(No Model.) 3 Sheets—Sheet 1.

N. W. PRATT.

FIRE TUBE BOILER.

No. 321,248. Patented June 30, 1885.

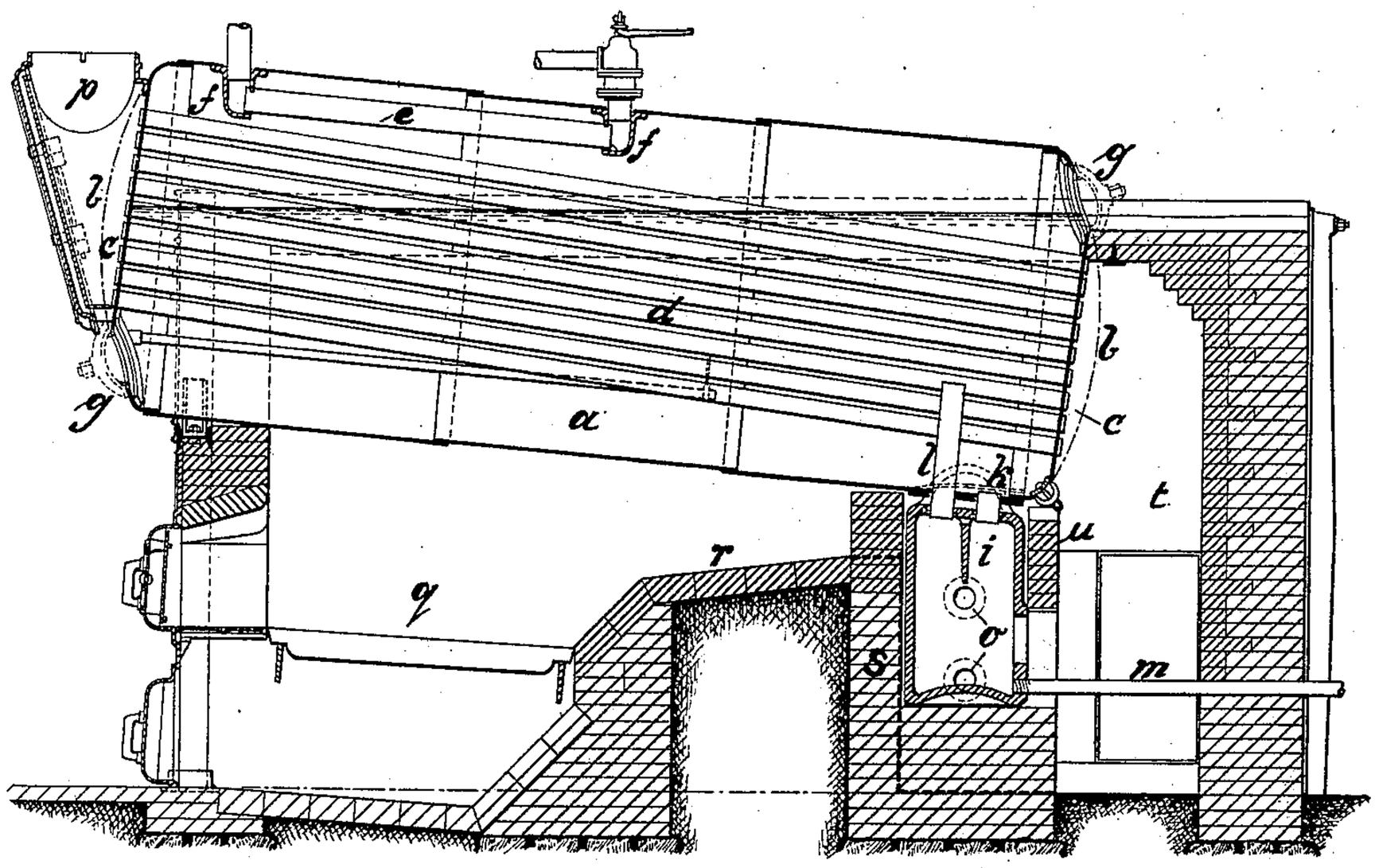

FIG. 1

WITNESSES:
C. R. Waterbury
C. S. Miller

INVENTOR.
Nathaniel W. Pratt.
by Charles A. Gorbis
Attorney

(No Model.)

