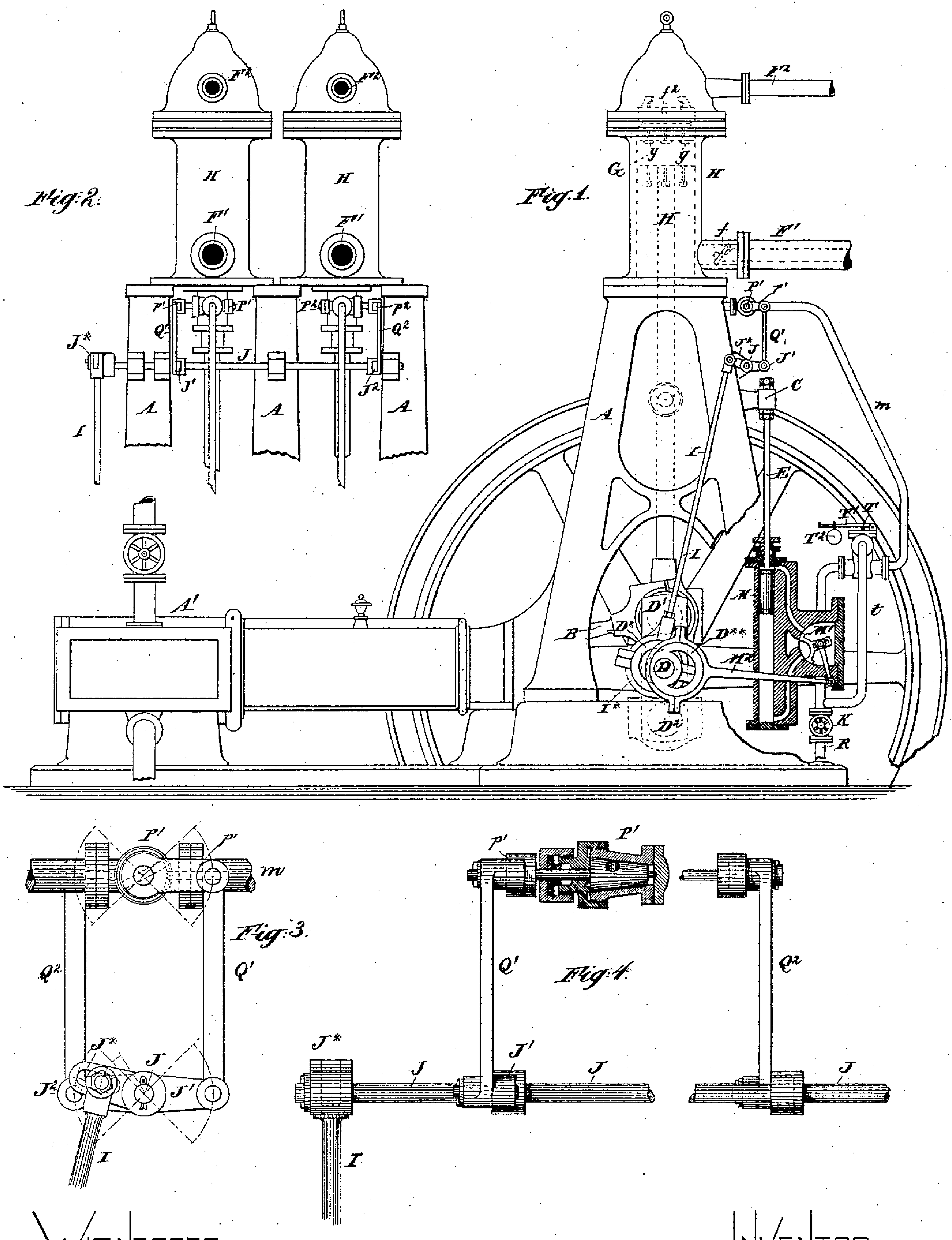
(No Model.)

L. BLOCK.

GAS COMPRESSOR.

No. 314,992. Patented Apr. 7, 1885.



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UNITED STATES PATENT OFFICE.

