

Dec. 2, 1958

R. L. BURKE

2,862,574

STEAM DRIER

Filed Dec. 20, 1957

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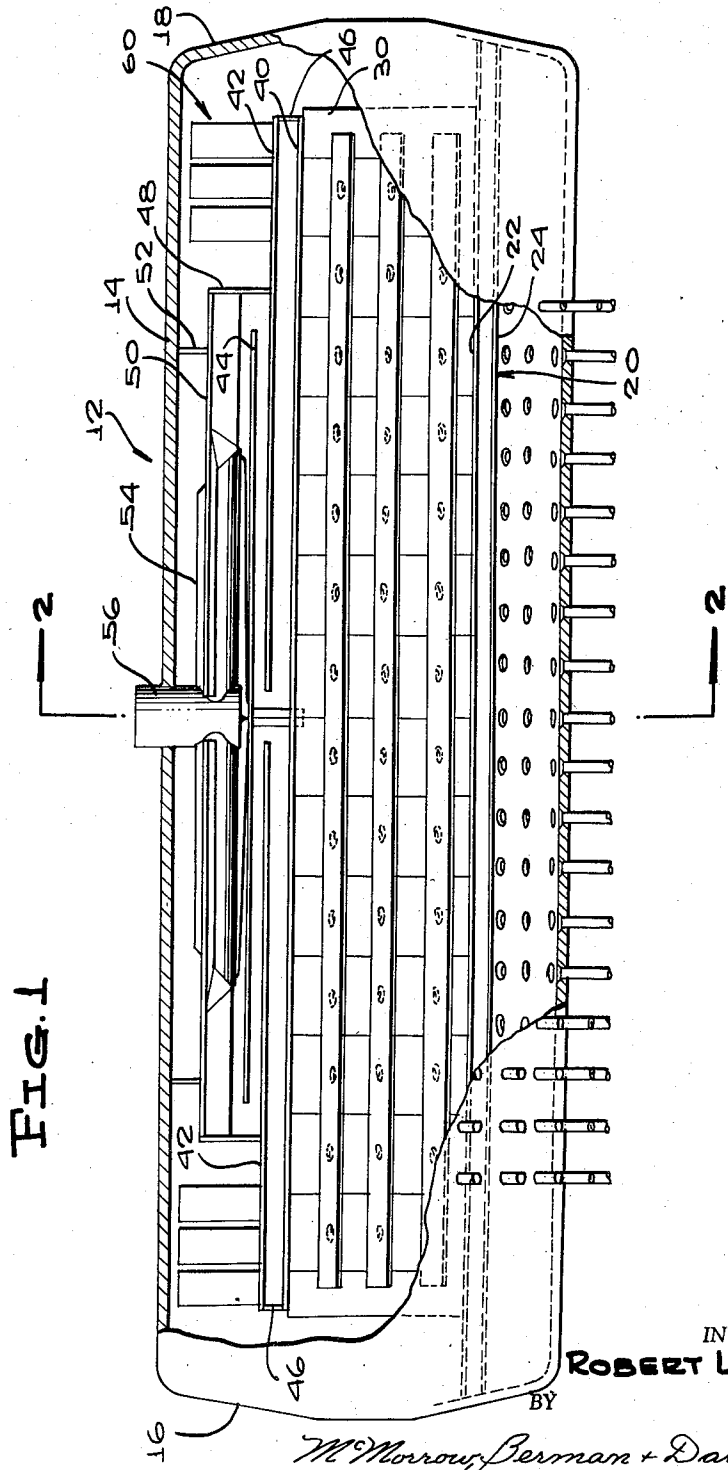


FIG. 1

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FIG. 2

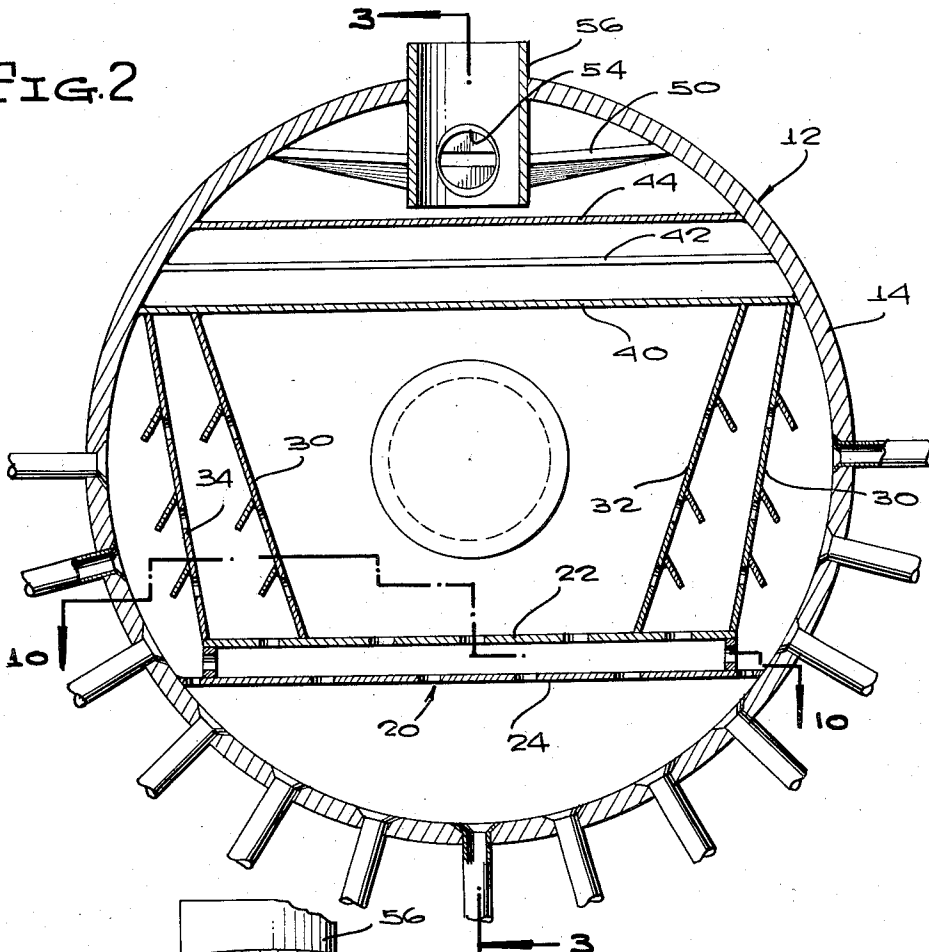
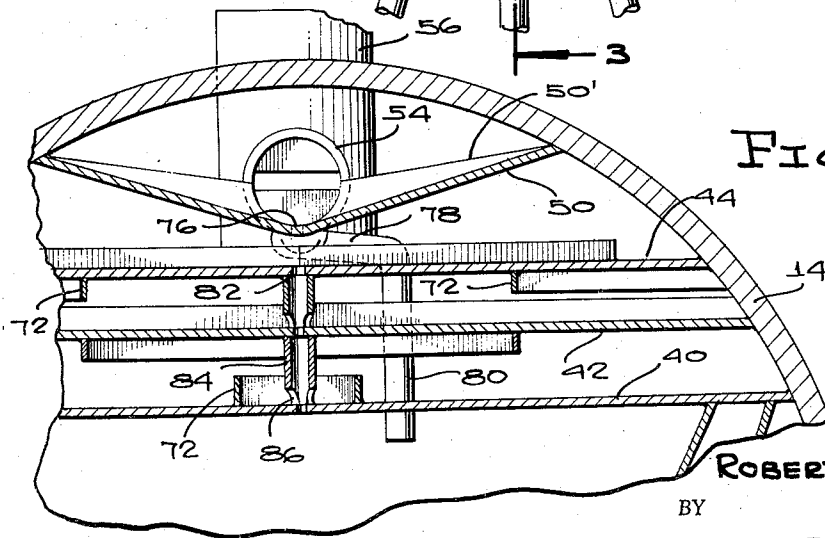


