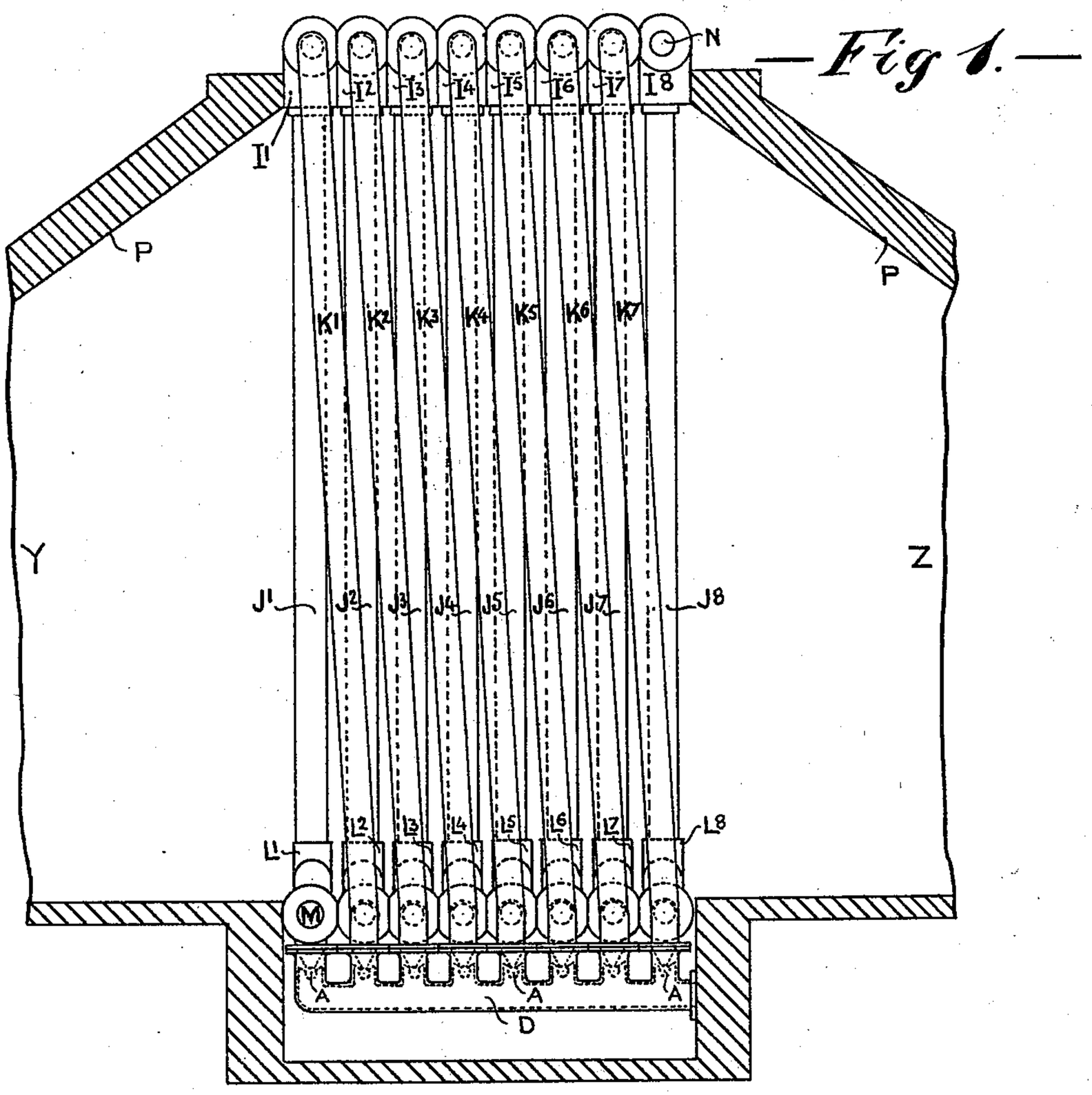
(No Model.) 4 Sheets—Sheet 1.

