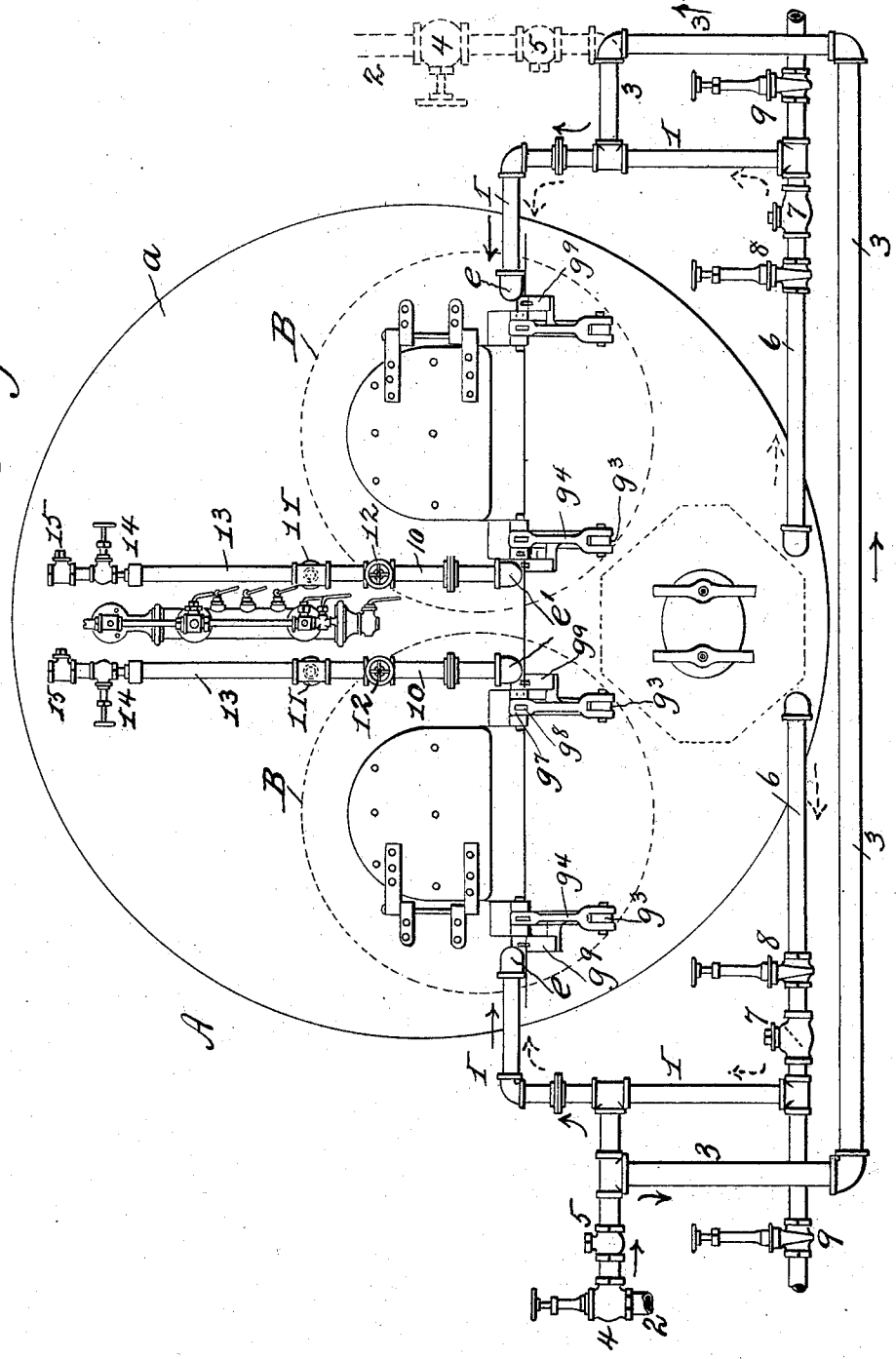
(No Model.) 5 Sheets—Sheet 1.

J. REAGAN.

CIRCULATING WATER BAR AND SHAKING GRATE.

No. 545,979. Patented Sept. 10, 1895.

Fig. 1.



Witnesses:
J. M. Fowler Jr.
Chas. F. Vanstavoren

Inventor:
James Reagan
By J. Vanstavoren
Attorney.

(No Model.) 5 Sheets—Sheet 2.

J. REAGAN.

CIRCULATING WATER BAR AND SHAKING GRATE.

No. 545,979. Patented Sept. 10, 1895.

