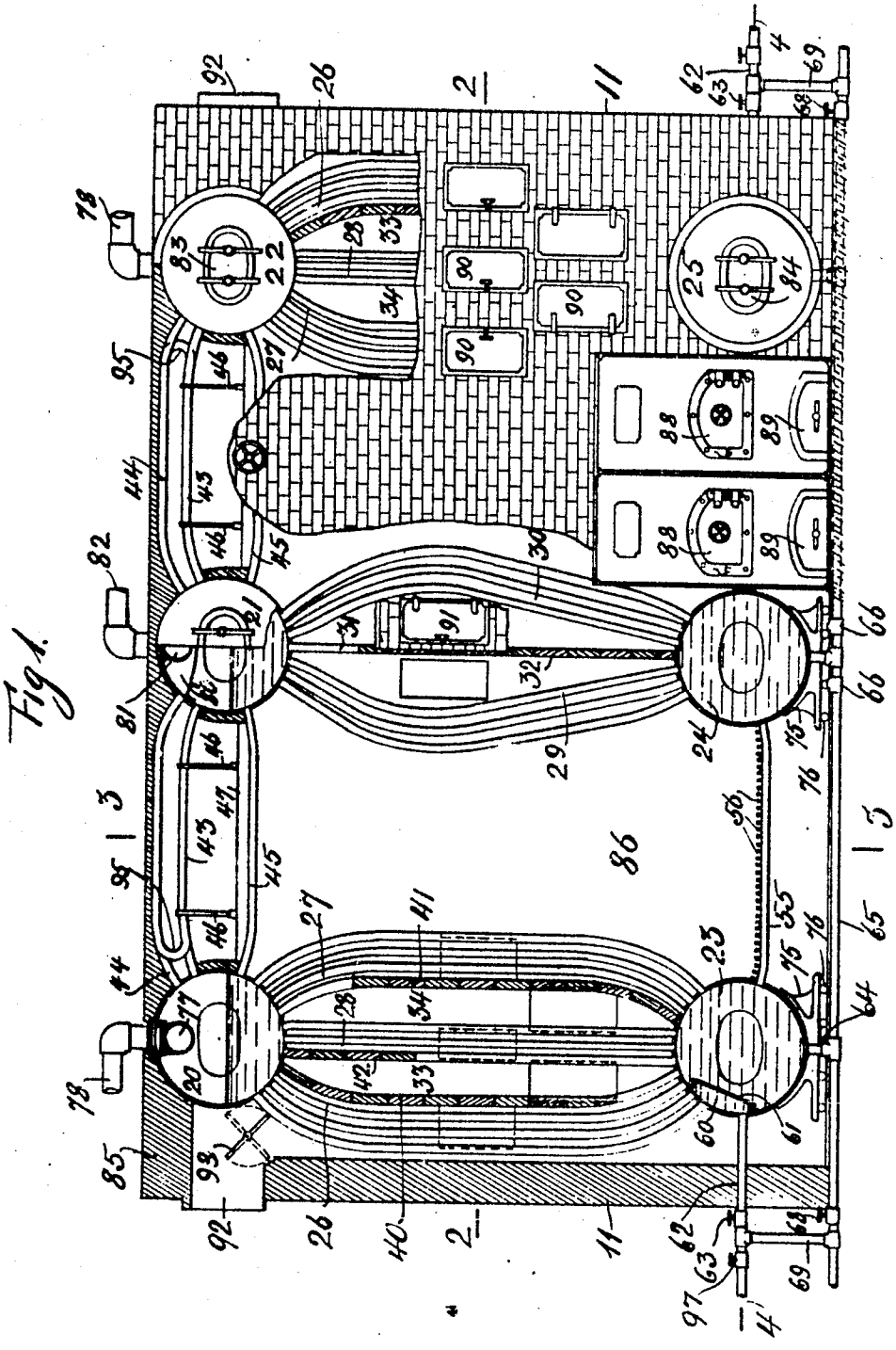
J. MILNE.

STEAM GENERATING APPARATUS.