J. G. CALVERT.

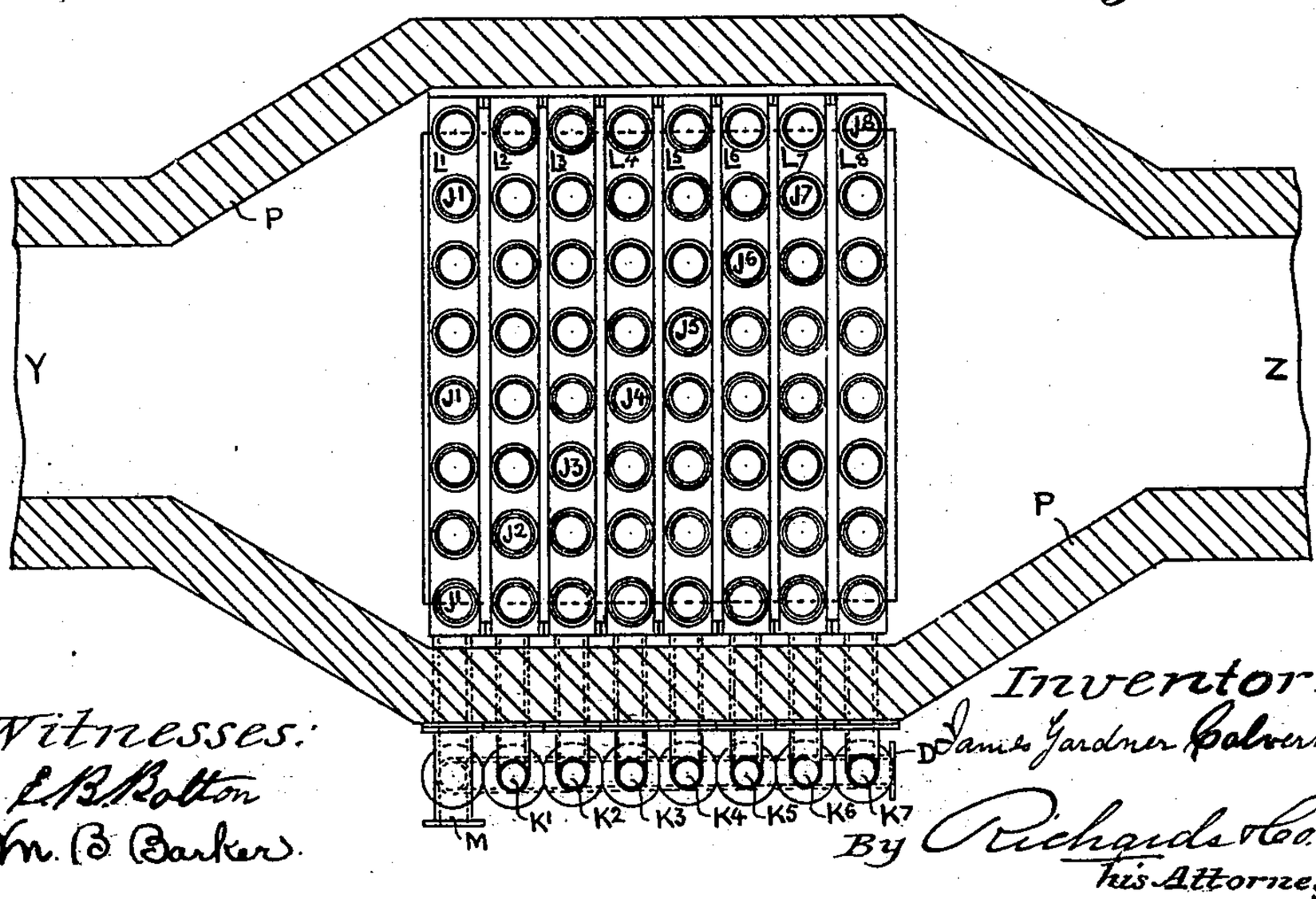
FEED WATER HEATER.

No. 518,019. Patented Apr. 10, 1894.

—Fig 1.—



—Fig 3.—



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Inventor:
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By Richards & Co.
his Attorneys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.)

4 Sheets—Sheet 2.

J. G. CALVERT.

FEED WATER HEATER.

No. 518,019. Patented Apr. 10, 1894.

Fig 2.

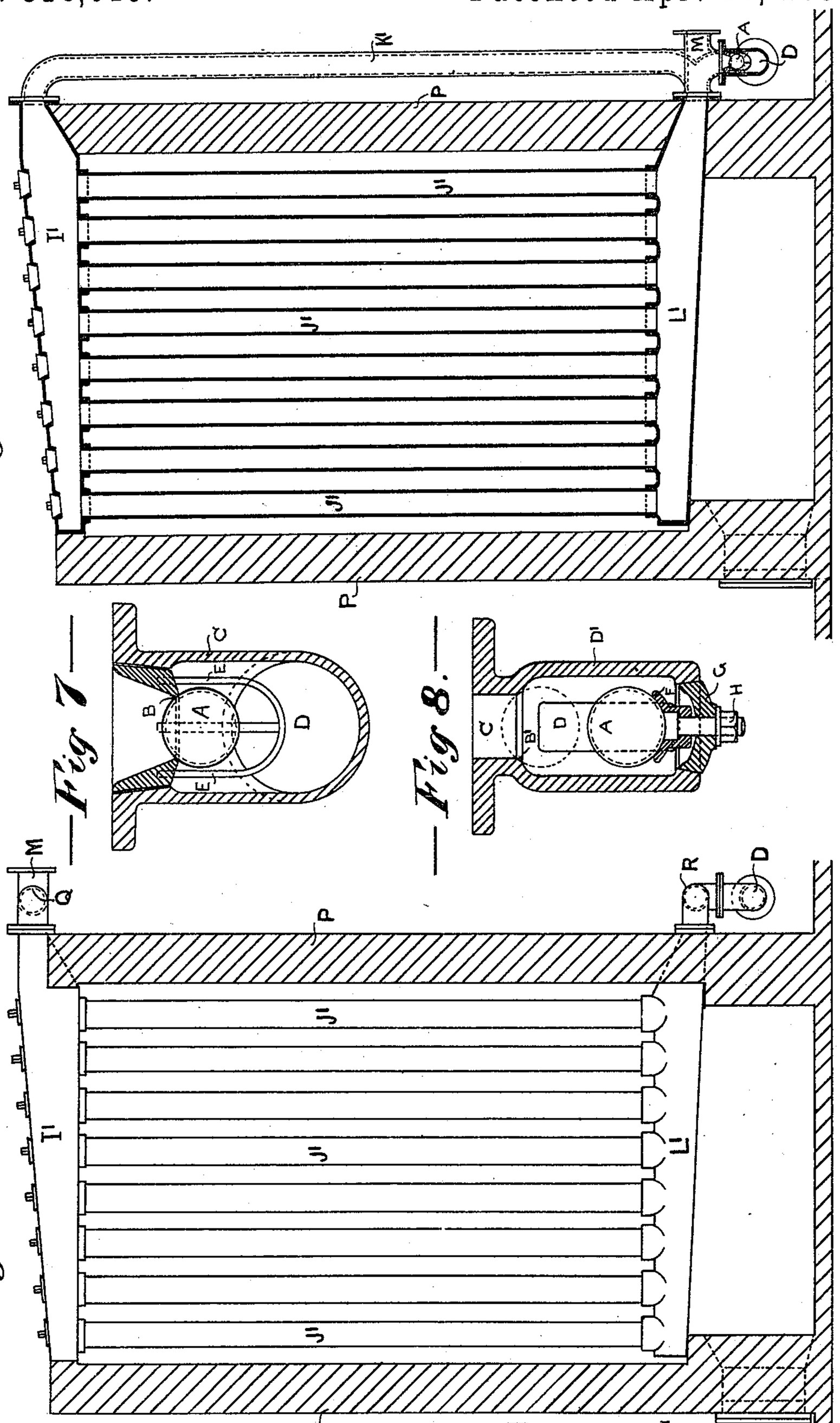

Fig 5.

