No. 776,923. PATENTED DEC. 6, 1904.

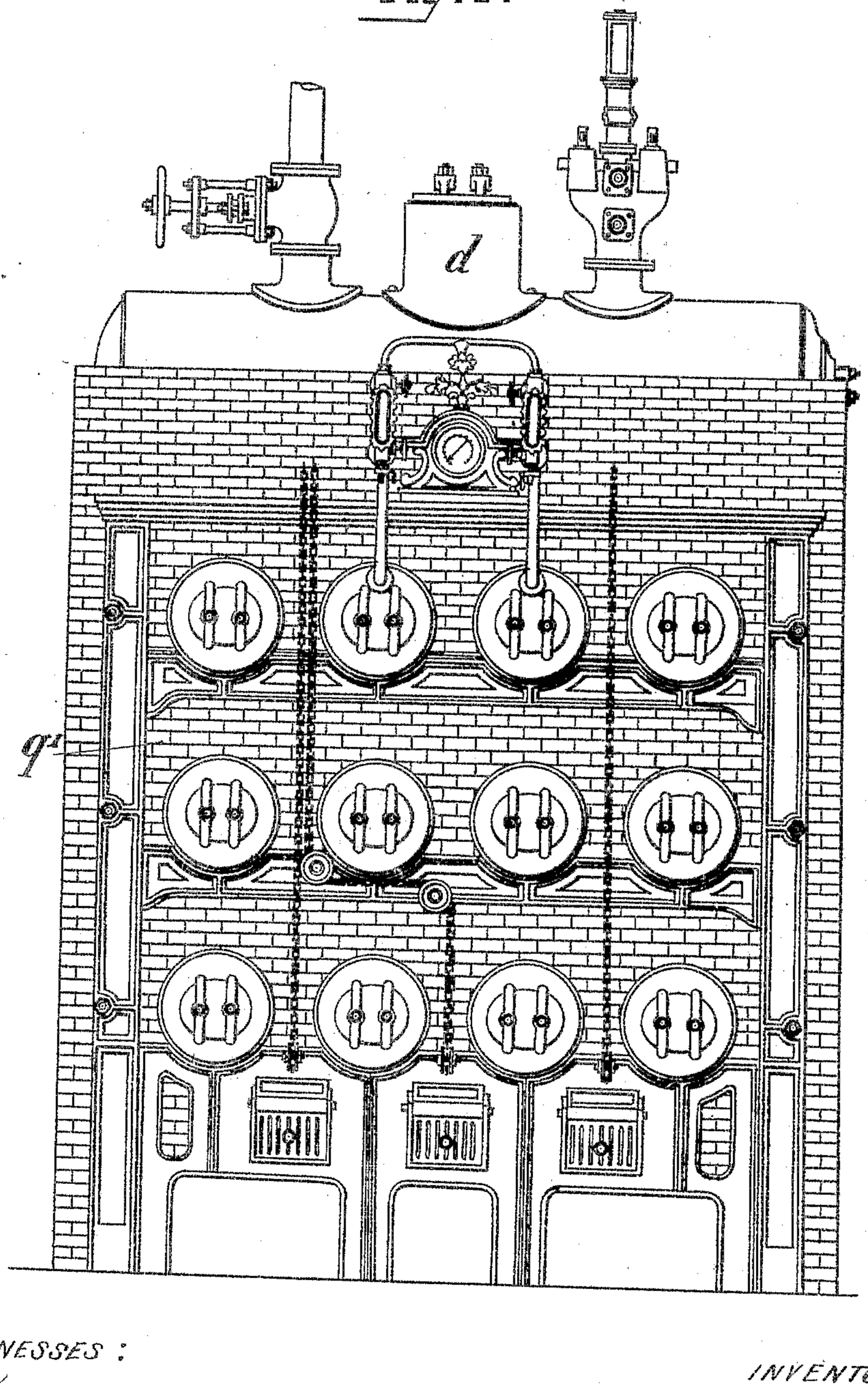
P. E. LEROUX.

STEAM GENERATOR.

