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Patented Feb. 7, 1899.

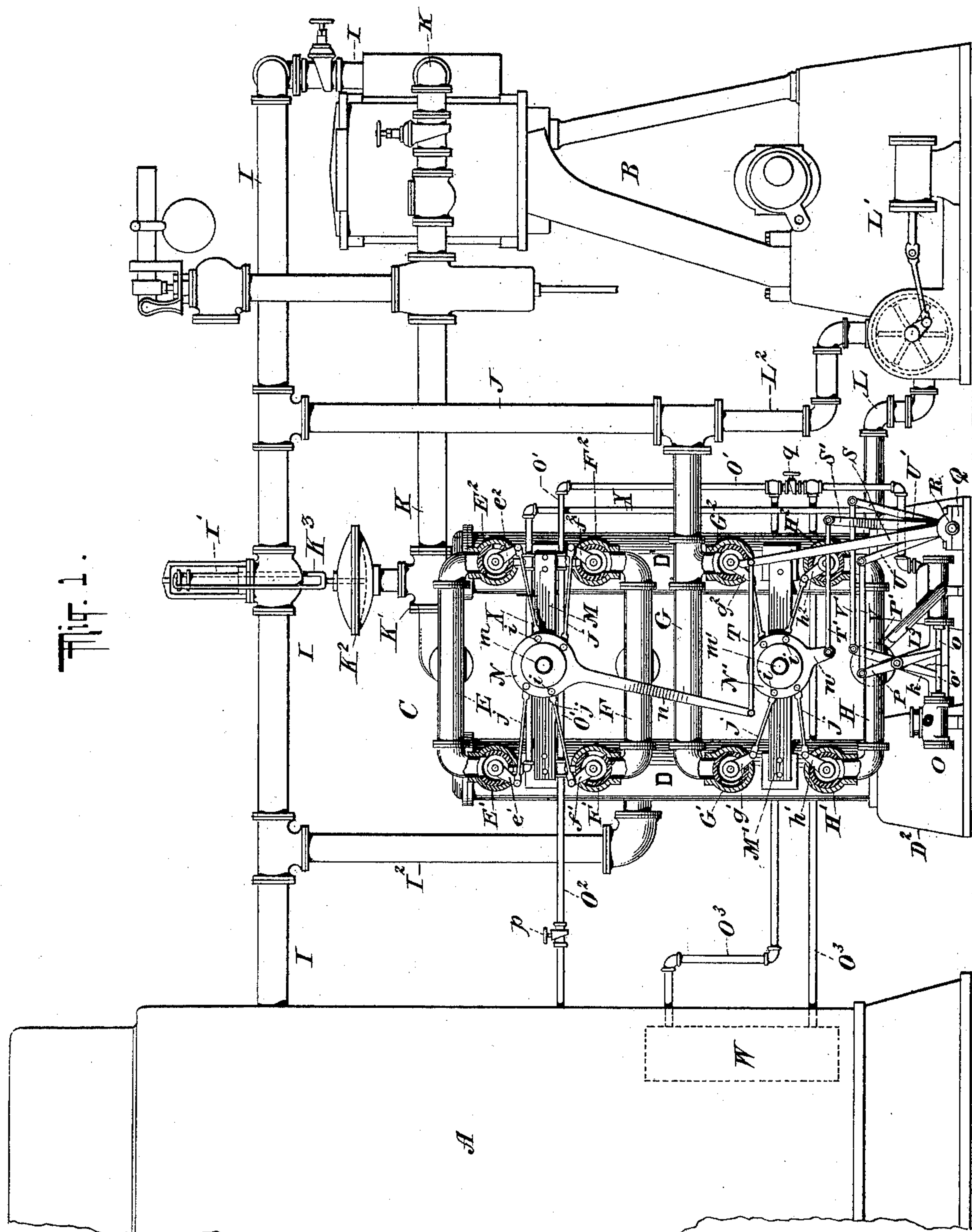
H. J. BARRON.

