(No Model.)

L. BLOCK.

REFRIGERATING MACHINE.

No. 518,541. Patented Apr. 17, 1894.

Fig: 1.

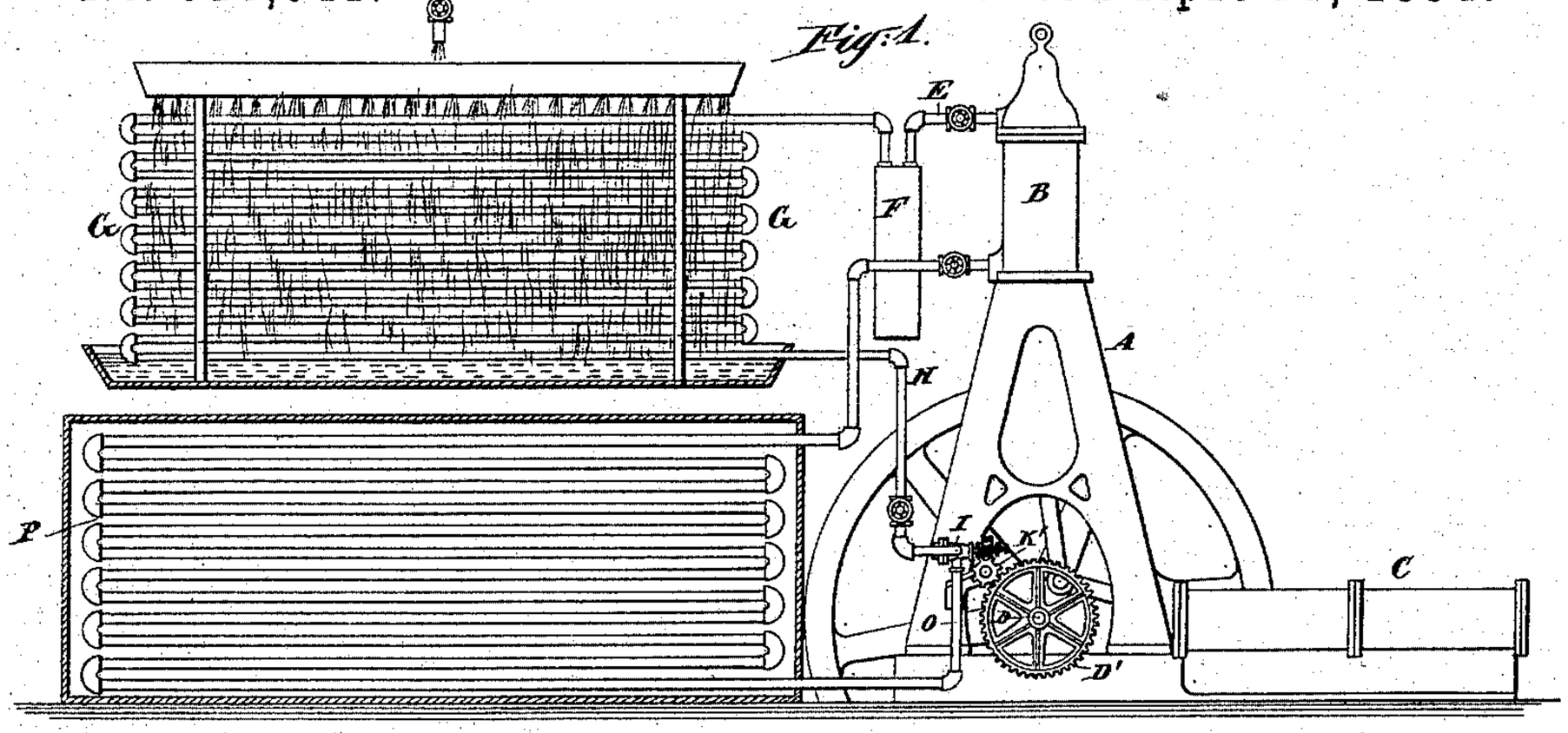


Fig: 2.