FIG. 6



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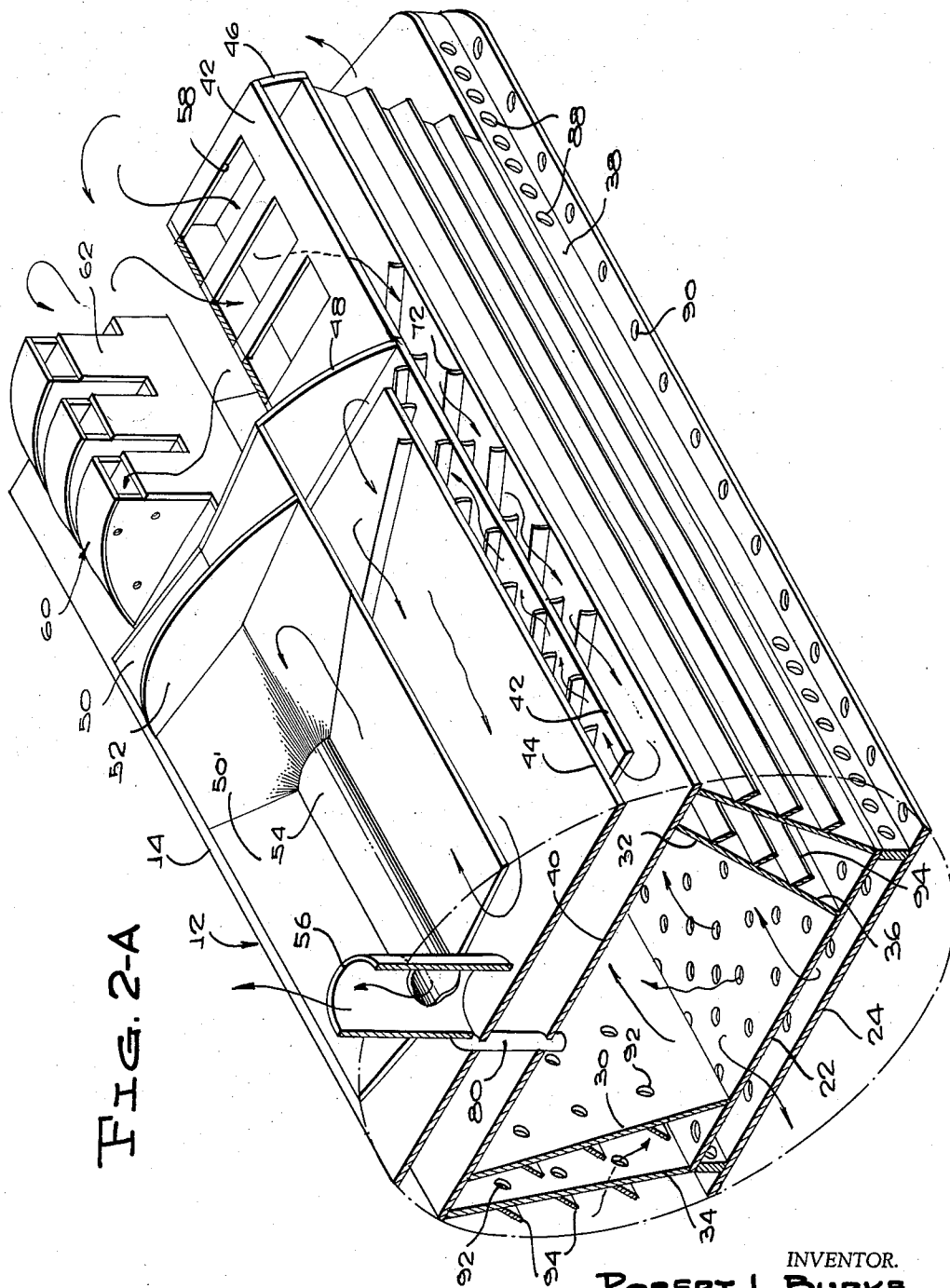