LOUIS BLOCK, OF NEW YORK, N. Y., ASSIGNOR TO THE DE LA VERGNE REFRIGERATING MACHINE COMPANY, OF SAME PLACE.

GAS-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 314,992, dated April 7, 1885.

Application filed September 12, 1884. (No model.)

To all whom it may concern:

Be it known that I, LOUIS BLOCK, of New York city, in the county and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Treating a Heat-Absorbing Liquid in Gas-Compressors, of which the following is a specification.

The invention is intended more especially for use in connection with refrigerating apparatus with ammonia or other gas which is subjected to compression and develops heat, which, after the removal of the heat by any suitable cooling means—as water—by expansion, absorbs heat and induces the desired low temperature in breweries, cold storage-chambers, or other apparatus to be cooled, through which the gas-containing pipes are led. A different liquid should be introduced with the liquid ammonia. The liquid used may be the lubricating-oil obtained by the distillation of petroleum. A liquid in the gas-compressor performs four useful functions: first, it tends to stop the leaks past the piston and piston-rod, and also to pack the valves so that there is no leakage past them; second, it fills the clearance and valve passages at the ends of the strokes, thus avoiding the retention of a quantity of compressed gas, which, by its expansion during the return-stroke, would interfere with the sucking in of the desired fresh installment; third, it lubricates the piston and piston-rod; and, fourth, it absorbs the heat of compression, so that when the gas is compressed from, say, two atmospheres to eight, instead of raising the temperature from 32° Fahrenheit, the initial temperature, to 500° Fahrenheit, which would be the result if the heat of compression were all retained in the gas, the temperature only rises to about 200° Fahrenheit, by reason of the great absorption of the heat by the liquid.

Under the conditions named the gas is delivered at a pressure of eight atmospheres and with a temperature of 200°. The liquid is delivered at nearly the same temperature. If we could command a practicable liquid which would perform these useful functions without absorbing gas, it would be an important step. I have not attained that to my satisfaction; but I have made a discovery and have successfully reduced to practice an improvement in the art based thereon. Under the conditions which obtain in practice the oil in the compressor absorbs many times its volume of gas, which is given out again when the liquid is relieved from pressure. This is an objectionable function performed by the oil. So long as it is kept under pressure in the presence of the compressed gas it absorbs more if not fully saturated; but the moment the pressure is relieved it rapidly gives off its gas. It is not easy to utilize that portion of the gas which is absorbed by the oil. When the oil is not separated from the ammonia either before or after its liquefaction and is allowed to pass into the expansion-pipe, it hardens in consequence of the low temperature obtaining in these pipes, and, by filling them up, defeats the whole refrigerating operation. The oil must be separated from the gas before the latter passes the expansion-valve. When separated before liquefaction of the ammonia-gas, it is taken away with its absorbed gas, and if allowed to flow into the compressor before the latter has obtained its full charge, the gas will be liberated and will occupy a space in the compressor to the exclusion of the same volume of gas which has done useful work. I separate the oil from the gas as soon as it has absorbed the heat, and after partially cooling the oil in a suitable set of cooling-pipes return it to the compression apparatus. I control it by a positively-operated valve placed close to the point at which it is discharged into the compression apparatus. This valve only opens after the compression apparatus has drawn in its proper measure of gas. If the oil under pressure, and containing many times its volume of compressed gas, is allowed to enter the compression-cylinder while the latter is drawing in gas, the gas contributed by the oil, by its prompt liberation, fills a large portion of the space and forbids the entrance of so much of the like gas. My valve positively forbids the entrance of any of the liquid until that portion of the movement of the compressor during which the gas is inhaled is completed, then during the reverse movement of the compressor-piston the oil is injected. I use a pump or analogous forcing or measuring device, which aids to determine the proper quantity to be introduced. An ordinary pump would allow the liquid at high pressure to pass freely through the pump and enter the compressor-cylinder at a wrong period, except for my valve. In what I esteem the most complete form of the invention I I use a pump having its provisions for admitting and discharging the fluid so constructed and operated that the oil cannot be forced past it, however high may be the pressure behind it. It provides a certain definite capacity for oil to be forced in at each stroke. This amount cannot be exceeded under any conditions. It cannot be reduced except by choking or otherwise obstructing the admission of the oil.