APPLICATION FILED DEC. 9, 1903.

NO MODEL. 5 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 5 SHEETS—SHEET 2.

Fig. 2.

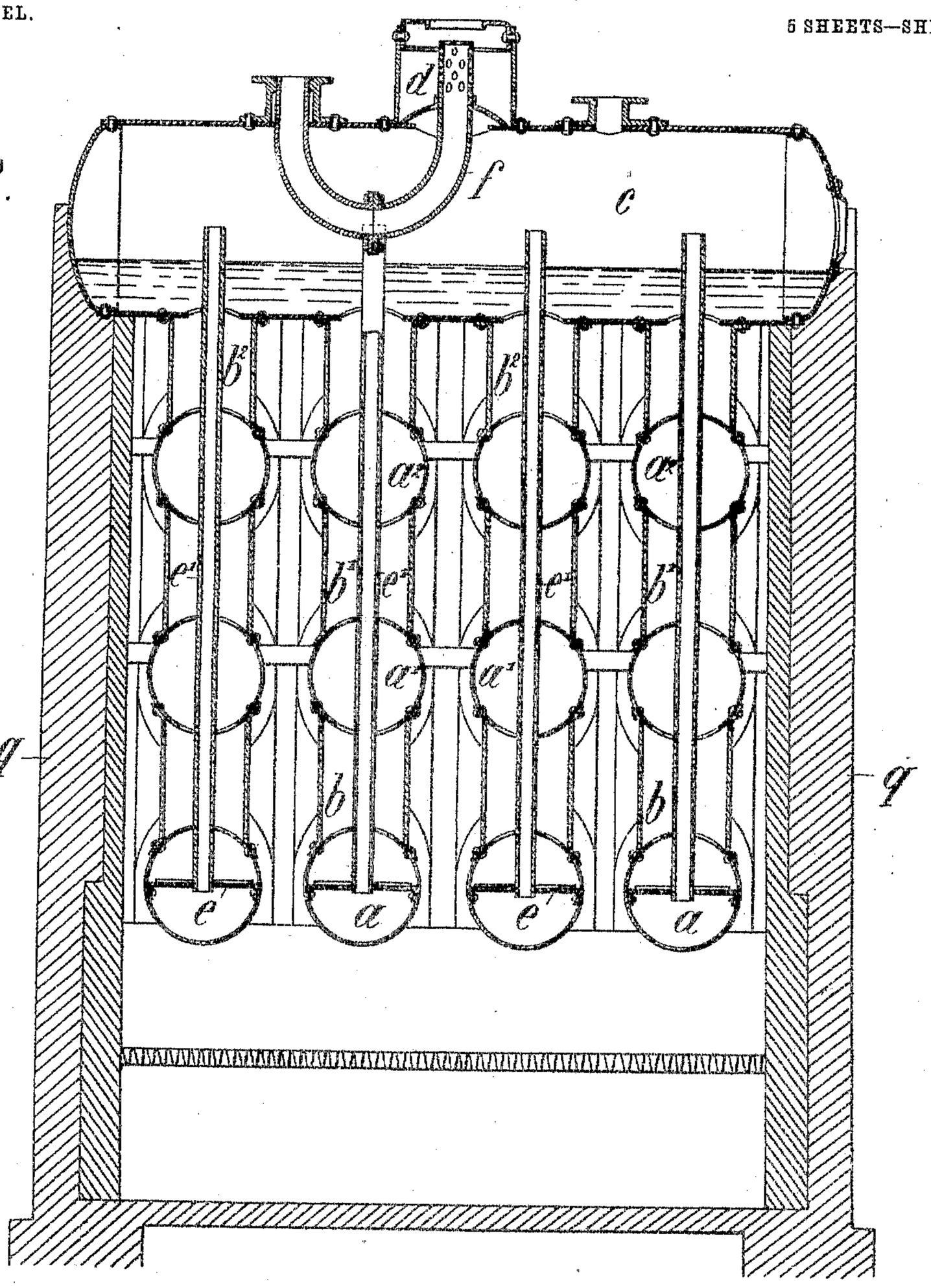
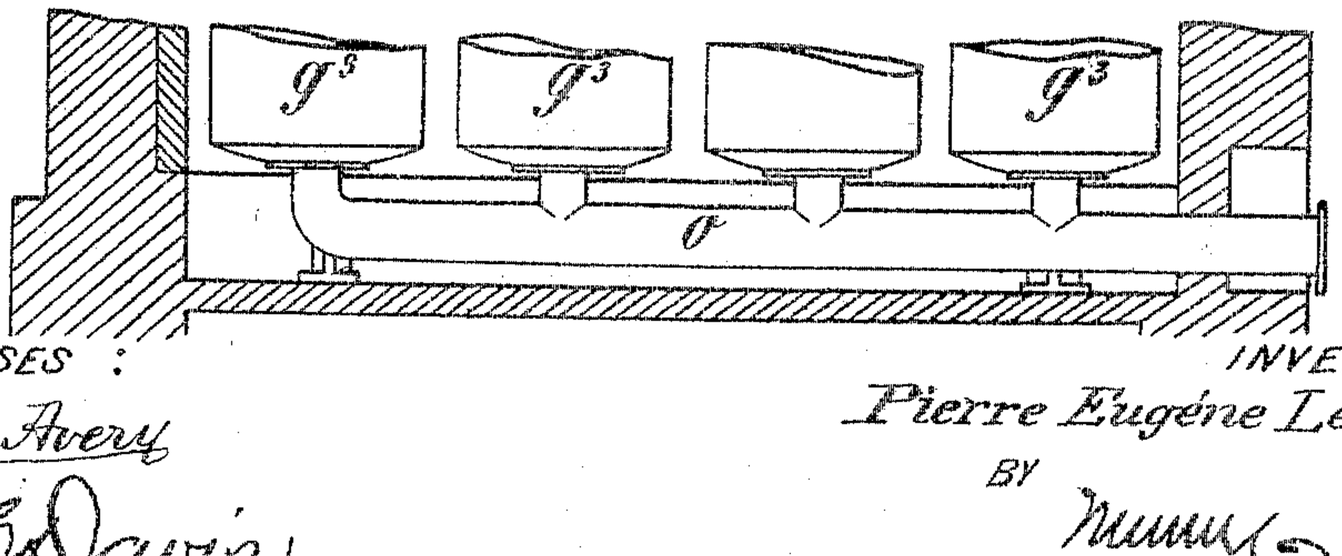