FIG. 2-A

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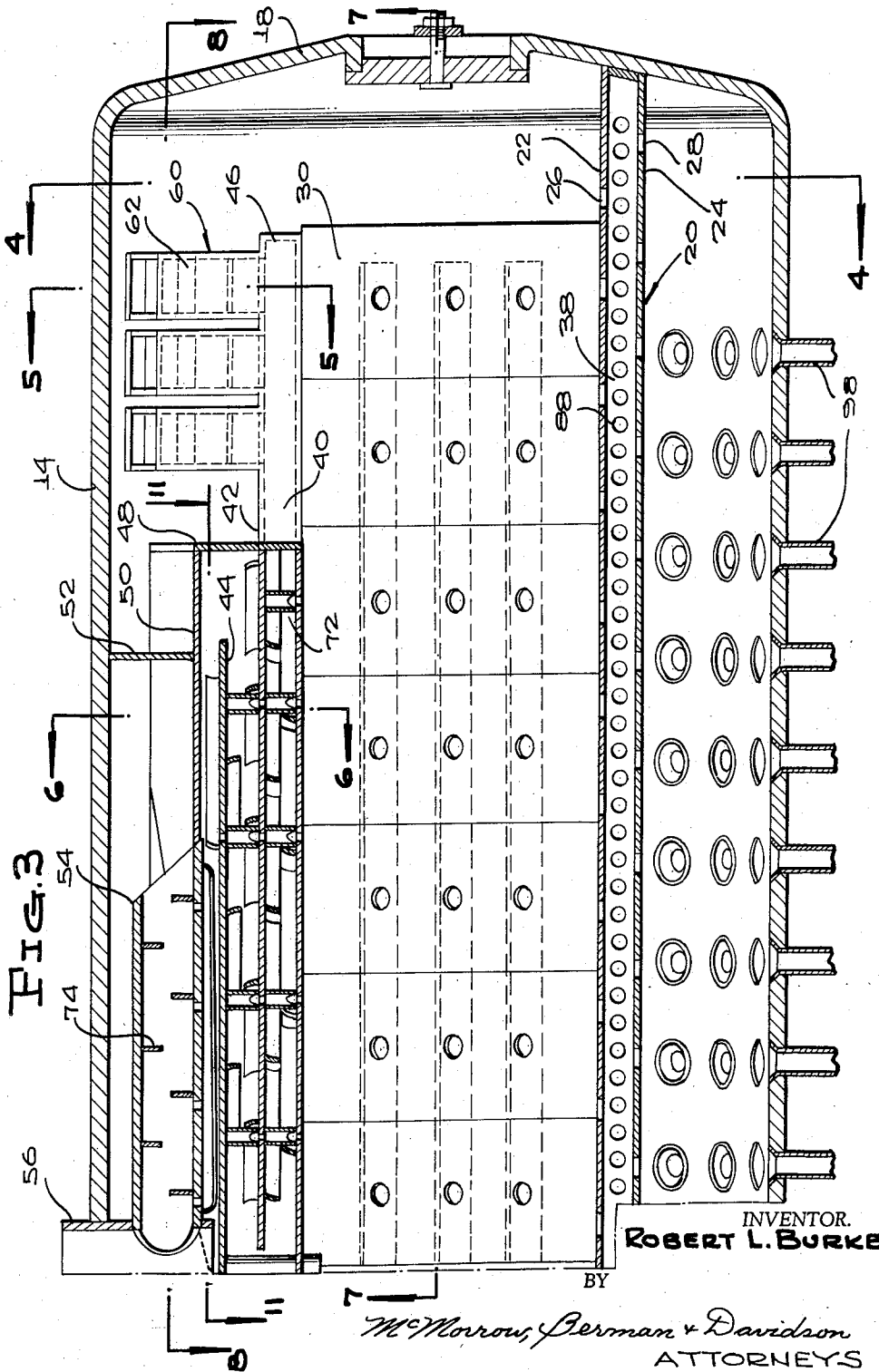
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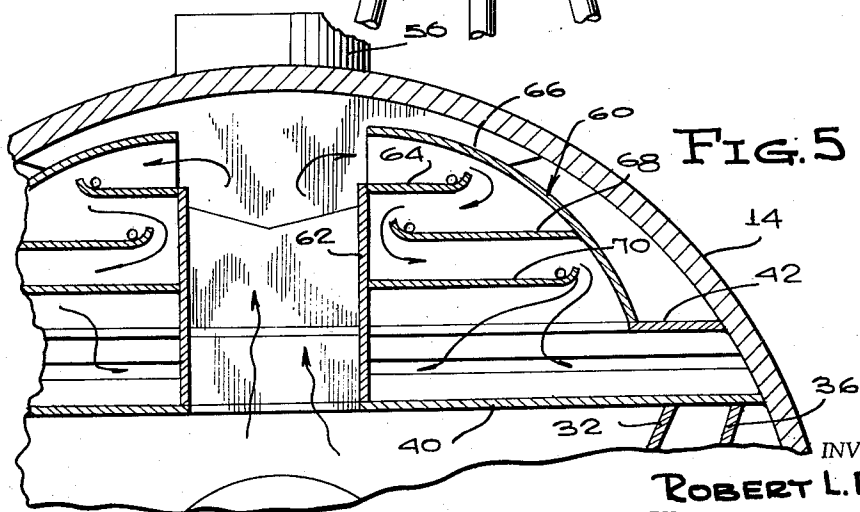
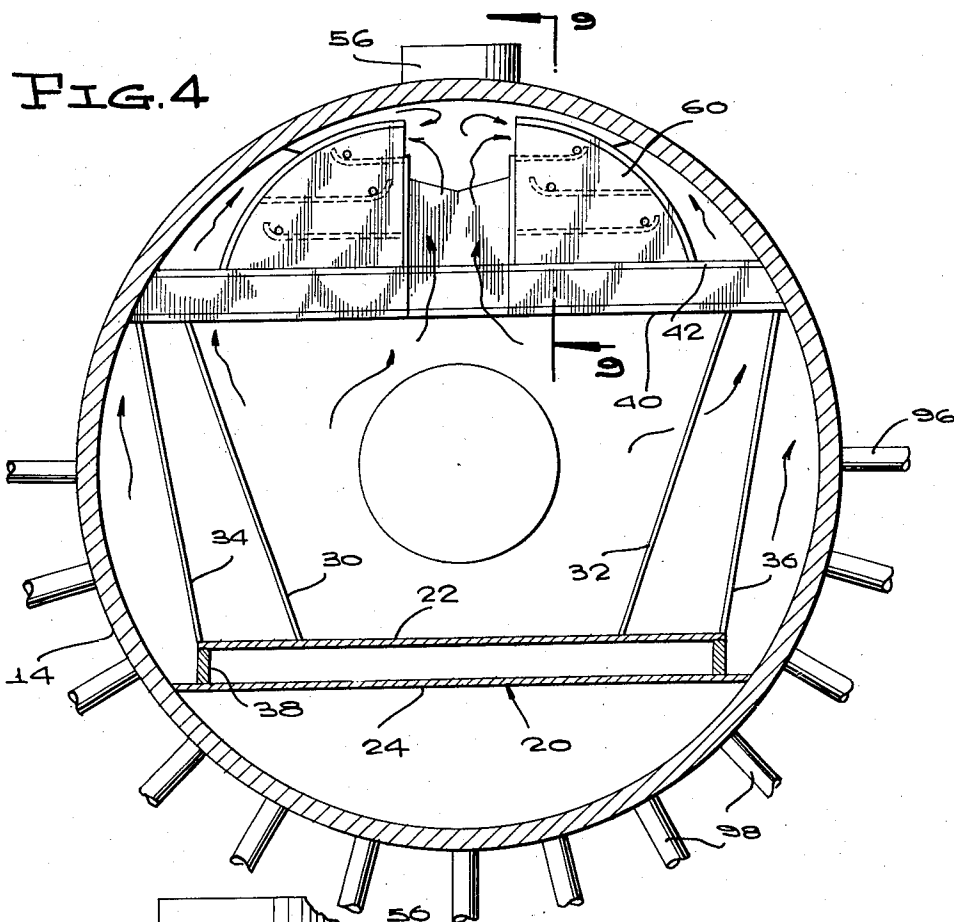
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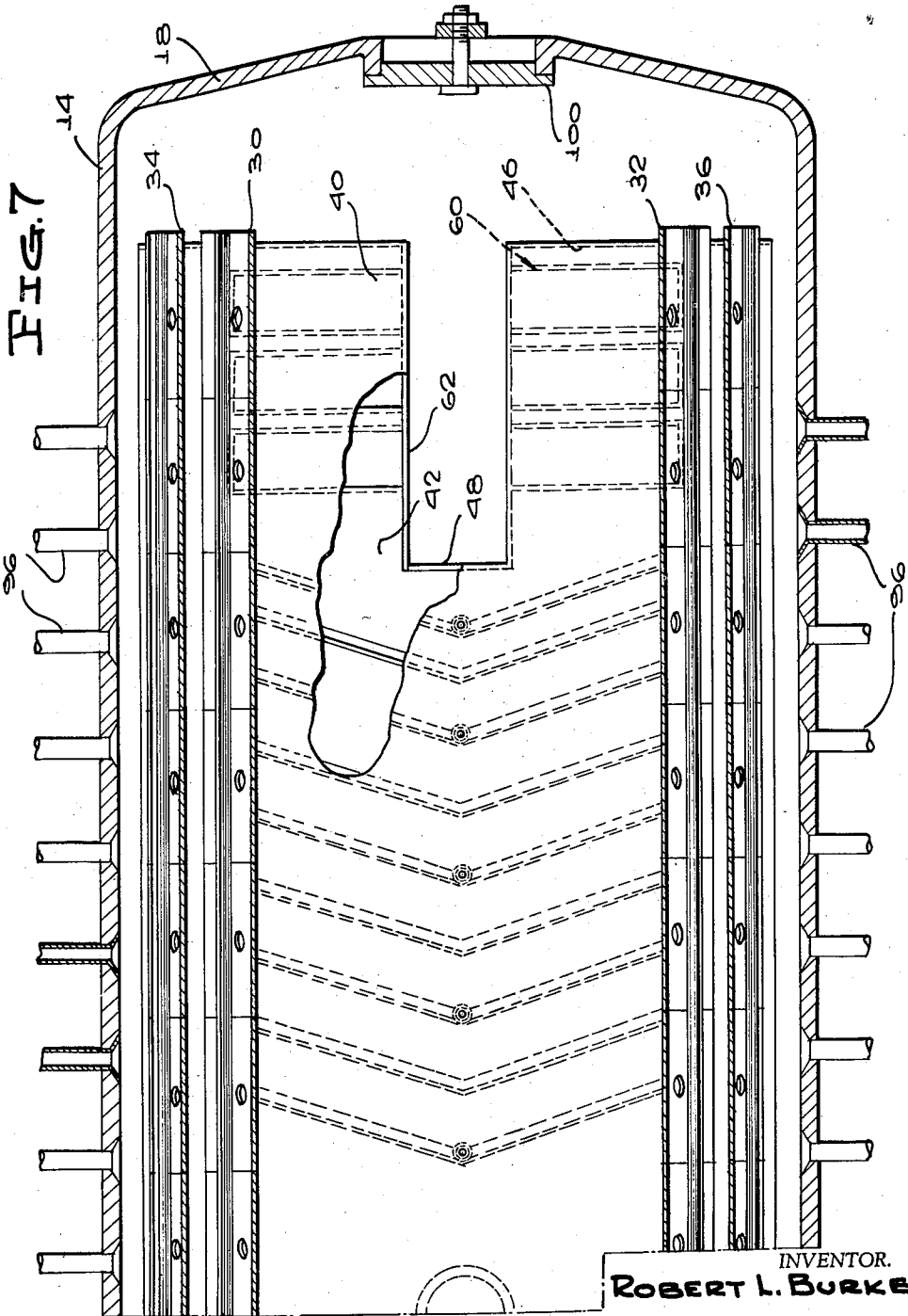
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STEAM DRIER