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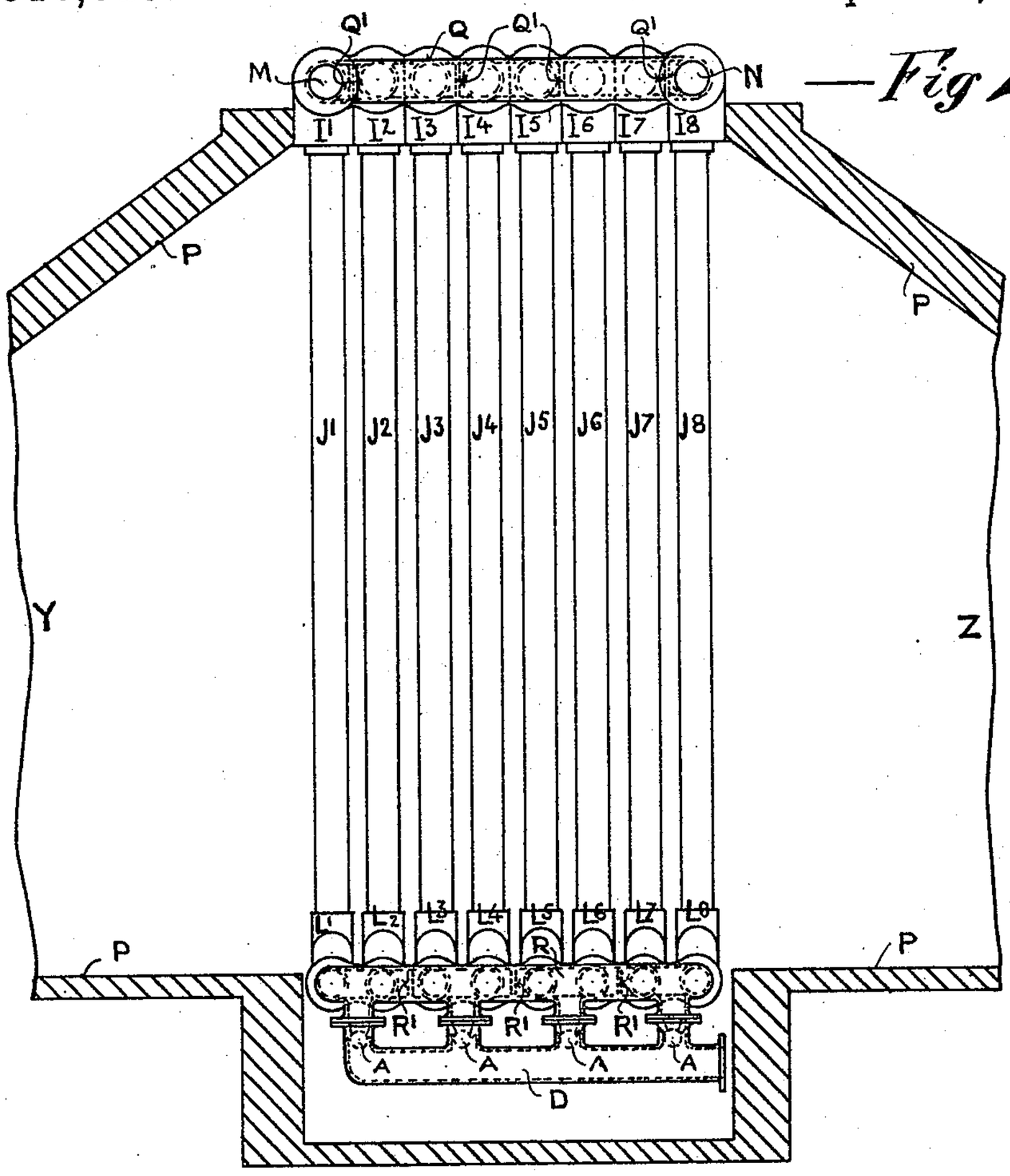
(No Model.) 4 Sheets—Sheet 3.