APPLICATION FILED JAN. 25, 1907.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
M. Zimanzky.
John J. Millin

Inventor:
John Milne
By his attorney
Arthur Bonneville

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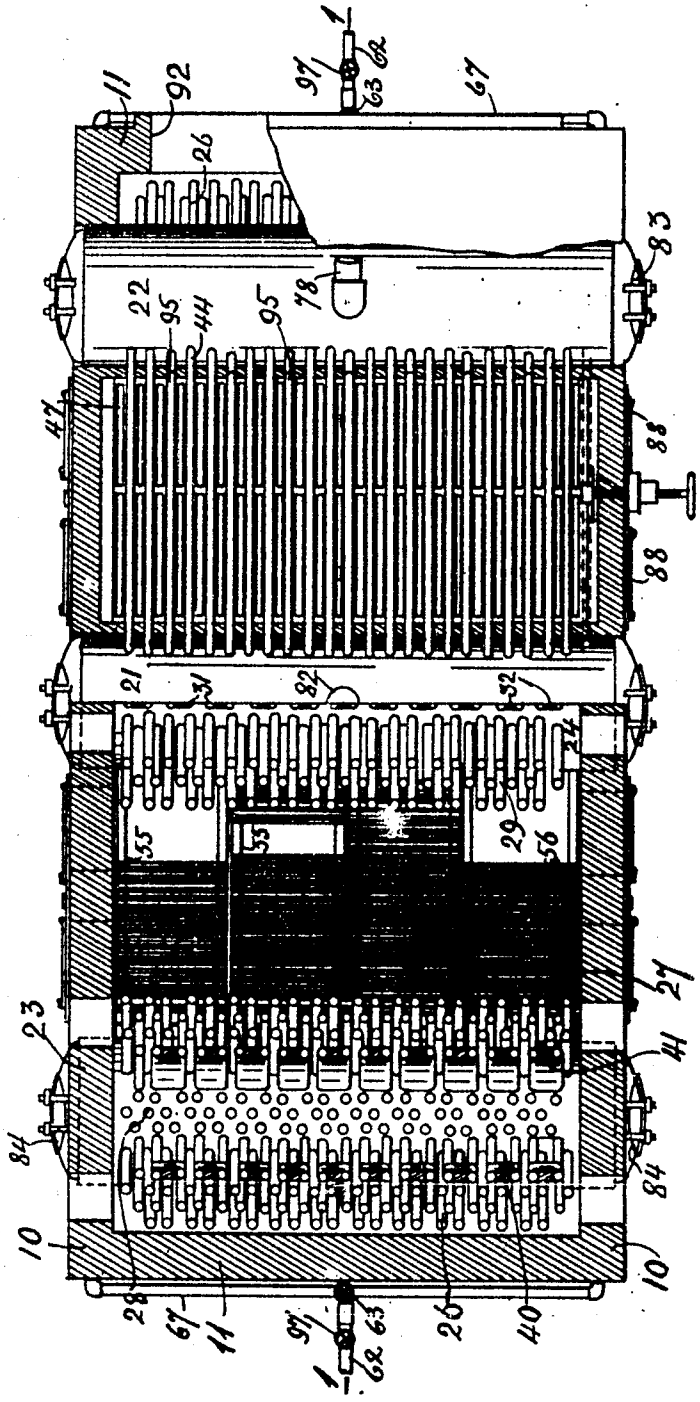
J. MILNE.

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APPLICATION FILED JAN. 25, 1907.

3 SHEETS—SHEET 2

Fig 2



Witnesses:
M. Zimansky.
John Smith

Inventor:
John Milne
By his Attorney
Wilde Bonnell

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J. MILNE.

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3 SHEETS—SHEET 3.

Fig 3.

