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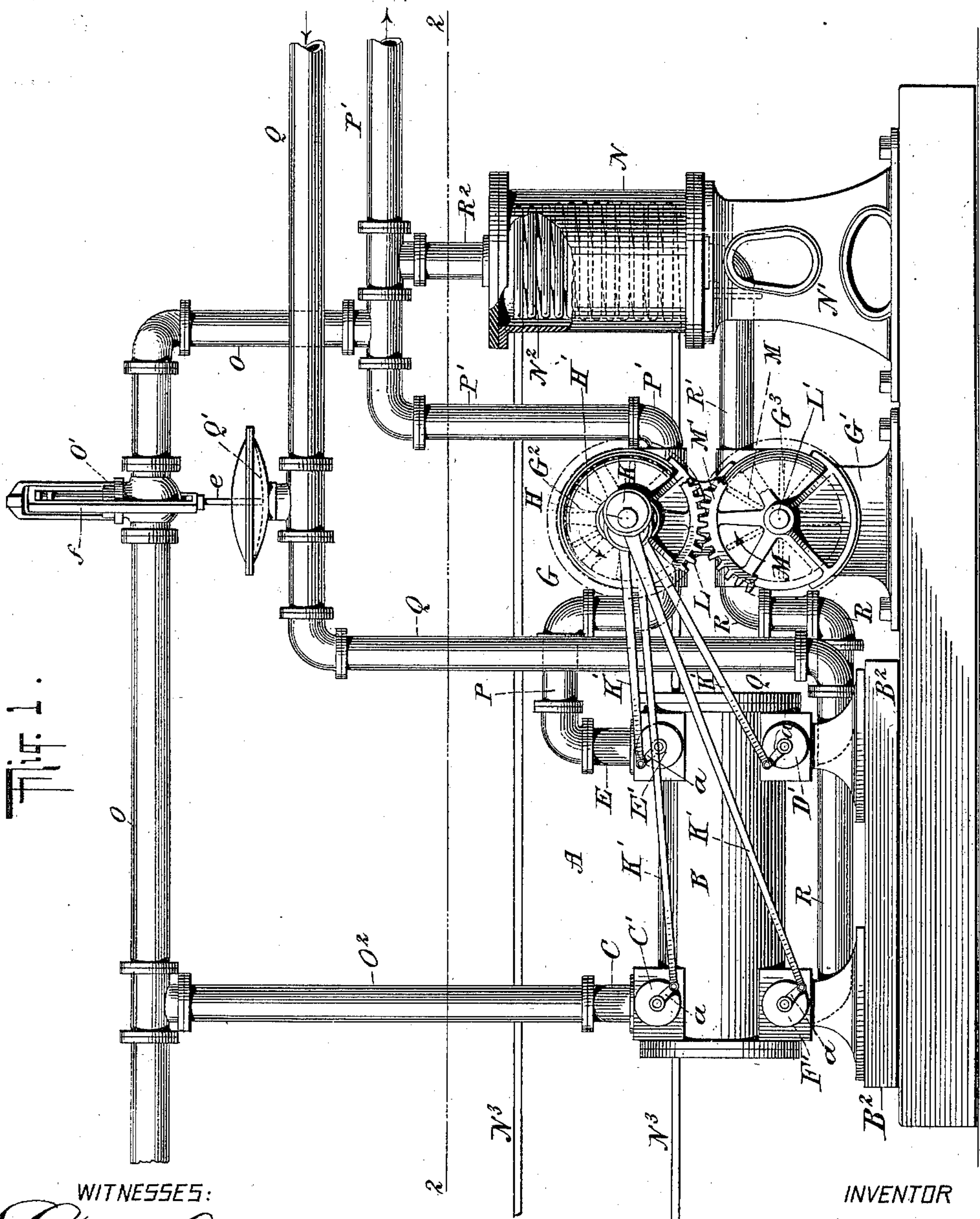
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APPARATUS FOR REGENERATING EXHAUST STEAM.

(Application filed Dec. 10, 1898.)

(No Model.)