J. G. CALVERT.

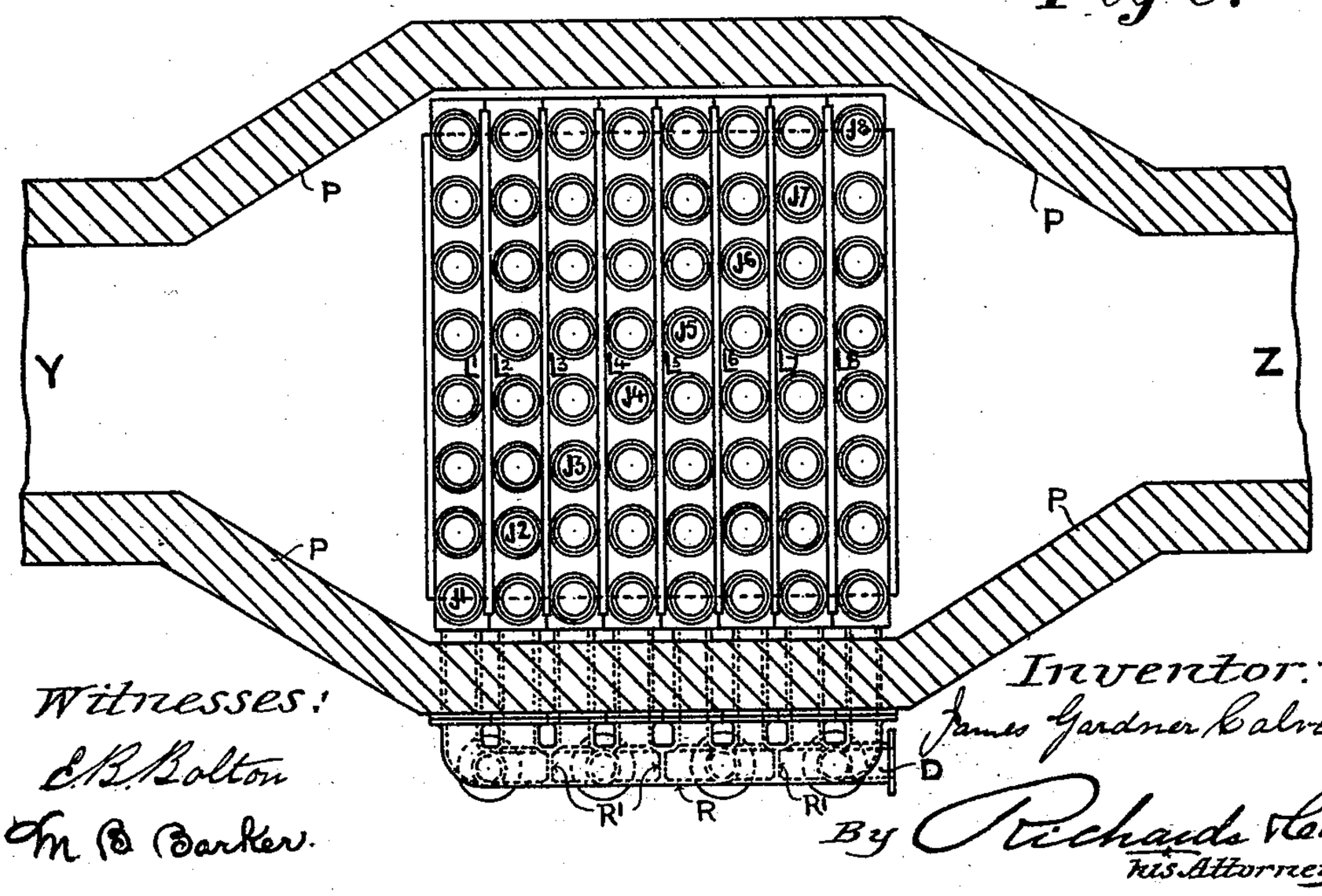
FEED WATER HEATER.

No. 518,019. Patented Apr. 10, 1894.

— Fig 4. —



— Fig 6. —



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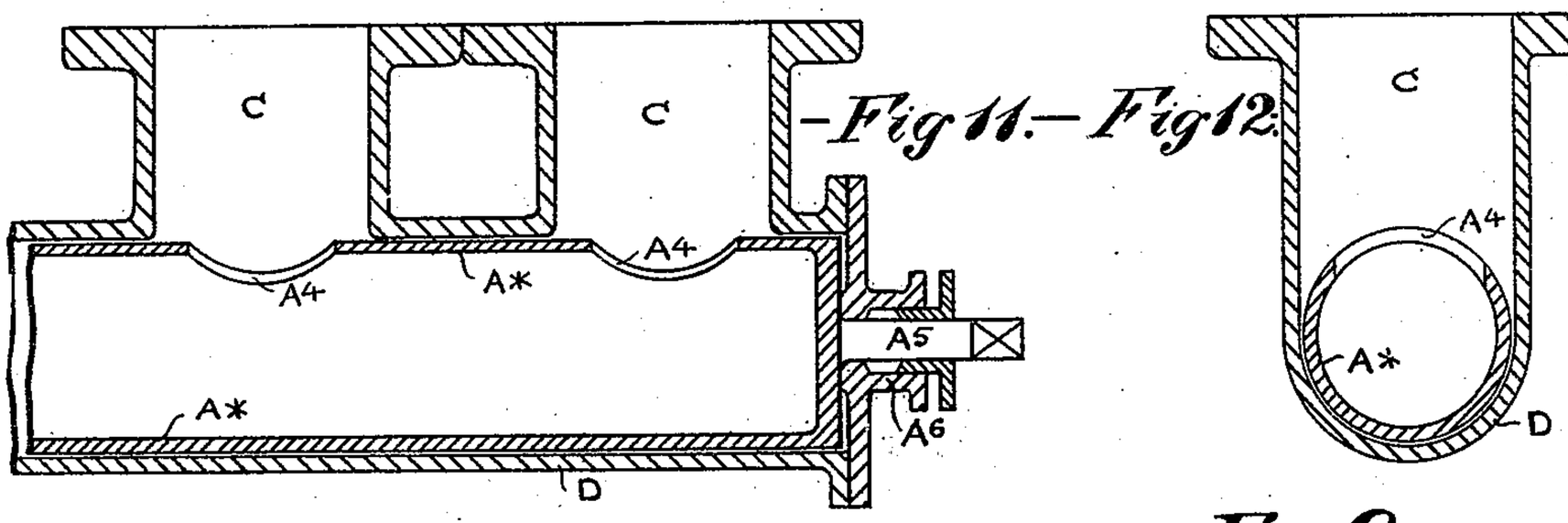
J. G. CALVERT.

FEED WATER HEATER.