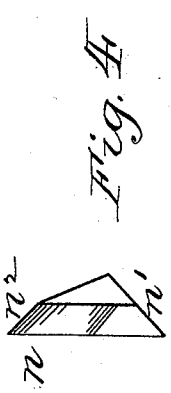


Fig. 4

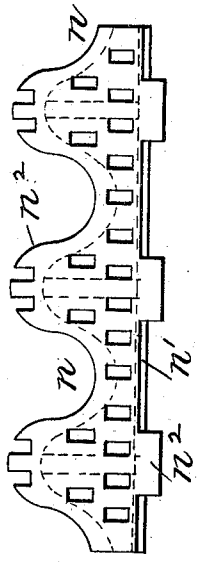


Fig. 3

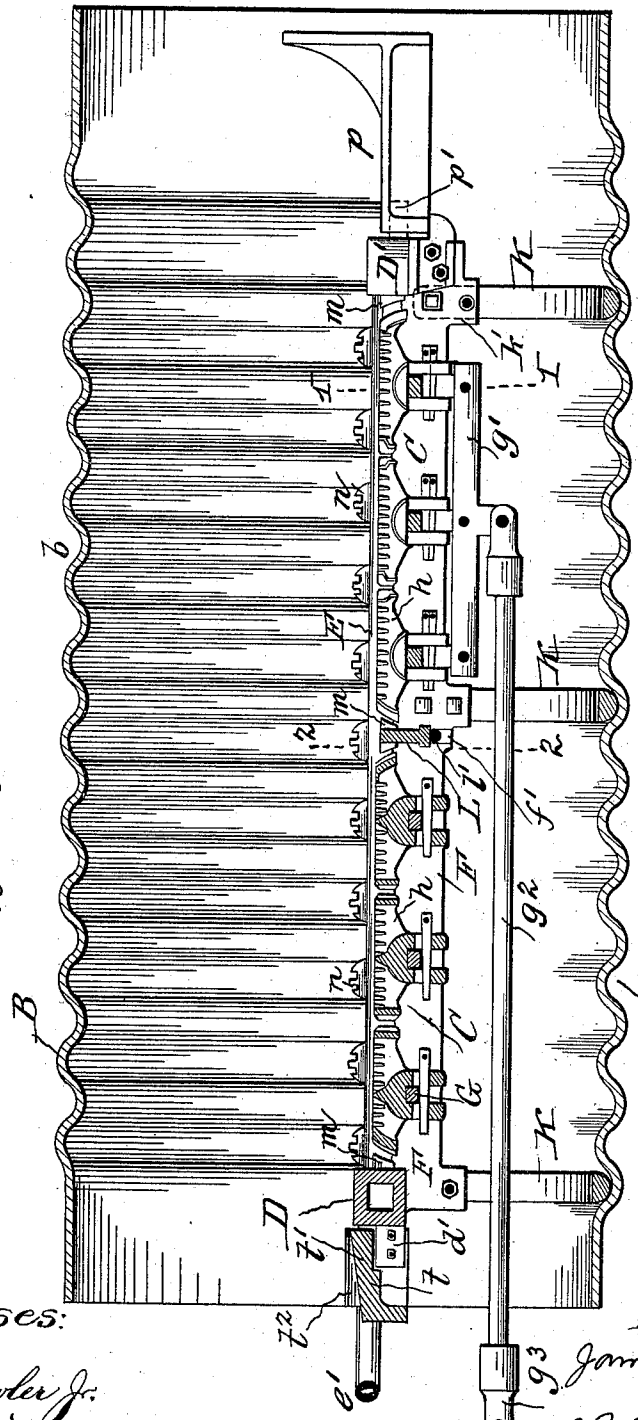


Fig. 2

Witnesses:

J. McFowler Jr.

Chas. F. Vanstavorn

Inventor:

James Reagan

By O. J. Vanstavorn

Attorney.

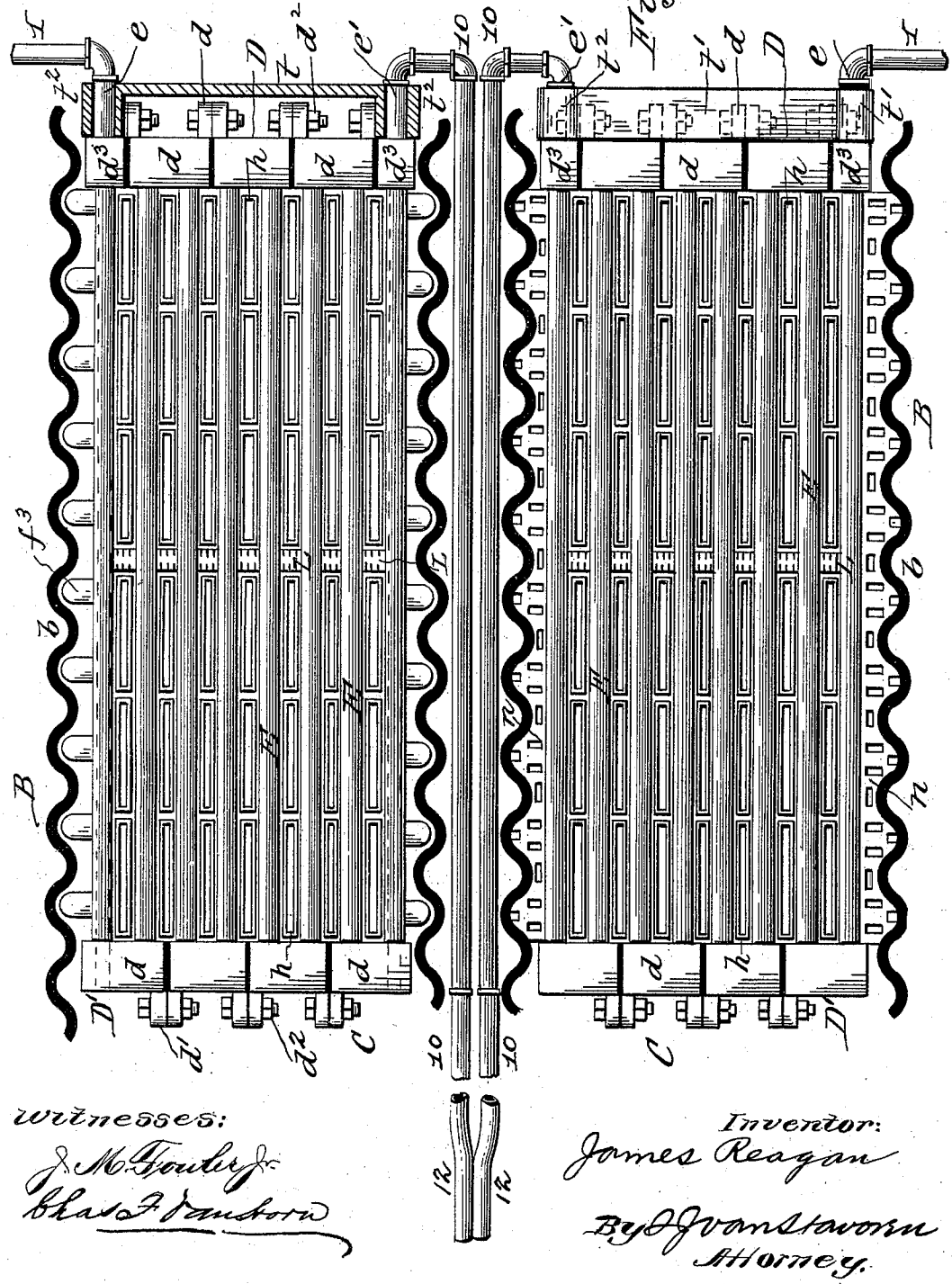
(No Model.) 5 Sheets—Sheet 3.

