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Patented Aug. 15, 1899.

L. DOERR & J. MUNROE, JR.
STEAM BOILER.

(Application filed Apr. 1, 1899.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 4.

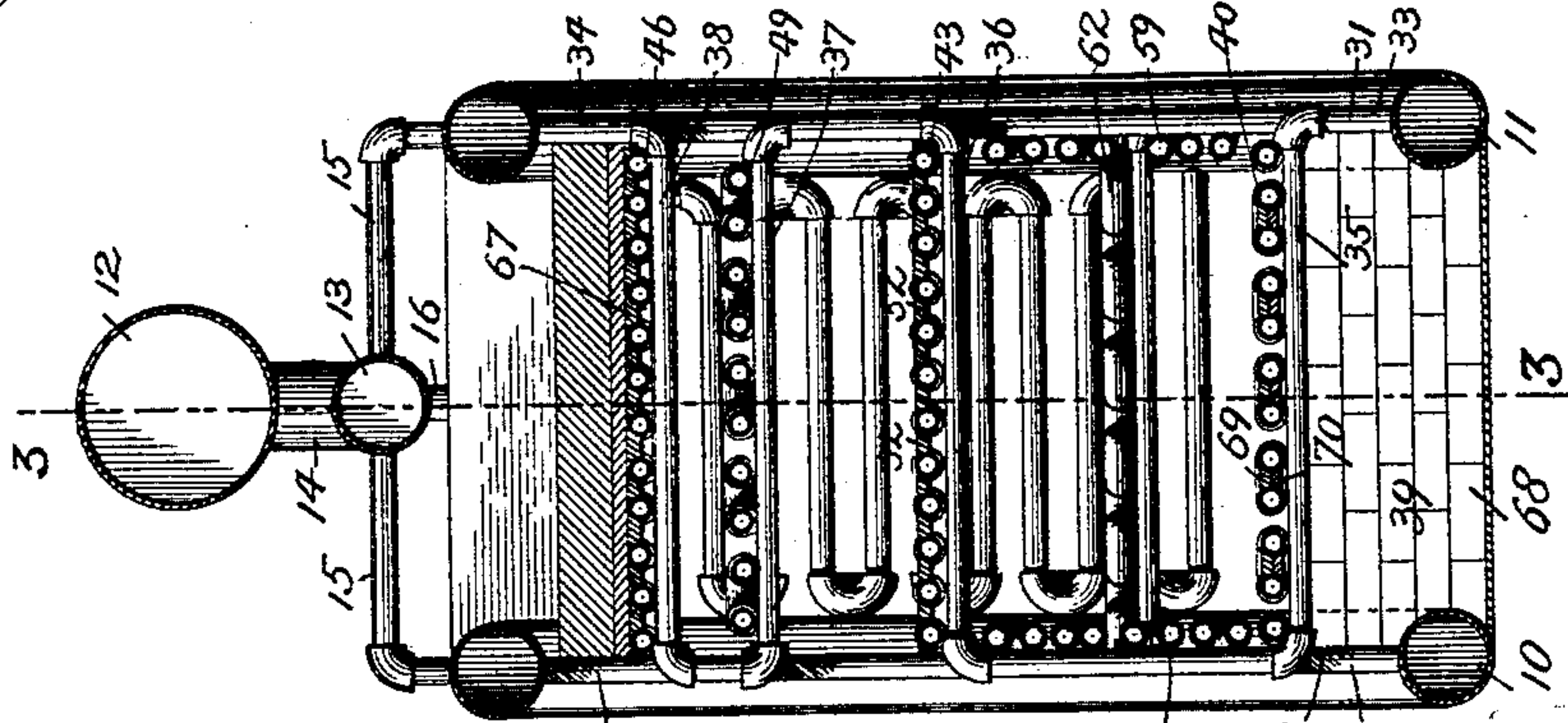


Fig. 5.