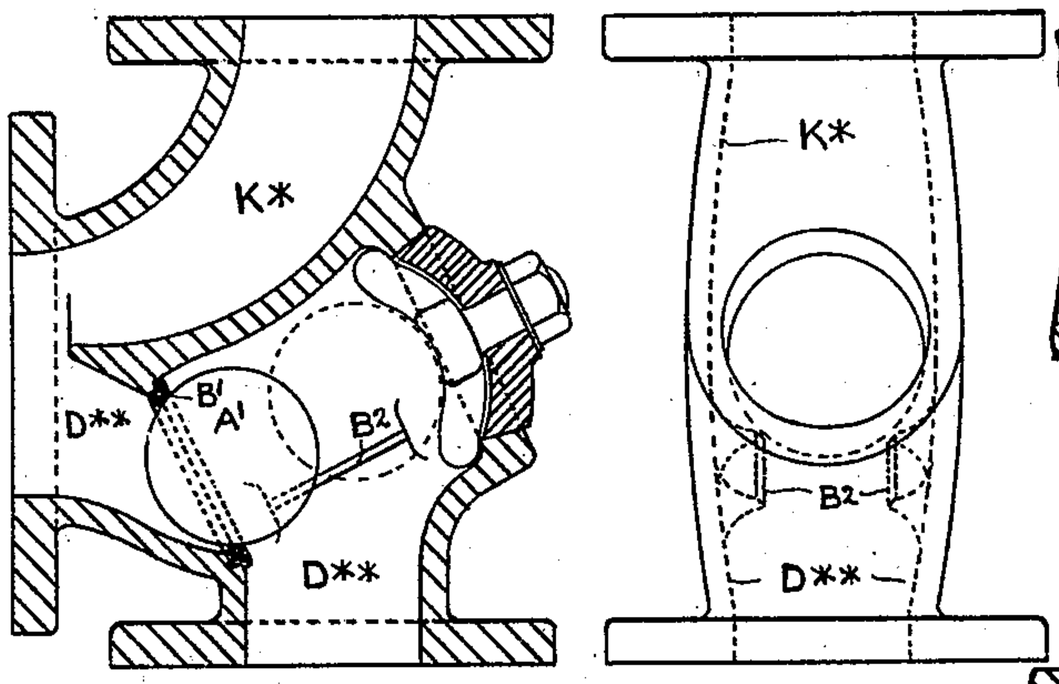
No. 518,019. Patented Apr. 10, 1894.

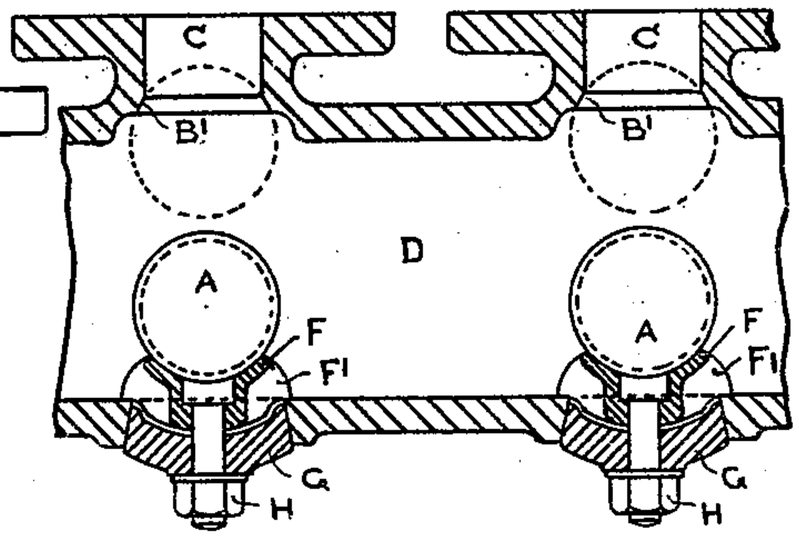
—Fig 11.— —Fig 12.