APPARATUS FOR REGENERATING EXHAUST STEAM.

(Application filed Sept. 21, 1898.)

(No Model.)

2 Sheets—Sheet 1.



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2 Sheets—Sheet 2.

Fig. 2.

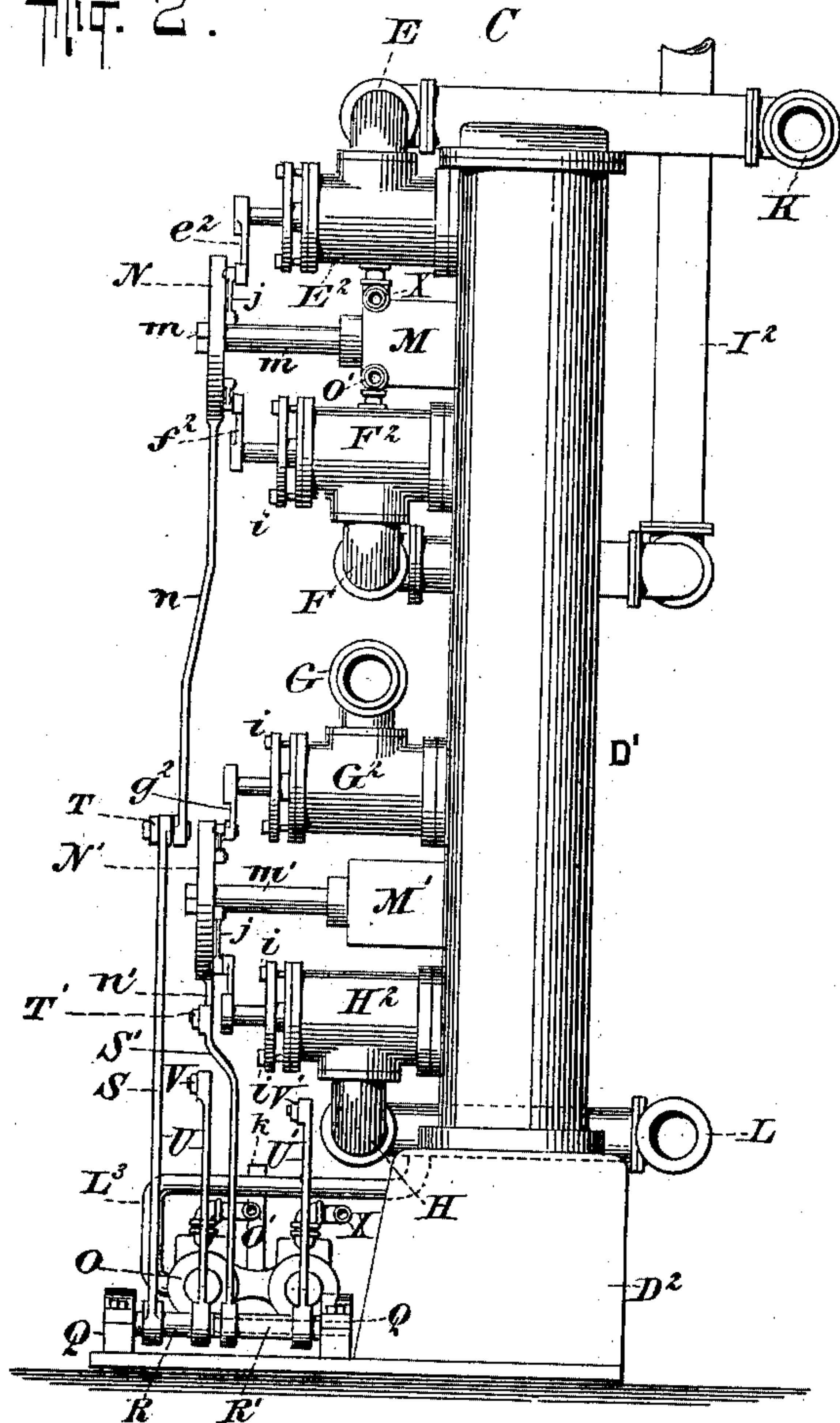
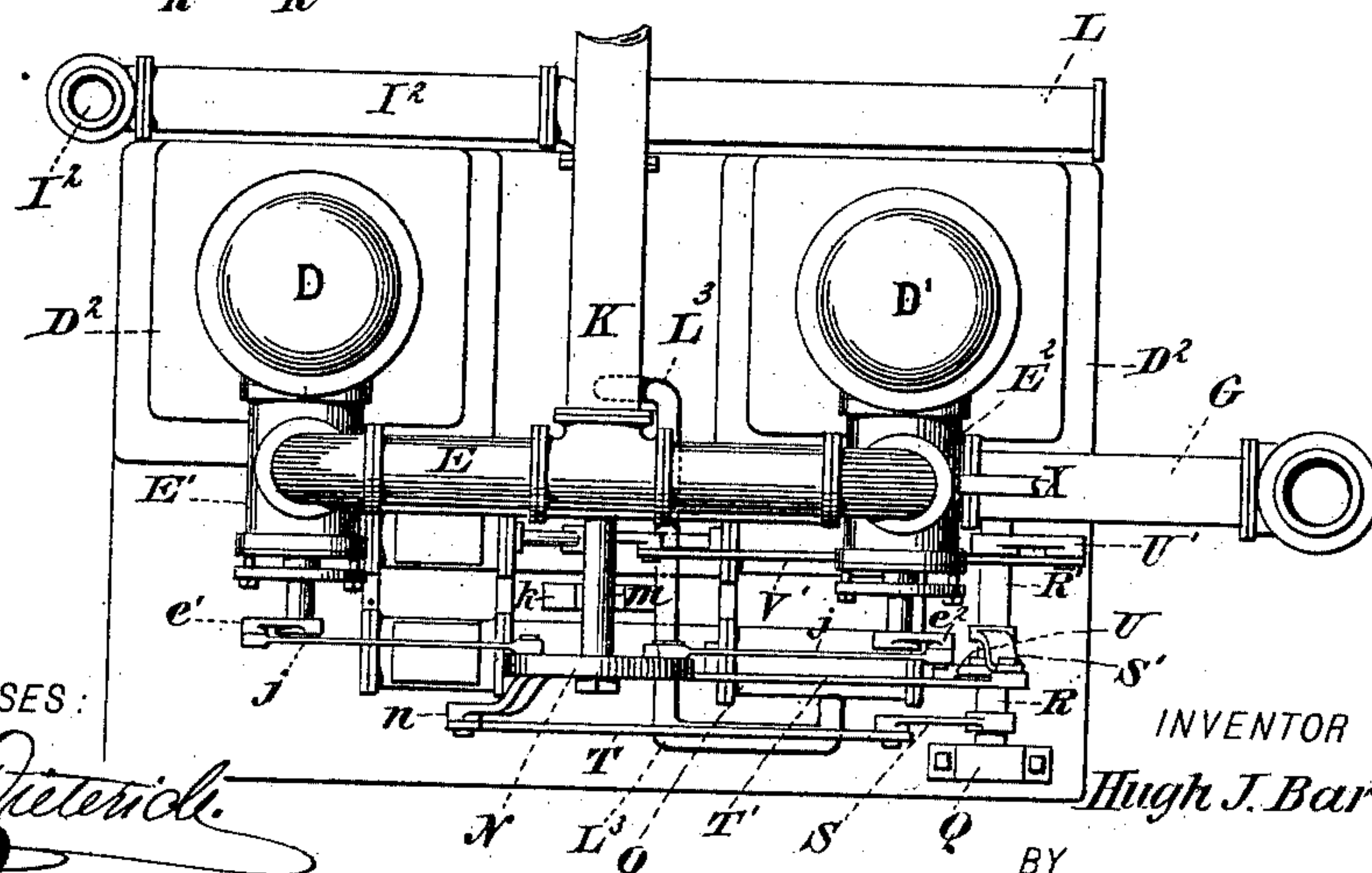


Fig. 3.



