No. 692,062. Patented Jan. 28, 1902.

J. H. McDONALD & G. G. WORTHINGTON.

STEAM BOILER.

(Application filed Dec. 21, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. VI.

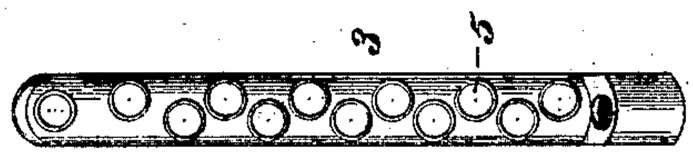

Fig. I.

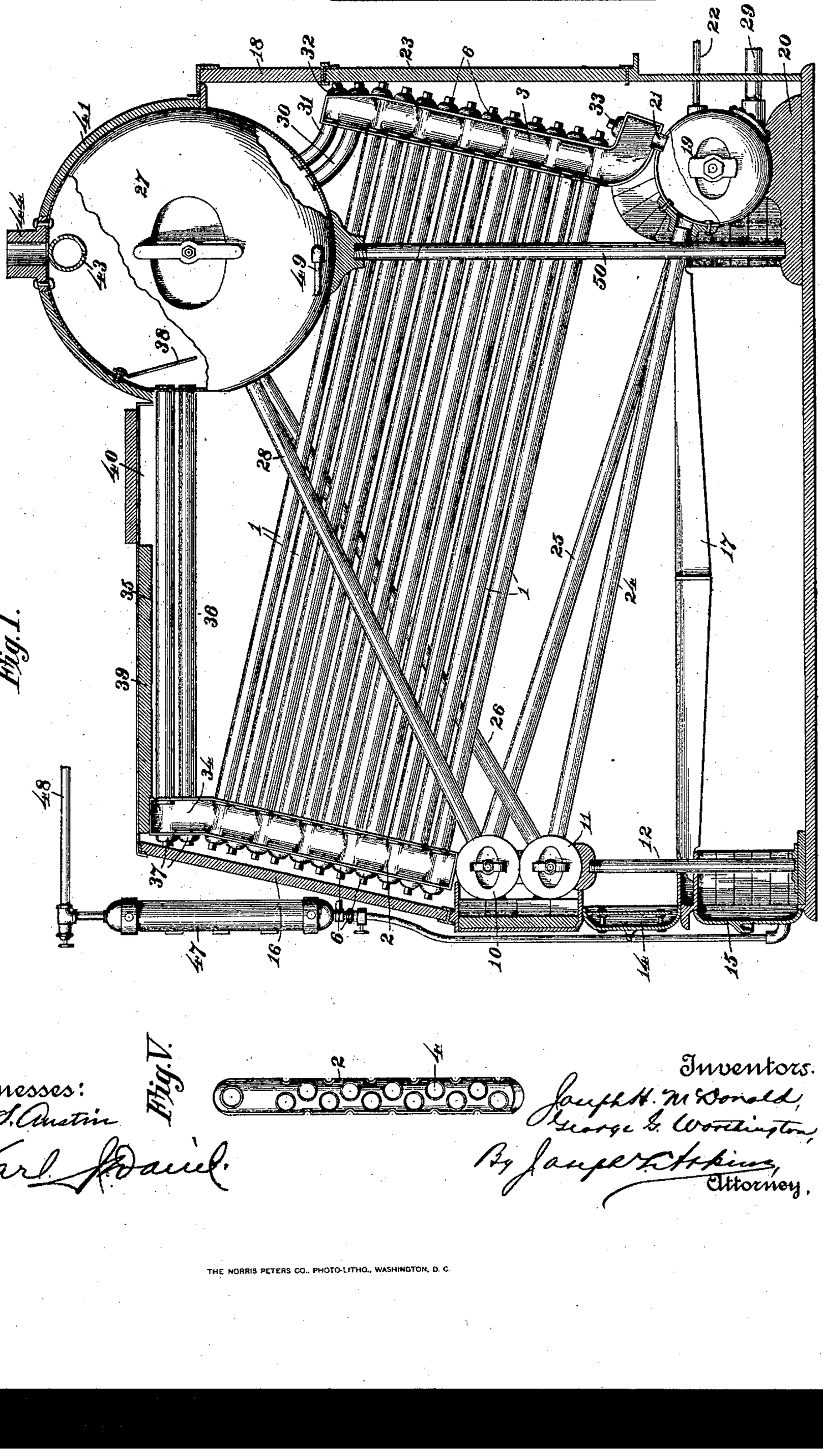

Fig. V.