The following is a description of what I consider the best means of carrying out the invention. The accompanying drawings form a part of this specification.

Figure 1 is a side elevation showing the entire apparatus. Fig. 2 is a front view of a part, showing my valves and the immediately adjacent parts. The remaining figures are on a larger scale. Fig. 3 is a side elevation corresponding to Fig. 1; and Fig. 4 is a front elevation, partly in section.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

A is a fixed frame-work, and A′ is the cylinder of a steam-engine which it will be understood is equipped with any ordinary or suitable piston and valves and operating means. It gives rotation by the connecting-rod B to a double-cranked shaft D, which, by means of the two opposite cranks D′ D^2, gives alternate elevation and depression to single-acting pistons G, mounted in cylinders H. Each piston G works in the cylinder H as a single-acting pump, taking in the gas through a pipe, F′, and discharging it through a pipe, F^2, at a greatly-increased pressure. I will term the cylinders H "gas-compression cylinders" or "compressors." The gas-compression pistons G are provided with self-acting valves *g* opening upward, as indicated. The gas is received through a self-acting valve, *f*, and delivered through a self-acting valve, f^2. All the valves are arranged to be flooded or packed by a moderate quantity of the oil.

Each cross-head of the compressors carries an arm, C, to which is fixed a vertical rod, E, which rises and sinks with the corresponding piston G, and operates a double-acting pump, M, at a lower level. This pump forces the required quantity of oil at each stroke up through the pipe *m*, controlled by two cocks or sets of cocks or valves, K P′ P^2. The first cock, K, is in the pipe R, through which the oil is received. It is adjustable by the attendant. It may be set wide open or closed to any required extent, and will remain in that condition for an indefinite period, offering any required amount of obstruction to the movement of the oil. Each cock P′ P^2 is rocked by connections from the shaft D, so as to open and close during each double stroke of the corresponding piston G.

D* is an eccentric fixed on the shaft D. It is embraced by the eccentric-ring I*, by which it operates an eccentric-rod, I, which is connected to an arm, J*, on a shaft, J, which latter is mounted in fixed bearings and is rocked by the arm J*.

There is one cock, P′ or P^2, for each of the compressors. One cock, P′, is provided with an arm, *p′*, extending forward. It is connected by a link, Q′, to an arm, J′, extending forward from the rocking shaft J. The other cock, P^2, has an arm, p^2, extending backward. It is connected by a link, Q^2, with an arm, J^2, extending backward from the rocking shaft J. All the several rods and arms may be equipped with adjusting means, by which their relations may be changed within moderate limits. The adjustment is such that each cock P′ or P^2 is only open during the period while the oil is to be admitted into the corresponding compressing-cylinder during all the remaining time that cock P′ or P^2 is tightly closed.

The oil-pump M is double acting. A single rolling valve, M′, controls the entire induction and eduction at both ends. Its form and mode of operation will be understood from the drawings, Fig. 1. Its proper rocking motion is derived through an arm operated by an eccentric-rod, M^2, from an eccentric, D**, keyed or otherwise firmly adjusted on the main shaft D of the engine. This valve works in effect like the ordinary hollow-throated slide-valve of a steam-engine without "lead" or "lap," but admitting oil instead of steam. The oil may be at a higher pressure behind it, endeavoring to force its way past the pump, or it may be at a lower pressure, thus holding back and requiring to be forced by a pump; but in either condition the pump provides a uniform capacity for the oil, always forcing forward the quantity which it receives and refusing to allow any more to pass. My invention allows the oil to be kept at full pressure until it passes the cock P′ or P^2.

I may repeat that the operations are so timed that the cock P′ or P^2 will not allow the passage of the oil into its connected compression-cylinder during the period while the latter is taking in gas to be compressed. During all that period the cock P′ or P^2 is tightly closed, and the gas at the low pressure which obtains in the refrigerating-pipes is taken in freely through the pipe F′.