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HUGH J. BARRON, OF NEW YORK, N. Y.

APPARATUS FOR REGENERATING EXHAUST-STEAM.

SPECIFICATION forming part of Letters Patent No. 619,119, dated February 7, 1899.

Application filed September 21, 1898. Serial No. 691,485. (No model.)

To all whom it may concern:

Be it known that I, HUGH J. BARRON, a citizen of the United States, residing at the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Apparatus for Regenerating Exhaust-Steam, of which the following is a full, clear, and exact specification.

My invention relates to improvements in steam-engines, and has for its object to provide an apparatus for regenerating exhaust-steam of the type disclosed in United States Letters Patent No. 607,582, granted to me July 19, 1898; and my present invention has for its object more particularly to provide an apparatus wherein only a portion of the live steam need be diverted and employed to attain the desired result, and thus enable me to more economically reëvaporate and re-utilize the exhaust-steam discharged from the engine and at the same time generate new steam by contact or association with the live steam maintained intermediate the boiler or main generator and the apparatus or auxiliary generator.

The object above set forth I am enabled to attain by means of my invention, which consists in the novel details of construction and the combination, connection, and arrangement of parts, as hereinafter more fully described and then pointed out in the claims.

In the accompanying drawings, forming part of this specification, wherein like letters of reference indicate like parts, Figure 1 is a front view showing a boiler and engine and an apparatus constructed according to and embodying my invention in combination therewith. Fig. 2 is an enlarged end elevation of the apparatus disconnected from the boiler and engine, and Fig. 3 is a top or plan view thereof.

In said drawings, A designates a boiler of ordinary construction, B an engine, and C the apparatus or auxiliary steam-generator. D D' denote cylinders supported in vertical positions upon a suitable base D².

E, F, G, and H denote pipes arranged in the order named, beginning at the top of the cylinders D D' and communicating therewith, and E' F' G' H' and E², F², G², and H² denote valves arranged in the pipes E, F, G, and H, adjacent to the cylinders D D', respectively,

said valves having outwardly-projecting stems, to the ends of which are respectively secured levers *e' f' g' h' e² f² g² h²*.

I denotes the main steam-pipe, leading from the boiler A to the engine B, having a pressure-reducing valve I', arranged therein. From said main steam-pipe I intermediate the boiler A and the reducing-valve I', extends an inlet-pipe I², which is connected between the cylinders D D' to the pipe F.

J denotes the outlet-pipe, which is connected at one end to the pipe G, connecting the cylinders D and D', and at its other end to the main steam-pipe I, intermediate the reducing-valve I' and the engine B.

K denotes the exhaust-steam pipe leading from the engine B and connected between the cylinders D and D' to the pipe E, said exhaust-pipe K having an outlet K' therein, a diaphragm K² connected thereto, and a connecting-section K³ uniting the same with the reducing-valve I' of the pipe I, whereby a uniform pressure is maintained in the receptacles D D', and L the condensation and vapor pipe, which is connected to an exhaustor L', and L² denotes a pipe connected to the exhaustor L' and the pipe J.

L³ denotes a branch pipe leading from the condensation and vapor pipe L to the suction part of the forward cylinder of the pump O, as seen in Fig. 1.