J. REAGAN.

CIRCULATING WATER BAR AND SHAKING GRATE.

No. 545,979. Patented Sept. 10, 1895.

Fig. 5.



Witnesses:
J. M. Foulke Jr.
Chas. F. Faustorn

Inventor:
James Reagan
By J. Van Santvoorn
Attorney.

(No Model.) 5 Sheets—Sheet 4.

J. REAGAN.

CIRCULATING WATER BAR AND SHAKING GRATE.

No. 545,979. Patented Sept. 10, 1895.

Fig. 6

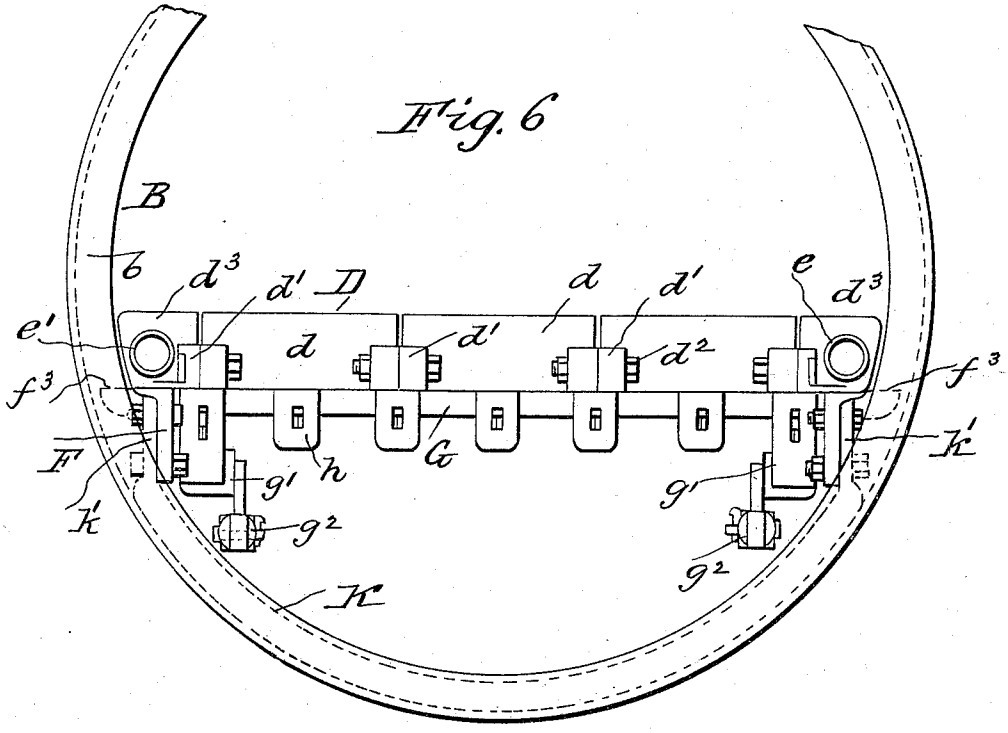


Fig. 7

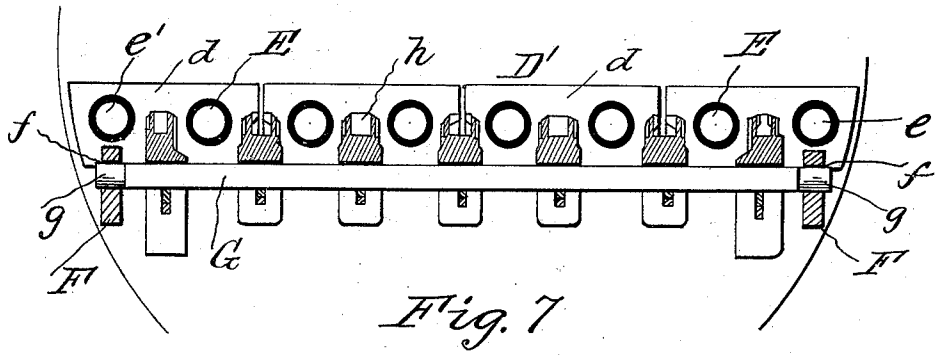
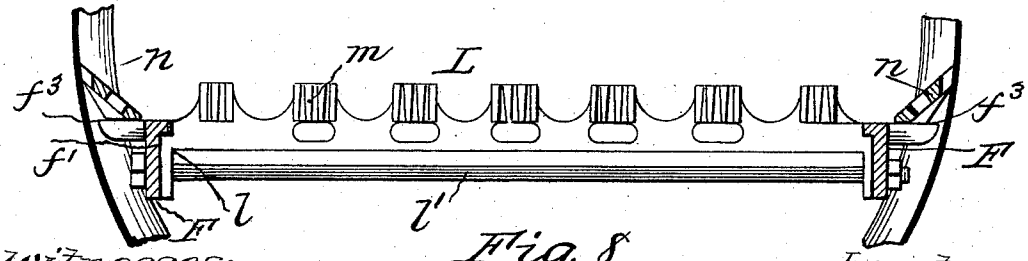