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(No Model.) 4 Sheets—Sheet 2.

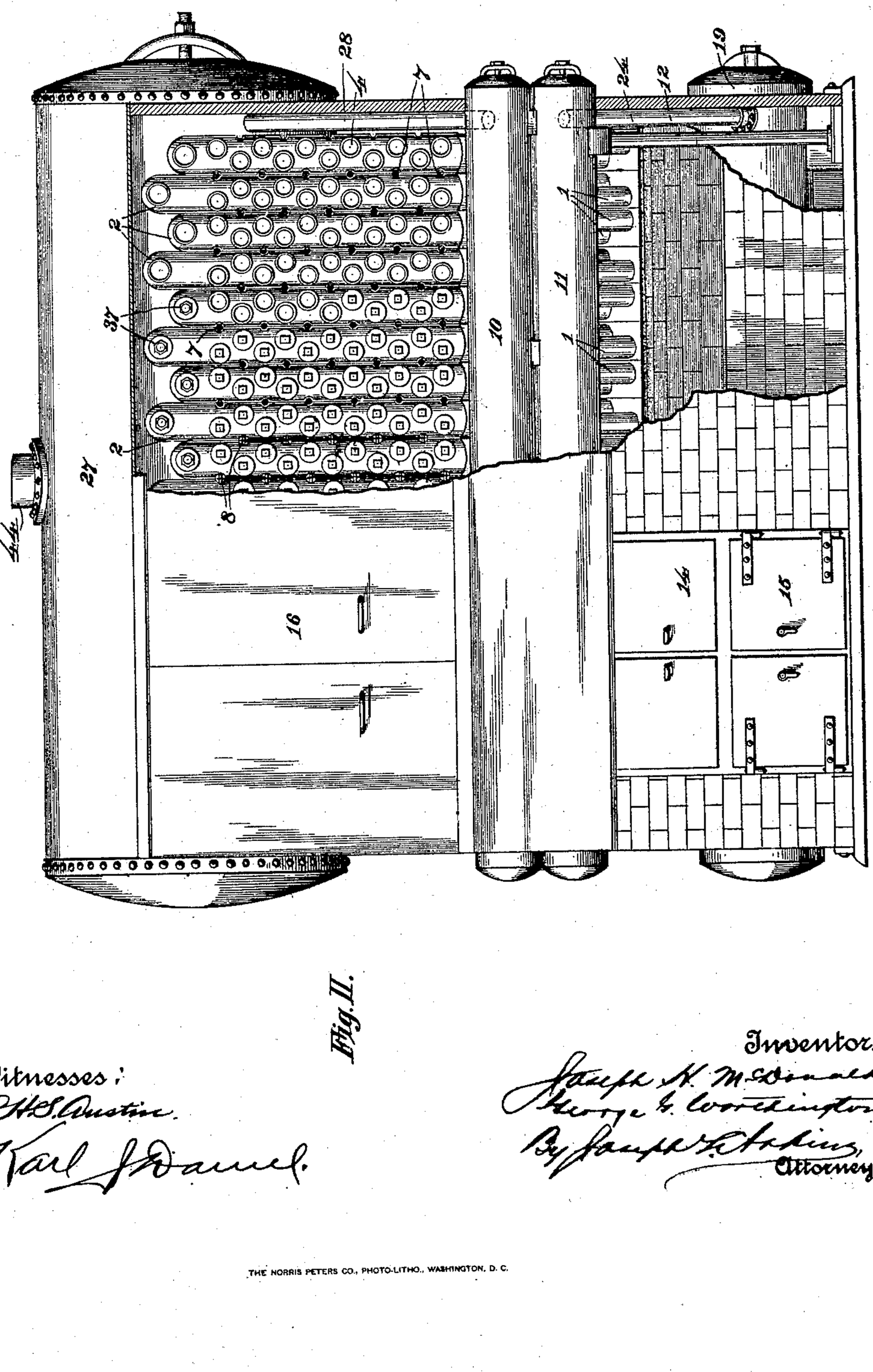

Fig. II.