M M' denote brackets the ends of which are secured to the cylinders D D', the bracket M being secured between the sets of valves E' E² and F' F² and the bracket M' between the sets G' G² and H' H². Upon the outer surfaces of said brackets M M', about midway of the distance between the cylinders D D', are provided studs *m m'*, upon which are mounted wrist-plates N N', respectively, the wrist-plate N being provided with a long depending bent arm *n* and the wrist-plate N' provided with a shorter depending arm *n'*, and upon the rear sides, adjacent to their peripheries, said wrist-plates N N' are provided with pins *i i'*, respectively, and *j j'* denote links having their outer ends pivotally secured to the ends of the valve-stem levers and their inner ends similarly secured to the wrist-plates N N' by the pins *i i'*.

O denotes a duplex direct-acting steam-pump provided with a bracket *k*, upon which

are pivotally supported the levers P P', the lower ends of which levers are respectively connected to the piston-rods o o' of the pump, and adjacent to one end of the pump O are provided bearings Q Q, within which is supported a rock-shaft R, having a loose sleeve R' thereon. Upon the rock-shaft R is fixed one end of the lever S, the other end of which is connected by a link T with the arm n of the wrist-plate N, and fixed also upon said rock-shaft R is one end of a lever U, the outer end of which is connected by a link V with the upper end of the lever P of the pump O, and upon the sleeve R' is fixed one end of the lever S', having its other end connected by a link T' with the arm n' of the wrist-plate N', and U' denotes a lever having one end fixed upon the sleeve R' and its other end connected by a link V' to the upper end of the lever P' of the pump O.

To one cylinder of the pump O is connected the hot-water-supply pipe O', which is connected with the valves F' F² and has a branch section O², provided with a valve p and connected to the boiler A. O³ denotes a loop-section arranged in the pipe O', which communicates with a heater W, provided in the boiler, and q denotes a valve arranged in the pipe O' intermediate the ends of the loop-section O³ for causing the water to pass through said loop-section. To the other cylinder of the pump O is connected the cold-water-supply pipe X, which is connected to the valves E' E², whereby cold water is admitted to the cylinders D D' for the purpose of reducing the temperature of any steam which may remain therein before or simultaneously with the admission of exhaust-steam to said cylinders D D'.

The operation of the apparatus is as follows: If we assume the apparatus C to be in the position indicated at Fig. 1 and the cylinder D' to contain exhaust-steam, the live steam from the boiler, with a pressure, for example, of one hundred and twenty-five pounds, will be conducted from the boiler through the main steam-pipe I, and after passing through the reducing-valve I' be supplied to the engine at, say, a uniform or constant pressure of one hundred pounds. At the same time, however, the excess of steam or a portion thereof maintained in that section of the pipe I intermediate the boiler and the reducing-valve I' will be diverted and conducted to the cylinder D' by the pipe I², pipe F, and valve F², absorb a charge of hot water conducted to said valve F² by the pipe O', convert the same into steam, and thence pass into the cylinder D' and unite with the exhaust-steam contained therein, and thereby regenerate the same. The regenerated exhaust-steam, with a pressure of about one hundred and five pounds, will thence pass out of the cylinder D' by way of the valve G², pipe G, pipe J, and into the main steam-pipe I, intermediate the reducing-valve I', and unite with the steam passing therethrough and to the engine. At the