Fig. 8



Witnesses:
J. M. Fowler Jr.
Chas. F. Dunstorn

Inventor:
James Reagan
By C. J. Van Slaorn
Attorney.

(No Model.) 5 Sheets—Sheet 5.

J. REAGAN.

CIRCULATING WATER BAR AND SHAKING GRATE.

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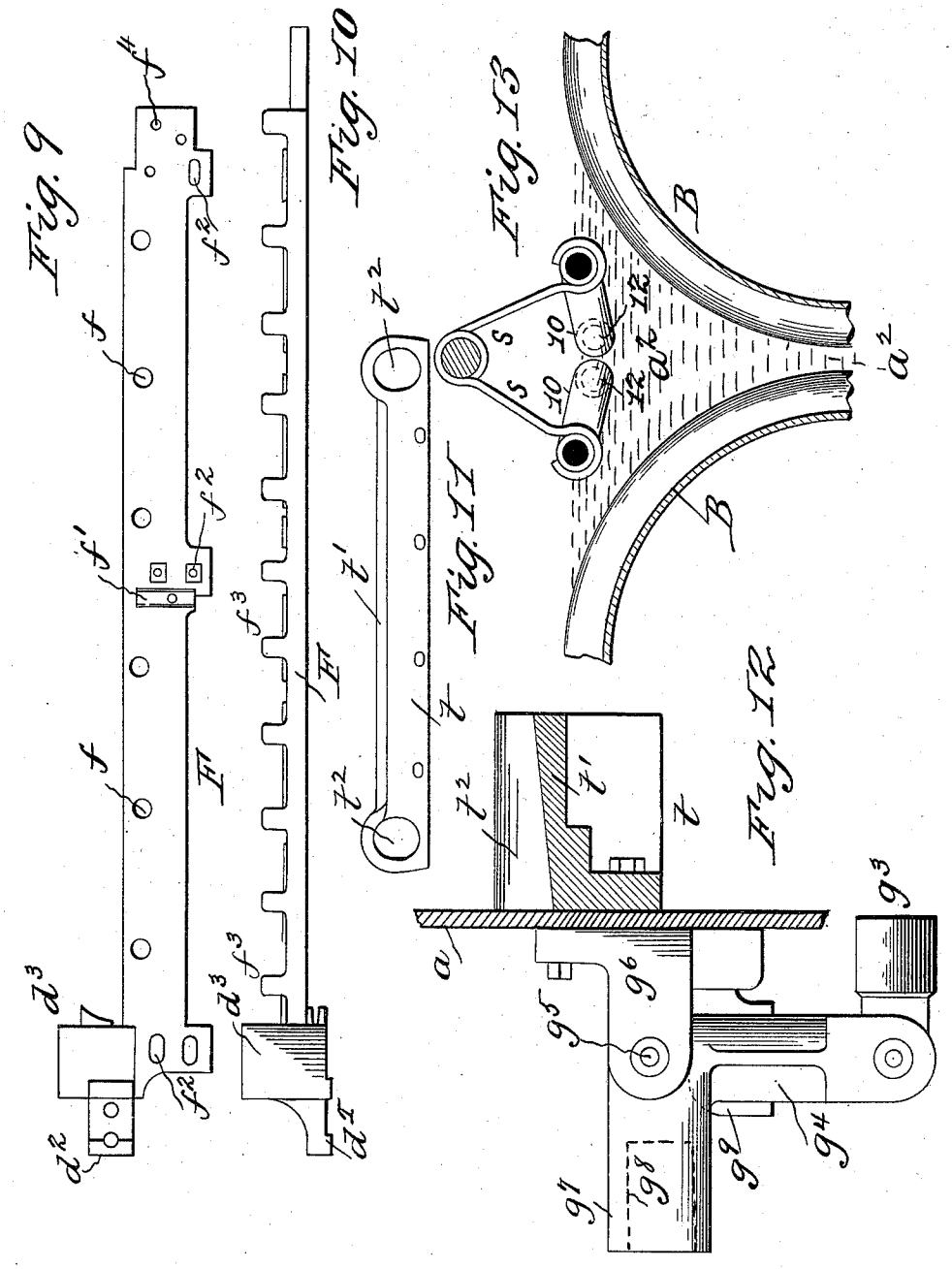

Witnesses:
J. M. Fowler Jr.
Chas. F. Burroughs

Inventor:
James Reagan
C. J. Vanstavoren
By
Attorney.

UNITED STATES PATENT OFFICE.

JAMES REAGAN, OF PHILADELPHIA, PENNSYLVANIA.

CIRCULATING WATER-BAR AND SHAKING GRATE.

SPECIFICATION forming part of Letters Patent No. 545,979, dated September 10, 1895.

Application filed September 10, 1894. Serial No. 522,547. (No model.)