3 Sheets—Sheet 2.

N. W. PRATT.

FIRE TUBE BOILER.

No. 321,248. Patented June 30, 1885.

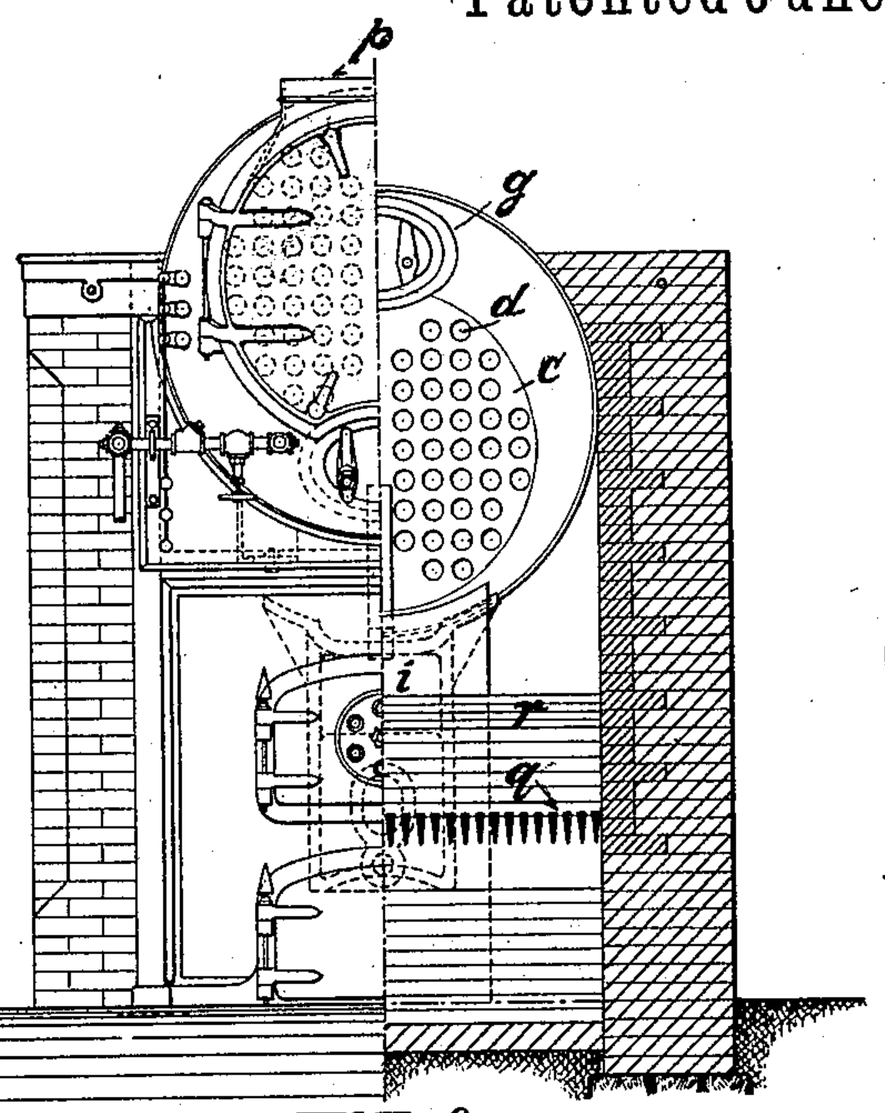

FIG 2

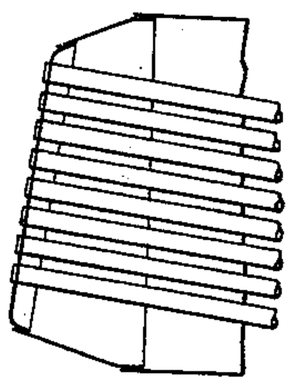

FIG 4

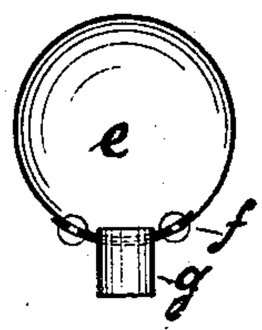

FIG 3

