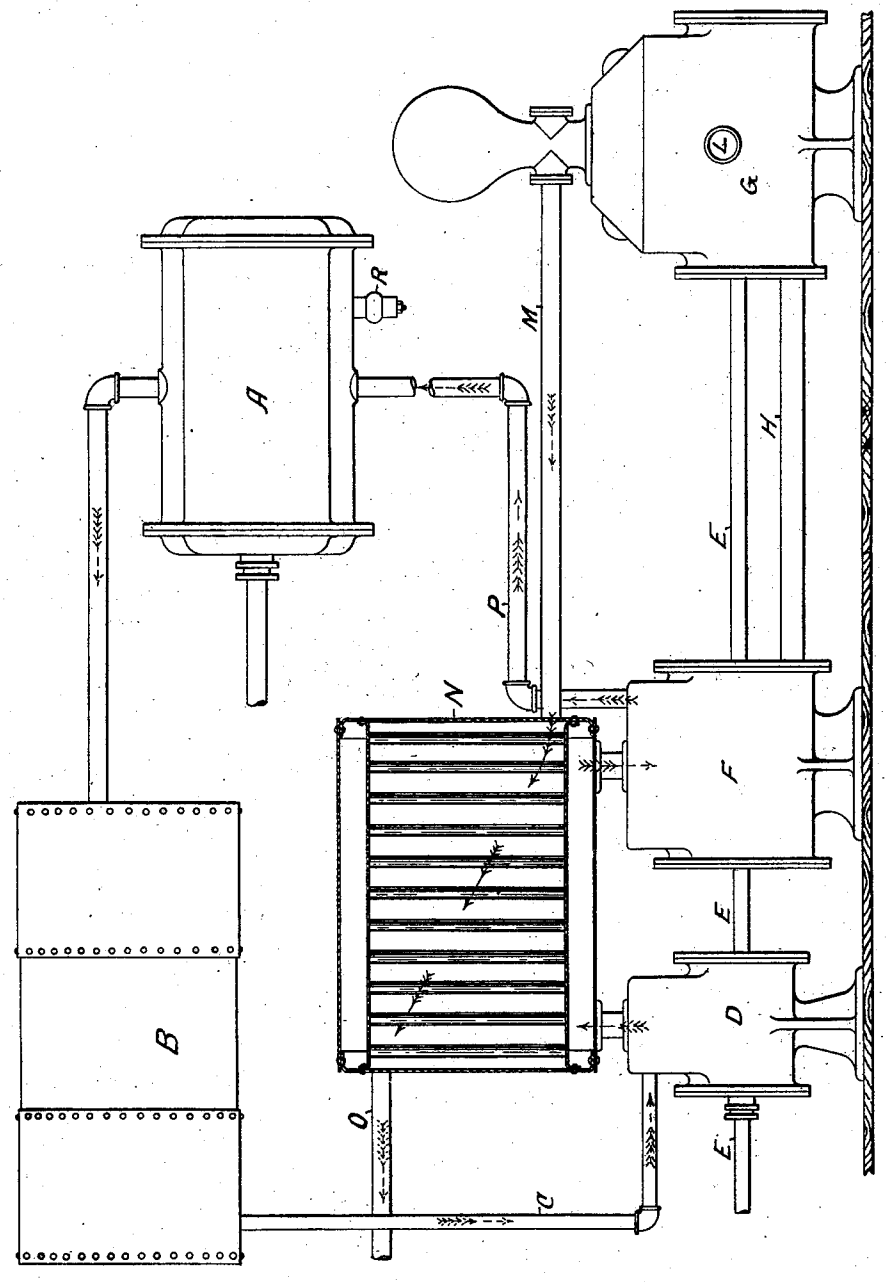
(No Model.)

E. HILL.

OPERATING PUMPS BY COMPRESSED AIR.

No. 244,603. Patented July 19, 1881.



WITNESSES.

Eugene N Elliot

William H Johnson

INVENTOR.

Ebenezer Hill

By his attorney

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UNITED STATES PATENT OFFICE.

EBENEZER HILL, OF SOUTH NORWALK, CONNECTICUT.

OPERATING PUMPS BY COMPRESSED AIR.

SPECIFICATION forming part of Letters Patent No. 244,603, dated July 19, 1881.

Application filed April 14, 1881. (No model.)

To all whom it may concern:

Be it known that I, EBENEZER HILL, of South Norwalk, in the county of Fairfield and State of Connecticut, have invented new and useful Improvements in Operating Pumps by Compressed Air, &c., of which the following is a specification.