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8 Sheets-Sheet 6



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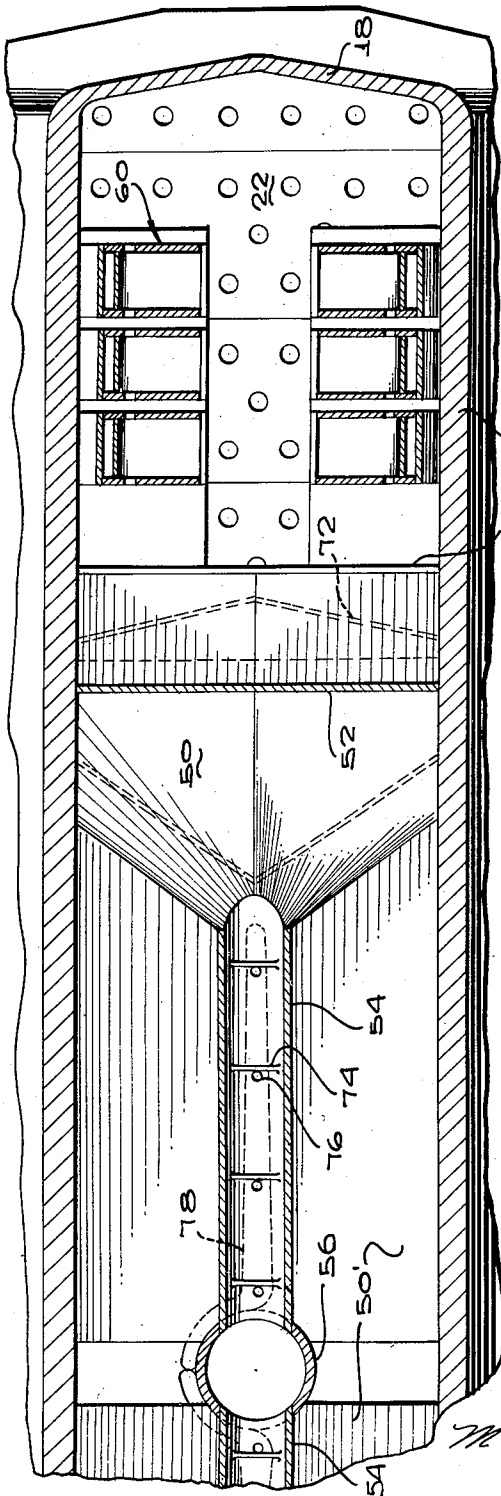