2 Sheets—Sheet 1.



WITNESSES:
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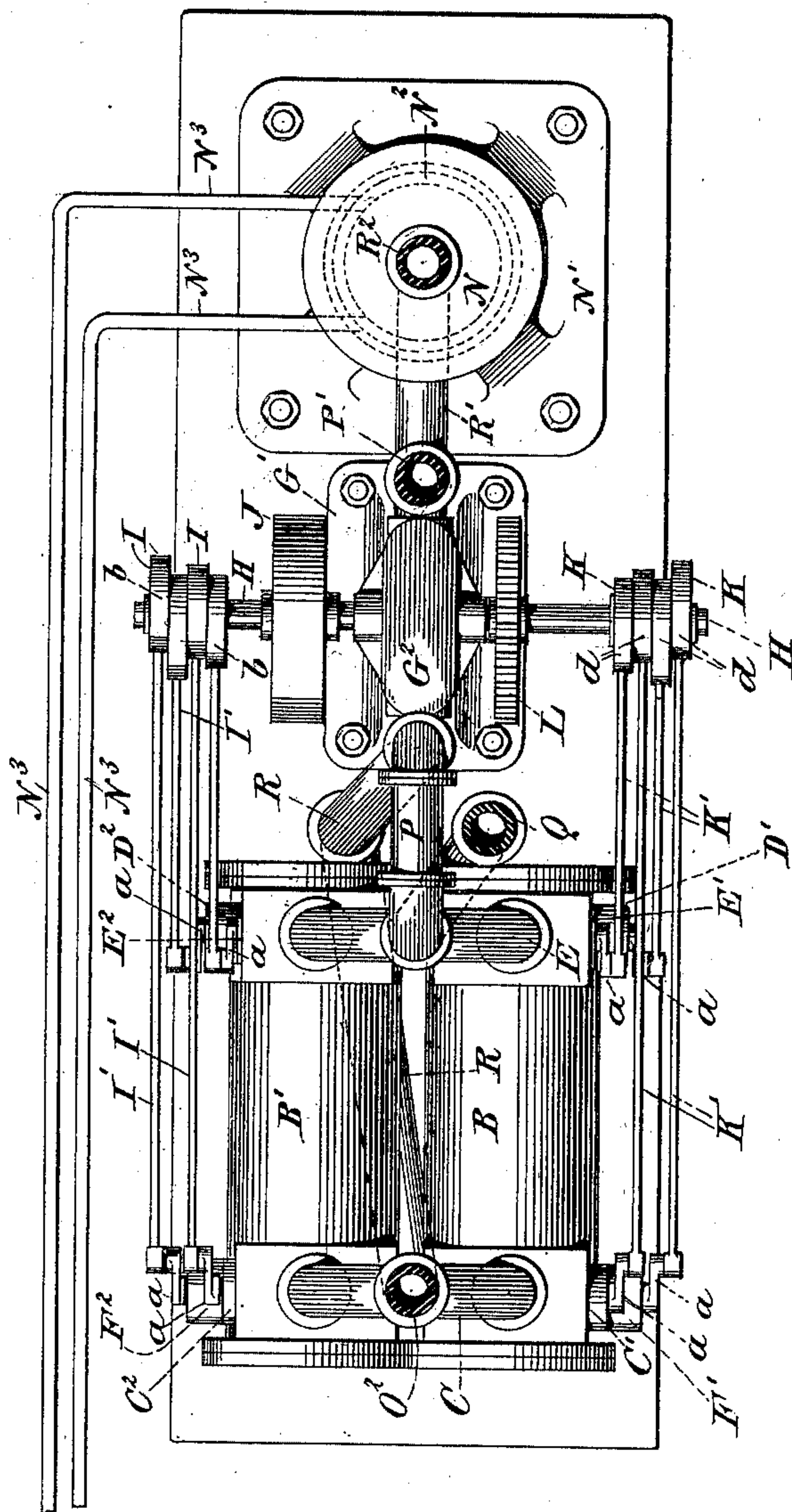
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Fig. 2.



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APPARATUS FOR REGENERATING EXHAUST-STEAM.

SPECIFICATION forming part of Letters Patent No. 619,120, dated February 7, 1899.