Fig. 5.



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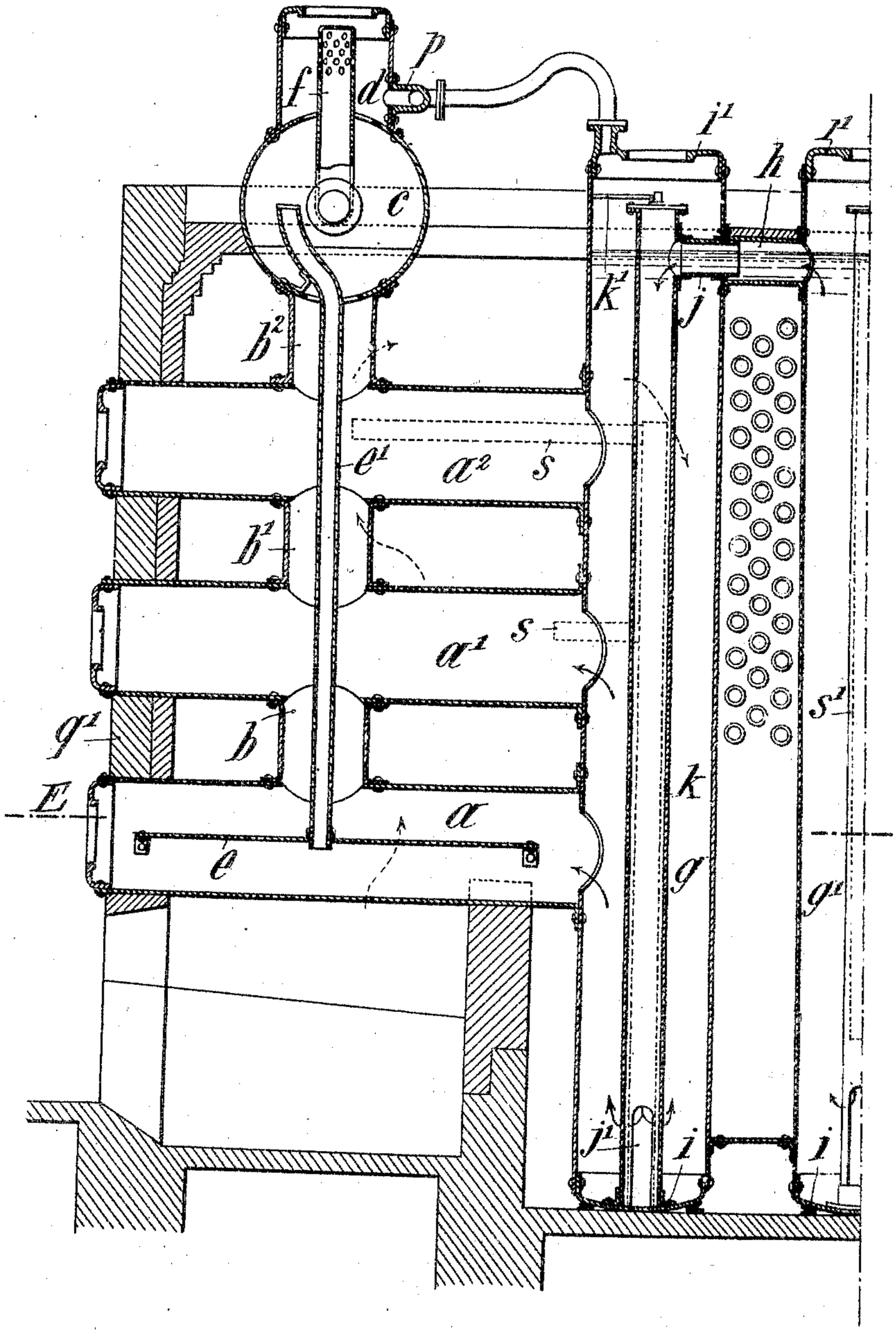
NO MODEL. 5 SHEETS—SHEET 3.

Fig. 3.