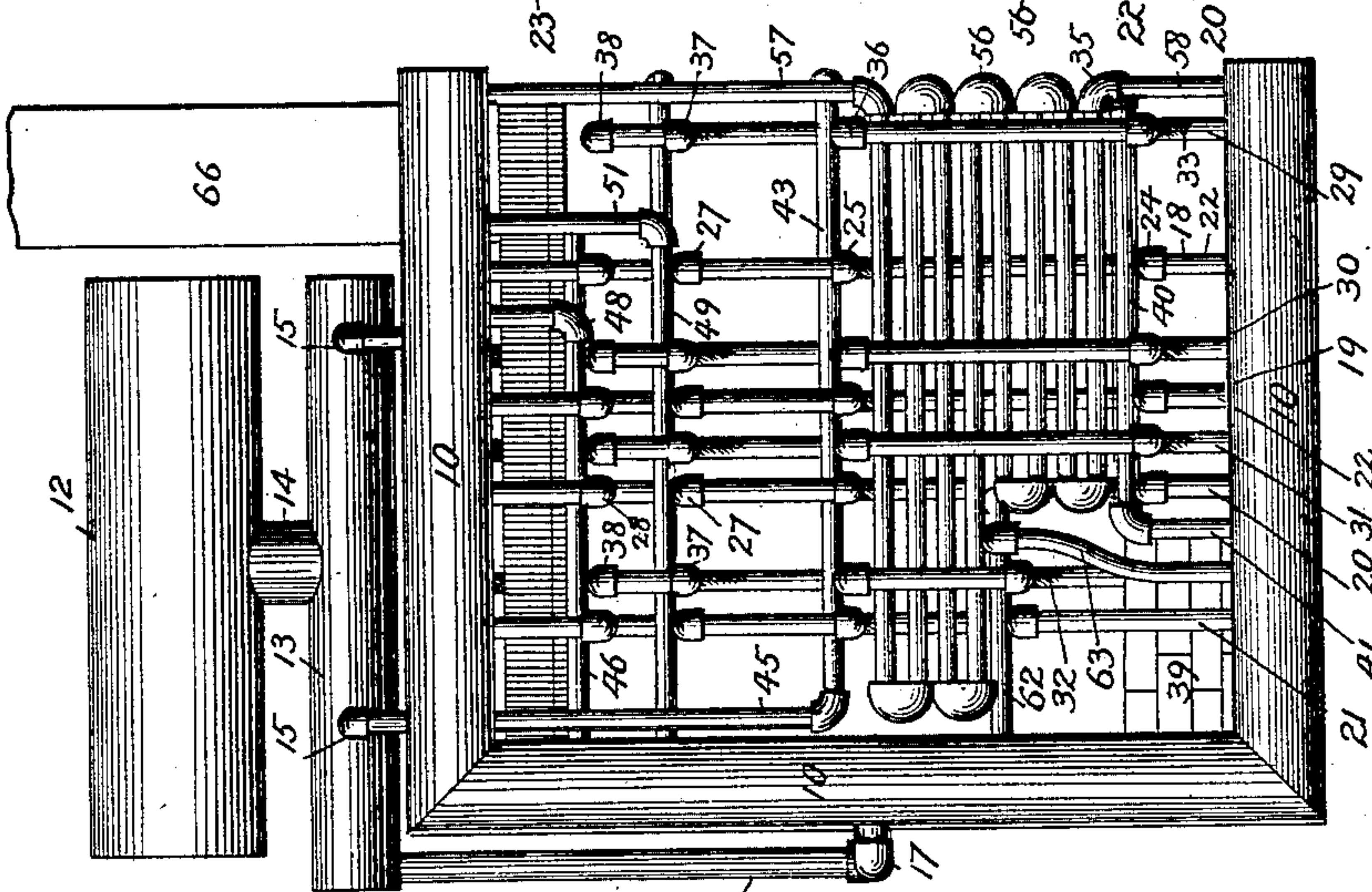