Application filed December 10, 1898. Serial No. 698,805. (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 more particularly to provide an apparatus whereby to economically regenerate the exhaust-steam discharged from the engine partly by contact or association with high-pressure live steam maintained intermediate the boiler and engine and partly by compressing and superheating said exhaust and the unregenerated steam.

The object above set forth I am enabled to attain by means of my invention, which consists in the novel details of construction and in 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 of an apparatus constructed according to and embodying my invention; and Fig. 2 is a section taken on the line 2 2 of Fig. 1, showing the apparatus proper in plan.

In said drawings, A designates the apparatus, comprising two separate cylinders B B', suitably mounted longitudinally upon a base B².

C and E denote pipes connecting said cylinders B B', which are secured to said cylinders upon their upper surfaces, adjacent to their ends, and D and F denote similar pipes (not seen) connecting said cylinders and secured upon the under surfaces of said cylinders adjacent to their ends.

C' D' E' F' denote valves arranged in the pipes C D E F, adjacent to their ends, secured to the cylinder B, and C² D² E² F² denote similar valves arranged in said pipes C D E F, adjacent to the ends, secured to the cylinder B', and *a a* denote levers which are secured to the projecting ends of the stems of said valves C' D' E' F' C² D² E² F².

To one side of the apparatus is situated an exhauster and compressor, which may be of

the ordinary piston form or any other construction which will serve to effectually remove the unregenerated steam or vapor from said apparatus A. However, I prefer to employ the apparatus herein shown and described, which comprises a casing G, having two separate compartments G² G³ therein provided with inlet and outlet ports and suitably supported upon a base G'. Within the upper compartment G² is supported in bearings a shaft H, both ends of which project beyond the walls of the compartment, and upon the portion of said shaft H within the said compartment G² is fixed a fan-wheel H'. Upon the rear end of said shaft are fixed four eccentrics I, which are encircled by straps *b* and connected to the levers *a* of the valves C² D² E² F² of the cylinder B' by links I', and adjacent to the casing is fixed a fly-wheel J, and upon the forward end of said shaft H are fixed four eccentrics K, encircled by straps *d* and connected to the levers *a* of the valves C' D' E' F' of the cylinder B by links K', and adjacent to the casing is fixed a gear-wheel L.

Within the lower compartment G³ is supported a shorter shaft L', having fixed thereon within the casing the fan-wheel M and upon its forward-projecting portion adjacent to the casing a gear-wheel M' in gear with the gear-wheel L of the shaft H.

To the side of the exhauster and compressor is mounted upon a base N' a cylinder N, having arranged therein a coil of pipe N², the ends N³ of which extend through the wall of said cylinder and are connected to a suitable heating apparatus—such, for example, as a water-heater arranged in the boiler-furnace.

O denotes the main live-steam pipe leading from the boiler to the engine, and O' denotes a reducing-valve arranged in said main live-steam pipe. From the section of the main live-steam pipe O intermediate the boiler and reducing-valve O' extends an inlet-pipe O², which is connected intermediate the valves C' C² to the pipe C, connecting the cylinders B B', and P denotes a live-steam-outlet pipe, one end of which is connected intermediate the valves E' E² to the pipe E and its other end connected to the inlet-port of the upper compartment G² of the exhauster and compressor, and a further section P' of said pipe is connected to the outlet-port of said com-

partment G^2 and the section of the main live-steam pipe O intermediate the reducing-valve O' and the engine, the live steam from the apparatus A , striking the blades of the fan-wheel H' in said compartment G^2 , being adapted to constantly rotate said shaft H in one direction and at the same time impart motion to the shaft L' in the lower compartment through the gearing $L M'$ and cause the shaft L' and fan-wheel M' in said lower compartment G^3 to rotate in the reverse direction.

Q denotes the exhaust-steam-inlet pipe leading from the engine and connected intermediate the valves $D' D^2$ to the pipe D , connecting the cylinders $B B'$, and Q' denotes a diaphragm arranged in said pipe Q directly below the reducing-valve O' in the main live-steam pipe O , said diaphragm having a stem e , projecting upward therefrom, terminating in a yoke f , connected to the reducing-valve O , whereby to automatically open or close the reducing-valve O' as the pressure of the exhaust-steam within the pipe Q increases or diminishes, and R denotes the vapor or unregenerated-steam pipe, which is connected intermediate the valves $F' F^2$ to the pipe F and to the inlet-port of the lower compartment G^3 of the exhauster and compressor G .