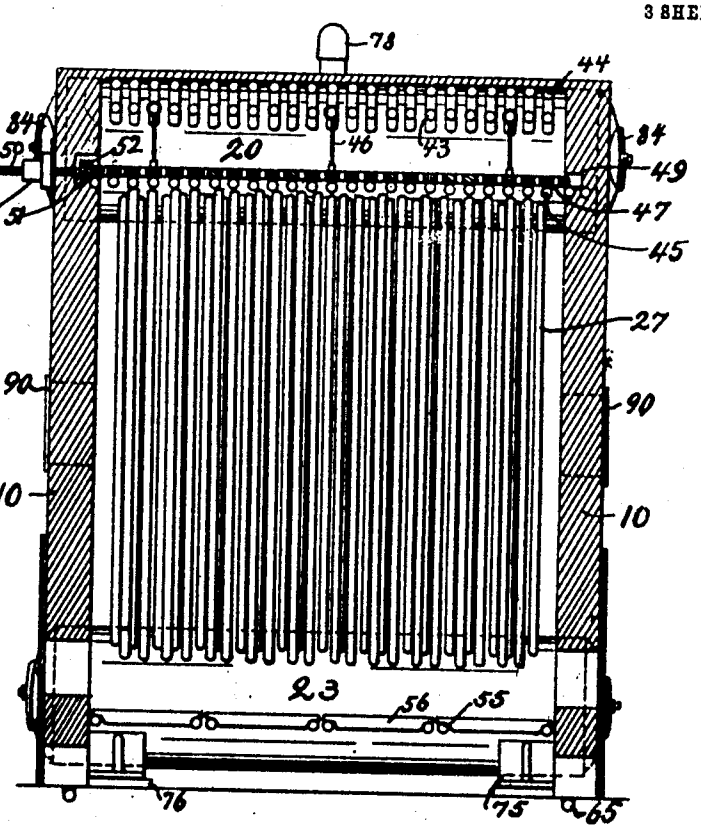


Fig 4

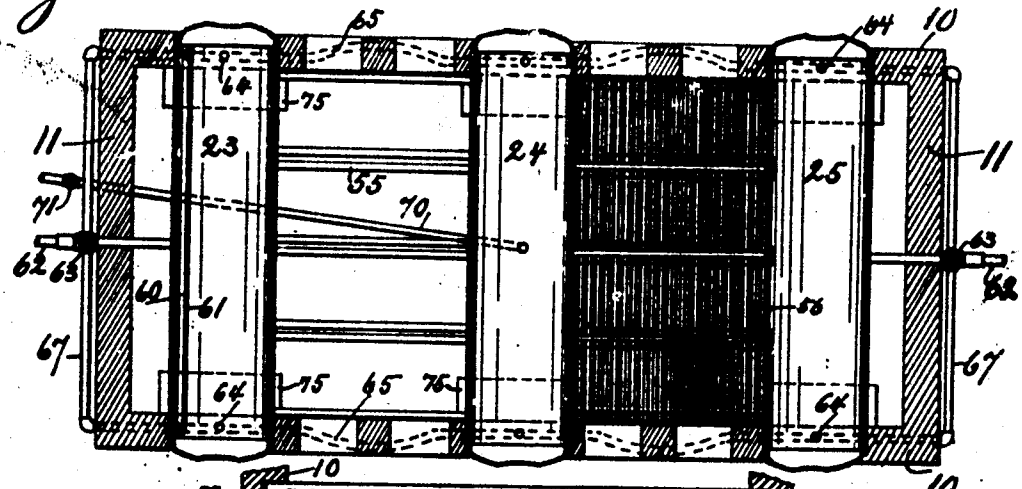
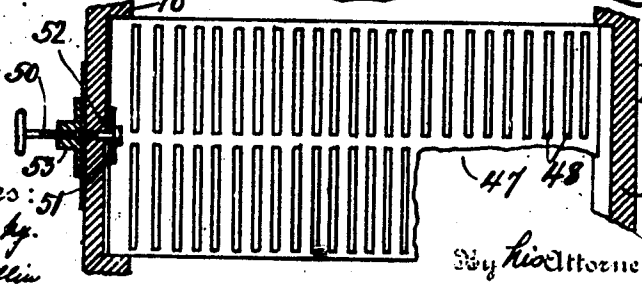


Fig 5



Witnesses:
M. Gimmersby.
John J. Millie

Inventor
John Milne
By his Attorney
Arthur Bonnaila

UNITED STATES PATENT OFFICE.

JOHN MILNE, OF BROOKLYN, NEW YORK.

STEAM-GENERATING APPARATUS.