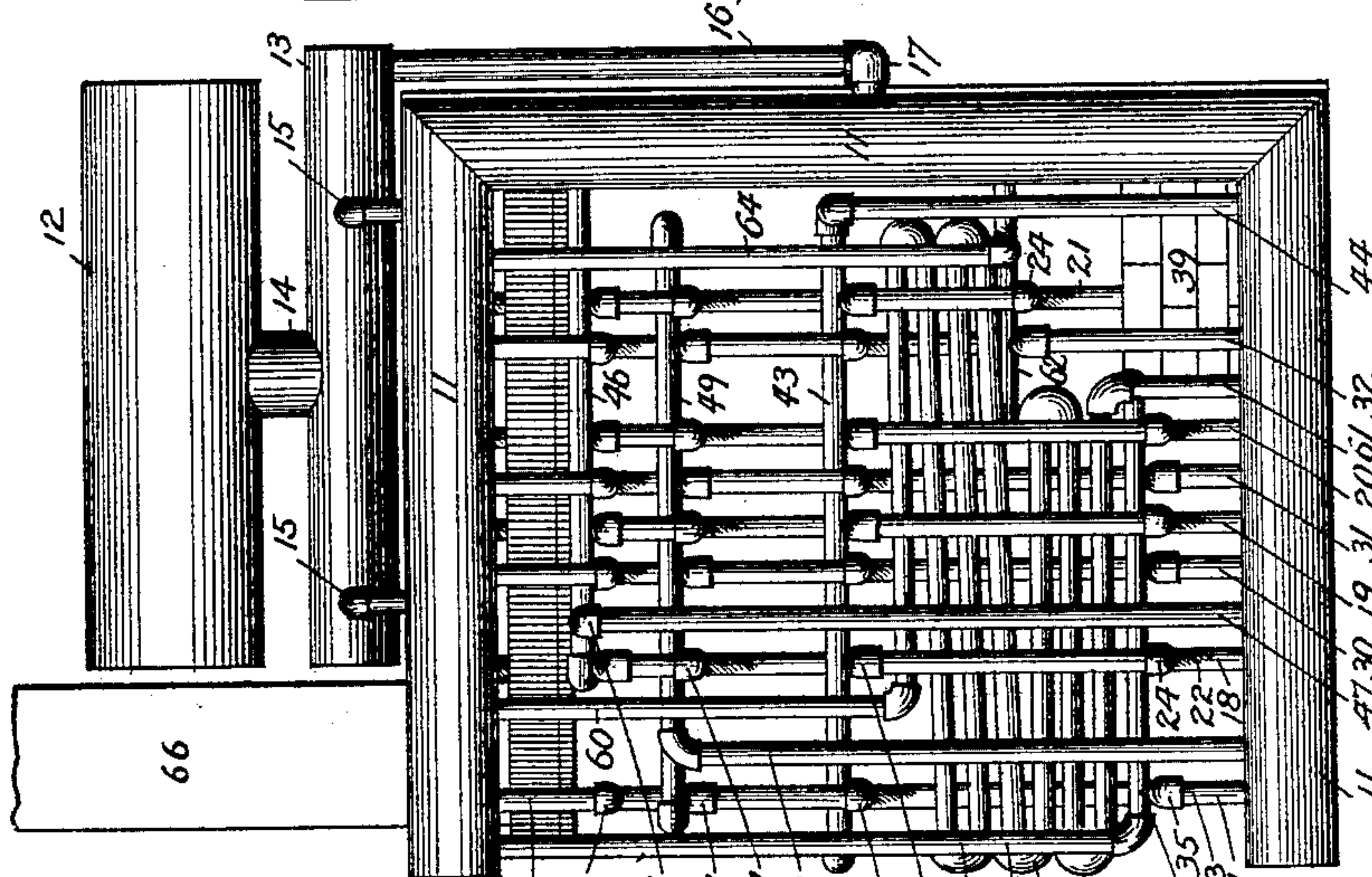