This invention relates to that class of machines in which water-pumps, as they are used in mines, excavations, &c., are driven by compressed air, which is forced into a reservoir outside of the mine or at a great distance from the point of application; and the invention has for its object the utilization of the heat in the water discharged by the pump in expanding the air after compression and the utilization of the exhaust-air from the last power-cylinder; and the invention consists, first, in the process or method of combining the heat of the water, whatever it may be, with air under pressure after work performed in a power-cylinder, but reduced in temperature by expansion in a chamber before it enters a second power-cylinder, to perform work in operating the pump, as will hereinafter appear.

The second part of the invention also consists in the process of returning the exhaust-air from the last power-cylinder of an air-power engine to the suction side of the air-compressor, as will hereinafter appear.

The third part of the invention consists in the combination, with a pump driven by a compound air-power engine, of an interheater between the two power-cylinders of the engine, for utilizing the heat from the water after its discharge from the pump, as will hereinafter appear; and, fourth, the invention also consists in combining a suction-pipe for supplying the air-compressor with the exhaust-ports of the last power-cylinder of the engine, as will hereinafter appear.

It is well known that air under pressure, when permitted to expand, is greatly reduced in temperature. Consequently, if air from a reservoir under a given pressure is used to operate a piston for driving a pump, and then is permitted to escape as exhaust into a chamber through which the water from the pump is caused to flow in tubes like a condenser, and thereby impart its heat to the expanded and cold air, a further expansion will thereby be caused, and it may be utilized by working it in a larger cylinder to furnish power in driving the pump; and, as it is easier to compress air at a low temperature, I propose to conduct the air from the second cylinder, or the last in the series, (if more than two be used,) to the suction side of the compressor, to be again returned to the air-reservoir. One form of such an apparatus is represented in the accompanying drawing, in which—

A is an air-compressor; B, the reservoir for the compressed air; C, a pipe leading from the reservoir to the first cylinder of the compound air-engine D, the piston-rod of which, as at E, works through a second power-cylinder of larger size, F, and is connected directly with the piston of a water-pump, as at G, which has a suction-pipe, H, and a discharge-pipe, L, which conducts the water from its air-chamber M to a chamber, N, filled with tubes, as a condenser, and which has an outlet-pipe, O, to the final point of discharge. Said chamber, M, is connected with the exhaust side of the first power-cylinder, D, and with the port side of the second power-cylinder, F, as by suitable pipes and valve-connections, so that the air from the first cylinder is used to supply power to the second, and, after it has done its work in the second cylinder, passes through in exhaust-pipe P to the suction or inlet side of the air-compressor, and thus the air is used over and over again without waste or loss of power whenever the temperature of the atmosphere is greater than the air from the last exhaust.

To supply any waste or deficiency from leaks, an inlet-valve, R, is attached to the suction side of the compressor, and it is provided with a regulating-spring, so that it may open whenever the vacuum is equal to a certain pressure.

In constructing such an apparatus care must be taken to proportion the cylinders and the interheaters to the pressures required and to the water from the pump. For example, if an air-pressure of sixty pounds above the atmosphere is to be used, I should proportion the two power-cylinders so that the larger one would be two and two-tenths greater than the first or smaller cylinder. Under such circumstances, if the air from the reservoir had a temperature of 62° when it entered the first cylinder, it would have, on being exhausted into

the interheater, a temperature of 80° below zero. If, then, the discharge-water of the pump be passed through the interheater at a temperature of about 60°, as under ordinary circumstances, then the cold air will be raised to a temperature of about 60°, and consequently about fifteen per cent. will be added to the effective power of the pumping-engine. It is evident that the same end may be accomplished by drawing the water through said heater as by forcing it through it. Consequently it may be connected either to the suction or discharge side of the pump.

I therefore claim—

1. The method of expanding or increasing the effective force or power of the air in a pumping-engine driven by compressed air by utilizing the heat of the water acted upon by the pump, as hereinbefore set forth.

2. The combination, with a compound air-motor pumping-engine, of an interheater, to be supplied with water from the pump, as and for the purposes hereinbefore set forth.

3. The combination of an air-compressor with the exhaust side of a compound air-motor pumping-engine, as and for the purposes hereinbefore set forth.

In testimony whereof I have hereunto set my hand and seal in the presence of two subscribing witnesses.

EBENEZER HILL. [L. S.]

Witnesses:

EUGENE N. ELIOT,

RICHARD J. CARTER.