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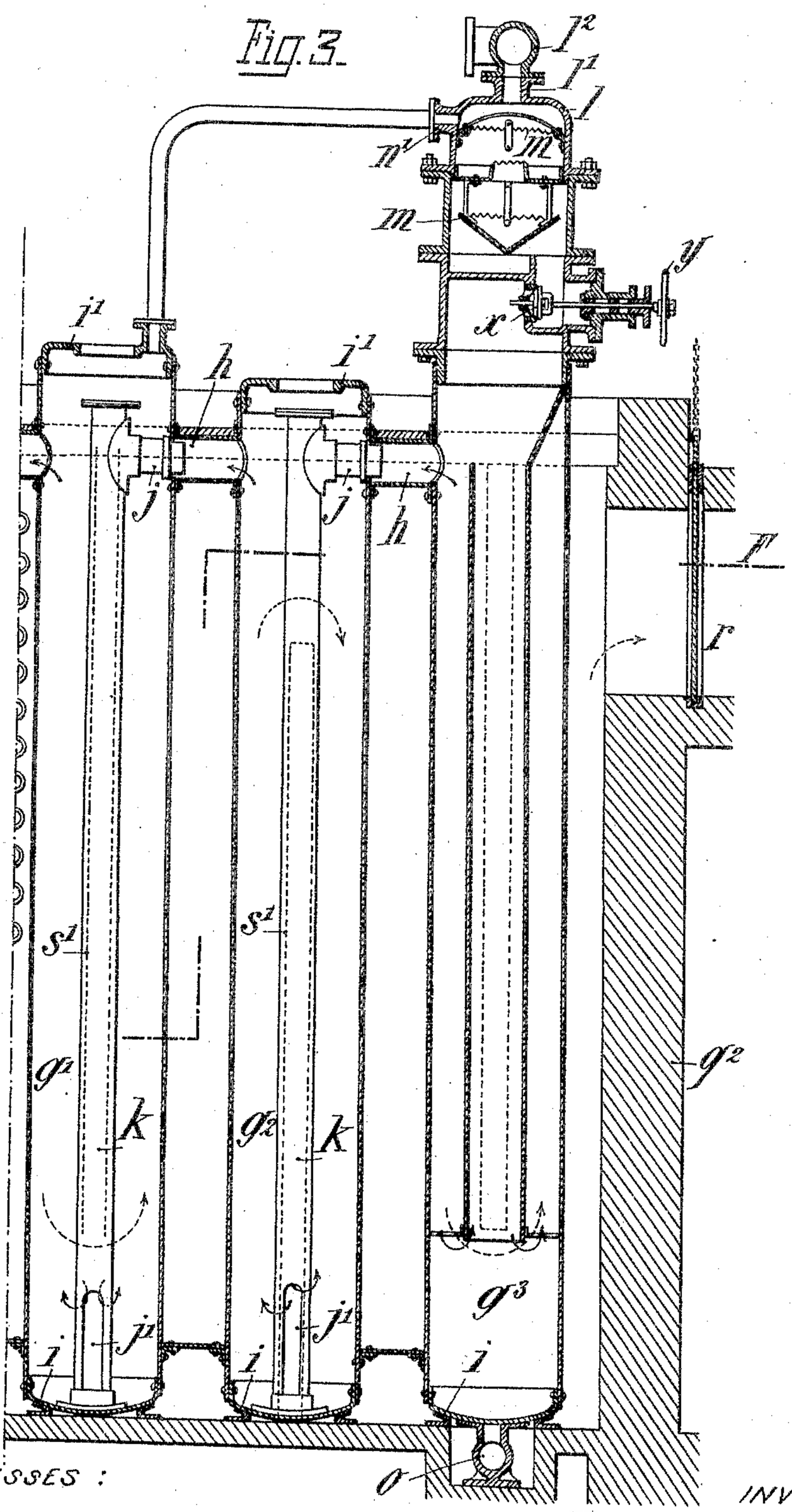
NO MODEL. 5 SHEETS—SHEET 4.

Fig. 3.