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(No Model.) 4 Sheets—Sheet 3.

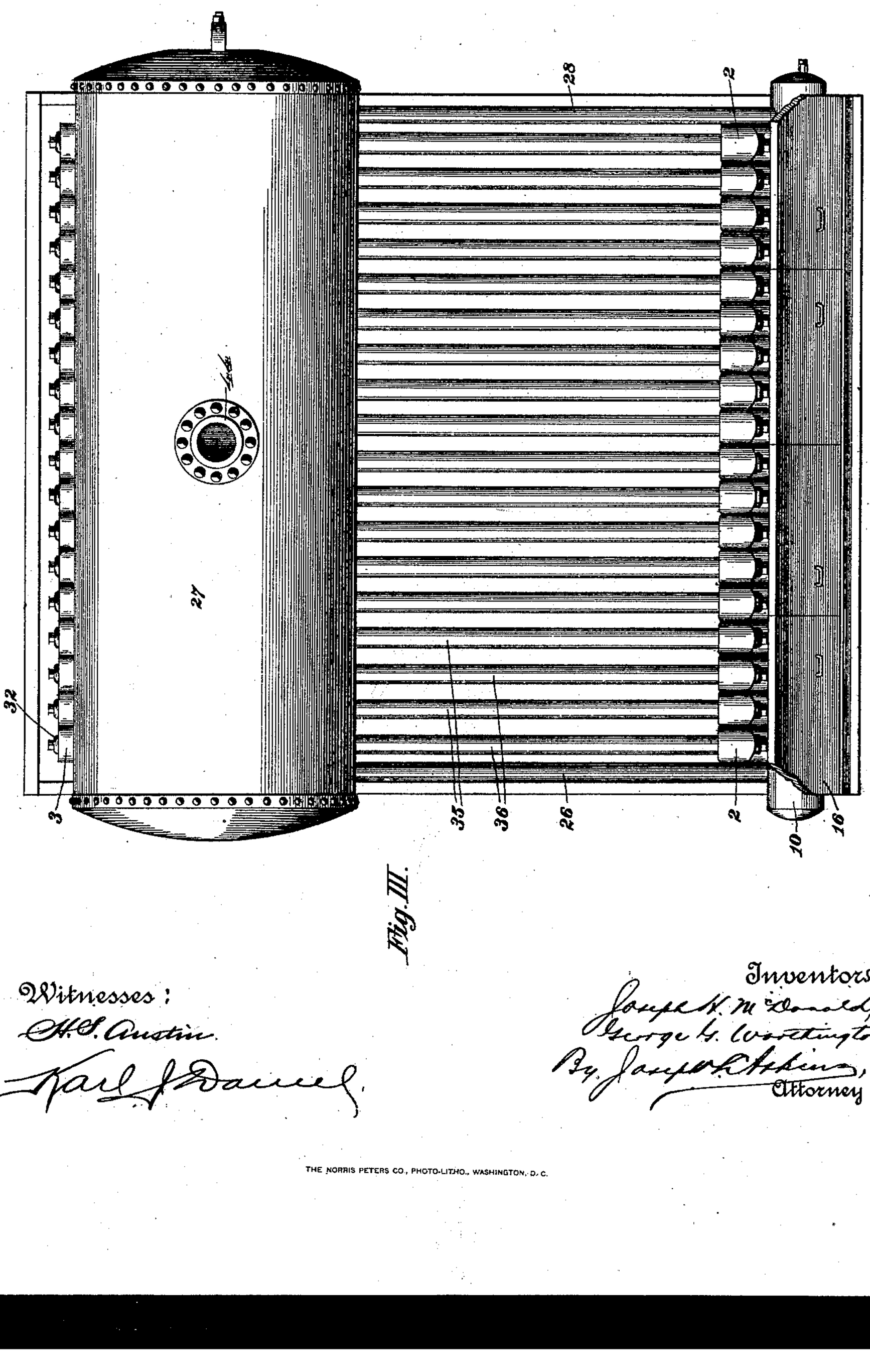

Fig. III.