To all whom it may concern:

Be it known that I, JAMES REAGAN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Circulating Water-Bar and Shaking Grates; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has relation generally to grates for marine boilers, or particularly to that form of boilers having parallel separate circular furnaces the walls of which are either smooth or are laterally corrugated from end to end of the furnace for securing maximum heating-surface.

My invention has for its object the application to such boiler-furnaces of the circulating water-bar and shaking grates, particularly that form of the same shown, described, and claimed by me in United States Letters Patent dated and numbered, respectively, September 8, 1891, No. 459,342, and December 8, 1891, No. 464,649. To effect this described application it is essential that the grate be a self-contained grate, so that all of its parts can be assembled together before it is inserted in position in the furnace, and when inserted therein and lowered to find its supports or bearings it will conform as near as may be to the circular formation of the furnace, and in such manner that its supports do not offer any projecting obstructions on the floor or bottom of the ash-pit of the furnace; the height of the ash-pit is maintained unimpaired or unobstructed and all dead spots at the sides of the grate contiguous to the longitudinal sides of the furnace are avoided, and, furthermore, to have the side bearing-bars of the grate so constructed and located relatively to the outside water-bars of the grate that all danger of warping or burning out said side bearing-bars is prevented.

My invention has for its further object to so circulate the feed-water through the grate and provide for an automatic circulation of water from the boiler to and through the grate back to the boiler when the feed is cut off that the temperature of the water in all parts of the boiler is equalized instead of varying, as is now the case, and hence the expansion and contraction due to such variable temperature of the water in the boiler are obviated and all separate or extraneous devices heretofore used in attempts to procure such equalization of temperature are dispensed with.

To the accomplishment of the above-described objects the water-bars and shaker or chopper bars of the grate are supported upon side bars which are connected to and supported by laterally-located U-shaped feet or bars, which fit into the corrugations of the lower part of the furnaces to hold themselves and the grate in position, and which also admit of assembling all parts of the grate together and introducing it as a whole in position into the furnace. Furthermore, the side bearing-bars of the grate are located below and within the line of the outside water-bars of the grate in order that such outside water-bars may form the outer sides of the grate to be contiguous to the side walls of the furnace for preventing the formation of dead spots in the fire along such sides and avoid warping and burning out of the side bearing-bars of the grate, said outside water-bars also affording bearings or contact-surfaces for inclined plates having outer side edges conforming to the longitudinal outline of the corrugated furnace-walls for preventing such plates burning out. Furthermore, the system of feed-water circulation through the water-bars for each furnace may be a separate one for each grate; or, if preferred, a feed common to both may be used. Again, for the purpose of more effectually cleaning the bottom of the boiler and the water-bar parts of the grates separate or more than one blow-off system of pipes with valves may be employed.

My invention accordingly consists of the combinations, constructions, and arrangements of parts, as hereinafter more fully described in the specification and pointed out in the claims.

Reference is had to the accompanying drawings, wherein—

Figure 1 is a front elevation of a form of marine boiler, showing a system of pipe connections with the separate furnace-grates for feeding the water into and through the grates to the

boiler and for effecting an automatic circulation from the bottom of the boiler through the grates back to the top of the boiler, also for blowing off either from the top of the boiler through the grates or from the bottom of the boiler, and also for preventing the formation of steam or air traps in the water-bar grates. Fig. 2 is a longitudinal section, partly in elevation, of one of the boiler-furnaces and a water-bar shaking grate embodying my improvements. Fig. 3 is a plan, drawn to an enlarged scale, of part of the loosely-supported side plates for use with the grates when inserted in furnaces having laterally-corrugated walls. Fig. 4 is an end view of such plates. Fig. 5 is a plan view, partly sectional, showing the separate parallel circular corrugated furnaces broken away, the grates therein, and part of the feed and discharge pipe connections therefor. Fig. 6 is an open end view of one of the furnaces and the grate. Fig. 7 is a partial section on the line 1 1, Fig. 2. Fig. 8 is a like view on the line 2 2, Fig. 2. Fig. 9 is an elevation from an inside point of view of the side bearing-bars for the grate, showing the integral formation of said bars with the end support or box for the inlet and outlet pipe connections for the water-bars of the grate. Fig. 10 is a plan view of the same. Fig. 11 is a front elevation of a form of dead-plate for use with the water-bar and shaking grate. Fig. 12 is a sectional elevation drawn to an enlarged scale, showing the front plate of the boiler, the dead-plate connected thereto, and shaking appliances located outside of said front plate for attachment to the shaker-bars of the grate for actuating them. Fig. 13 is a detail sectional elevation drawn to an enlarged scale, showing more plainly the position of the grate discharge-pipes in the boiler and also supports for the same.

A represents a marine boiler of any suitable construction, or one having the usual or other type of parallel furnaces, B B, the walls of which may be plain, straight, or laterally-corrugated from end to end, as shown at *b* in the drawings.