FIG. 8

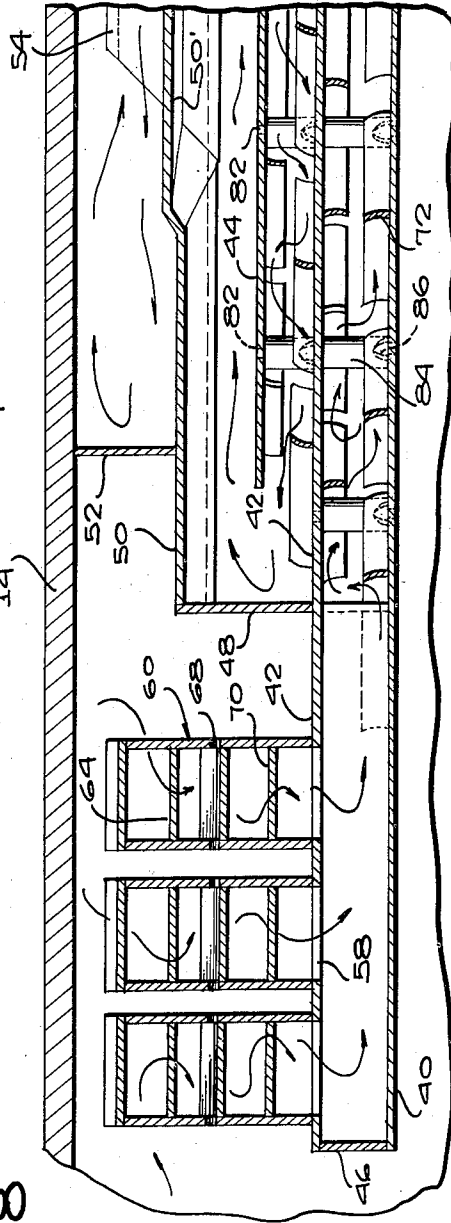


FIG. 9

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FIG. 10

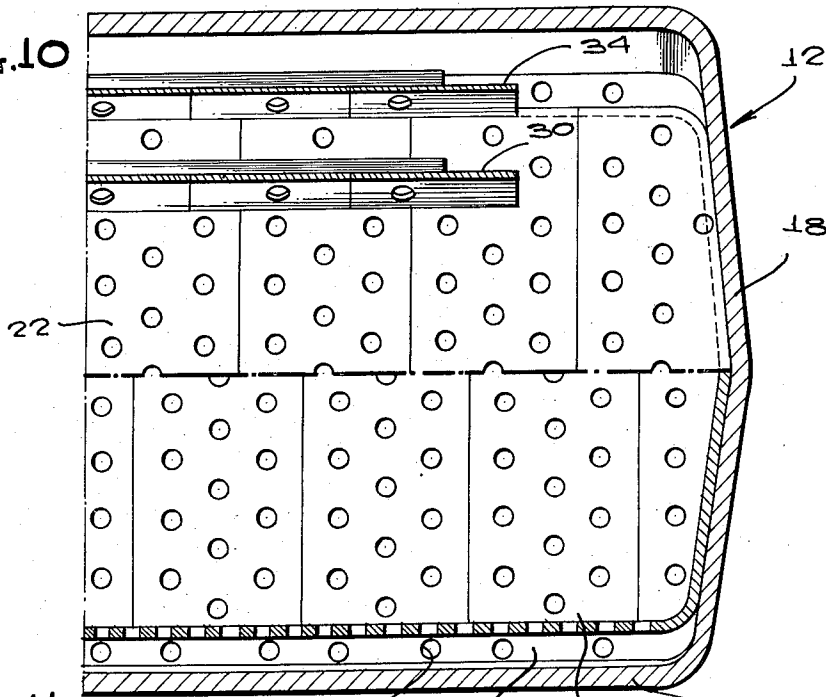
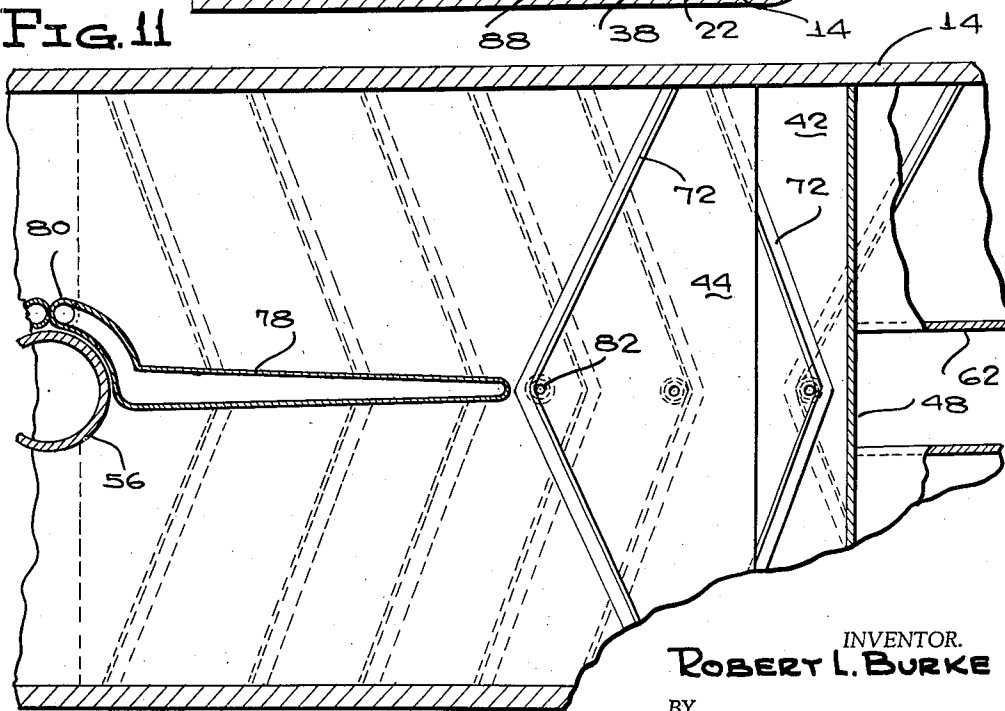


FIG. 11



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STEAM DRIER

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5 Claims. (Cl. 183—75)

The present invention relates to a steam drier and in particular to a steam drier for installation in a high-pressure high-temperature boiler of the type used to generate steam for public utility generators, power plants and the like.