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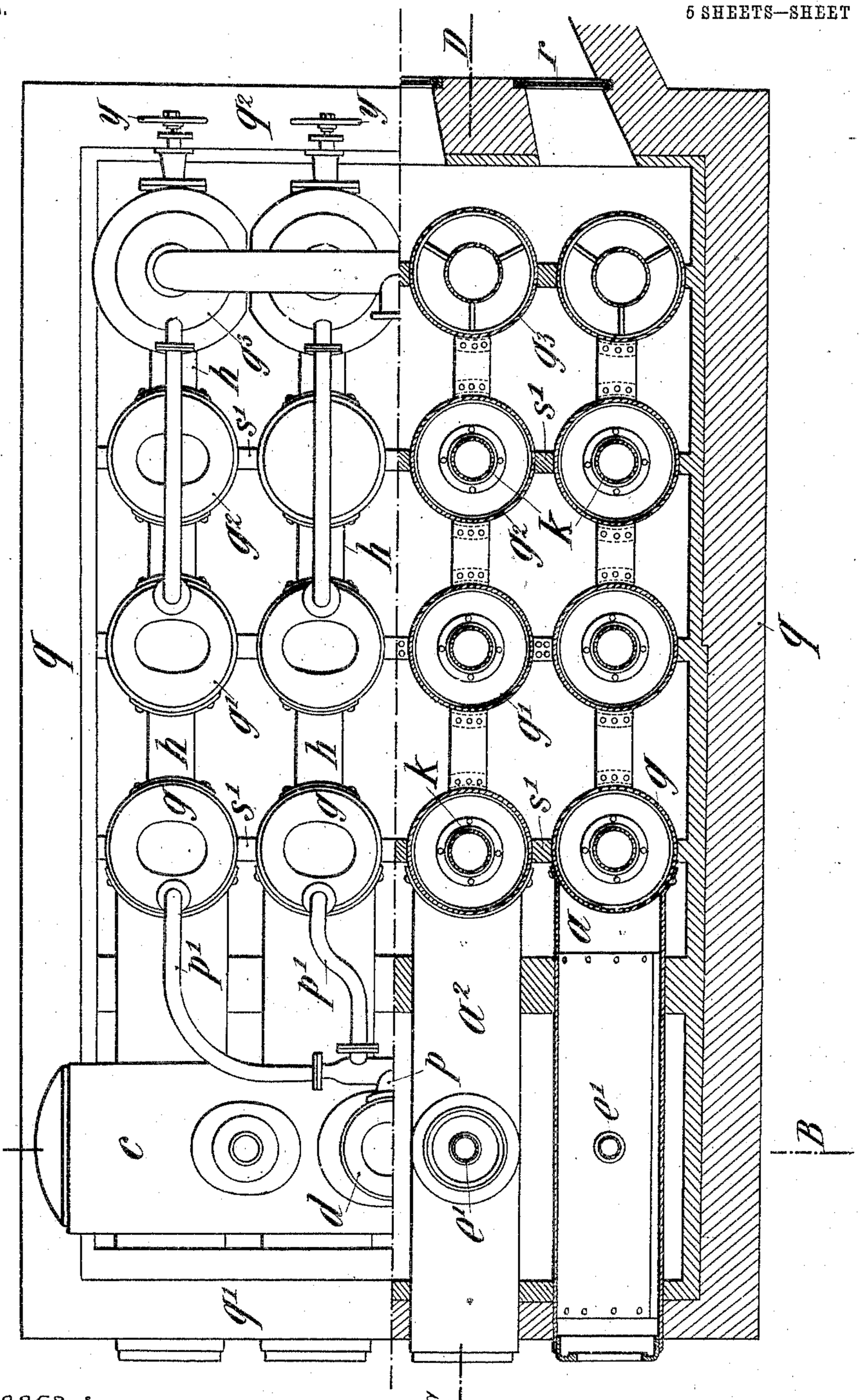
NO MODEL. 5 SHEETS—SHEET 5.

Fig. 4.



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No. 776,923. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

PIERRE EUGÈNE LEROUX, OF ARRAS, FRANCE.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 776,923, dated December 6, 1904.

Application filed December 9, 1903. Serial No. 184,405. (No model.)

To all whom it may concern:

Be it known that I, PIERRE EUGÈNE LEROUX, engineer, of 7 Rue Sainte-Croix Arras, Tasde Calais, Republic of France, have invented Improvements in Steam-Generators, of which the following is a full, clear, and exact description.

This invention relates to a new steam-generator having a large water-space and especially arranged so as to produce an automatic forced circulation of water, and thereby avoid swell and stagnation.

This generator comprises one or more series of horizontal water-drums connected either in series or in parallel to a steam-collector and arranged above the fireplace, each series being branched upon a vertical drum and preceded by one or more vertical water-drums in the flue. The upper part of each drum is connected to the following drum by means of a tube extending to the bottom of the latter, so that the water arriving to the bottom of this tube will be forced upward through the whole drum in order to pass then into the next one. Finally, the horizontal drums branched upon the last vertical drum are provided with a baffle or diaphragm intended to produce an obligatory circulation of water in these parts and prevent swell. The same arrangement has also for its result in the drum next to the fireplace the cooling of the surface directly exposed to the flames.

The invention is illustrated in the accompanying drawings, wherein—

Figure 1 represents a front elevation of the generator; Fig. 2, a transverse section on line A B, Fig. 4; Fig. 3, a longitudinal section on line C D, a part being on Sheet 3 and a part on Sheet 4, Fig. 4; and Fig. 4, a part plan horizontal section on line E F, Fig. 3. Fig. 5 is a sectional elevation of the blow-out pipe.