No. 877,355. Specification of Letters Patent. Patented Jan. 21, 1908.

Application filed January 25, 1897. Serial No. 364,042.

To all whom it may concern:

Be it known that I, JOHN MILNE, a citizen of the United States, and a resident of the borough of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Steam-Generating Apparatus, of which the following is a specification.

This invention relates to steam generating apparatus. Its object is the production of a boiler with a plurality of drums and tubes connected therewith, which are all inclosed within one boiler setting preferably devoid of bridge walls. The number of drums with their tubes can be increased to any amount, thereby securing steam generating apparatus of any desired capacity. Partitions are located between some of the tubes, by means of which the directions of the gases and products of combustion are divided, so that portions of said gases and the like take horizontal directions, and other portions take up and down directions.

Tubes connect upper drums in the boiler over which is located a movable cover, in the nature of a damper, by means of which other tubes above those just specified may or may not be exposed to the intense heat of the gases. Vertical tubes connect the drums in the boilers which are located in rows consisting of one or more lines which are separated from each other, and arranged so that the tubes will be staggered when viewed in directions perpendicular to the longitudinal axes of their drums, and are at the same time located in parallel lines oblique to the longitudinal axes of the said drums. The invention is further characterized with isolated feed chambers in some of the bottom drums, isolated steam chambers in some of the upper drums, furnaces which can be fired from opposite sides, rollers supporting each pair of drums with its tubes to allow for expansion, a novel arrangement of blow off piping, and other novel features described hereinafter.

The invention is exemplified in the accompanying drawings in which

Figure 1 shows a front view of a boiler and a partial section as on the line 1, 1 of Fig. 2, Fig. 2 represents a partial section of Fig. 1 on the line 2, 2, and a partial top view with the covering removed, Fig. 3 is a section of Fig. 1 on the line 3, 3, Fig. 4 shows a partial section of Fig. 1 on the line 4, 4, on a somewhat reduced scale, Fig. 5 is a partial top plan view of a cover plate.

The invention is shown comprising a boiler with the side walls 10 and end walls 11, within which are located the upper drums 20, 21, 22 lower drums 23, 24, 25. The pairs of end drums 20, 23 and 22, 25 are connected by the outer nests of tubes 26 and 27, and the central nests 28. The central pair of drums 21, 24 are connected by the outer nests of tubes 29, 30 and the central row of tubes 31. Each nest of tubes consists of parallel rows preferably in pairs oblique to the longitudinal axis of their drums. The distances between the rows of each pair of tubes being preferably less than the distance between the pairs of rows. To be more specific the vertical planes passing through the oblique rows of tubes are inclined to the vertical planes passing through the longitudinal axes of the drums with which they are connected. The inclinations of the planes of the axial lines of the tubes secures the staggering of tubes when viewed in directions perpendicular to the axes of the drums.

The oblique parallel rows allow their easy cleaning and replacement if necessary. The flow of the gases of the furnace being at right angles to the longitudinal axes of the drums, secures with the staggered and oblique rows of tubes, the encirclement of the tubes with the gases. The tubes are at same time located in rows parallel to the longitudinal axes of the drums, and this disposition allows the easy insertion of baffles or partitions between the tubes in the said parallel rows. Partitions 40, 41 and 42 are shown in the nests 26, 27, 28 in longitudinal rows, joining the oblique rows, which latter have clear inclined passages between them. Partitions 32 are located between the alternate tubes 31 that connect the central pair of drums. The said partitions form secondary chambers 33, 34 with the nests of tubes. The said partitions are preferably located in the spaces in the said rows parallel to the longitudinal axes of the drums that separate the pairs of tubes, and which spaces are somewhat greater than the distances between each pair of tubes in said rows parallel to the longitudinal axes of the drums.