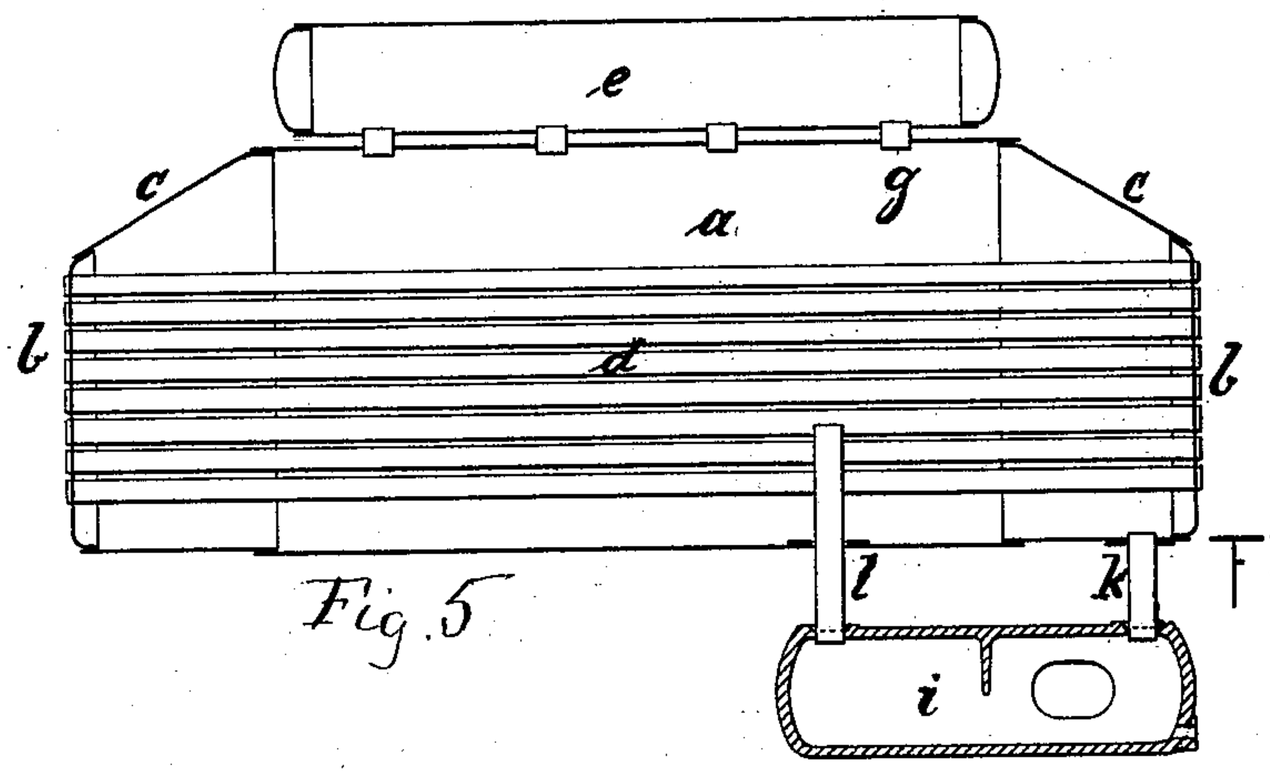

Fig. 5

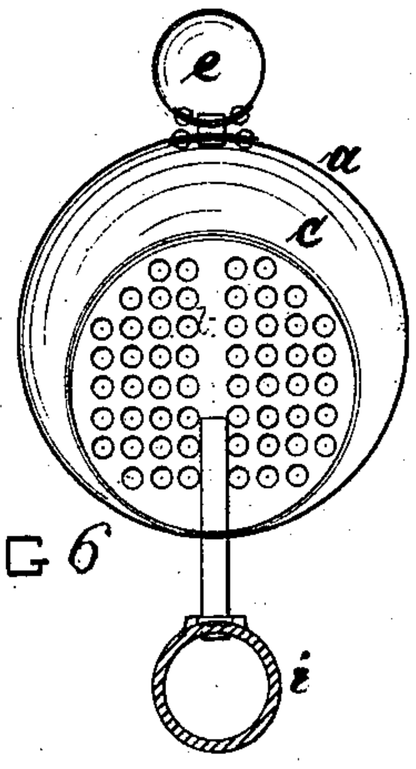

FIG 6

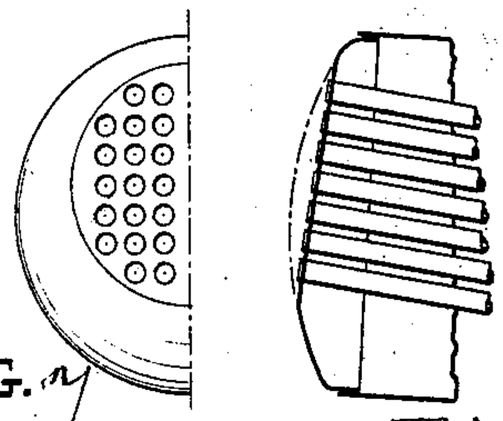

FIG. 7

Fig. 8

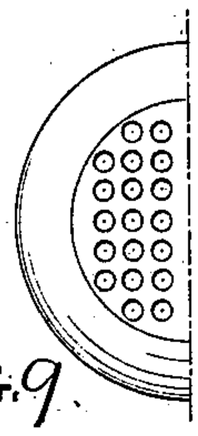

FIG. 9

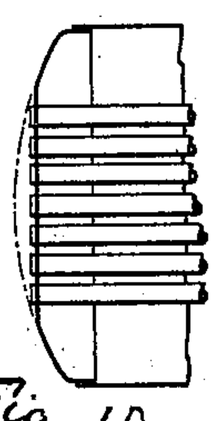

Fig. 10

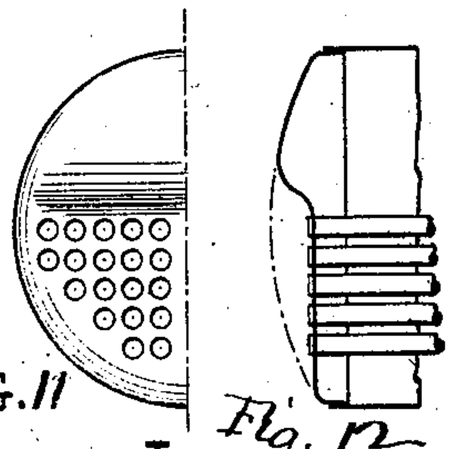

FIG. 11

Fig. 12

WITNESSES:

C. R. Waterbury

C. L. Miller

INVENTOR.

Nathaniel W. Pratt.

by Charles N. Forbes

Attorney

(No Model.)

3 Sheets—Sheet 3.

N. W. PRATT.

FIRE TUBE BOILER.

No. 321,248. Patented June 30, 1885.