R' denotes a pipe connected to the outlet-port of said compartment G^3 and the inlet in the base of the cylinder N , and R^2 denotes a pipe connecting the outlet in the top of said cylinder N with the section of the live-steam pipe O intermediate the reducing-valve O' and the engine.

The operation of the apparatus is as follows: If we assume the apparatus A to be in the position indicated at Fig. 1 and the cylinder B to contain exhaust-steam, the live steam from the boiler, of a pressure, for example, of one hundred and twenty-five pounds, to be conducted from the boiler through the main steam-pipe O and after passing through the reducing-valve O' be supplied to the engine at a uniform pressure of about one hundred pounds, the excess of live steam (twenty-five pounds) or a portion thereof contained in the section of the pipe O intermediate the reducing-valve O' and the boiler will be diverted and conducted into the cylinder B through the pipe O^2 , pipe C , valve C' and unite with the exhaust-steam contained in said cylinder B , and thereby regenerate the same. This regenerated steam, of about one hundred and five pounds, will thence pass out of said cylinder B by way of the valve E' , pipe E , and pipe P into the compartment G^2 of the exhauster and compressor G , and strike the blades of the fan-wheel H' therein, causing the same and the shaft H , to which they are secured, to rotate in the direction of the arrow, Fig. 1, and thence pass out of said compartment by way of the pipe P' into the main steam-pipe O , and thence to the engine. At the same time the exhaust-steam from the engine will be returned directly to the cylinder B' through the exhaust-steam pipe Q ,

pipe D , and valve D^2 , and at about the same time, but before the reversal of the valve mechanism, the unregenerated steam which may remain in the cylinder B will be withdrawn or removed therefrom through the valve F' , pipe F , and pipe R by the action of the fan-wheel M in the lower compartment G^3 of the apparatus G , which is operated by the shaft L' and gear-wheel M' , fixed thereon in gear with the gear-wheel L on the shaft H in the upper compartment G^2 , and said unregenerated steam thence conducted through the pipe R' and compressed into the cylinder N , superheated and expanded therein by the heat imparted thereto by the coil N^2 , arranged within said cylinder, and the now regenerated steam conducted from said cylinder to the main steam-pipe O through the pipe R^2 .

As soon as the operation above described has taken place the valve mechanism of both cylinders B and B' will be reversed by the eccentrics I and K on the shaft H and cause the live steam to enter the cylinder B' through the pipes O^2 and C and the valve C^2 and after regenerating the exhaust-steam therein pass out of said cylinder B' through the valve E^2 , pipes E and P , through the upper compartment G^2 of the apparatus G , and into the main steam-pipe O , the exhaust-steam now being returned directly to the cylinder B from the engine through the pipes Q and D and the valve D' and the unregenerated steam remaining in the cylinder B' withdrawn therefrom through the valve F^2 and pipes F and R by the fan-wheel M in the lower compartment G^3 of the apparatus G , and thence conducted by the pipe R' to the cylinder N , into which said unregenerated steam will be compressed, superheated therein, and thence conducted to the main steam-pipe O through the pipe R^2 . Hereupon the valve mechanism of both cylinders will be again shifted by the operation of the eccentrics I and K on the shaft H of the apparatus G and the initial operation repeated, and so on.

Without limiting myself to the details of construction, which may be varied within the scope of the invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination with a boiler and engine and a live-steam pipe connecting the same, of an apparatus adapted to receive steam to regenerate the same, and means for compressing and superheating the unregenerated steam remaining therein, and delivering said superheated steam to the live-steam pipe connecting the boiler and engine, substantially as specified.

2. The combination with a boiler and engine having a live-steam pipe and an exhaust-steam pipe, of means for compressing and superheating the exhaust-steam, and delivering the same to the live-steam pipe, substantially as specified.