Fig. 6.



Witnesses

Chas. H. Ourand
H. J. Berukoff

By their Attorneys,
Lawrence Doerr and
John Munroe, Jr. Inventors.

C. A. Snow & Co.

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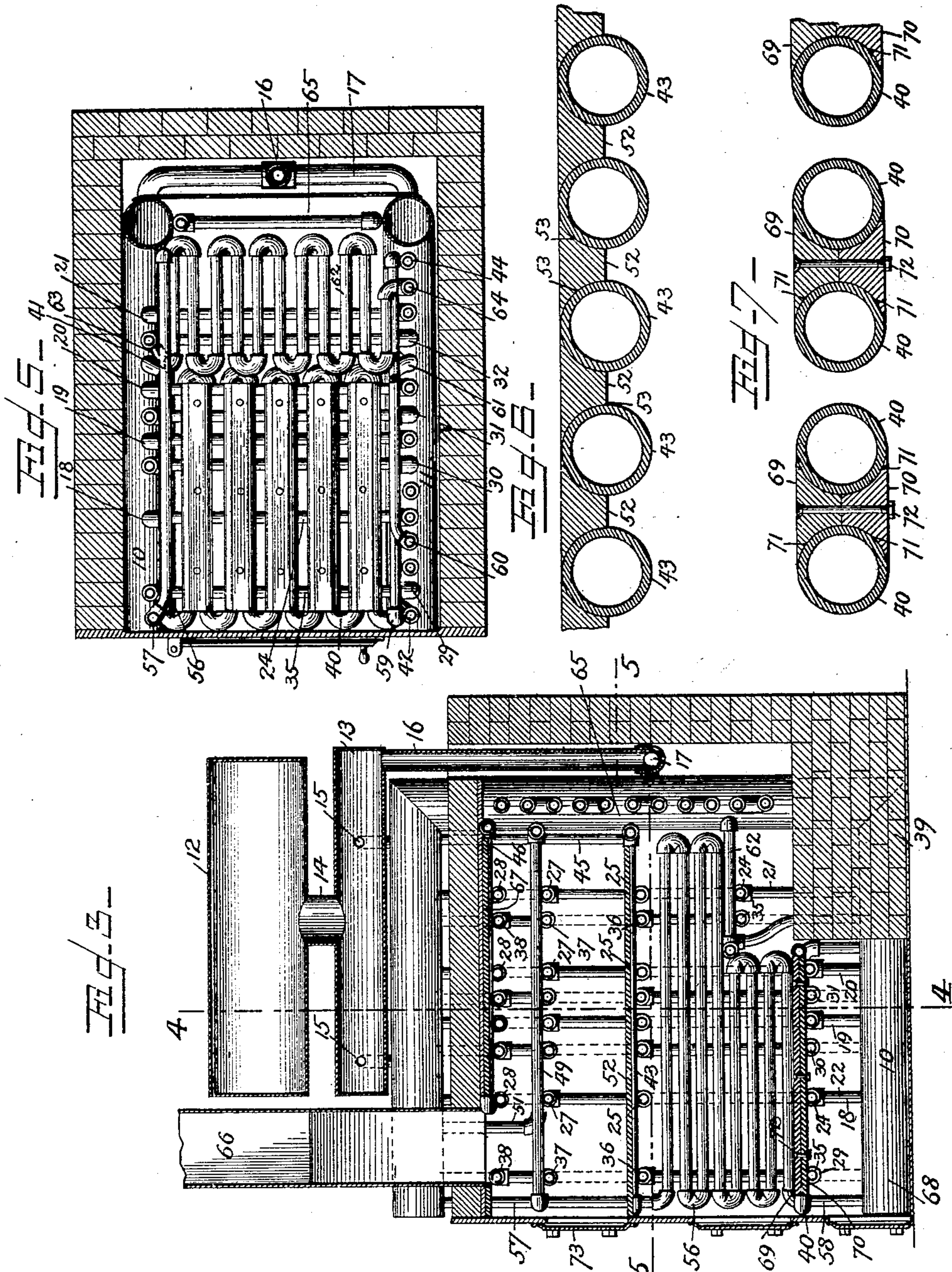
L. DOERR & J. MUNROE, JR.

STEAM BOILER.

(Application filed Apr. 1, 1899.)

(No Model.)

2 Sheets—Sheet 2.



Witnesses

Chas. H. Curran

H. J. Benning

By their Attorneys,

Lawrence Doerr and John Munroe, Jr. Inventors

C. A. Snow & Co.

UNITED STATES PATENT OFFICE.

LAWRENCE DOERR AND JOHN MUNROE, JR., OF SOUTH ARM, MICHIGAN.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 631,006, dated August 15, 1899.

Application filed April 1, 1899. Serial No. 711,399. (No model.)

To all whom it may concern:

Be it known that we, LAWRENCE DOERR and JOHN MUNROE, Jr., citizens of the United States, residing at South Arm, in the county of Charlevoix and State of Michigan, have invented a new and useful Steam-Boiler, of which the following is a specification.

Our invention relates to improvements in steam-boilers; and the object in view is to provide a simple structure in which a large number of tubes provide for the circulation of water and form the walls of the fire-box, the grate, and the walls of the tortuous passage, by which the heat and waste products of combustion may circulate through the boiler to enable them to be utilized in the generation of steam.