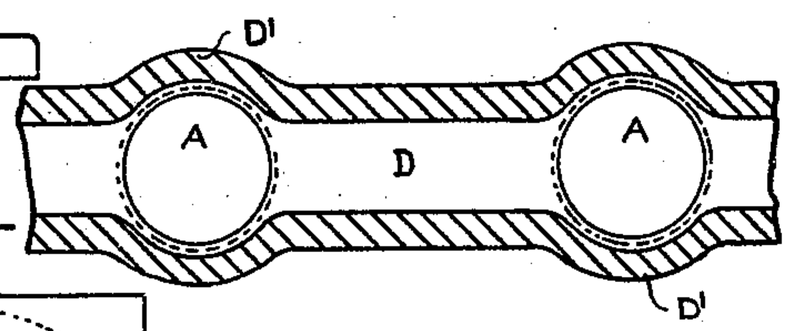
—Fig 9.—

—Fig 13.— —Fig 14.—

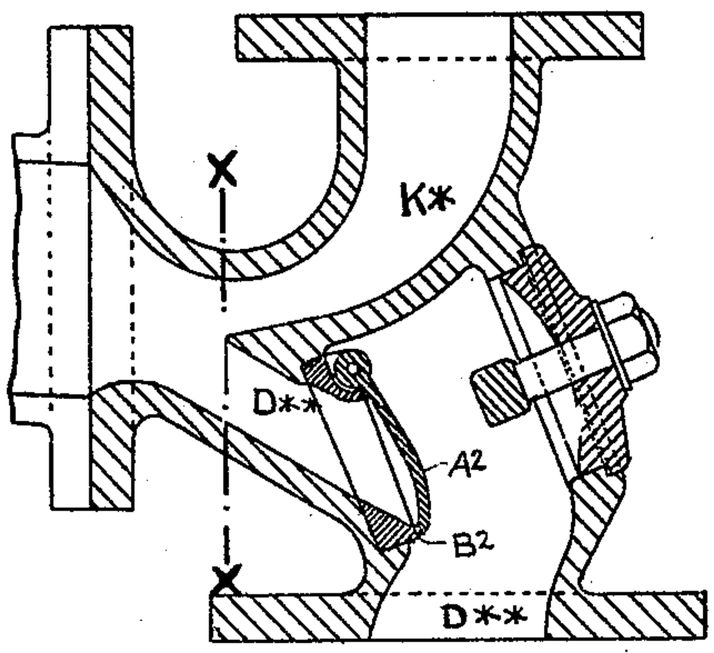


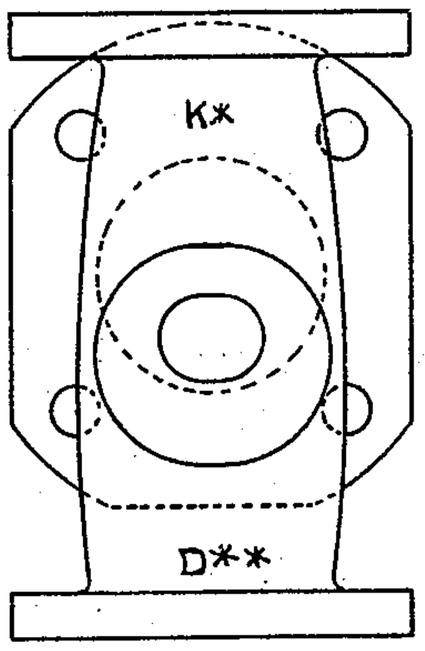


—Fig 10.—

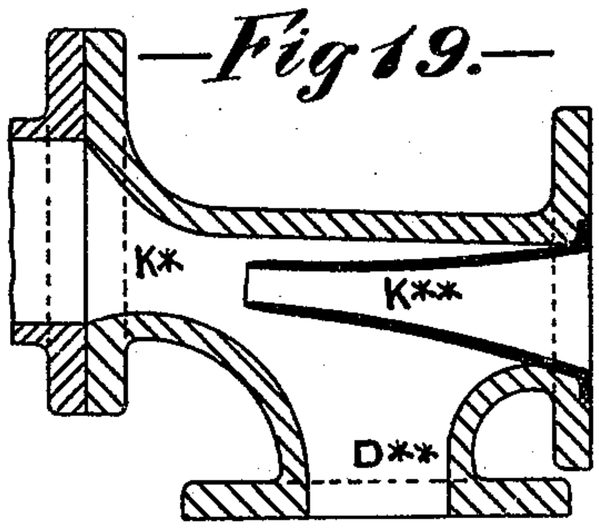


—Fig 15.— —Fig 16.—

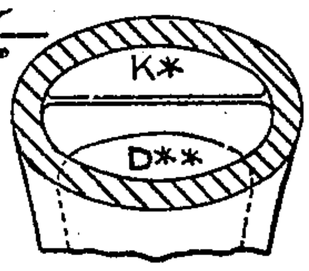




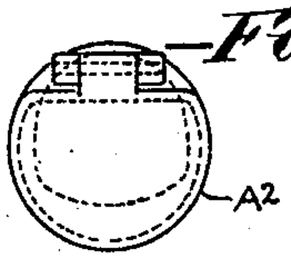
—Fig 19.—



—Fig 17.—



—Fig 18.—



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UNITED STATES PATENT OFFICE.

JAMES GARDNER CALVERT, OF GOTHENBURG, SWEDEN.

FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 518,019, dated April 10, 1894.

Application filed December 1, 1893. Serial No. 492,443. (No model.)

To all whom it may concern:

Be it known that I, JAMES GARDNER CALVERT, engineer, a subject of the Queen of Great Britain, residing at 19 Kyrkogatan, Gothenburg, in the Kingdom of Sweden, have invented a certain new and useful Improvement in Fuel-Economizers or Feed-Water Heaters, applicable, also, to tubulous steam-boilers, of which the following is a specification.

This invention relates more especially to that kind of fuel economizer or feed water heater which consists of a number of vertical or more or less inclined pipes or tubes arranged in series or sections, the upper ends of the pipes forming each section being connected to a junction box in communication with the feed pipe leading to the boiler; and the lower ends of the pipes forming each section being connected to a junction box in communication with the feed water inlet pipe and with the blow off pipe; but the invention is also more or less applicable to tubulous steam boilers.

In fuel economizers or feed water heaters of the above mentioned kind as usually constructed, the feed water entering through the feed pipe is intended to be broken up into as many separate currents as there are separate sections of pipes or tubes in the economizer or heater, and each such current is intended to rise straight through the particular section of pipes or tubes to which it happens to be directed and then to go straight to the feed pipe leading to the boiler, but it is obvious that if the feed water were forced to pass through all the sections of pipes or tubes in succession, commencing with the section nearest the chimney and finishing with the section nearest the furnace, the efficiency of the apparatus would be very much increased; but heretofore this has not been found practicable because of the unavoidable presence of the blow-off pipe which, being connected with all the sections, enables the feed water to short circuit, so to speak, more or less directly to the outlet pipe.

The object of my invention is to provide suitable and efficient means whereby the circulation of the water successively through all the sections of the apparatus is made certain notwithstanding the presence of the blow off pipe. For this purpose I employ a back pressure valve or obturator between the lower junction box of each section of the heating pipes or tubes and the blow off pipe that is to say preferably a back pressure valve or obturator for each separate section of such pipes, but in some cases arrangements may be made whereby one back-pressure valve or obturator may be made to serve for two, three or more of such sections. These back-pressure valves or obturators enable me to arrange the economizer or heater in such a way as to insure the passage of the feed water successively through all the sections of the heating pipes, and I also sometimes employ instead of the back-pressure valves or obturators, or in combination therewith an injector or ejector arrangement which serves the same purpose as the back pressure valves or obturators or assists their action.

In the drawings Figure 1 is an elevation of an economizer or feed water heater constructed in accordance with my invention, and placed in the flue between the furnace and the chimney. Fig. 2 is a transverse sectional elevation, and Fig. 3 a sectional plan of same. Figs. 4, 5 and 6 are similar views of a modified arrangement of same. Fig. 7 is a transverse section of the blow-off pipe of an economizer or feed water heater such as is illustrated in Figs. 1 to 6 inclusive, showing one of the back pressure valves above referred to. Figs. 8, 9 and 10 are respectively transverse, longitudinal, and horizontal sections of part of such a blow-off pipe with the said valves applied in a somewhat different manner. Figs. 11 and 12 are respectively longitudinal and transverse sections of parts of such a blow-off pipe with another kind of valve applied thereto. Figs. 13 and 14 are respectively a longitudinal section and front elevation of another form of back pressure valve combined with an injector arrangement. Figs. 15 and 16 are respectively a longitudinal section and front elevation of another kind of back pressure valve also combined with an injector arrangement. Fig. 17 is a section taken on line X X of Fig. 15 and Fig. 18 is an elevation of the flap valve shown in section in Fig. 15. Fig. 19 is a longitudinal section of a form of injector applicable more especially to the feed water inlet into

the first section of economizer pipes or tubes but it may also be used at the inlets of any of the other sections.