3. The combination with a boiler and engine having a live-steam pipe connecting the

same comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, of an apparatus adapted to receive steam interposed
5 between the boiler and engine and communicating with the high and low pressure sections of the live-steam pipe, and means for taking the unregenerated steam or vapor from said apparatus compressing and superheating the
10 same and delivering said superheated vapor or regenerated steam to the low-pressure section of the live-steam pipe, substantially as specified.

4. The combination with a boiler and engine having a live-steam pipe connecting the
15 same, comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, of an apparatus adapted to receive steam interposed
20 between the boiler and engine and communicating with the high and low pressure sections of the live-steam pipe, an apparatus adapted to exhaust the unregenerated steam or vapor from said interposed apparatus and compress
25 the same, and an apparatus, in communication with the apparatus last named and the low-pressure section of the live-steam pipe, adapted to receive the said compressed vapor to superheat the same, substantially as specified.
30

5. The combination with a boiler and engine having a main live-steam pipe connecting the same comprising a section containing steam under high pressure and a section containing
35 steam under relatively low pressure; of an apparatus adapted to receive live and exhaust steam, a live-steam-inlet pipe connecting said apparatus with the high-pressure section of the main live-steam pipe, and a live-steam-outlet pipe connecting said apparatus
40 with the low-pressure section of the main live-steam pipe, an exhaust-steam-inlet pipe connecting said apparatus with the exhaust side of the engine, a vapor or unregenerated-steam outlet pipe connected to said apparatus,
45 an exhauster and compressor connected to the vapor or unregenerated-steam outlet pipe, and a superheating-cylinder connected to said exhauster and compressor and the low-pressure section of the main live-steam pipe, substantially as specified.
50

6. In an apparatus for the purposes specified, an exhausting and compressing apparatus comprising a casing having a plurality
55 of compartments therein, provided with inlet and outlet ports, shafts supported by said compartments and extending through the walls thereof, fan-wheels fixed upon said shafts within the compartments, gear-wheels, in
60 mesh, fixed upon said shafts outside of the compartments, and a fly-wheel fixed upon one of said shafts, substantially as specified.

7. In an apparatus for the purposes specified an exhausting and compressing apparatus comprising a casing having two separate com- 65
partments therein, each provided with inlet and outlet ports, shafts supported thereby partly within and partly without said compartments, said shafts having fan-wheels fixed thereon within the compartments, and gear- 70
wheels, in mesh, fixed thereon without the compartments, and a fly-wheel fixed upon one of said shafts without its compartment, substantially as specified.

8. The combination with a boiler and engine having a live-steam pipe connecting the
75 same, of an interposed apparatus adapted to receive steam comprising a plurality of connected receptacles provided with valve mechanism for alternately admitting high and relatively low pressure steam thereto, a superheating-cylinder normally in communication with the low-pressure receptacle and the live-steam pipe, and an apparatus adapted to receive and compress steam comprising a plu- 85
rality of compartments, one of said compartments being normally in communication with the high-pressure receptacle and the live-steam pipe, and the other of said compartments normally in communication with the 90
low-pressure receptacle and the superheating-cylinder, substantially as specified.

9. The combination with a boiler and engine having a live-steam pipe connecting the
95 same comprising a section containing steam under high pressure, and a section containing steam under relatively low pressure, of an interposed apparatus adapted to receive steam comprising a plurality of connected receptacles provided with valve mechanism for al- 100
ternately admitting high and relatively low pressure steam thereto, a superheating-cylinder normally in communication with the low-pressure receptacle of said interposed apparatus and the low-pressure section of the live-steam pipe, and an apparatus adapted to receive and compress steam comprising a plu- 105
rality of compartments having fan-wheels operating therein, one of said compartments being normally in communication with the high-pressure receptacle of the aforesaid apparatus, and the low-pressure section of the live-steam pipe, and the other of said compartments normally in communication with the low-pressure receptacle of the interposed 115
apparatus and the superheating-cylinder, substantially as specified.

Signed at the city of New York, in the county and State of New York, this 9th day of December, 1898.

HUGH J. BARRON.

Witnesses:

GUSTAVE DIETERICH,
JOHN KEHLENBECK.