C represents the circulating water-bar and shaking grate for each furnace, which grates, so far as their water-circulating system and their pipe connections with the boiler feed devices and with the boiler itself are concerned, may be of any suitable construction; but for obtaining the efficient results already described I prefer the form of grates and the construction of their parts as shown in the drawings and hereinafter to be described. As the grates for each furnace are identical in construction, a description of one will answer for both. A grate C consists of front and rear end bearing-bars D and D′, composed of sections or boxes *d*, having preferably horizontally-located side lugs *d′*, which are bolted together, as indicated at d^2, (see more plainly Fig. 6,) to make said end bearing-bars componently self-sustaining. The lugs *d′* are preferably horizontally located on the outer sides of the sections *d* for two reasons: first, being horizontal instead of vertical, they do not depend into the ash-pit to obstruct the upper part of the same; or, in other words, the height of the ash-pit remains unimpaired, furthermore, as such lugs do not come in contact with the curved sides of the furnace, a full width of grate-surface is obtained; and, second, said lugs form outside projections at end of the grate for engagement at its front end with the under side of the dead-plate and at its rear end with a cross-bar or the bridge-wall for holding down the grate in a firm position, as hereinafter more fully set forth. The sections *d* of the rear end bearing-bar D′ are hollow, and each section forms part of the water way or line of the grate, as is also the case for the sections *d* of the front end bearing-bar D, except the outer sections d^3, which do not form part of such water way or line, but simply serve as supports for the projecting ends of the inlet and outlet pipes *e* and *e′*, respectively, of the system of pipes E, connecting the front and rear end bearing-bar boxes or sections *d*. The supporting boxes or sections d^3 of the front end bearing-bar D may be of any suitable construction, and they may be secured to the side bearing-bars F F in any suitable manner; but for the sake of compactness of construction, as well as to provide for locating the side bearing-bars F below and in the line of the vertical center of the outside water-bars *e e′*, the sections or boxes d^3 of the front bearing-bars D are formed integral with the side bearing-bars F F, as shown more plainly in Figs. 9 and 10. In this construction of side bearing-bars F F there are formed in them bearings *f* at intervals along their length, inner vertical recesses *f′* on their inner sides, and bolt-openings f^2, for purposes hereinafter set forth.

Upon the outer surfaces of bearing-bars F F are laterally-projecting lugs f^3 for projection into the depressions of the corrugations *b* of the furnace-walls, (see more plainly Fig. 5,) for a purpose hereinafter explained. When the furnace-walls are not corrugated, these projecting lugs on the bars F F may be dispensed with. The sections or supports d^3 on bars F F, are formed with lugs d^2 for bolting thereto the sections *d* of the front bearing-bar D, while the rear sectional bearing-bar D′ is bolted directly to the rear ends of the side bearing-bars F F, suitable openings f^4 being made in said ends for such connection.

In the bearings *f* of the side bars F F are mounted the journals *g* of cross-shafts G, which preferably are of an angular form in cross-section, and upon which are keyed or otherwise fastened the chopper or shaker bars *h*. (See more plainly Figs. 2 and 7.) These chopper or shaker bars *h* are preferably of the form and are fastened to the cross-shafts G as shown and as fully set forth and claimed in United States Letters Patent granted to me

December 8, 1891, No. 464,649, and need not, therefore, be more particularly described.

The chopper or shaker bar shafts G for long length of grates are divided into one or more series, and each of the latter have suitable link connections g' with an operating-rod g^2, (see more plainly Fig. 2,) the outer end g^3 of which is in engagement with a bell-crank lever g^4, pivoted at g^5 in a hanger g^6 on the front plate of the boiler. The limb g^7 of the bell-crank g^4 has a recess or socket g^8 for the reception of an actuating-handle for shaking the choppers or shakers h. If desired, any suitable form of pivoted latch g^9 may be employed for engagement with the bell-crank g^4 for locking it and the series of shaker-bars h which it controls in their normal position, which latch is released when the shakers are to be actuated. According as is the formation or outline of the furnace in cross-section within which the grate is to be inserted therein will be the configuration of the legs or supports K for grate. In the drawings these legs K are shown segmental or U-shaped to conform to the circular outline of the lower part of the furnaces B, and if the walls of the latter are corrugated, as shown, said legs are preferably constructed of half-round iron, with the rounding parts thereof turned down to fit into and have their bearing in the depressions of the corrugations, as more plainly shown in Fig. 2. The upper ends k' of the hoop-legs or supports K are secured to the side bars F by bolts or other fastening media passing through the openings f^2 in said side bars.

L represents the transverse bridge-bar which is used in long lengths of grates. This bar may be of any suitable construction in cross-section. (Seen more plainly in Fig. 8.) Its ends l fit into the vertical recesses f' on the inner side of the side bearing-bars F F and are held in place by a cross-bolt l', upon the top of which the lower side of the bridge-bar L impinges to afford additional stay for said bridge-bar. The inner sides of the end bearing-bar sections d, as well as both sides of the bridge-bar L, may be provided with projecting lugs m, having curved sides next to the ends of the adjacent shakers or choppers h (see more plainly Fig. 2) to fill up the spaces between said parts, and thereby avoid coal falling from the grate.

n represents loosely-supported inclined plates in position between the side bearing-bars of the grate and the adjacent wall of the furnace. These plates may be of any suitable construction in cross-section, or, as shown more plainly in Figs. 2 and 8, the lower edge n' thereof rests on the projecting lugs f^3 of the side bars F F and has depending lugs n^2 intervening between the lugs f^3, (see more plainly Fig. 5,) and the other corrugated edge n^2 of said plates conforms to and rests against the corrugations b of the furnace-walls. The plates n are used to prevent fuel falling down between the sides of the furnace-wall and the grate when the former is corrugated. The plates n are perforated as desired or as shown to provide the proper air-supply at the sides of the grate next the furnace-walls.

The rear end of the grate is held down by any suitable construction of cross-bar or by the bridge-wall p engaging with the upper side of the lugs d on the end bearing-bar D', as indicated at p', Fig. 2.

t represents the dead-plate at the front end of the boiler, which is bolted to its front plate a, as shown more plainly in Fig. 12, and its horizontal part t' laps over the lugs d' on the front bearing-bar D to hold down the front end of the grate. Each end t^2 of said dead-plate is made tubular (see more plainly Fig. 11) for the passage through said ends of the inlet and outlet ends e e' of the pipe system E of the grates, and corresponding and aligning openings are also made in the front plate a for a like purpose, so as to bring said ends e e' to the outside of the front of the boiler. The system of pipe connection for said ends e e' of the grates with the boiler feed device and with the boiler is more plainly shown in Figs. 1 and 5.