The outside upper drums 20, 22 are connected with the central upper drum 21 by horizontal rows of tubes 43, 44 above the water line in said upper drums, and the horizontal rows of tubes 45 below the water line in said drums, a number of the latter being embedded in the side walls 10 of the boiler. A

number of returnbend preferably U shaped tubes 95 extend from the upper central drum, each with its lower leg extending from the said drum below the isolated chamber 80 but above the water line in the drum, and its upper leg connected with said chamber 80. Upon a number of tubes in each of the rows 43 are suspended hangers 46 which are attached to cover plates 47 having slits or openings 48. The cover plate covers the tubes 45, and openings 49 are formed in the side walls for the cover plates. At one end of said plates there extends the screw 50, having the collar 51, which is held by the cap 52. The threads of the screw 50 engage with a threaded cap 53, attached to end wall 11 of the boiler.

The lower drums 23, 24 and 25 are connected by the horizontal pipes 55, which can constitute the grates of the furnace or grate bars 56 are supported on the same. In one or both of the lower drums 23 and 25 there is secured an isolated feed chamber 60, preferably with a removable bonnet 61, into which enter some of the tubes of the nests 26, constituting the feed water tubes. One or more feed pipes 62 with valves 63 and 97 enter the chambers 60. From the lower sides and at the ends of the lower drums 23, 24 and 25 extend the vertical members 64 of the blow-off piping which connect with the horizontal longitudinal members 65, and in the latter are located the check valves 66. The members 65 are connected by the cross-members 67 having the valves 68. Piping 69 extends between the members 67 and the pipes 62. Independent blow-off piping 70 with valve 71 extends from the central lower drum. The lower drums 23, 24 and 25 are supported on cradles 75 which latter rest on rollers 76.

In the upper end drums 20 and 22 there are preferably located the dry pipes 77 which connect with the steam outlet piping 78. In the central upper drum 21 is formed the isolated chamber 80 with which the tubes 44 connect. A dry pipe 81 in said chamber connects with the outlet piping 82. Manholes with covers 83 are provided for the upper drums and manholes with covers 84 are provided for the lower drums.

The steam boiler as already stated is inclosed by the four walls 10, 11 and the roof 85. Fire chambers 86 are formed between the nests of tubes 27 and 29. Furnace openings 87, with doors 88 are preferably located in both the side walls 10 with suitable openings for the ash pit doors 89 beneath them. Openings with doors 90 are formed in the side walls to obtain access to the nests of tubes 26, 27 and 28, and openings with doors 91 are formed in the said walls 10 to obtain access to the central row of tubes 29, 30 and row of tubes 31. Outlets 92 with dampers 93 carry away the products of combustion.

To operate the invention, the boiler is filled with water to the proper level as shown in the upper drums and fuel ignited on the grates. The hot gases will take up and down directions by reason of the partitions between the tubes, and practically horizontal directions are given to the gases by reason of the clear spaces between the tubes. The products of combustion leave the boiler at the outlets 92. The feed water entering through the feed pipes will pass through the feed chambers 60 and rise with steam that may be generated in the tubes of the nests 26 connected with said feed chamber, enter the upper drums 20 and 22 and then return to lower drums 23 and 25 through the remaining rows of the nests 26 and down the tubes of the nests 28, rising in the tubes of the nests 27, again entering the upper drums 20 and 22 from which it enters the lower horizontal rows of tubes 45 on its way to the lower portion of the central upper drum 21. Then it drops in the row of tubes 31 to the lower drum 24 by reason of the insulation caused by the partition 32. The product then rises in the nests of tubes 29 and 30 and again enters the upper drum 21. A portion of the products generated leave the upper drum 21 through the rows of horizontal tubes 43, enter the drums 20 and 22 above the water line, then enter the tubes 44, and from the latter enter the isolated chamber 80 in the upper central drum 21. Other portions of the products generated in the drum 21 enter the lower leg of the U shaped tubes 95 below the isolated chamber 80 and return through the upper leg into said chamber. The dry pipe 81 in the chamber 80 leads the products generated to the steam outlet piping 82. It will be noted that the steam also leaves by way of the piping 78 connected with the upper drums 20 and 22.

The swinging cover 47 is located with its slots over the row of tubes 45 when it is not desired to expose the tubes 43, 44 to the intense heat of the gases of the furnace; and is moved so that the slots shall be opposite the spaces between the tubes 45 when the tubes 43, 44 are to be exposed to the said intense heat producing superheated steam. It will be noted that the steam which travels through the U shaped tubes connected with the upper drum 21, leaves the latter above the water line and then enters the isolated chamber 80, without danger of coming in contact with moisture in the other upper drums. The tubes with the two legs are U shaped, although other forms of return bent tubes may be used.