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(No Model.) 4 Sheets—Sheet 4.

Fig. VII.

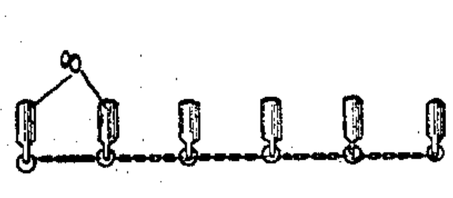
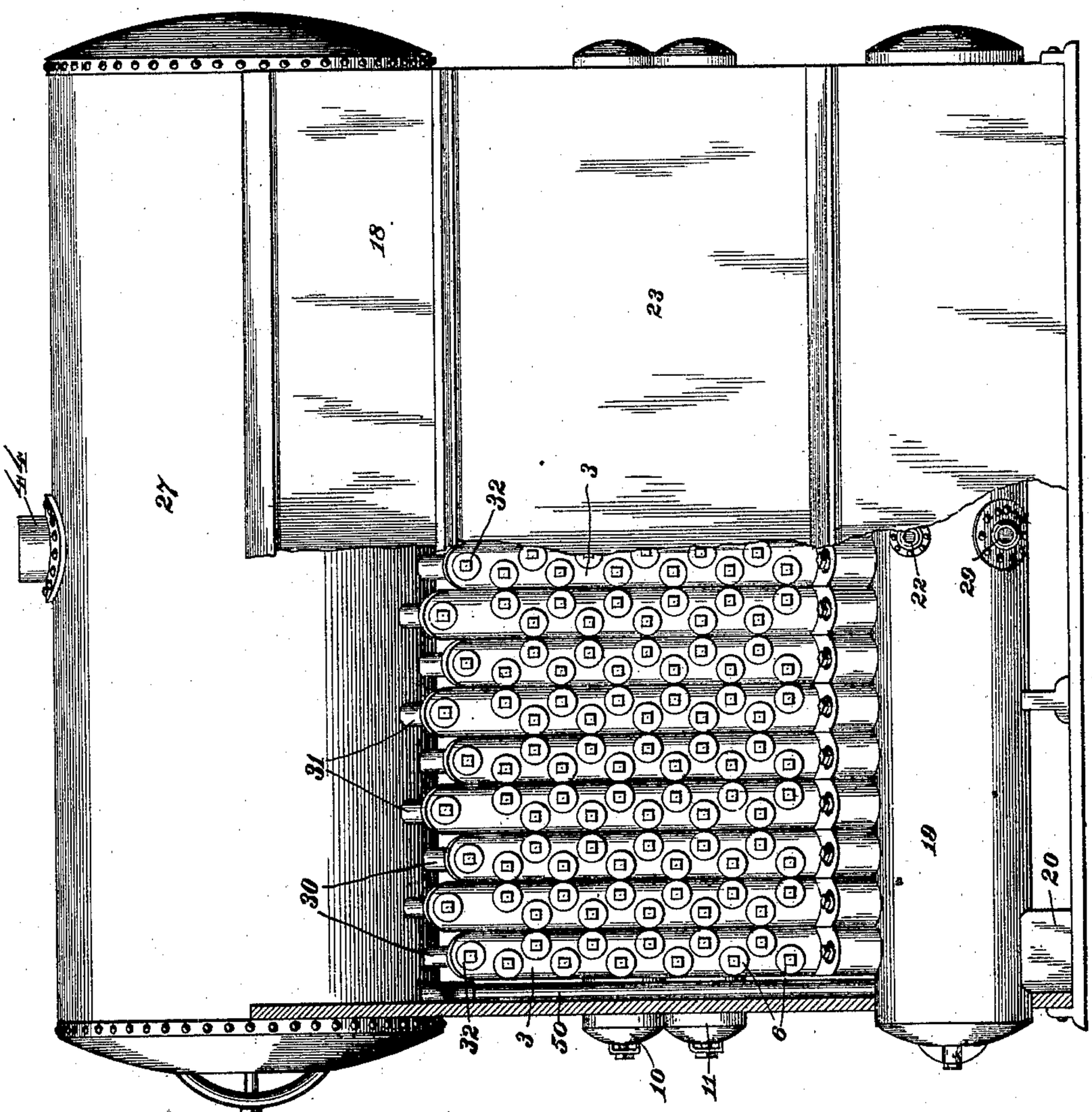