The same letters of reference indicate the same parts in all the figures.

The horizontal water-drums a a' a^2 are connected by vertical water-legs b b' b^2, of sheet-steel, Figs. 2 and 3, with each other and with a steam-drum c, having a dome d. The lower horizontal drums, which are directly exposed to the flames, are provided with an internal baffle or diaphragm e, from below which a tube e' opens above the water-level in the steam-drum c. Each of the horizontal drums may have such a tube, and in this case the other tubes will be concentric with e'.

The steam-pipe f is in two parts bolted together and of curved form, as shown, the inlet end of said pipe, which rises into the dome, being perforated, while its other end is connected to the base of the steam-stop-valve casing, Fig. 2, the pipe dipping into the boiling water, so as to prevent priming.

The horizontal water-drums a a' a^2 are riveted to the nearest of a series of rows of vertical water-drums g, connected by riveted sheet-steel tubes h or by cast-steel joint-pieces with other rows of vertical water-drums g' g^2 g^3, in number depending on the size of the boiler. The bottoms i of the drums g g', &c., are seated on cast-iron rings and their upper ends are provided with manholes. Each is provided with a dip-pipe k, which is connected by a branch j, connected by a saddle-piece to the tube k and fitting at the other end in the connecting-pipe h, so that the dip-pipes may be easily placed in position. The dip-pipe has outlet-openings j' near its lower end for the circulation of the water, and it is held in position at the lower end by a socket riveted to the bottom end of the drum, while its upper end is secured on the one side by the branch j and on the other by a steadying-bar k'. The last row of drums g^3 are provided at the upper end with a precipitation-dome l, having a connection l' to the feed branch l^2. The dome l is bolted to and jointed upon an intermediate ring-casting riveted to the upper end of the water-drum and has fixed within it a series of serrated baffle-plates m for dividing the mass of the feed-water into successive cascades. It has also a connection n' with a pipe n, leading from the corresponding drum of the row g' for the supply of steam for heating the feed-water, the condensation of the steam causing a reduction of pressure, whereby circulation is established as soon as the heating of the vertical drums commences.

The precipitation-drum may be readily dismounted when the generator is under pressure by the interposition of a stop-valve x, seated in a division-plate in the intermediate ring and operated by a hand-wheel y. To

clean out the precipitator, the valve x is closed and the dome unbolted from the ring and removed without interfering with the working of the boiler.

The bottom of each drum g^3 is connected by a branch with the blow-out pipe o, as shown in Fig. 5. The dome of the steam-drum is connected by a multiple branched steel casting p and branch pipes p' with the row g of vertical drums from which it receives steam.

The construction of generator herein described is well adapted for the use of a superheater placed between the vertical drums according to the degree of superheating desired. The vertical drums are assembled by sheet-metal gusset-piece w, bolted to angle-iron brackets riveted to the drums. This construction of generator permits, for the same amount of heating-surfaces, of varying its dimensions as regards height, breadth, or length according to the space available. The feed-water is supplied through l^2 to the precipitation-domes l of the last row of drums g^3, where it is raised to a sufficient temperature to give up the carbonates and principal matters in suspension which it contains, and after being cascaded by the baffles m it is received by a down-pipe k and conducted to the lower part of the drum g^3, in the outer annular space whereof it rises and becomes more and more heated by contact with the walls exposed to the hot gases and flows thence into the next succeeding drums. The hot furnace-gases first impinge against the horizontal drums under the guidance of the baffles s and then pass successively in contact with the whole of the vertical drums under the control of the cross-baffles s' and then escape through as many dampers as there are fire-doors to the chimney, care being taken in determining the path traversed by the gases that the temperature of the gases on their discharge shall not exceed 160° centigrade, with a velocity of about two meters per second at the flue-outlet. The path of the gases is represented by the arrows drawn in dot-and-dash lines, while that of the water is shown by the arrows shown in full line.