Having described my invention I claim:

1. In a steam generating apparatus the combination of a plurality of upper and lower drums, tubes connecting the upper and lower drums, other tubes connecting the upper drums some above and some be-

low the water line in the upper drums, means coacting with the tubes connecting the upper drums by which the area of the passages between said latter tubes may be varied.

2. The combination in a steam generating apparatus of a plurality of upper and lower drums, tubes connecting the drums, horizontal tubes connecting the upper drums both above and below the water line, a cover over the horizontal tubes that are below the water line, and means to move said cover to different positions.

3. The combination in a steam generating apparatus of an upper drum and a lower drum, outer nests of tubes connecting the drums, and a nest of tubes connecting the drums between said outer nests, the tubes in each nest forming parallel rows oblique to the longitudinal axes of the drums and at the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, and partitions between some of the tubes of the said rows, that are parallel to the axes of the drums.

4. The combination in a steam generating apparatus of two pairs of drums each comprising an upper and a lower drum, nests of tubes connecting each pair of upper and lower drums, a row of tubes connecting the upper drums, a second and lower row of tubes connecting the said upper drums, a cover having openings over said lower row of tubes, and means to move said cover to different positions.

5. The combination in steam generating apparatus of an upper and lower drum, water tubes connecting the drums, an isolated chamber in the upper part of the upper drum having a steam outlet, a row of tubes connecting the interior of the isolated chamber with the interior of the upper drum, a cover having openings suspended from the latter tubes, means to move the cover to different positions.

6. The combination in a steam generating apparatus of three pairs of drums, comprising two outer pairs and one central pair, each outer pair of drums connected by outer nests of tubes and an inner nest of tubes, the tubes in each nest forming parallel rows oblique to the longitudinal axes of their drums and at the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, outer nests of tubes connecting the central pair of drums disposed and located as the nests of the outer pair of drums, a row of tubes connecting the central drums between the outer nests of tubes connected therewith, and furnaces between the nests of tubes of the outer drums and the central drums.

7. The combination in a steam generating apparatus of three pairs of drums, comprising two outer pairs and one central pair, each outer pair of drums connected by outer nests of tubes and an inner nest of tubes, the tubes in each nest forming parallel rows oblique to the longitudinal axes of their drums and at the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, outer nests of tubes connecting the central pair of drums disposed and located as the nests of the outer pair of drums, a row of tubes connecting the central drums between the outer nests of tubes connected therewith, furnaces between the nests of tubes of the outer drums and the central drums, a horizontal row of tubes between the upper central drum and the two outer upper drums below the water line in the drums, two rows of tubes between the central upper drum and each outer upper drum above the water line in the upper drums, steam outlets for the upper drums, and means to feed the lower drums.

8. The combination in a steam generating apparatus of three pairs of drums, comprising two outer pairs and one central pair, each outer pair of drums connected by outer nests of tubes and an inner nest of tubes, the tubes in each nest forming parallel rows oblique to the longitudinal axes of their drums and at the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, outer nests of tubes connecting the central pair of drums disposed and located as the nests of the outer pair of drums, a row of tubes connecting the central drums between the outer nests of tubes connected therewith, furnaces between the nests of tubes of the outer drums and the central drums, a horizontal row of tubes between the upper central drum and the two outer upper drums below the water line in the drums, an isolated chamber in the upper portion of the central upper drum, a row of tubes between the isolated chamber of the central upper drum and the upper portion of each outer upper drum above the water line, a second row of tubes from the central upper drum below its isolated chamber and above the water line therein, connecting with the outer upper drums above the water line, a third row of tubes connecting the upper central drum below the water line with each outer upper drum below the water line, a steam outlet connected with the isolated chamber in the central upper drum and outlets for the outer upper drums.