same time the exhaust-steam from the engine will be returned to the cylinder D through the exhaust-steam pipe K, pipe E, and valve E', and at about the same time or shortly before the admission of the exhaust-steam to said cylinder D a charge of cold water will be admitted to said cylinder by the valve E' from the supply-pipe X and upon entering the same be sprayed therein by suitable means, and thereby sufficiently reduce the temperature of any high-pressure steam which may have remained therein from the previous operation, and thus avoid excessive back pressure and facilitate the admission of exhaust-steam to said cylinder D at the reversal of the valves. The condensation, if there be any, or any hot or cold water which may remain unevaporated in said cylinder will be conducted therefrom by the valve H' and pipe H to the hot-water cylinder of the pump O, and thence again supplied partly to said cylinders D D' by the pipe O' and to the boiler by the branch pipe O², and simultaneously therewith uncondensed vapor remaining in said cylinder will be taken by the exhauster L in sufficient quantity to maintain a normal back pressure in the apparatus, which vapor thus withdrawn will thence be forced through the pipe L² into the section of the main steam-pipe I intermediate the reducing-valve I' and the engine. It will be observed that at this period or stage of operation steam under high pressure will be supplied to the engine B by the main steam-pipe I, pipe I², cylinder D', and pipe J, while exhaust-steam will be conducted through the main exhaust-pipe K, pipe E, and into the cylinder D, and the unevaporated hot and cold water and condensation, if there be any, conducted from the apparatus by the pipe L and pump O and recirculated and the uncondensed vapor taken by the exhauster L' and supplied to the engine. As soon as the operation above described has taken place the wrist-plates N N' will be partially rotated by the action of the steam-pump O, communicated thereto by the intermediate mechanism, comprising the levers S S', links V V', levers U U', and links T T', and cause the valves F² G² of the cylinder D' and the valves E' H' of the cylinder D to close, and open the valves F' G' of the cylinder D and the valves E² H² of the cylinder D'. Hereupon steam from the boiler will pass through the main steam-pipe I, pipe I², pipe F, valve F', and into the cylinder D and in so doing receive at the valve F' a charge of hot water from the pipe O', absorb and convert the same into steam, and thereupon unite with the exhaust-steam contained in said cylinder D and regenerate the same, and thence pass out of said cylinder D through the pipe G, valve G', pipe J, and through the main steam-pipe I to the engine B. The exhaust-steam now being returned from the engine to the cylinder D' through the exhaust-pipe K, pipe E, and valve E², and at about the same time or shortly before the exhaust-steam enters the cylinder D',

a charge of cold water is taken from the pipe X at the valve E² and sprayed within said cylinder D' to reduce the temperature of any live steam which may have remained therein from the previous cycle of operation, and thereby facilitate the entrance of exhaust-steam into said cylinder, the hot and cold water admitted to said cylinder which may remain unevaporated or the condensation, if there be any, being conducted from the apparatus by the pipe H, pipe L, and recirculated and the uncondensed vapor taken by the exhauster L' and supplied to the engine B, as hereinbefore described. Immediately thereupon the valve mechanism will be again shifted and assume the initial position and the operation first above described repeated, and so on, the inlet-valves F' F² being arranged to close a trifle in advance of the outlet-valves G' G². However, the precise manner of operation of the valves must be determined by actual experiment in each case, and I do not wish to limit or confine myself in this respect, nor do I wish to confine myself to the form of exhauster shown. These I consider mere details which may be varied without departing from the spirit of the invention; but

What I do claim, and desire to secure by Letters Patent, is—

1. The combination with a boiler and engine of a main steam-pipe connecting the same comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, an apparatus adapted to receive steam connected thereto, and means for maintaining said apparatus in constant communication with the high-pressure section of the main steam-pipe and the engine.

2. The combination with a boiler and engine of a main steam-pipe connecting the same comprising a section containing steam under high pressure and a section containing steam under relatively low pressure, an apparatus adapted to receive steam connected thereto comprising a plurality of receptacles, and means for placing said receptacles alternately in communication with the high-pressure section of the main steam-pipe and the working side of the engine, and the low-pressure section of the main steam-pipe and the exhaust side of the engine, substantially as specified.

3. The combination with a boiler and engine of a main steam-pipe connecting the same comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, an apparatus adapted to receive steam connected thereto, and means for maintaining a portion of said apparatus in constant communication with the high-pressure section of the main steam-pipe and the working side of the engine, and a portion of said apparatus in constant communication with the exhaust side of the engine and the low-pressure section of the main steam-pipe, substantially as specified.

4. The combination of a boiler and engine having a live-steam-inlet pipe and an exhaust-pipe with means for taking the exhaust-steam from the exhaust-pipe, compressing the same, and delivering the compressed steam to the live-steam-inlet pipe, substantially as specified.