An object of the present invention is to provide a steam drier which lends itself to the production of dry steam for use in steam turbines and the like, one which is highly efficient in operation, one which is easily and readily repaired when worn or damaged, and one which is highly effective in action.

Another object of the present invention is to provide a steam drier which lends itself to economical manufacture and assembly, one which is of simple structure, and one which is sturdy in construction.

These and other objects and advantages of the present invention will be fully apparent from the following description when taken in conjunction with the annexed drawings, in which:

Figure 1 is an elevational view of the steam drier of the present invention with a portion of the wall of the drier broken away;

Figure 2 is a sectional view, on an enlarged scale, taken on the line 2—2 of Figure 1;

Figure 2A is an isometric view with parts broken away of the portion of the drier seen on line 2—2 of Figure 1, the arrows indicating the path of movement of the steam through the drier;

Figure 3 is a sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a sectional view taken on the line 4—4 of Figure 3;

Figure 5 is a sectional view taken on the line 5—5 of Figure 3;

Figure 6 is a sectional view taken on the line 6—6 of Figure 3;

Figure 7 is a sectional view taken on the line 7—7 of Figure 3;

Figure 8 is a sectional view taken on the line 8—8 of Figure 3;

Figure 9 is a sectional view taken on the line 9—9 of Figure 4;

Figure 10 is a sectional view taken on the line 10—10 of Figure 2; and

Figure 11 is a sectional view taken on the line 11—11 of Figure 3.

Referring in greater detail to the drawings in which like numerals indicate like parts throughout the several views, the steam drier of the present invention is designated generally by the reference numeral 12 and comprises a drum 14, constituting a hollow enclosure, having a pair of closed ends 16 and 18. The elements within the drum inwardly of each of the closed ends 16 and 18 are identical and will be described with reference to the elements inwardly of the end 18, as shown in Figure 3. The drum 14 constitutes a wall interposed between and secured to the closed ends 16 and 18.

A floor 20 is positioned within the drum 14 and ex-

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tends from one to the other of the closed ends and has its perimeter fixedly attached to the closed ends of the drum 14 and the adjacent parts of the wall of the drum 14. The floor 20 is seen in Figure 3 to have an upper section 22 and a lower section 24 with spaced apertures 26 and 28 in such sections respectively, the apertures not being in registry with each other.

Means providing four longitudinal spaced flues are positioned within the enclosure and have each of the adjacent ends spaced inwardly of the adjacent closed end of the drum 14, the space between each of the closed ends and the adjacent ends of such flues forming a collection chamber for hot steam. Specifically, this means consists in a first pair of upright aprons 30 and 32 arranged in an upwardly extending diverging direction and positioned within the drum 14 and spaced from the wall of the drum 14 with each of the adjacent ends of such aprons 30 and 32 spaced inwardly of the adjacent closed end of the drum 14 and having the convergent ends fixedly supported upon the upper surface of the floor section 22, as shown most clearly in Figure 4. Another apron 34 is positioned between the apron 30 and the adjacent portion of the wall of the drum 14 and a fourth apron 36 is positioned between the apron 32 and the opposite portion of the wall of the drum 14. The lower ends of the aprons 34 and 36 are similarly secured to the floor section 22 which is seen in Figure 4 to be supported upon longitudinally extending beams 38 spaced inwardly from the wall of the drum 14.

Means providing a plurality of tortuous communicating passages arranged in superimposed relation is positioned within the drum 14 and extends longitudinally over the diverging ends of the aprons 30, 32, 34, and 36. This means has one end adjacent to and spaced from one of the collection chambers formed by the ends of the aprons and has the other end adjacent to and spaced from the other of such collection chambers. Specifically, this means consists in, as shown in Figure 2, a lowermost horizontally disposed plate member 40 extending between opposed portions of the wall of the drum 14 and fixedly secured to the upper ends of the aprons 30, 32, 34, and 36, as shown in Figure 2.

The plate member 40 extends the full length of the aprons and a second plate member 42 extends inwardly from each end of the plate member 40 to a point spaced outwardly of a medial transverse line bisecting the plate member 40, as shown most clearly in Figure 2. Another plate member 44 is positioned in superimposed spaced relation with respect to the portion of each of the plate members 42 extending from a point intermediate the ends thereof to the terminating point of each of such plate members 42 contiguous to the midportion of the plate member 40. The longitudinal side edges of each of the plate members 40, 42, and 44, extend to and are fixedly secured to the wall of the drum 14. The space between the end of each plate member 42 contiguous to the free ends of the plate member 40 is closed by a vertical wall section 46 extending inwardly from each side of the drum 14 and terminating at a point spaced from the longitudinal center line of the drum 14.

Referring to Figures 2A and 7, it will be seen that each of the end portions of the plate members 40 and 42 have a centrally disposed cutaway portion providing a duct for hot steam connected in communication with the adjacent collection chamber which is inwardly of the contiguous drum end 16 or 18. In Figure 3 it will be seen that the inner end of this cutaway portion is closed by another upstanding wall section 48 which is spaced from the adjacent end of the plate member 44 and closes that end of the passageway formed by the adjacent portion of the plate member 42 and the adjacent portion of the plate member 44.

Another plate member 50 of substantially the same length as the portion of the plate member 42 inwardly of the wall section 48 is positioned in superimposed spaced relation above each of the adjacent portions of the plate member 44 and has one end secured to the wall section 48, as shown most clearly in Figure 3. Referring to Figure 2A, it will be seen that the plate member 50 is in two sections sloping inwardly toward their longitudinal meeting edge forming a shallow trough the width of the drum at that portion of the drum. The edges of the plate member 50 are fixedly secured to the wall of the drum. An upright wall section 52 rises from the plate member 50 inwardly of the wall section 48 and has its upper end sealingly secured to the undersurface of the upper end portion of the drum 14. The plate member 50 at a point spaced inwardly from the wall section 52 has other downwardly sloping surfaces as at 50' in Figure 2A, the meeting edges of which are bridged by a horizontally disposed shell 54 having the end spaced from and adjacent the wall section 52 open and having the other end connected in communication with an upright cylinder 56 which is positioned in the midportion of the drum 14, as shown in Figure 1.