The inlet ends e have a pipe connection 1 with the boiler feed device, which may be a pump or injector. (Not shown in the drawings, as they are well known.) Each pipe 1 may connect with a separate feed device pipe 2, as indicated by full lines to the left and by dotted lines to the right of Fig. 1 in the drawings, or one feed-device pipe 2 may serve for both, in which case the pipe 2 to the left of said drawing has a branch 3, which connects with the pipe 1 to the right of said drawing. In either case the feed-pipe 2 is provided with a normally-open cut-off valve 4, and between the latter and the inlet end e of the grate is located a check-valve 5, which opens to the feed of the pump and closes under the boiler-pressure. This check 5 is used to avoid back-pressure on the pump when the feed to the boiler is cut off. Pipes 1 have a connection with pipe 6, leading to the bottom of the boiler, in the line of which is a check-valve 7 and a normally-open cut-off valve 8 between said check 7 and the boiler. These check-valves 7 close against the feed-pressure and open to the boiler-pressure. Beyond the connection of pipes 1 with pipes 6 is located another cut-off valve 9, which is normally closed and forms the blow-off valve for the boiler and grates. The outlet-pipes e' of the pipe systems E connect to pipes 10, which pass into the boiler at or near its water-level, as shown at 11, Fig. 1, and are conducted into the boiler to beyond the rear end of the grates, or as desired. Their ends 12 are brought together, so as to deliver the heated water therefrom upon or into the column of water between the furnaces B B, or as indicated at a^2, Fig. 13, thereby preventing such water falling upon the furnace-walls to injure or deteriorate the same.

Suitably-constructed stay or supporting rods *s* are located within the boiler for the pipes 10, as shown more plainly in Fig. 13, which also shows the location laterally of the path of the pipes 10 within the boiler relatively to the furnace-walls and also the junction of their delivery ends. In the line of pipes 10, in advance of their entrance to the boiler, are located normally-open cut-off valves 12. Immediately in advance of the entrance of pipes 10 into the boiler said pipes have vertically-projecting branches 13, which include normally-open cut-off valves 14 and check-valves 15 beyond the former, which checks open to the air under pressure of any accumulating air or steam in pipes 10 and 13. Both the latter are of the same diameter to more effectually provide for preventing the formation of air or steam trapping in the water-bars of the grates, as fully described in my aforesaid patent.

The feed from the pump-pipe 2 passes in the directions of the full-line arrows to the inlet ends *e* of grates, through the latter, and thence to the water-level of the boilers. This flow continues as long as the feed devices are in operation. When the latter are cut off, the check-valves 5 automatically close and the check-valves 7 correspondingly open to provide for an automatic circulation in the direction of the dotted-line arrows from the boiler through the grates and back to the boiler.

By closing the cut-off valves 8 and opening the blow-off valves 9 the top of the boiler is blown off, and by opening valves 8 and closing valves 12 the bottom of the boiler is blown off. By opening both valves 8 and 12 both the bottom and top of the boiler may simultaneously be blown off. This may be effected at any time, either while the boiler is in action or otherwise. In blowing off from the top of the boiler the line thereof is back over that of the line of feed through the grates, and the latter are thereby blown off or cleansed.

From the foregoing it will be noted that, owing to the manner of feeding the water to the boiler through the separate grates and the delivery of such feed into the boiler at or near its water-level and of connecting the grates to the bottom of the boiler to provide for the automatic circulation of the water from the bottom of the boiler to and through the grates and back to the top of the boiler, the temperature of its water is equalized and expansion and contraction of the boiler due to any varying temperature of its contained water are avoided. This is an especially desirable result to obtain in marine boilers, as it is well known that in them the water below the fire-line is of a lower or different temperature from that above the fire-line. Attempts have been made to equalize such varying temperature of the water in the boiler by using extraneous pumps or injectors to circulate such water; but they are only effective in starting fresh fires. After the boiler is under pressure these devices are defective, as the steam finds its way down through the water to the pumps or circulating devices. Hence as soon as the boiler is under pressure said devices are cut off and the varying temperature of the boiler-water is left to take care of itself, whereas with the foregoing device the automatic circulation, as described, circulates such water from bottom to the top of the boiler through the grates, when the feed-water is cut off to equalize its temperature and all danger due to such variable temperature of the boiler-water is avoided. From this it follows that in getting up steam in a cold boiler much less time is required and the pressure is maintained with less consumption of fuel.

It will be further noted that the grate is a self-contained one and is inserted in position in the boiler without delay. Hence expensive setting is avoided.

To insert the grates in the furnaces, the front plate *a* of the boiler is removed, and after insertion they are lowered until their feet or supports find their bearings on the floor of the furnaces. The front plate *a* is then replaced and the pipe connections with the ends *e e'* of the systems B and with the boiler and its feed devices are then made. It will also be noted that, as the water-pipes *e e'* of the grates are adjacent to the walls of the furnace, the sides of the grate cannot burn out, and, furthermore, as the loosely-supported plates *n* at said sides impinge against said pipes, said plates are also prevented from burning out and no dead spots can occur in the fire at said sides. The water-bars of the grate being round and the shakers *h* being located between the water-bars and below the same, the shakers, when actuated, cause the burnt or dead fuel to fall from the water-bars so that the fire throughout its entire area is maintained clean and bright.