After the reception of the gas is completed and the compressor has received all the gas that it can contain at that pressure, the oil is injected, and being properly distributed in the cylinder produces its desired effects of lubricating absorbing heat, preventing the passage of gas past the piston or valves and filling the clearance and valve passages.

T is a relief-valve held down to its seat by a lever, T′, carrying an adjustable weight, T^2. The under side of this valve receives the pressure induced by the oil-pump M. The upper side is in connection by a pipe, t, with the passage R, through which the pump receives its oil. Whenever the pump forces the oil faster than the cock P′ or P^2 will allow it to pass, this relief-valve T rises a little and allows a portion of the oil to flow idly back through the passage t. It is especially important to vary the amount of opening of both cocks P′ and P^2, so as to increase and diminish at will the quantity of oil to be admitted. The oil-pump M is made of sufficient capacity to force or measure in all that will ever be required under all conditions. The relief-valve T, loaded to a pressure a little greater than ever obtains, allows all excess which is pumped or measured to flow idly back to the pipe R.

If a large quantity of oil is required in the cylinder, the point of connection of the eccentric-rod to the arm J* is adjusted so near the shaft J that a large amount of rocking motion will be given to the shaft J, and consequently through the arms J′ J^2, links Q′ Q^2, and arms p' p^2 to the cocks P′ P^2. Thus conditioned, the cocks P′ P^2 will be open during nearly or quite the whole stroke of the oil-pump. If a less quantity of oil is required in the cylinder, the point of connection of the eccentric-rod I to the arm J* is shifted outward from the axis J. The effect is to induce a less amount of rocking motion of the shaft J, and consequently of the cocks P′ P^2. The ports are so formed and the parts so adjusted that a great amount of vibrating motion of the cocks will hold open the passage for the oil to a great extent and for a long period, and successively less amounts of rocking motion of the cocks will give shorter periods and a less liberal opening of the passage for the oil.

It will be understood that there are any ordinary or suitable means for shutting off the access of the oil to the pump M. Whenever I desire it, I can so contract the passage as to partially shut off the oil from the pump M, and instead of allowing the full capacity of the pump to be filled at each stroke I can allow only half or such other part as may be desired to be filled. In such case only the last part of the stroke of the pump will be effective in forcing oil into the compressor.

Modifications may be made in the forms and proportions by any good mechanic without departing from the principle or sacrificing the advantages of the invention.

The invention may be applied to double-acting pumps serving as compressors. In such case a corresponding set of oscillating stop-cocks or analogous valves operating by the mechanism should be employed at each end of each compression-cylinder.

The invention may be applied with other fluids than oil. Glycerine is in some respects a desirable fluid. It will endure a very low temperature without hardening. It has a high boiling-point, and is a good lubricator. My invention may be used with any liquid. I prefer oil.

The invention may be used in connection with compressing apparatus for other purposes than for refrigerating. I propose to use it in connection with apparatus for compressing air for operating engines in mines, and in many other situations.

The invention may be applied with only a single compressor. In such case the rocking-valve J, with its arms J′ J^2, may be dispensed with, and a connection made directly from the arm p' on a single stop-cock, P′, to the eccentric-rod I.

I claim as my invention—

1. In a gas-compressing apparatus, the combination, with the compression-cylinder H, of the valve or cock P′, actuated by the engine so as to forbid the passage of oil during the period while the compression-cylinder is taking gas, substantially as herein specified.

2. In a gas-compressing apparatus, the oil valve or cock P′, operated by the engine, in combination with the adjustable valve or cock K, adapted to control the area of aperture open, substantially as herein specified.

3. In a gas-compressing apparatus, the valves or cocks P′ P^2, operated by the engine, in combination with a pump or measuring device, M, adapted for joint operation, as herein specified.

4. In a gas-compressing apparatus, the oil-pump M, relief-valve T, regulating-valve K, and the valves P′ P^2 and their several connections, and operating means, all arranged to serve relatively to the compressing-cylinder H and its connections, substantially as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, N. Y., in the presence of two subscribing witnesses.

LOUIS BLOCK.

Witnesses:
CHARLES R. SEARLE,
EDW. WM. FRANCIS.