A further object of the invention is to provide for the circulation of water admitted to each coil of the boiler from the bottom to the top of said boiler and from one manifold thereof to the other, to insure the return of the water of condensation from the steam-drum to the manifolds, and to close the spaces between certain of the pipes by novel means to form the crown-sheet, as well as to close some of the spaces between certain of the pipes in the coil forming the grate-surface.

With these ends in view the invention consists in the novel combination of elements and in the construction and arrangement of parts which will be hereinafter fully described and claimed.

To enable others to understand the invention, we have illustrated the same in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a side elevation showing the wall broken away and illustrating the structure of the boiler. Fig. 2 is an elevation looking at the opposite side of the boiler. Fig. 3 is a vertical longitudinal sectional elevation taken centrally through the boiler and on the plane indicated by the dotted line 3 3 of Fig. 4. Fig. 4 is a vertical transverse section on the plane indicated by the dotted line 4 4 of Fig. 3. Fig. 5 is a sectional plan view, the plane of section being taken through the combustion-chamber and on the line 5 5 of Fig. 3. Fig. 6 is an enlarged detail view illustrating a series of the pipes forming one of the coils and the means which coact with said pipes to form

the crown-sheet of the combustion-chamber. Fig. 7 is an enlarged detail view illustrating a series of pipes of the coil which forms the grate-surface of the combustion-chamber, and also showing the means for closing the spaces between certain of the grate-pipes in order to reduce the area of the air-inlet openings to the combustion-chamber.

Similar numerals of reference are used to indicate like and corresponding parts in each of the several figures of the drawings.

The framework of our boiler consists of the manifolds 10 and 11, which are disposed in vertical positions on opposite sides of the boiler and in corresponding and parallel relation to each other. Each manifold consists of two horizontal branches or members and a vertical leg which is joined to the horizontal members at one end thereof, each manifold being preferably cast or otherwise produced in a single piece of metal.

The main steam-drum 12 is arranged in a horizontal position above the boiler and about midway between the vertically-disposed manifolds, and below this steam-drum 12 is arranged an auxiliary steam-drum 13, which is of smaller diameter than the drum 12 and is joined firmly thereto by the central connection 14. The auxiliary steam-drum is connected with the upper horizontal members of the two manifolds by means of the transverse steam-pipes 15. The auxiliary drum lies below the main drum and is connected with the manifolds in a manner to convey the steam from the manifolds to the main drum, but the water of condensation which may be formed in the main drum is free to flow through the central connection 14 into the auxiliary drum. A return-pipe 16 is attached to one end of the auxiliary drum 13 to convey water of condensation back to the vertical legs of the manifolds through a branch pipe 17, which is coupled to the return-pipe 16 at its lower end and is fastened to said vertical legs of the manifolds at points intermediate the length thereof.

In our improved boiler we employ two series of water-circulating pipes, which are arranged to occupy the space between the vertical parallel manifolds and are constructed to form a series of benches adapted to support the several series of horizontal coils,

which are embodied in the construction of the boiler to increase the area of the heating-surface thereof, and these transversely-disposed water-circulating pipes each have one
 5 end connected to a lower member of one manifold, while its other end is connected to the upper member of the opposite manifold, thus insuring the circulation of water through
 10 said pipe from the lower part of one manifold to the upper part of the other manifold.

The numerals 18 19 20 21 designate one series of water-circulating pipes, each of which is provided at its lower end with a vertical branch 22, that is coupled to the lower horizontal member of the manifold 10, while the
 15 opposite upper end of each pipe is provided with a vertical branch 23, coupled to the upper horizontal member of the oppositely-arranged manifold 11. Each pipe of the series
 20 of transversely-disposed water-circulating pipes is bent to extend in a horizontal direction, as at 24, below the fire-box, thence carried backwardly and across the top of the fire-box, as at 25, thence extended upwardly
 25 and carried back and forth, as at 27 and 28, in the upper flue for the circulation of the heat and products of combustion. The other series of transverse water-circulating pipes are indicated by the numerals 29 30 31 32, as
 30 arranged in the intervals between the first-named series of circulating-pipes 18 to 21, inclusive. Each of the last-named series of pipes 29 to 32, inclusive, is provided at its lower end with a branch 33, coupled to the
 35 lower leg of the manifold 11, and its other end has a branch 34, fastened to the upper leg of the manifold 10, whereby the pipes 29 to 32, inclusive, are arranged and connected in reverse order to the pipes 18 to 21, inclusive,
 40 to insure the circulation of water through the two series of pipes in reverse directions. Each of the pipes 29 to 32, inclusive, is bent to provide the horizontal lengths 35 36 37 38, which are disposed in the horizontal planes
 45 of the lengths 24, 25, 27, and 28, respectively, of the circulating-pipes 18 to 21, inclusive. These horizontally-disposed lengths of the transverse circulating-pipes herein described provide a series of benches or supports
 50 adapted to sustain and brace the horizontal circulating-coils which enter into the construction of the boiler.