It will be further noted that, the side bearing-bars F F being beneath and in line with the vertical center of the outside water-bars of the grate and said water-bars forming the extreme outer sides of the grate and lying contiguous to the furnace-wall, the bearing-bars F F do not obstruct the air-passage and they do not warp or burn out, and as said outer water-bars are round they permit the burned fuel to run down off of them and from the plates *n* when the choppers adjacent to said water-bars are actuated.

The hoop form of legs or supports for the grate does not obstruct the floor-line of the ash-pit in corrugated boilers.

While I have shown my invention especially applicable to marine boilers, it is evident that the same may be used for all kinds of boiler-furnaces. So, too, if desired, the system of water circulation herein described may be applied to feed-water heaters or water-bars located in the furnaces above the grates, if the latter be or be not water-circu-

lating grates. Again, the system of pipe connections for the grates with the boiler and the feed devices for the latter may be variously changed without departing from the spirit of my invention.

What I claim is—

1. A boiler having a longitudinal flue, a self contained grate structure therein, consisting of front and rear bearing bars, suitably connected and supported, water bars connecting the latter, shaking grates intermediate said water bars connections from said water circulating grate to the upper and lower portions of the boiler, and a feed device whereby an effective circulation is caused in the bottom of the boiler, substantially as described.

2. A boiler having separate parallel furnaces of substantially circular form in cross section, and a self-contained grate structure in said furnaces, comprising front and rear bearing bars, suitably connected and supported, water bars therebetween, shaking grate sections and feet or equivalent devices for supporting said grate structure within the boiler, substantially as described.

3. A boiler having separate parallel furnaces of circular form in cross-section, a self contained grate water bar and shaking grate having hoop shaped feet or supports, substantially as set forth.

4. A boiler having separate parallel furnaces with laterally corrugated walls, and a grate in said furnaces supported upon semicircular shaped feet or supports fitting said corrugations, substantially as set forth.

5. A boiler having a circular fire box with laterally corrugated walls, a grate in said fire-box and semi-circular feet or supports for said grate, fitting the depressions of said corrugations, substantially as set forth.

6. A boiler having parallel separate furnaces, a water-bar grate in said furnaces having its side water bars extending beyond and above the side bars of the grate, and loosely supported plates between said side bars and the wall of the furnace, said plates being inclined upwardly and outwardly from the grates, substantially as set forth.

7. A boiler having parallel separate furnaces of a circular form in cross-section, water-bar circulating and shaking grates in said furnaces, pipe connection with cut-off valves and check valves between the inlet ends of said grate and the bottom of the boiler and between said pipe connection and the feed devices for the boiler, pipe connection with cut-offs between the outlet end of said grates and the top of the boiler, and branches with cut-offs and checks leading to the atmosphere for said last named pipe connections, substantially as set forth.

8. A boiler having separate adjacent furnaces, a grate structure therein comprising front and rear bearing bars, suitably connected and supported, water bars therebetween shaking grates between said water bars, connections from the water grate to the top and bottom of the boiler, and a single feed water device for the boiler, substantially as described.

9. A boiler having adjacent separate furnaces, a grate structure in each comprising front and rear bearing bars, suitably connected and supported, water bars, shakers therebetween, and delivery connections from each water grate, into the boiler juxtaposed to each other, and means for supporting the latter within the boiler, substantially as described.

10. A water bar grate composed of sectional end bearing bars, and side bearing bars located below the water bars of the grate, the above parts being suitably connected and supported substantially as set forth.

11. A water-bar grate composed of sectional end bearing bars side bearing bars located below the water bars and loosely supported plates *n* for the sides of the grate, substantially as set forth.

12. A water bar grate composed of side bearing bars, having at one end integral water bar bearing supports and sectional end bearing bars, substantially as set forth.

13. A water bar grate composed of side bearing bars having at one end integral water-bar bearing supports, sectional end bearing bars and the outer side water bars extending laterally beyond the side bearing bars, substantially as set forth.

14. A water-bar grate composed of sectional end bearing bars, side bearing bars located below the water-bars and U shaped feet or supports secured to said side bearing bars, substantially as set forth.

15. A water-bar grate having side bearing bars intervening between and below the outer water-bars and integral supports on one end of said side bearing bars for one end of said water-bars, substantially as set forth.

16. A water bar grate having side bearing bars with outer corrugated or serrated surfaces and located below the plane of the water-bars, substantially as set forth.

17. A water bar grate having top-most water bars, suitable connections therefor, shakers or choppers, the upper surfaces of which are in a plane below that of the top of the water bars, side bearing bars below the bottom of said water bars, in combination with hoop-shaped feet or supports for sustaining said grate in position, substantially as described.

18. A self-contained water bar and shaking grate, the extreme outer sides of which are water bars, shakers or choppers between the latter, actuating mechanism therefor, in combination with hoop-shaped feet or supports adapted to sustain said grate within a furnace, substantially as described.

19. In a water-bar grate having side bearing bars vertical recesses on the inner sides of said

bearing bars, a bridge bar the ends of which fit in said recesses and a transverse bolt bar securing said bridge bar in position and supporting its under side, substantially as set forth.

20. A self contained water-bar and shaking grate having outer side water-bars, shakers or choppers between the water bars, side bearing bars below said outer water bars and feet or supports secured to said side bearing bars, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES REAGAN.

Witnesses:
JOHN RODGERS,
S. J. VAN STAVOREN.