Fig. IV.



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UNITED STATES PATENT OFFICE.

JOSEPH H. McDONALD, OF NEW YORK, AND GEORGE G. WORTHINGTON, OF BROOKLYN, NEW YORK.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 692,062, dated January 28, 1902.

Application filed December 21, 1900. Serial No. 40,657. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH H. McDONALD, of the city and county of New York, and GEORGE G. WORTHINGTON, of the city of Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a complete specification, reference being had to the accompanying drawings.

The object of our invention is to produce an efficient, economical, and durable boiler, preferably of the sectional class, which, on account of its structural features and the arrangement of its various elements, is adapted to generate a comparatively large volume of steam at relatively small expense, both with respect to the cost of operation and with respect to wear.

In this general statement it may be observed that our boiler embodies particularly certain improved means for applying and utilizing heat in the generation of steam for promoting combustion in proximity to the boiler-tubes and for cleaning the tubes, and thereby preserving the efficiency of the boiler.

In the accompanying drawings, Figure I is a side elevation of our boiler installed but exposed and partly in section. Fig. II is a front elevation of our boiler complete, a portion of its enveloping wall being broken away and the headers of the boiler being shown with the caps and plugs removed. Fig. III is a plan view of the boiler exposed. Fig. IV is a rear elevation of the same. Fig. V is a front view of one of the front headers detached and without caps. Fig. VI is a similar view of a rear header detached. Fig. VII is a side elevation of a string of plugs detached.

Referring to the numerals on the drawings, 1 indicates the tubes of the boiler, the opposite ends of which, respectively, are fixed within assembling members or headers, one of the front headers 2 being shown in Fig. II and one of the rear headers 3 being shown in Fig. IV. Both headers are shown assembled with their connecting-tubes in Fig. I. These headers not only afford means of direct intercommunication between the tubes therewith assembled, as well as with other members of the boiler hereinafter referred to, but being provided, respectively, with circular apertures 4 and 5, opposite to and concentric with the several tubes assembled with the respective headers, afford means not only for setting the tubes in the first place, but also for washing or otherwise cleaning the interior of the tubes as often as required. When the boiler is in operation, the several apertures 4 and 5 are closed, as by screw-caps 6.

An important feature of our invention consists in arranging the tubes of the boiler in a plurality of circular series, as clearly shown in Fig. II of the drawings. By this arrangement throughout the assemblage of tubes is provided a series of combustion-chambers defined by the encircling tubes, each tube of the series being separated from its neighbor by a comparatively narrow space. In the construction illustrated the center of each combustion-chamber around which the tubes are grouped is indicated in Fig. II by the reference-numerals 7, which respectively designate circular apertures formed by semicircular recesses in each header. These apertures, formed only in the front wall of the furnace—that is to say, in the front headers constituting said wall—are designed to afford access to the exterior surfaces of the water-tubes 1 for cleaning purposes. For those purposes a hose may be introduced into them, and an air-blast or other means may be utilized for removing from them soot or other products of combustion. When the furnace is in operation, the apertures 7 are kept closed, as by plugs 8, which may be simply slipped into place and which for convenience are strung together, as shown in Fig. VII. By the arrangement of the tubes of the boiler in circular groups defining among them a series of combustion-chambers provision is made for retarding the heated products of combustion and unconsumed gases from the furnace as they ascend or pass between the tubes of the boiler, so that within each group of tubes, as in an ordinary combustion-chamber, a local combustion is promoted. Consequently the gases from the furnace instead of finding ready passage around the tubes of the boiler are retarded and made to pass from one combustion-chamber to another, so that in pass-