In the lower part of the boiler, at the rear side thereof, we erect a bridge-wall 39, preferably of masonry or fire-brick and which is
 55 disposed in rear of the combustion-chamber and has its upper surface lying in the plane of the lengths 24 35 of the transverse water-circulating pipes.

40 designates a series of pipes forming, practically, a horizontal coil, which is arranged to rest on the lengths 24 35 of the transverse water-circulating pipes, and this horizontal coil 40 occupies the bottom of the combustion-chamber and serves as the grate-surface therein to support the fuel, thereby obviating the employment of a separate grate. Said horizontal

coil is provided at one end with a depending branch 41, which is fastened to the lower member of the manifold 10 on one side
 70 of the furnace. The other end of the horizontal coil 40 has an upwardly-extending branch 42, which is united to the upper member of the manifold 11 on the opposite side of the furnace, thus insuring the circulation of water
 75 through the coil 40 from the lower part of the manifold 10 to the upper part of the manifold 11. Another horizontal coil 43 is arranged at a suitable elevation above and in the plane parallel to the coil 40, and this coil
 80 43 constitutes the top wall of the combustion-chamber. Said coil 43 rests upon the horizontal lengths 25 36 of the transversely-bent circulating-pipes, and it is equipped with the branches 44 45, the former of which is coupled
 85 to the lower member of the manifold 11, while the latter is coupled to the upper member of the manifold 10, thereby insuring the circulation of water through the coil 43 in a reverse direction to the circulation through
 90 the lower grate-coil 40.

At the top or roof of the boiler we arrange a horizontal coil 46, which is disposed in a plane parallel to the coils 40 43 and is arranged
 95 to rest upon the horizontal lengths 28 38 of the transversely-bent circulating-pipes. Said top coil is provided with the branches 47 48, connected, respectively, to the lower branch of the manifold 11 and the upper branch of the manifold 10. Between the horizontal coils 43
 100 46 and within the circulating-flue for the heat and products of combustion is arranged the horizontal coil 49, which rests on lengths 27 37 of the two series of transversely-bent circulating-pipes, said coil 49 lying in a plane parallel
 105 to the coils 43 46. The horizontal coil 49 is provided with branches 50 51, which are fastened to the lower member of the manifold 11 and upper member of the manifold 10, respectively, the water circulating through the
 110 coil 49 in the same direction that the water circulates through the coil 46, although the arrangement of the branches of the two coils may be reversed, if preferred.

In connection with the pipes which constitute the horizontal coil 43 we employ a series
 115 of bars 52, which are arranged in horizontal positions from front to rear of the furnace and are so related to the members of the coil 43 as to form therewith the crown-sheet for the
 120 combustion-chamber. The bars 52 are each provided with concave faces 53, which fit snugly to the pipes of the coil and serve to close the spaces between said pipes, whereby the lower surfaces of the pipes forming the
 125 coil and the bars 52 present a practically continuous surface which arrests the passage of the heat and products of combustion through the coil 43, and thereby forms a complete crown-sheet to the combustion-chamber.
 130

To further increase the area of surface exposed to the action of the heat in the furnace, we employ circulating-coils at the sides of the combustion-chamber, said coils being dis-

posed in vertical positions and connected independently to the manifolds. The vertical coil 56 at one side of the combustion-chamber has its branches 57 58 connected to the upper and lower members of the manifold 10. The similarly-disposed coil 59 on the opposite side of the combustion-chamber has its branches 60 61 coupled to the lower and upper members of the manifold 11. The two vertically-disposed coils constitute the side walls of the combustion-chamber, and they are exposed to the action of the heat therein for the purpose of heating the water which may circulate through said coils from the lower to the upper parts of the manifolds.