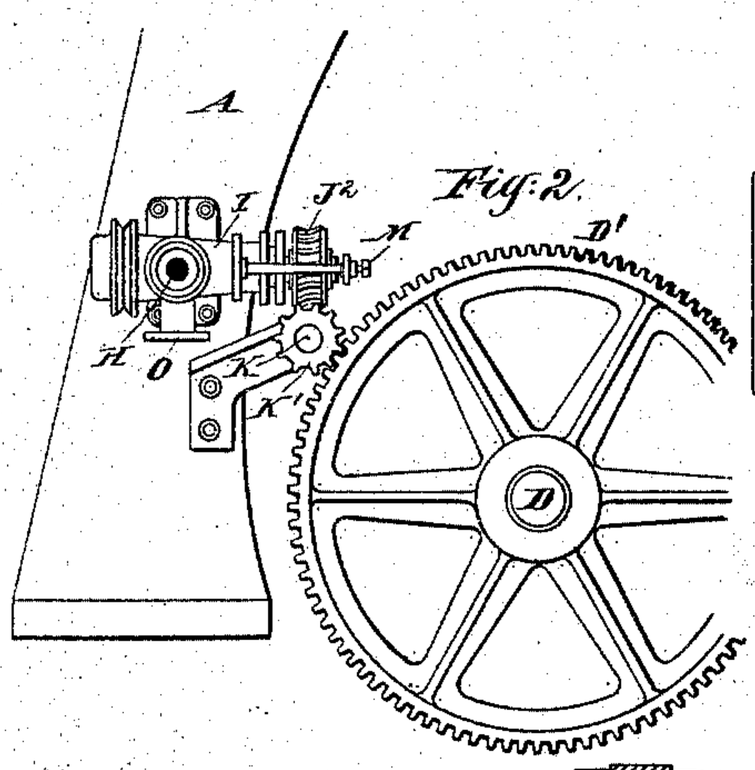


Fig: 3.

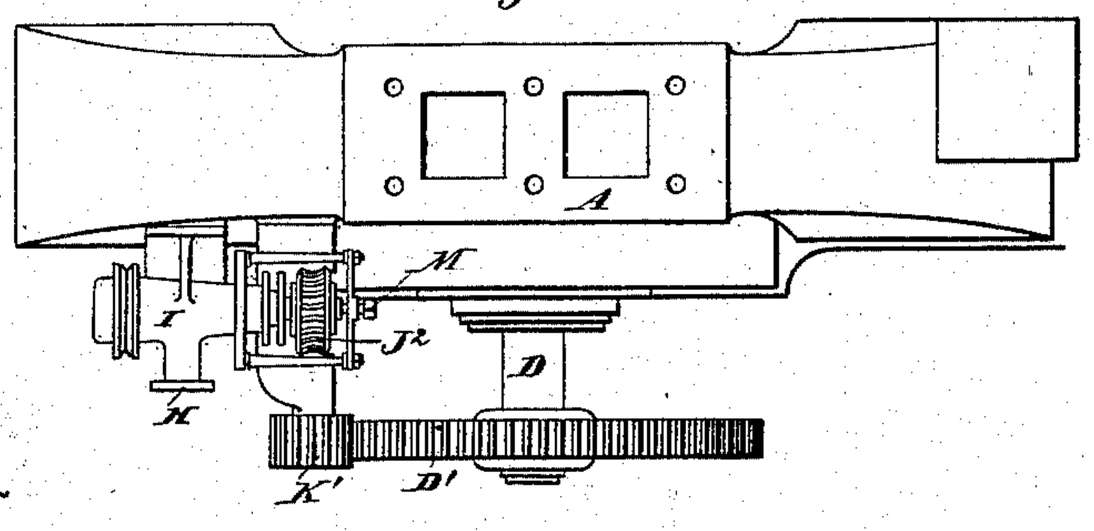


Fig: 4.