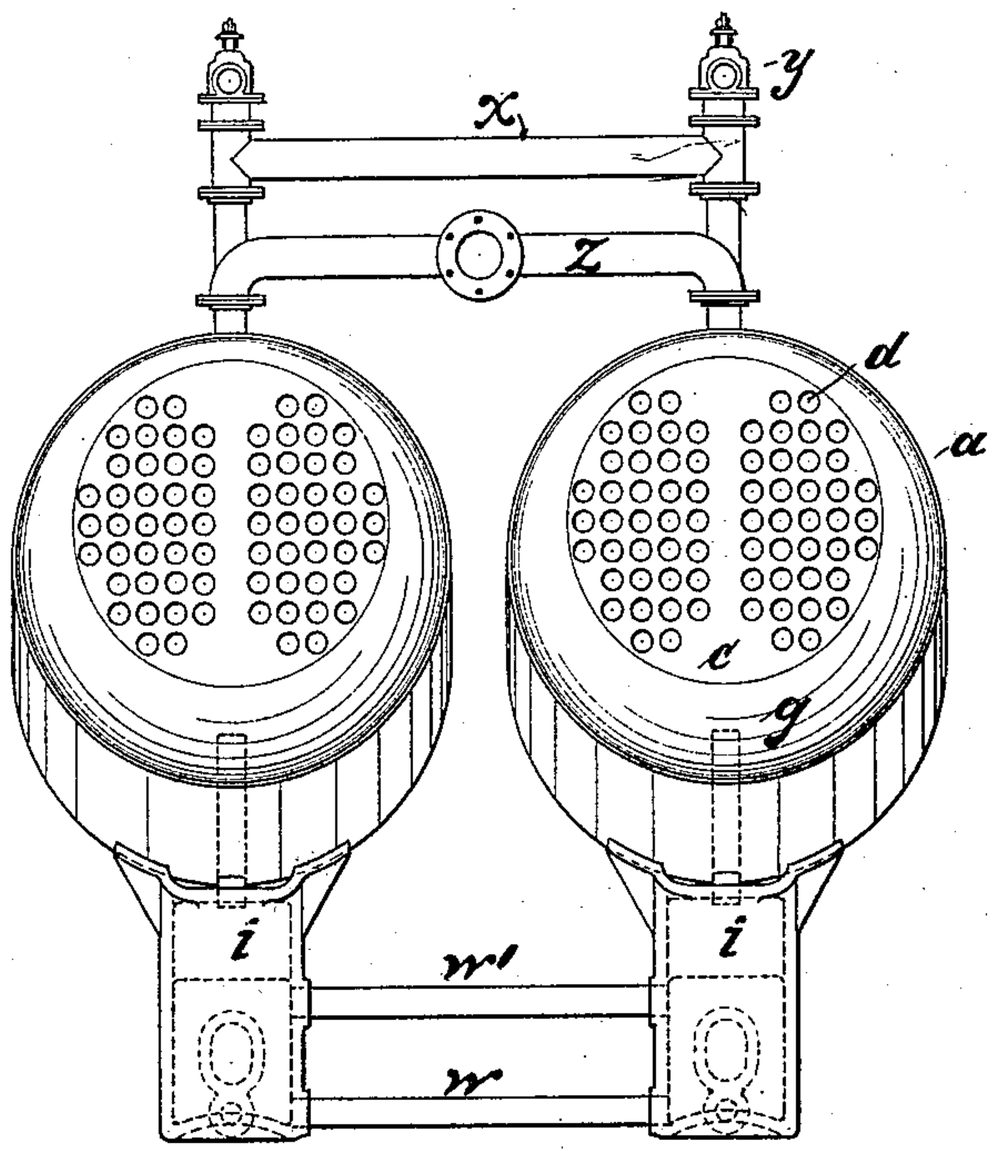

FIG. 13

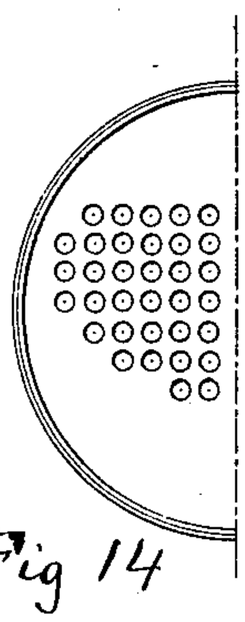

Fig 14

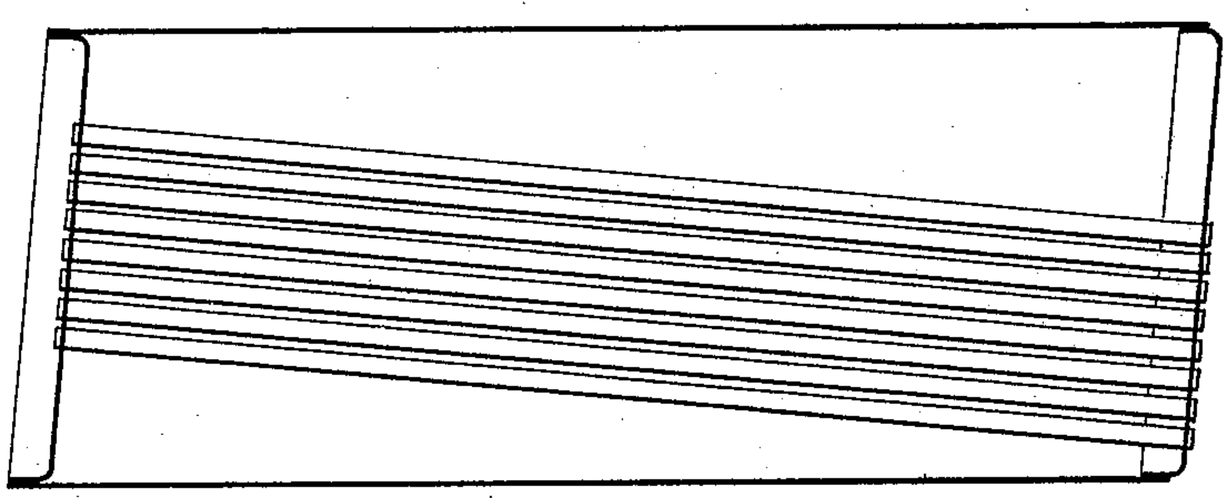

FIG. 15

WITNESSES:
C. R. Waterbury
C. S. Miller

INVENTOR.
Nathaniel W. Pratt
by Charles A. Gorbe
Attorney

UNITED STATES PATENT OFFICE.

NATHANIEL W. PRATT, OF BROOKLYN, NEW YORK.

FIRE-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 321,248, dated June 30, 1885.

Application filed June 20, 1884. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL W. PRATT, a citizen of the United States, residing at Brooklyn, in the county of Kings, and State of New York, have invented a new and useful Improvement in Fire-Tube Boilers, of which the following is a specification, reference being had to the accompanying drawings, forming a part of the same, in which—

Figure 1 is a side elevation, partly in section, and Fig. 2 a similar end view, of a boiler and setting embodying my invention. Figs. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 represent enlarged views of modified forms and constructions, the several figures in each being particularly referred to in connection with the following descriptive matter.

The main objects of this invention are to modify the construction of the ordinary return tubular boiler so as to dispense with the stays used for supporting such portions of the heads that are not held in place by the tubes, to render the interior more accessible for cleaning and repairs, to make a more efficient disposition of the surfaces to take up the heat from the furnace, all as hereinafter described and claimed.

In the drawings, *a* represents the shell set in an inclined position; *b b*, the dome-shaped heads, having flattened portions *c*, into which the tubes *d* are expanded. The curvature of the heads *b b* is determined from a radius equal to the diameter of the shell *a* to insure corresponding strength with an equal thickness of metal, and may be set in either position to form a concave or convex exterior, the latter being shown, for example, and preferred. The flattened portions *c* of the respective heads are equal in area to the space occupied by the connected tubes *d*, and stand parallel with each other, and preferably at a slight angle to a line vertical with the axis of the shell *a*, so that the tubes *d* when secured will stand at an angle with said axis, thereby serving to stay the flattened portions of the heads, the balance or curved portion not requiring such support. The tubes *d* are placed in vertical and horizontal rows at suitable distances from each other, the central rows being placed farther apart to allow of greater circulation at such point.