ing from the furnace to the stack they are perfectly consumed and their availability for producing heat developed. It is obvious that the extent to which the heated products of combustion may be retarded in passing from the furnace among the tubes and of promoting combustion of the gases from the furnace is limited only by the number or extent of the tubes employed.

The arrangement of the tubes in circular groups to constitute between them a series of combustion-chambers may be secured by assembling them otherwise than in the particular form of header illustrated; but in that preferred form of assembling member the circular arrangement of the tubes may be provided for by the staggered arrangement therein, as clearly illustrated, for example, in Figs. III and IV. The term "staggered arrangement" is thought to be sufficiently understood in the art to clearly indicate the structure referred to; but it may be defined as denoting that disposition of the tubes in each header in which the center of every tube is located upon the opposite side of a longitudinal medial line in the header from that of each next adjacent neighbor.

The assemblage of headers 2 is designed to be supported as on the front wall 9 of the furnace; but it may rest partially upon the top of the evaporating-drums 10 and 11, supported one upon the other, as by terminal uprights 12. The front wall of the furnace is broken, as usual, by furnace-doors 14 and ash-pit doors 15 and may be provided with a sliding or otherwise-movable door 16, covering the assemblage of headers 2.

17 indicates the grate-bars of the furnace, suitably supported, as by ordinary means, below the tubes 1, so as to define between the several walls of the furnace the usual combustion-chamber and ash-pit.

Adjacent to the rear wall 18 of the furnace we provide a mud-drum 19, bedded, as upon a bolster 20, and adapted to support the assemblage of rear headers 3. The headers 2 and 3 are so arranged as to dispose the tubes 1 at an angle of inclination toward the headers 3, each of which communicates, as through a connection 21, with the interior of the drum 19, into which, as through a pipe 22, the feed-water of the boiler is supplied and toward which the contents of the tubes 1 gravitate.

23 indicates a sliding or otherwise-movable door in the rear wall 18 of the furnace, through which the headers 3 are accessible.

The drum 19, being laterally coextensive with the boiler and preferably projecting at its ends a little distance beyond the ranks of the tubes 1, is connected at its opposite extremities, as by pipes 24 and 25, with the evaporating-drums 11 and 10, respectively, above referred to. From the end of the drum 11 opposite to that at which the pipe 24 communicates a pipe 26 leads to one end of a steam-drum 27, with the interior of which it communicates. At the opposite end of the steam-drum 27 a pipe 28 communicates with one end of the evaporating-drum 10 which is opposite to that end thereof with which the pipe 25 communicates. The pipes 24, 25, 26, and 28 are all inclined so that their contents, like those of the tubes 1, gravitate toward the drum 19. The drum 19 is provided with a blow-off pipe 29, and being located at the lowest point of the boiler is properly styled a "mud-drum;" but it may also be denominated a "feed-water receptacle," since it receives the feed-pipe 22 and is, being the lowermost member of the feed-water circulatory system, the receptacle into which alone cold water is introduced. The feed-water circulatory system embraces the drum 19, the pipes 24 and 25, the drums 11 and 10, the pipes 26 and 28, the steam-drum 27, and the headers 2 and 3, the several headers 3 communicating, respectively, with the drum 19 through the connection 21 and completing circulation with the steam-drum 27 through pipes 30 and 31, respectively. It may here be noted that screw-caps 32 are located in the headers opposite the pipes 30 and 31, respectively, and a screw-cap 33 opposite each of the connections 21.