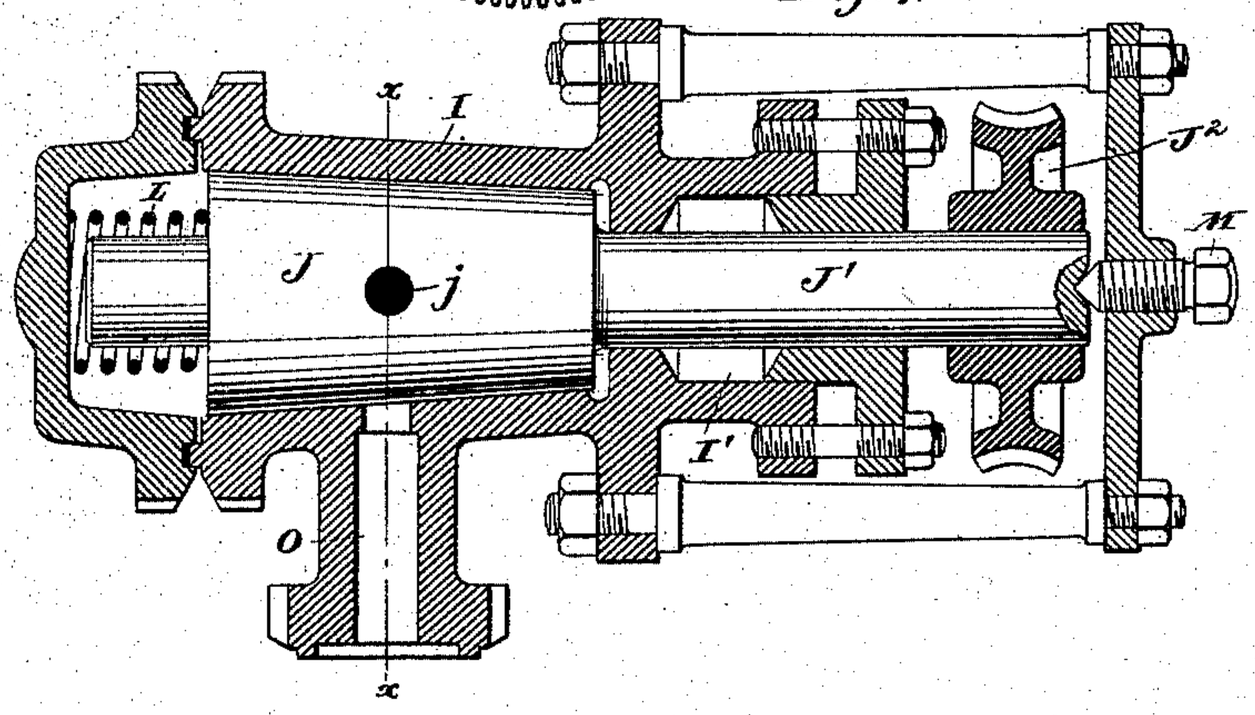
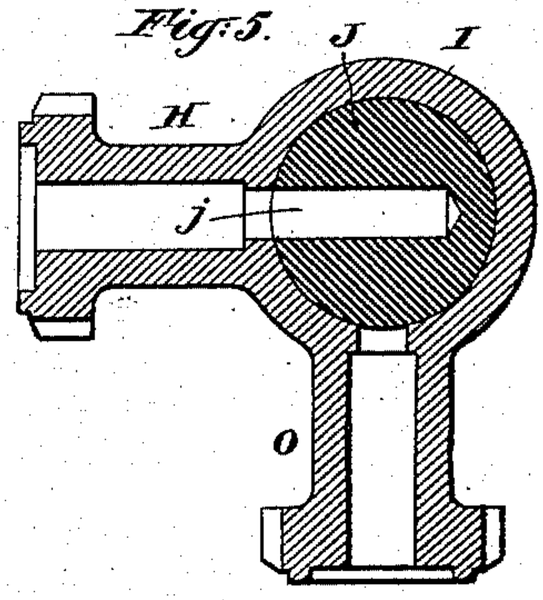


Fig: 5.



Witnesses:

Charles R. Searle.

M. F. Boyle.

Inventor:

Louis Block

by his attorney

James Drew Stetson

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LOUIS BLOCK, OF NEW YORK, N. Y.

REFRIGERATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 518,541, dated April 17, 1894.

Application filed July 11, 1891. Serial No. 399,208. (No model.)

To all whom it may concern:

Be it known that I, LOUIS BLOCK, a citizen of the United States, residing in the city and county of New York, in the State of New York, have invented a certain new and useful Improvement in Refrigerating-Machines, of which the following is a specification.