The cylinder 56 has its lower end open and spaced above, as shown in Figure 3, the midportion of the plate member 44. The space within the shell 54 constitutes a longitudinally extending passage for dry steam and the cylinder 56 constitutes means providing an outlet for withdrawing dry steam from such longitudinal passage. The space between the plate member 50 and the plate member 54 constitutes another longitudinal passage, the space between the plate member 54 and the plate member 42 inwardly of the wall section 48 constitutes a further longitudinal passage and the space between the plate members 40 and 42 constitute the lowermost one of the longitudinal passages.

Means is provided in the drum of the present invention for forming a plurality of tortuous communicating passages arranged in superimposed relation and extending transversely of the aforesaid longitudinal passages heretofore described and also between one end of such longitudinal passages and the adjacent collection chamber contiguous to the drum end 16. Another plurality of tortuous passages are arranged in superimposed relation in a similar manner between the adjacent collection chamber and the contiguous drum end 18.

Specifically, this last-named means consists in a plurality of spaced openings 58 provided in each section of the plate member 52 on each side of the cutaway portion, as shown in Figure 2A. A housing 60 bridges each of the openings 58 and has spaced upright side walls each shaped to fit a quarter of a circle, as shown in Figures 2A and 4. In Figure 2A, the three housings 60 on the forward side of the drum 14 are shown removed so as to more clearly show the openings 58. An upstanding wall section extends over the confronting ends of the housings 60 and bridges the space between the longitudinal inner edges of the plate members 40 and 42 on each side of the duct formed by such cutaway portions. The upper ends of the wall section 62 where it bridges the open end of the housing 60 is cut away to form a passageway connected in communication with the duct. A horizontally disposed shelf 64 extends from the upper end of each of the portions of the wall section 62 bridging the open end of the adjacent housing 60 and terminates at a point spaced from the arcuately curved housing wall 66, as shown in Figure 5. Another shelf 66 is positioned in spaced relation below the shelf 68 and extends from the housing 66 to a point spaced from the wall section 62. A still further shelf 70 extends from the wall section 62 to a point spaced from the housing wall 66 and together with the opening 58 in the plate member 42 forms a tortuous passage connected at one end in communication with a passage formed by the shelves 68 and 70, the latter being connected in communication with a passage

formed by the shelves 64 and 68. As shown in Figures 2A and 5, the flow of the steam from the duct formed by the cutaway portions of the plate members 40 and 42 and the adjacent housings 60 is over the top of the upper ends of the portions of the wall section 62 and thence downwardly around each of the shelves 64, 68, and 70, and through the openings 58 into the longitudinal passage provided by the plate members 40 and 42. The further flow of the steam is shown in Figure 2A as it passes between the plate members 40 and 42 and thence upwardly between the plate members 42 and 44 and still further upwardly above the plate member 44 and over the end of the section 50' of the plate member 50 and through the shell 54 and upwardly out of the cylinder 56. A plurality of baffles 72 are arranged in spaced relation within the longitudinally extending passageways formed by the plate members 40 and 42 and 42 and 44 with alternate baffles rising from the lowermost ones of such plates and interposed by baffles depending from the uppermost one of such plate members. Other baffles 74 extend transversely within the shell 54 and depend from the upper wall thereof and rise from the lower wall thereof. Adjacent each of the baffles 74 in the lower half of the shell 54 is an aperture 76 opening into a trough 78 which extends along the underface of the portion 50' of the plate member 50 for substantially the length of the shell 54, as shown in dotted lines in Figure 8. The trough 78 has its lower end connected in communication with a downwardly extending conduit 80 (Figure 6) which extends through the plate members 40, 42, and 44 and has its lower end spaced below the plate member 40 and connected in communication with the space between the adjacent aprons 30 and 32 and above the floor section 22.

Other apertures are positioned adjacent the converging ends of contiguous baffles 72, as shown in Figure 11 and designated by the reference numeral 82 and extending through each of the associated plate members 40, 42, and 44, as shown in Figure 9. Referring to Figures 6 and 9, it will be seen that between the plate member 40 and the plate member 42 and between the plate member 42 and the plate member 44 are posts 84, each hollow and having an opening 86 in the lower end thereof. The interior of each post 84 is connected in communication with the adjacent aperture 82 in the associated plate member 42 or 44.

Each of the beams 38 which support the upper floor section 22 is provided with a plurality of spaced apertures 88, as shown most clearly in Figures 3 and 10. The portion of the floor section 24 outwardly of the beams 38 are each provided with other apertures 90, as shown in Figure 2A. Other spaced apertures 92 extend through each of the aprons 30, 32, 34, and 36 with the apertures 92 arranged in rows and being covered by a plurality of spaced horizontally disposed and downwardly sloping baffles 94 having their upper ends secured on the face of the associated apron facing toward the adjacent portion of the drum wall.

Referring to Figure 4, it will be seen that means is provided for introducing wet steam into the flues formed by the aprons 36 and 34 and the adjacent portions of the wall of the drum 14, such means constituting conduits 96 representing the risers in boiler pipes in a conventional boiler installation. Means is also provided for introducing wet steam and simultaneously withdrawing condensed water from the portion of the drum 14 below the floor 20, such means embodying pipes or conduits 98 constituting the downcomer tubes of such a boiler installation. The apertures 88 and the beams 38 constitute ingress means in the floor 20 and in communication with each of the flues formed by the aprons 34 and 36 and the adjacent portions of the walls of the drum and serve to convey condensed water received from the flues into the portion of the drum below the floor 20.

In operation, steam and water are introduced into the

drum 14 in the area below or slightly above the floor 20 and steam is separated from the water and passes through the flues into the duct at each end of the drum 14 and then upwardly into the housings 60 which are arranged as transverse passages intermediate the ends of the ducts, and thence into the longitudinally arranged passageways centrally of the drum and inwardly of each end thereof and finally upwardly over the uppermost plate member 50 into the shells 54 and thence to an outlet from the drum 14 represented by the cylinder 56 for use in the conventional manner.