5. The combination of a boiler and an engine having a live-steam-inlet pipe, a reducing-valve arranged in said inlet-pipe, and an exhaust-steam pipe in communication with the live-steam-inlet pipe, with an apparatus adapted to receive and compress steam arranged in the exhaust-steam pipe intermediate the engine and the section of the live-steam pipe intermediate the reducing-valve and the engine, substantially as specified.

6. In an apparatus for the purposes specified, the combination with a receptacle containing live steam, a source of hot-water supply and means for conducting said hot water from its source to said receptacle to be evaporated by contact with the live steam therein, substantially as specified.

7. In an apparatus for the purposes specified the combination with a receptacle adapted to receive live steam, a receptacle adapted to receive exhaust-steam, and means for taking the unevaporated hot water from the exhaust-steam receptacle and discharging the same into the live-steam receptacle to be evaporated therein by contact with said live steam, substantially as specified.

8. The combination with a boiler and engine of a main steam-pipe connecting the same comprising a section containing steam under high pressure and a section containing steam under relatively low pressure, an apparatus adapted to receive steam connected thereto comprising a plurality of receptacles, a part of said receptacles being normally in communication with the high-pressure section of the main steam-pipe and the working side of the engine, and a part of said receptacles normally in communication with the low-pressure section of the main steam-pipe and the exhaust side of the engine, and means for reversing the order of communication of said receptacles, substantially as specified.

9. The combination with a boiler and engine of a main steam-pipe connecting the same comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, an apparatus adapted to receive steam comprising a high-pressure receptacle in communication with the high-pressure section of the main steam-pipe and the working side of the engine, and a low-pressure receptacle in communication with the low-pressure section of the main steam-pipe and the exhaust side of the engine, valve mechanism for reversing the order of communication of said receptacles, and means for operating said valve mechanism, substantially as specified.

10. The combination with a boiler and engine of a main steam-pipe connecting the same

comprising a section containing steam under high pressure and a section containing steam under relatively low pressure, an apparatus adapted to receive steam connected thereto
 5 comprising a plurality of receptacles, valve mechanism for alternately placing said receptacles in communication with the high-pressure section of the main steam-pipe and the engine, and the low-pressure section of
 10 the main steam-pipe and engine, cold and hot water supply pipes common to said receptacles, means for discharging the said cold and hot water into said receptacles and means for exhausting the unevaporated water and un-
 15 condensable vapor in said cylinders, substantially as specified.

11. The combination with a boiler and engine of a main live-steam pipe connecting the same, having a reducing-valve arranged
 20 therein, an apparatus adapted to receive steam comprising a plurality of connected receptacles, having live-steam-inlet valves, live-steam-outlet valves, exhaust-steam-inlet valves, and discharge-valves, a live-steam-
 25 inlet pipe communicating with the main live-steam pipe intermediate the boiler and reducing-valve and the live-steam-inlet valves, a live-steam-outlet pipe communicating with the main live-steam pipe intermediate the re-
 30 ducing-valve and engine, and the live-steam-outlet valves, an exhaust-steam-inlet pipe communicating with the engine and the exhaust-steam-inlet valves, and a discharge-
 35 pipe having a branch section communicating with the discharge-valves and the live-steam-inlet valves and the boiler, a pump connected to said branch section, and a branch section communicating with the live-steam-out-
 40 let pipe provided with an apparatus for exhausting the uncondensable vapor from the receptacles and forcing the same into the live-steam-outlet pipe, and a cold-water-supply pipe connected to the exhaust-steam-inlet valves and a pump, substantially as specified.