Similar letters of reference relate to like parts in all the figures of the drawings.

The aforesaid back pressure valves may be constructed in any suitable way that will allow the water and sludge to flow freely from each section of heating pipes to the blow-off pipe, when the main blow-off cock or valve is opened, but will, when such blow off cock or valve is closed, prevent the water flowing back from the blow-off pipe to any of the said sections of heating pipes. A serviceable and cheap valve for the purpose may consist of a hollow ball A (see Fig. 7) of glass, metal (such as iron, copper, tin, aluminium, or alloy, for example) or other suitable material, or a solid ball of some suitable light substance, floating upward against a valve seat B let into the pipe junction C between each section of heating pipes and the blow-off pipe D. The ball A may be guided into its place by suitable guides E which, when the main blow-off cock or valve is opened, allow the ball to drop automatically a sufficient distance to permit of a free flow of water and any deposit from the sections of heating pipes to the blow-off pipe D the ball A naturally floating up to its seat as soon as the blow-off cock or valve is closed. In the arrangement shown in Figs. 8, 9 and 10 the blow-off pipe D is shown of oblong section with cylindrical enlargements D′ where the ball valves A occur. These cylindrical enlargements D′ form guides for the ball valves A, and the seats B′ for the latter may be formed at the lower ends of the pipe junctions C as shown. In this case the ball valves A are inserted through holes at the lower ends of the cylindrical enlargements D′ and rest, when allowed to fall by the opening of the blow-off cock, on supports F formed on the cross bars F′ by which the plugs G, which close the aforesaid holes, are held in place through the medium of the bolts and nuts H.

Instead of a floating ball, any other suitable kind of valve kept to its seat by the pressure of a spring or by gravity or otherwise may be employed such as the ball A′ for example shown in Fig. 13 which being heavier than water tends to roll by gravity down to its seat B′ on the side ribs B^2 when the blow-off cock is shut, or a simple flap valve A^2 closing against its seat B^2 may be used as shown in Figs. 15 and 18. Or the blow-off pipe D may be shut off more or less completely from the sections of heating pipes by means of an obturating pipe $A^\times$ (see Figs. 11 and 12) contained within and running the whole length of that part of the blow off pipe D where the junction branches C from the sections of heating pipes are situated. This internal pipe $A^\times$ is open at the end next the blow-off cock and fits more or less accurately into the blow-off pipe D and has holes A^4 formed in it corresponding with the aforesaid junction branches C. It is adapted so that it can be turned round at pleasure in the blow-off pipe by means for example of a spindle A^5 connected to it at one end and passing out through a stuffing box A^6 on one end of the blow-off pipe D. By this means the internal pipe $A^\times$ can be turned so that the holes A^4 in it coincide with the junction branches C of the sections of heating pipes when it is desired to blow-off, and with the said holes away from such junctions when it is desired to close the connections between the blow-off pipe and the sections of heating pipes.

In some cases it may be desirable and practicable to so fit the aforesaid internal pipe in the blow-off pipe as to entirely prevent the passage of the feed water along the blow-off pipe when the internal pipe is turned with its holes away from the junctions, but in most cases it will be sufficient to fit the said internal pipe somewhat loosely in the blow-off pipe, the passage-way for the feed water to pass along the blow-off pipe being so reduced by the presence of the internal pipe that the quantity of water that can pass between the external surface of the internal pipe and the internal surface of the blow off pipe is not sufficient to cause any material inconvenience or loss of efficiency in the apparatus.

The employment of the above described back-pressure valves or obturating pipe enables me to arrange the economizer or heater as shown in Figs. 1 to 6 inclusive in such a way as to insure the passage of the feed water successively through all the sections of the heating pipes, the said feed water preferably going in at the end Y nearest the chimney and coming out at the end Z nearest the furnace (see Figs. 1, 3, 4 and 6) whereby the hottest gases meet the hottest water, and the coldest gases meet the coldest water, and to effect this, instead of connecting all the lower junction boxes with the inlet feed pipe, and all the upper junction boxes with the outlet feed pipe, as heretofore practiced, I connect the upper junction box I′ (see Figs. 1, 2 and 3) of the first section of heating pipes J′ by a connecting pipe K′ with the lower junction box L^2 of the second section, the upper junction box I^2 of the second section J^2 by a connecting pipe K^2 with the lower junction box L^3 of the third section J^3 and so on throughout the apparatus. The feed water inlet pipe M is connected to the lower junction box L′ of the first section J′ and the feed water outlet pipe N to the upper junction box I^8 of the last section J^8. By this arrangement the feed water enters the first lower junction box L′, is forced to ascend through the first section of heating pipes J′ into the upper junction box I′, then down the connecting pipe K′ to the lower junction box L^2 of the second section, up the pipes of the second section J^2 into the upper junction box I^2, then down the connecting pipe K^2 to the lower junction box L^3 of the third section, up the pipes of the third section J^3 and so on throughout the apparatus until it at last leaves by the feed outlet pipe N

at the upper junction box I^8 of the last section. Thus the water is heated and allowed to rise slowly in every section of pipes J′ to J^8 and is rapidly passed down through the connecting pipes K′ to K^7 to the bottom of the next section.

The connecting pipes K′ to K^8 may be placed inside the flue P or preferably outside the flue same as shown in the drawings, as that arrangement offers greater facilities for repairs and inspection than that in which the pipes are placed inside the flue.