From the foregoing description, taken in connection with the drawings, it will be noted that the coils 40 43 are disposed parallel to each other to form the bottom or grate surface and the top or crown sheet of the combustion-chamber, while the vertically-disposed coils 56 59 form the side walls of the combustion-chamber. The rectangular or oblong space inclosed or bounded by the coils 40 43 56 59 form the combustion-chamber 55, which communicates or discharges at its rear end to a circulating-flue 65, that leads over the crown-sheet formed by the coils 43 and the bars 52.

Immediately over the bridge-wall 39 and at the rear of the combustion-chamber 55 is arranged a short horizontal coil 62, having one branch 63 thereof connected to the lower member of the manifold 10, while its other branch 64 is attached to the upper member of the manifold 11. The smoke-flue 65 leads from the combustion-chamber over the crown-sheet and coils 43 and below the coils 46 49, and the waste heat and products of combustion are conveyed by this return-flue 65 through a course to act directly against the coils 46 49, thereby utilizing the waste heat in the generation of steam in the boiler. The smoke-flue 65 bends or returns from the rear part of the boiler to the front thereof, and it discharges into the smoke-outlet 66, which is situated in front of the steam-drums 12 13, as shown.

The roof of the boiler is formed by the horizontal coil 46 and a series of bars 67, each similar in construction to the bars 52 and fitted to the pipes or members of the coil 46 in a similar manner. The bars and upper coil are covered with a layer of asbestos and fire-brick in the manner to complete the roof and confine the heat and products of combustion within the boiler.

The ash-pit 68 is below the grate formed by the lowermost coil 40, and it includes the space bounded by the lower members of the two manifolds and the front of the bridge-wall 39.

The employment of the horizontal coil 40 to constitute the grate-surface leaves openings of large area adapted to admit a large volume of air to the fuel in the combustion-chamber, and it is desirable to reduce the area of these openings between the members

of the said coil 40. We attain this end by the employment of a pair of bars 69 70 between certain of the pipes forming the horizontal coil 40—as, for instance, a pair of bars may be disposed between alternate pairs of pipes in the coil 40. The bars 69 70 are provided with the concave faces 71, which are arranged to fit snugly to the curved surfaces of the pipes forming the coil, and the bar 70 of each pair is arranged in a reverse position to the bar 69, so that the space will be effectually closed between the pipes, and the bars may be united together by the through-bolt 72.

The entire structure of the boiler is housed or inclosed within a suitable brick casing or with any other material, which is provided with doors to admit access to the combustion-chamber and the ash-pit. The front of the furnace is furthermore equipped with a door for the attendant to attain access to the circulating-flue 65 for cleaning out the same.

In our improved boiler the water circulates from one manifold to the other through the transversely-arranged series of pipes and the horizontal coils in the combustion-chamber and the heat-escape flue, and the water also circulates through the side coils and the manifolds. All of these parts are exposed to the heat within the furnace and an exceedingly large area of pipe-surface is thus subjected to the heat for the rapid and economical generation of steam. The coils are comparatively small in diameter, each being composed of piping bent or coupled in sections, and the heat thus acts rapidly on the water to secure generation of steam and circulation of the water. In the series of transverse circulating-pipes the water circulates in opposite directions through adjacent pairs of pipes and the several elements are so disposed that the circulation from one manifold to the other must take place through the pipes.

Changes in the form, proportion, size, and the minor details of construction within the scope of the appended claims may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

What we claim is—

1. In a steam-boiler, the combination of independent manifolds arranged vertically on opposite sides of a combustion-chamber, circulating-pipes each connected at their respective ends with upper and lower parts of the oppositely-arranged manifolds, and horizontal coils arranged to form the combustion-chamber and the heat-circulating flue, each coil connected at its respective ends to the opposite manifolds, substantially as described.

2. In a steam-boiler, the combination of the vertical manifolds arranged on opposite sides of a combustion-chamber, horizontal coils forming the grate-surface and the crown-sheet of the combustion-chamber and terminally connected to the oppositely-arranged manifolds, and means for supporting the horizontal coils, substantially as described.