45 12. In an apparatus for the purposes specified the combination with a main steam-pipe having a reducing-valve arranged therein, of a plurality of receptacles, a live-steam-inlet pipe, a live-steam-outlet pipe, an exhaust-
 50 steam-inlet pipe having a valve arranged therein connected to the reducing-valve in the main steam-pipe, and a discharge-pipe having a branch connected to the live-steam-outlet pipe, said pipes having branch sections
 55 connected to said receptacles, a cold-water-supply pipe having a branch section and connected to the exhaust-steam-inlet pipe, a hot-water-supply pipe connected to the discharge-pipe aforesaid and the live-steam-inlet pipe,
 60 valves arranged in said pipes adjacent to the receptacles, and means for shifting said valves, substantially as specified.

13. The combination with a main steam-pipe having a reducing-valve arranged there-
 65 in, of an apparatus for the purposes specified comprising two receptacles, a live-steam-inlet pipe connected to the high-pressure sec-

tion of the main steam-pipe and having branch sections each connected to one of said
 70 receptacles, valves arranged in said branch sections, a live-steam-outlet pipe connected to the low-pressure section of the main steam-pipe and having branch sections provided with valves and connected to said recepta-
 75 cles, an exhaust-steam-inlet pipe having a valve therein connected to the reducing-valve in the main steam-pipe, and having branch sections provided with valves and connected to said receptacles, a cold-water-sup-
 80 ply pipe having branch section connected to said valves, and a discharge-pipe having branch section provided with valves and connected to said receptacles, a branch connect-
 85 ed to the live-steam-outlet pipe, and a branch hot-water pipe having branch sections and connected to the valves of the live-steam-inlet pipe; the valves in the live-steam inlet and outlet branch pipes and the exhaust and
 90 discharge branch pipes being provided with levers, brackets secured to said receptacles intermediate the uppermost and lowermost sets of valves, wrist-plates mounted upon
 95 said brackets having links connected thereto and to the ends of the valve-levers, and means for partially rotating said wrist-plates to open the valves in the live-steam inlet and outlet
 100 pipes of one receptacle and the valves of the exhaust and discharge branch pipes of the other receptacle, and closing the remaining valves of both receptacles, substantially as

14. An apparatus for the purposes specified comprising the main steam-pipe I having the pressure-reducing valve I', receptacles D, D', pipes E, F, G, H connecting the same pro-
 105 vided with valves E', E², F', F², G', G², H', H², having levers e', e², f', f², g', g², h', h², respectively, a live-steam-inlet pipe I² connected to high-pressure section of the pipe I and the pipe F, a live-steam-outlet pipe J con-
 110 nected to the low-pressure section of the pipe I, an exhaust-steam-inlet pipe K having a valve K' therein, a connection K³ uniting the same with the reducing-valve I' in the pipe I, said pipe K being connected to the pipe E, a
 115 discharge-pipe L connected to the pipe H having a branch L² provided with an exhauster L' and connected to the live-steam-outlet pipe J, and another branch L³ connected to one cylinder of a pump, a hot-water-supply
 120 pipe O' communicating with said pump-cylinder and pipe L³, and the valves E', E², a cold-water-supply pipe X communicating with the other cylinder of the pump O and the valves F', F², brackets M, M' secured to
 125 said receptacles D, D' wrist-plates N, N' mounted thereon, provided with arms n, n', respectively, links j, j, having their inner ends secured to said wrist-plates M, M' and their outer ends to the valve-stem levers e',
 130 e², f', f², g', g², h', h², and the shaft R and sleeve R' having respectively fixed thereon the levers S, S' links T, T' connecting their upper ends with the arms n, n' of the wrist-

plates N, N', levers U, U', and levers P, P'
having their lower ends connected to the piston-rods of the pump O, and their upper ends
connected to the upper ends of the levers U,
5 U' by the links V, V' respectively, substantially as specified.

Signed at the city of New York, in the county

and State of New York, this 19th day of September, 1898.

HUGH J. BARRON.

Witnesses:

GUSTAVE DIETERICH,
JOHN KEHLENBECK.