In the arrangement above described and shown in Figs. 1, 2 and 3 I prefer to connect each of the pipes K′ K^2, &c., to its corresponding lower junction box by a bend as shown to a larger scale at $K^\times$ in Figs. 13 and 15, the outlet end of such bend being preferably contracted as shown to impart considerable velocity to the issuing water, the connection of the said lower junction box with the blow off pipe being effected by means of a bend or passage $D^{\times\times}$ of opposite curvature or direction. By this arrangement the water flowing down the pipe K′ is caused to enter the lower junction box at considerable velocity in a direction away from the blow off pipe, and the tendency for the water to flow to the blow off pipe, even when the back pressure valve is not present, is wholly or partially prevented by the ejector-like action of the jet of water issuing from the bend $K^\times$. This arrangement may therefore be employed whether the back pressure valves are used or not. The continuous flow of the feed water through each section of heating pipes in succession may also be effected by the arrangement shown in Figs. 4, 5 and 6 in which I connect the feed water inlet pipe M say to the upper junction box I′ of the first section J′ of heating pipes, the lower junction box L′ of that section with the lower junction box L^2 of the second section J′, the upper junction box I^2 of the second section with the upper junction box I^3 of the third section J^3, the lower junction box L^3 of the third with the lower junction box L^4 of the fourth section J^4 and so on, and finally the feed water outlet N with the upper junction box I^8 of the last section of pipes J^8. By this arrangement the feed water is forced to ascend in one section of pipes and to descend in the next; alternately ascending and descending throughout the whole of the sections of pipes composing the apparatus.

The connection of the upper junction boxes in pairs and of the lower junction boxes in the same way may be effected by plain U bends but in the drawings I have shown them connected by pipes Q and R respectively provided with branches corresponding to the junction boxes to be connected together but each pair of branches separated from the next pair by diaphragms Q′ R′ cast in the said pipes Q and R respectively. Fig. 4 shows the back pressure valves A in the blow-off pipe D applied each to a branch from the connection of two sections, whereby one valve is made to serve for two sections of pipes as above mentioned.

Whichever of the two above described arrangements is employed, the beforementioned back pressure or non-return valves or obturating pipe or injector-like arrangements, as the case may be, prevent more or less the passage of the feed water by way of the blow-off pipe instead of through the heating pipes and force it to pass successively through all the sections of heating pipes.

Fig. 19 shows an injector arrangement which may be used for the connection between the pipes K′ K^2, &c., and the respective lower junction boxes L^2 L^3, &c., but is more particularly intended to be used at the feed-water inlet to the first lower junction box L′ for the purpose of inducing firstly, a strong current of feed water through the first section of heating pipes to assist the circulation and secondly to draw from the blow off pipe any heated water that may find its way from any of the other sections into it, thus preventing such water from finding its way to the section nearest the outlet to the boiler and when desired this apparatus may be arranged to draw a certain amount of hot water from the sections through the back pressure valves and to return it along with the feed to the first section when it is desired to raise the temperature of the feed water before it comes in contact with any of the pipes of the economizer. In this arrangement of injector, $K^\times$ is the passage leading to the lower junction box, $D^{\times\times}$ the passage leading from the blow-off pipe, and $K^{\times\times}$ a contracted nozzle which directs the feed water, or the return water from the down pipe K′ K^2, &c., as the case may be, through the throat $K^\times$ into the lower junction box, inducing, as before stated, a current of heated water through the passage $D^{\times\times}$ from the blow-off pipe to mix with the feed water as above described. In this case also the back pressure valve between the junction box and the blow-off pipe may be omitted.

I claim—

1. In a fuel economizer, feed water heater or tubulous boiler, the sections connected together to permit the feed water to flow from one section to the other in succession, a blow off pipe common to all the sections, and the back pressure valves between the sections and the blow off pipe, arranged to cut off said sections from the blow off pipe and to allow passage of water successively through all the sections, one after the other substantially as described.

2. In a fuel economizer, feed water heater or tubulous boiler, the water heating sections, the return pipe, the junction box connected thereto, the blow off pipe and the injector device to direct the return water into the said

junction pipe and away from the blow off pipe consisting of the curved or bent passage leading from the return pipe to the junction box and the passage connecting with the blow off pipe curving or bending in the opposite direction, substantially as described.

3. In combination, in a fuel economizer, feed water heater or tubulous boiler the two or more sections of heating pipes, the inlet for the feed water, the blow off pipe common to all the sections and the back pressure valve between the sections and the blow off pipe, substantially as described.

4. In a fuel economizer, feed water heater or tubulous boiler the combination of an injector device with the return pipe, blow-off pipe and lower junction box or boxes of one or more sections of heating pipes or tubes the sections of heating pipes or tubes communicating with each other to allow the water to circulate successively through all the said sections substantially as described, and for the purpose specified.

5. In a fuel economizer, feed water heater or tubulous boiler, in which the several sections of heating pipes or tubes communicating with each other as to allow the water to circulate successively through all the sections of such pipes or tubes the combination of an injector device consisting of a bend or curved passage connecting the return pipe to its corresponding junction box and a bend or curved passage of opposite curvature or direction connecting the said junction box to the blow-off pipe, with a back pressure valve interposed between the lower junction box and the blow-off pipe, substantially as described, and for the purposes specified.

6. In combination, in a fuel economizer, feed water heater or tubulous boiler the two or more sections of heating pipes, the inlet for the feed water, the blow off pipe, common to the sections, and the injectors between the sections and the blow off pipe, substantially as described.

7. In combination in a fuel economizer, feed water heater or tubulous boiler, the heating sections, the upper and lower boxes, the connections between said boxes consisting of the pipes K′ to K⁷, the blow off pipe D common to all the sections and the back pressure valves between the lower junction boxes and the blow off pipe, substantially as described.

8. In combination, in a fuel economizer, feed water heater or tubulous boiler the sections communicating with each other to permit the feed water to flow successively from one to the other, the blow off pipe and the injection devices between the blow off pipe and the sections comprising the bent passage and the nozzle located therein, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

JAMES GARDNER CALVERT.

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