Figs. 7, 8, 9, 10, 11, and 12 show modifications of the dome-shaped heads, having flattened areas to accommodate tubes placed either parallel with the axis of the shell or inclined thereto.

Figs. 14 and 15 show another modification in which heads may be placed at an angle to the shell for giving an incline to the tubes. In this arrangement that portion of the heads unsupported by the tubes must be held in position by stays.

Instead of the dome-shaped heads having flattened areas, as described, a small head having an area equal to said flattened portion may be used, connected to the main shell of the boiler by a taper course, as shown in Figs. 4, 5, and 6, and in either the dome or taper ends, the tubes may be placed horizontally or inclined relative to the shell, but preferably inclined, as described. This inclination of the tubes also enlarges the space beneath and between them and the crown-sheet at the front end and above and between them and the shell at the rear end accessible through man-holes *g g*, which in medium and large sizes of boiler permits the passage of a man therein, and enables him to reach part way between the tubes and shell at each end.

When erected the shell of the boiler is set on an incline, as shown in Fig. 1, the lowest end being farthest from the furnace which exposes the surface more advantageously to the current (at nearly right angles) of the heated gases, and also makes a positive circulation of the water which tends to carry any contained sediment toward the rear end, from whence it is automatically removed and deposited in the mud-drum *i*, through the circulating-pipes *k* and *l*.

The mud-drum *i* is preferably made of cast-iron, of cylindrical form, and may be used to support the rear end of the shell of the boiler. It is placed either vertically, Fig. 1, or horizontally, Fig. 5, and provided with an interior depending curtain or partition to deflect the current and facilitate the deposit of sediment, an opening being provided at the top of said partition to prevent steam from collecting at this point.

The pipes *k* and *l*, Figs. 1 and 5, connect the boiler with each division of the mud-drum,

the pipe *l* being extended some distance into the water-space for the purpose of producing an upward circulation, a downward circulation taking place through the pipe *k*, which carries the sediment away from the boiler and deposits it in the bottom of the mud-drum, the purified water returning through the pipe *l*. The circulation through those pipes may be produced by exposing one pipe to the action of the fire, Fig. 5, to create the upward current and protecting the return-pipe, the main points to be observed being to connect the lowest portion of the shell with one division of the mud-drum through a pipe having a downward circulation, and discharging it by a rising current through another pipe communicating with the other division.

m represents a blow-off pipe. (See Fig. 1.)

In some instances steam-domes are required, which may be riveted to the boiler in the usual way, or as shown in Figs. 5 and 6. In the construction shown, the ends of the sheets forming the courses are lapped by each other a sufficient distance to accommodate two rows of rivets, one on each edge of the sheet, leaving a space between of sufficient width to introduce connecting pipes or nipples *g*, Fig. 5, expanded into both thicknesses of the metal.

Whenever two or more boilers are placed in one furnace the steam-spaces are connected in the usual way, and the safety-valve openings connected together by means of balance-pipes and on top of which the safety-valves are placed, as at *y*, Fig. 13. This balance-pipe *x*, from which no steam is discharged except when the safety-valves are open, together with the pipes connecting the lowest water spaces and pipes that connect the mud-drums, serve to equalize the water-level and steam-pressure in the two boilers. The mud-drums should be connected at two different points in their height to insure a free water circulation, as shown at *w w'*, Fig. 13. In this arrangement the feed and blow-off pipes may also be connected.

By reference to Fig. 1 it will be observed that the front end of the upper rows of the tubes *d* are exposed to the steam for a portion of their length, while the greater portion passes through the valves. The small amount of heat escaping from the upper tubes serves to superheat and dry the steam, and at this, the highest point in the steam-space of the boiler, a steam-opening is made, and also a second one about midway of its length communicating by a dry-pipe, *e*, connected by angle-elbows *f f*, Fig. 1.