9. The combination in a steam generating apparatus of three pairs of drums, comprising two outer pairs and one central pair, each outer pair of drums connected by outer nests of tubes and an inner nest of tubes, the tubes in each nest forming parallel rows oblique to the longitudinal axes of their drums and at

the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, outer nests of tubes connecting the central pair of drums disposed and located as the nests of the outer pair of drums, a row of tubes connecting the central drums between the outer nests of tubes connected therewith, furnaces between the nests of tubes of the outer drums and the central drums, a horizontal row of tubes between the upper central drum and the two outer upper drums below the water line in the drums, an isolated chamber in the upper portion of the central upper drum, a row of tubes between the isolated chamber of the central upper drum and the upper portion of each outer upper drum above the water line, a second row of tubes from the central upper drum below its isolated chamber and above the water line therein, connecting with the outer upper drums above the water line, a third row of tubes connecting the upper central drum below the water line with each outer upper drum below the water line, a steam outlet connected with the isolated chamber in the central upper drum and outlets for the outer upper drums, hangers suspended from some of the upper tubes connecting the upper drums, a cover having slots suspended on the hangers over the lower row of tubes connecting the upper drums, and means to move the said cover to different positions.

10. The combination in a steam generating apparatus of an upper drum and a lower drum, outer nests of tubes connecting the drums, and a nest of tubes connecting the drums between said outer nests, the tubes in each nest forming pairs and parallel rows oblique to the longitudinal axes of the drums and at the same time forming rows parallel to said axes, the distance between the pairs of tubes being greater than the distance between the tubes of each pair, partitions in the said greater distances in the said horizontal rows.

11. In a steam generating apparatus, the combination of a plurality of upper drums and lower drums, tubes between the upper and their accompanying lower drums, tubes connecting the upper drums below the water line therein, return bend tubes with each of the legs connected with some of the upper drums above the water line, outlets from some of the upper drums, an adjustable cover over the tubes that connect the upper drums below the water line to control the amount of heat to the tubes directly above them, and means to protect the upper drums above the water line from said heat.

12. In a steam generating apparatus the combination of a plurality of upper drums and a plurality of lower drums, tubes connecting the outer drums and tubes connecting a pair of inner drums between the outer drums, a partition between some of the tubes of the inner drums to partially insulate them from the hot gases, and to produce a down circulation in the tubes connecting the said inner drums, tubes connecting the lower drums, walls encircling the drums and tubes, tubes connecting the upper drums, some of the latter tubes embedded in the walls to produce circulation between the upper drums.

13. The combination in a steam generating apparatus of three pairs of drums, comprising two outer pairs and one central pair, each outer pair of drums connected by outer nests of tubes and an inner nest of tubes, the tubes in each nest forming parallel rows oblique to the longitudinal axes of their drums and at the same time forming rows parallel to said axes, the tubes of each latter row being staggered with its parallel row next adjacent, outer nests of tubes connecting the central pair of drums disposed and located as the nests of the outer pairs of drums, a row of tubes connecting the central drums between the outer nests of tubes, the tubes in the rows which are parallel to the axes of the drums being located in pairs, the spaces between the pairs being greater than the spaces between the tubes of each pair in the same row, partitions in these greater spaces.

14. In a steam generating apparatus the combination of a plurality of upper drums and lower drums, tubes connecting the drums, blow-off piping extending from the lower drums, isolated feed chambers in some of the lower drums, feed pipes connecting with said feed chambers, connections between the feed pipes and the blow-off piping to blow off the feed chambers.

15. In a steam generating apparatus the combination of three pairs of drums, each pair comprising an upper and a lower drum, a blow-off pipe extending from the central lower drum, a blow-off pipe extending from each of the other lower drums, pipes connecting the pipe extending from the central lower drum with the pipes extending from the outer lower drums, check valves in the latter piping, pipes extending outward from the pipes of the outer drums, a valve in each of the latter pipes, an isolated feed chamber in some of the lower drums, a feed pipe leading to each feed chamber, two valves in the latter pipe, a connecting pipe between each feed pipe between its valve and the piping extending outward from the outer lower drums, and outward from the valves in the latter piping.

Signed at the borough of Manhattan in the county of New York and State of New York this 23d day of January, A. D. 1907.

JOHN MILNE.

Witnesses:
M. ZIMANSKY
M. H. COOK.