Water is received in droplets from the free end of each of the baffles 94 as the wet steam is introduced into the flues, such water dropping to the floor and passing through the apertures 26 and 28 into the space in the lower end of the drum for reheating and reuse.

Conventional manhole covers 100 detachably seal a manhole in each end 16 and 18 of the drum 14.

While only a preferred embodiment of the present invention has been shown and described, other embodiments are contemplated and numerous changes and modifications may be made therein without departing from the spirit of the invention as set forth in the appended claims.

What is claimed is:

1. In a steam drier, a hollow closure having a pair of closed ends, a fixed floor in said enclosure and extending from one to the other of the closed ends, means providing at least two spaced longitudinal flues including diverging ends positioned within said enclosure and having each of the adjacent ends spaced inwardly of the adjacent closed end, the space between each of the closed ends and the adjacent ends of said flues forming a collection chamber, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure and extending longitudinally over the diverging ends of said flue providing means and having one end adjacent to and spaced from one of said collection chambers and having the other end adjacent to and spaced from the other of said collection chambers, and means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure between and extending transversely of said one end of said longitudinal passages and the adjacent collection chamber and between the other end of said longitudinal passages and the other of said collection chambers, each of said transverse passages having a longitudinal duct extending through the midportion thereof and having one end in communication with the adjacent collection chamber with the intermediate portion in communication with one of the transverse passages on each side of said intermediate portion and another of the transverse passages on each side of said intermediate portion in communication with the adjacent end of said longitudinal passages.

2. In a steam drier, a hollow closure having a pair of closed ends, a fixed floor in said enclosure and extending from one to the other of the closed ends, means providing at least two spaced longitudinal flues including diverging ends positioned within said enclosure and having each of the adjacent ends spaced inwardly of the adjacent closed end, the space between each of the closed ends and the adjacent ends of said flues forming a collection chamber, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure and extending longitudinally over the diverging ends of said flue providing means and having one end adjacent to and spaced from one of said collection chambers and having the other end adjacent to and spaced from the other of said collection chambers, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure between and extending transversely of said one end of said longitudinal passages

and the adjacent collection chamber and between the other end of said longitudinal passages and the other of said collection chambers, each of said transverse passages having a longitudinal duct extending through the midportion thereof and having one end in communication with the adjacent collection chamber with the intermediate portion in communication with one of the transverse passages on each side of said intermediate portion and another of the transverse passages on each side of said intermediate portion in communication with the adjacent end of said longitudinal passages, means providing an outlet for withdrawing dry steam from one of the longitudinal passages, means for introducing wet steam to be dried into said flues, means for withdrawing condensed water from the portion of said enclosure below said floor, and ingress means in said floor and in communication with each of said flues for conveying the condensed water from said flues into the portion of said enclosure below said floor.

3. A steam drier comprising a hollow enclosure having a pair of closed ends and a wall interposed between and secured to said ends, a floor within said enclosure and extending from one to the other of said closed ends and having the perimeter fixedly attached to said closed ends and the adjacent parts of said wall, a pair of aprons arranged in an upwardly extending diverging direction positioned longitudinally within said enclosure and spaced from said enclosure wall with each of the adjacent ends of said aprons being spaced inwardly of the adjacent closed end and having the convergent ends fixedly supported upon said floor, the space between each of the closed ends and the adjacent ends of said aprons forming a collection chamber and the space between each apron and the adjacent portions of said wall and floor forming a longitudinally extending flue having both ends open and in communication with the collection chambers, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure and extending longitudinally over the diverging ends of said aprons and having one end adjacent to and spaced from one of said collection chambers and having the other end adjacent to and spaced from the other of said collection chambers, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure between and extending transversely of said one end of said longitudinal passages and the adjacent collection chamber and between the other end of said longitudinal passages and the other of said collection chambers, each of said transverse passages having a longitudinal duct extending through the midportion thereof and having one end in communication with the adjacent collection chamber with the intermediate portion in communication with one of the transverse passages on each side of said intermediate portion in communication with the adjacent end of said longitudinal passages, means providing an outlet for withdrawing dry steam from one of the longitudinal passages, means for introducing wet steam to be dried into said flues, means for withdrawing condensed water from the portion of said enclosure below said floor, and ingress means in said floor and in communication with each of said flues for conveying the condensed water from said flues into the portion of said enclosure below said floor.

4. A steam drier comprising a hollow enclosure having a pair of closed ends and a wall interposed between and secured to said ends, a floor within said enclosure and having the perimeter fixedly attached to said closed ends and the adjacent parts of said wall, a pair of aprons arranged in an upwardly extending diverging direction positioned longitudinally within said enclosure and spaced from said enclosure wall with each of the adjacent ends of said aprons being spaced inwardly of the adjacent closed end and having the convergent ends fixedly sup-

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ported upon said floor, the space between each of the closed ends and the adjacent ends of said aprons forming a collection chamber and the space between each apron and the adjacent portions of said wall and floor forming a longitudinally extending flue having both ends open and in communication with the collection chambers, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure and extending longitudinally over the diverging ends of said aprons and having one end adjacent to and spaced from one of said collection chambers and having the other end adjacent to and spaced from the other of said collection chambers, means providing a plurality of tortuous communicating passages arranged in superimposed relation positioned within said enclosure between and extending transversely of said one end of said longitudinal passages and the adjacent collection chamber and between the other end of said longitudinal passages and the other of said collection chambers, each of said transverse passages having a longitudinal duct extending through the midportion thereof and having one end in communication with the adjacent collection chamber with the intermediate portion in communication with one of the transverse passages on each side of said intermediate portion in communication with the adjacent end of said longitudinal passages, means providing an outlet for withdrawing dry steam from one of the longitudinal passages, means for introducing wet steam to be dried into said flues, means for

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withdrawing condensed water from the portion of said enclosure below said floor, and ingress means in said floor and in communication with each of said flues for conveying the condensed water from said flues into the portion of said enclosure below said floor, each of said aprons being provided with a plurality of apertures extending therethrough for egress therethrough of wet steam from said flues into the enclosure between said aprons, there being a plurality of holes in the portion of said floor between said aprons for the discharge therethrough of condensed water into the portion of said enclosure below said floor.

5. A steam drier according to claim 3 wherein each of said aprons has on the face facing toward the adjacent portion of said enclosure wall a plurality of spaced horizontally disposed and downwardly sloping baffles for separating the water droplets from the steam and directing the condensed droplets to said ingress means.

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