Each of the headers 2 is provided with a vertical terminal portion 34, which is operatively connected with the interior of the steam-drum 27, as by pipes 35 and 36, respectively, opposite to each of which in the header is provided a screw-cap 37. In front of the ends of the several pipes 35 and 36 within the steam-drum 27 is located a deflecting-plate 38, by which steam generated in the tubes 1 is deflected downwardly into the body of water contained in the steam-drum, thereby tending at the same time to eliminate moisture from the steam and to heat and agitate the water in the steam-drum 27.

39 indicates the top wall of the furnace, which, with the usual side walls, completes the enveloping wall of the boiler.

40 indicates a smoke-outlet from the furnace, and 41 a non-conductive covering for the exposed wall of the steam-drum 27.

43 indicates the usual dry pipe, and 44 the steam-nozzle, through which steam from the drum 27 is derived for service.

47 indicates a water-column communicating with the interior of the drum 27, as by pipes 48 and 49. The drum 27 may be supported, as upon terminal uprights 50.

In operation the boiler is supplied with water at a required level, as indicated in the column 47, and is replenished in the usual manner through the feed-pipe 22. The water of the feed-water circulatory system is heated and caused to circulate from the drum 19 through the pipes 24 and 25, the evaporating-drums 11 and 10, and the pipes 26 and 28, from the last of which it enters the steam-drum 27. Passing from the pipe 24 to the pipe 26, the water slowly traverses the length of the drum 11, and passing from the pipe 25 to the pipe 28 in like manner traverses the length of the drum 10. Consequently all

water which is supplied to the interior of the drum 27 is heated practically to the boiling-point and commingles with the water within the drum 27 without tendency to reduce its temperature, but, on the contrary, rather to maintain the same approximately at the point of ebullition. The water in the bottom of the drum 27 communicates freely through pipes 30 and 31 and headers 3 with the boiler-tubes and also down through headers 3 until met by the rising water from mud-drum 19, and thence into the boiler-tubes. The water from drum 27 will not become cold enough to fall into the mud-drum 19, but, on the contrary, may flow up from drum 19 and into the lower boiler-tubes. By these means a constant supply of heated feed-water is afforded to the tubes 1, wherein it is converted into steam, which passes into the steam-drum 27 through the pipes 30 and 31.

The employment of front and rear headers is preferred as affording means of constructing our boiler sectionally. By their aid the size of any boiler of the kind may be increased or diminished at comparatively small expense by adding to or subtracting from the number of headers, with their corresponding tubes, employed. The capacity of the several drums which are employed in organizing the headers and tubes together must be varied to accommodate material changes in the number of headers and tubes employed; but the expense involved in such changes is comparatively light.

What we claim is—

1. The combination with a steam-drum and system of water-tubes connecting therewith, of a furnace in operative communication with the tubes, and a feed-water circulatory system connecting at both ends with the steam-drum through the furnace, below its water-line.

2. The combination with a feed-water receptacle and steam-drum, of intermediate series of water-tubes communicating with the steam-drum, means of communication with the steam-drum, water-tubes, and feed-water receptacle, and members of a feed-water circulatory system establishing operative communication between the feed-water system and the furnace.

3. The combination with intercommunicating feed-water receptacle, water-tubes, headers, and steam-drum, of a plurality of evaporating-drums communicating at opposite ends, respectively, with the feed-water receptacle and the steam-drum.

4. In a boiler, the combination of its water-tubes, arranged in circular series to constitute a series of combustion-chambers throughout the boiler.

5. In a boiler the combination of its water-tubes arranged in circular series, the several members of each series being separated from each other by comparatively narrow distances, thereby constituting a series of well-defined combustion-chambers throughout the boiler.

6. In a boiler, the combination of its water-tubes arranged in circular series, and cleaning-apertures located concentrically with the ends of said series, respectively.

In testimony of all which we have hereunto subscribed our names.

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GEORGE G. WORTHINGTON.

Witnesses:
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FREDERICK RAICHLE.