3. In a steam-boiler, the combination of the

vertical manifolds arranged on opposite sides of a combustion-chamber, the circulating-pipes terminally connected to the opposite manifolds and bent between the latter to form horizontal branches, and horizontal coils resting on the branches at the bottom and top of the combustion-chamber and also terminally connected to the upper and lower parts respectively of the oppositely-arranged manifolds, substantially as described.

4. In a steam-boiler, the combination of vertical manifolds, the transverse circulating-pipes bent at numerous points between the manifolds to form a series of horizontal branches at the bottom and top of the combustion-chamber, each circulating-pipe connected at its respective ends to upper and lower parts of the oppositely-arranged manifolds, and the horizontal coils resting on said branches and each coil terminally connected at its respective ends to the opposite manifolds independently of the circulating-pipes, substantially as described.

5. In a steam-boiler, the combination of the manifolds arranged vertically on opposite sides of a combustion-chamber and the series of horizontal coils connected individually to the manifolds and extending back and forth across the space between said manifolds, each coil having one end coupled to the lower part of one manifold and its other end united to the upper part of the other manifold, substantially as described.

6. In a steam-boiler, the combination of the manifolds each having horizontal members joined at one end by a leg and with said manifolds arranged in vertical parallel positions at opposite sides of the furnace, the transverse circulating-pipes arranged in two series and connected in reverse order to the lower and upper members of the oppositely-arranged manifolds, and horizontal coils each having one end connected to the lower part of one manifold and its other end joined to the upper part of the other manifold, said circulating-pipes and the coils crossing the space between the oppositely-arranged manifolds substantially as described.

7. In a steam-boiler, the combination of the side manifolds each having the upper and lower members connected together by a leg, the horizontal coils each terminally connected to the upper and lower members of the oppositely-arranged manifolds, and the side coils lying in the vertical planes of the manifolds, each side coil connected at its upper and lower ends to the branches of one manifold, substantially as described.

8. In a steam-boiler, the combination of the side manifolds, the horizontal and vertical coils forming the combustion-chamber and connected individually to said manifolds, a bridge-wall at the rear of the combustion-chamber, and a horizontal coil over the bridge-

wall, at the rear of the combustion-chamber, and connected to the respective manifolds, substantially as described.

9. In a steam-boiler, the combination with oppositely-arranged manifolds each having the horizontal branches at its upper and lower ends, the grate-coil arranged horizontally at the bottom of the boiler and having the terminal branches connected respectively to the lower branch of one manifold and the upper branch of the other manifold, and a plurality of coils at the sides and across the space between said manifolds, each coil connected terminally to the opposite manifolds, substantially as described.

10. In a steam-boiler, the combination with oppositely-arranged manifolds each having at its upper and lower ends the horizontal branches, a grate-coil connected terminally to the upper and lower branches of the opposite manifolds, and the vertical coils arranged on opposite sides of the grate-coil to form therewith parts of the combustion-chamber, and each vertical coil connected terminally with the upper and lower branches of one manifold, substantially as described.

11. In a steam-boiler, the combination with oppositely-arranged manifolds, a horizontal grate-coil connected terminally with said manifolds, and a horizontal bench-coil arranged in rear of and on a plane above the grate-coil, and also connected terminally with said manifolds, substantially as described.

12. In a steam-boiler, the combination of side manifolds, the coils, a main steam-drum, an auxiliary steam-drum connected to the main drum and the upper members of the manifolds, and a return water-pipe connected to the rear end of the auxiliary drum and having branch connections with the manifolds at points intermediate the length of the manifold legs, substantially as described.

13. In a steam-boiler, the combination of the manifolds, the transverse pipes arranged in two series to form the benches and connected to upper and lower parts of the respective manifolds, the horizontal coils resting on said benches and connected individually to the manifolds, each transverse pipe and horizontal coil crossing back and forth through the space between the side manifolds, and the side coils each arranged in the vertical plane of one manifold and terminally connected to upper and lower parts of said manifold, substantially as described.

In testimony that we claim the foregoing as our own we have hereto affixed our signatures in the presence of two witnesses.

LAWRENCE DOERR.
JOHN MUNROE, JR.

Witnesses:

JOHN A. BOOSINGER,
FREDERICK E. BOOSINGER.