This system of generator embodies in practice the principle of bringing the coolest gases in contact with the coolest water, and so effects the methodical and rational utilization of the calorific power for the evaporation of the water. In the generator hereinbefore described the circulation is not only rendered obligatory, but, furthermore, the particular arrangement of the circulation-tube in the vertical drums even produces, when the boiler is in work, an automatic circulation in each of the drums by thermo-siphon action, which may be thus explained. When the hot gases impinge against the drums g g' g^2 g^3, the water in contact with the walls is heated and expanding acquires a density less than that of the water in the central down-pipe, and the consequent difference of pressure of the two liquid columns causes a downward movement in the central tube and an ascending movement in the annular space of each of the vertical drums, and communication being established between the annular space of the one and the down-tube of the next a positive or forced circulation is established throughout the whole series of drums. From the foregoing it results that no precipitation can be produced, because all the liquid streams are obliged to circulate at the same speed. On the contrary, in certain boilers in which vertical boilers are also provided these are joined together by means of connections at their upper part. Therefore the circulation only takes place at the level of these connections, while the coldest liquid streams immediately pass down to the bottom of the drum, together with their impurities, and remain there indefinitely. The diaphragms act in the horizontal drums in a way that can be compared to that of the tubes k. In fact, on reaching the lowermost drum, for instance, the water is divided into two sheets, the lower one of which being more exposed to the action of the flames will be vaporized first, the steam produced passing immediately through the tube e into the steam-receptacle. After this first sheet has been vaporized the upper sheet, which has passed round the diaphragm, takes now its place in the lower portion of the drum, as shown by the arrows in Fig. 3. The water thereby follows a determined course without swell. If the diaphragm c were not employed, the intensive bubbling which would be produced in the drum a would determine a perturbation which would oppose itself to a new introduction of the liquid, and this would be against the principle of the invention. Besides, the diaphragm also serves to send back to the surface directly exposed to the action of the flames the water sheet coming from the vertical drum and having the lowest temperature on account of its having been only in contact with the non-heated surface e.

The blowing out of the boiler is particularly easy, as by opening the blow-out cock when the pressure falls to about fifteen pounds the vertical drums and their down-pipes are emptied by siphoning off to within two or three inches of their upper ends, which has the advantage of retaining the liquid mud and of enabling its removal without opening the boiler.

I claim—

1. A steam-generator comprising a vertical boiler, a series of horizontal boiler-tubes, a partition in the lower of said horizontal boiler-tubes, a tube for the escape of steam opening over the water-level in such a way as to permit the easy escape of steam from said boiler-tube and the passage of water from the vertical boiler to the partition.

2. A steam-generator having a vertical drum, a series of horizontal drums, one of said drums being provided with a partition, a steam-escape tube ending above the water-level so that the steam will easily escape from the lower drum and the water will easily pass from the vertical drum, substantially as described.

3. A steam-generator comprising a vertical series of horizontal drums connected together, a steam-escape tube passing vertically through said drums, and a partition in the lowest of said drums above the end of said tube.

4. A steam-generator comprising vertical drums, a precipitation-dome above one of said drums, means for introducing feed-water into said dome, a baffle-plate in said dome, and means for permitting the water to pass from said dome to said drums.

5. A steam-generator comprising drums, a precipitation-dome, means for introducing feed-water into said dome, means for permitting the water to pass from said dome to said drums, a valve for regulating the passage of water to said drums, and a tube leading into said drum for conducting water to the end thereof.

6. A steam-generator comprising vertical drums, a pipe in each extending from the top downward, means for conducting feed-water into the pipe in one of said drums, and means for conducting the water from each of the drums to the pipe in the next drum.

7. A steam-generator comprising vertical drums, a precipitation-dome, means for introducing feed-water into said dome, means for conducting the water from said dome into said drums, and means for introducing steam into said dome.

The foregoing specification of my improvements in steam-generators signed by me this 7th day of November, 1903.

PIERRE EUGÈNE LEROUX

Witnesses:

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MAURICE H. PIGNET.