The outer opening of each elbow is tapped for steam-pipes and the inner opening of the forward elbow made plain and equal in size to the external diameter of the dry-pipe, while the inner end of the rear elbow is threaded and the end of the dry-pipe screwed into it.

The dry-pipe is provided with openings upon its upper side, through which steam passes from the boiler to the delivery-pipe. When a single boiler is placed in one furnace the safety-valve is attached to one of the openings in the dry-pipe and a steam-valve in the other.

The smoke-box *p* is formed of cast or wrought metal bolted to the front head of the boiler, and covers only the area occupied by the tube-sheets. It is provided with doors, through which the tubes may be reached for cleaning or repairs.

The position in which this boiler is placed and the design of the setting differs from the ordinary form of return-tubular-boiler setting.

Instead of placing the boiler horizontally it is set in an inclined position, for the purpose described, which also has the advantage of a higher furnace, giving more perfect combustion; and, also, instead of carrying the bridge-wall at the rear end of the grates up to a point near the bottom of the shell, and allowing only sufficient area between the walls and the shell for the passage of the gases, (as is usually done,) a furnace-floor, *r*, Fig. 1, is gradually raised from the level of the grates to a point near the rear end of the boiler, leaving more of the shell exposed to the direct radiant heat from the furnace, and avoiding the concentration of the heat at one point, as is done when the ordinary form of bridge-wall is used. This inclined furnace-floor reaches from the rear end of the grates, gradually approaching the under side of the boiler until it joins a vertical wall, *s*, which extends from a point near the under side of the boiler to the bottom of the boiler-setting, preferably on a level with the floor outside. Just back of the last-mentioned vertical wall a hollow pier is built, to protect the standard or mud-drum *i* and the rear end of the boiler from the direct action of the furnace heat. The gases, on leaving the furnace, pass over this inclined furnace-floor, then divide and pass each side of the pier mentioned into the chamber *t* of greatly-increased area, formed by the cross-wall and the rear and side walls of the boiler-setting. In this chamber an expansion of the gases takes place. The ashes which have been carried over by the draft are consequently dropped, and the gases pass through the tubes to the front end of the boiler, thence through the smoke-box *p*, and out the stack.

The front of the furnace is formed of two or more vertical I-beams of rolled iron set into cast-iron bases at such distances apart as to allow the shell of the boiler to pass between them. Said vertical beams are carried up to the top of the side walls and connected together just below the bottom of the shell by a cross-beam fastened to the verticals in any suitable manner. The lower spaces between these beams are filled in with panels bearing the fire and ash pit doors.

The boiler itself is set upon chock-blocks, which are in turn supported by the cross-beam connecting the two verticals, and the spaces between the boiler-shell and the upper part of the frame-work are filled in with metal panels fitted to the frame-work and the shell of the boiler. This arrangement exposes the

end of the boiler to inspection and leaves a man-hole plate, through which access is had to the crown-sheet in such position as to be easily reached, while the smoke-box, on account of the inclination at which the boiler is set, is raised above the head of the fireman, making a more convenient and cooler boiler to fire.

Having thus fully described my invention, I claim—

1. A fire-tube boiler having that portion of the heads which form parallel tube-sheets inclined at an acute angle in reverse relative position above and below the axis of the surrounding shell, in combination with connecting-tubes placed at an angle to said axis.

2. In a fire-tube boiler, a concave or convex head having a flattened area about equal to the space occupied by the heating-tubes, whereby said tubes may be arranged at any desired horizontal plane or inclination, and stays for the remaining or surrounding portion of the head dispensed with.

3. A fire-tube boiler having heads equal in area to the space occupied by the heating-tubes only, said heads being connected with the shell of the boiler by intermediate taper courses.

4. A shell having an area of increased thickness formed by overlapping the sheets a sufficient distance to include independent rows of rivets on each edge, with space between said rows of rivets to contain connections made through the double thickness.

NAT. W. PRATT.

Witnesses:
CHARLES W. FORBES,
JOHN S. CALDWELL.