The invention applies to all that class of refrigerating machines producing cold by evaporation of ammonia and analogous gaseous refrigerants previously liquefied by compression. The successful operation of a refrigerating machine working on this principle depends largely on the regulation of the flow of ammonia or other volatile refrigerant from the retainer in which it is held in a liquid form at common temperatures, into the evaporator in which it serves for cooling by evaporation. It is desirable to adapt such to take care of itself for a long period, thus enabling a refrigerating machine to serve on a small scale and on movable structures as railroad cars.

The apparatus known as the expansion cock requires to be frequently adjusted. This is especially necessary when, as is usually practiced, the compressor is worked more slowly during cool periods to economize power. It requires a more expensive attendant if the expansion cock must be adjusted than if only the speed of the machine shall require to be varied. It will be understood that in machines having skilled attendance a cock can be adjusted from time to time so as to be always just sufficiently open to allow the liquefied ammonia to flow from the high pressure retainer for the liquefied refrigerant into the evaporator or low pressure part of the apparatus and be evaporated at the proper rate. When from varying the speed of the machine or from any other cause the flow is, on the one hand, too restricted, or, on the other hand, too free, an engineer of skill and experience with this class of machinery, can remedy the difficulty by slightly opening or closing the expansion cock. But the expansion cock involves frequent and skillful attendance. Sometimes the contracted aperture becomes partially choked with a particle of solid matter in the liquid and the effect is greatly changed, even when no variation has been made in the speed of working.

I have discovered means for supplying the liquefied refrigerant as required for effective refrigeration which do not require that skillful attendance which the ordinary expansion cock demands. In the mode of carrying out my invention, which I esteem the best, I provide a slowly revolving plug connected to the compressor and operated by the same mechanism, which at one period in each revolution presents a cavity to the high pressure retainer for the liquefied refrigerant under such conditions that it is certain to be filled with the liquid ammonia, and at another point in each revolution presents the same cavity to the evaporator or low pressure part of the apparatus under such conditions that it is certain to be emptied. This device holds back the main body of the liquefied ammonia with absolute reliability, and discharges a just sufficient quantity to be evaporated. To this end the size of the measurer or measuring device and the volume of vapor removed at each transfer are proportioned inversely to the densities respectively of the liquefied refrigerant and the vapor under the conditions of effective working; or in other words, the volume of vapor removed from the evaporator or expansion coils at each transfer is as much greater than the measure of liquid transferred from the retainer for the liquefied refrigerant as the density of the liquefied ammonia is greater than that of vapor under the low pressure necessary for effective refrigerating operation. Thus by a positive operation, without careful manipulation on the part of the attendant, the pressure in the expansion coils will always be kept practically constant or within the limits of effective refrigeration, because any rise in the pressure and density of the vapor will result in the removal of more ammonia than supplied by the measurer or measuring device until equilibrium is established and owing to the proportioning of the size of the measurer relatively to the volume of vapor as above set forth this state of equilibrium will correspond with a sufficiently low pressure for effective refrigeration with the liquefied refrigerant. The intervals of transfer of the liquefied refrigerant are made to correspond with the rate of removal of the resultant vapor from the evaporator or expansion coils; or in other

words, the measuring device is operated at at the rate of the compressor mechanism. By having the measurer operating means connected with and operated by the said compressor mechanism, there is an automatic variation of the speed of the measurer with each variation of the speed of the compressor. Consequently when the speed of the machine slackens a positively operating means not apt to get out of order automatically adjusts the supply of liquefied refrigerant to the slower speed and it is impossible for the evaporator or expansion coils to be filled or supplied in excess with the liquid refrigerant. With the usual expansion cock when the machine slows down, if the said cock is not adjusted to the changed conditions, the liquefied refrigerant enters faster than it will volatilize, thus increasing the pressure and decreasing the rate of volatilization and allowing the temperature to rise. It has been proposed to employ self acting cocks which open only when there is a certain difference in pressure between the evaporator and the retainer of liquefied refrigerant, but these are not the equivalents for the measurer or measuring device used in this invention, because they do not operate in the same way, are not positive and are apt to get out of order.

Refrigerating machines have been constructed which utilized air as the refrigerating agent, but in such a machine the refrigerating effect is dependent upon the exterior work which the air is made to perform in expanding; and the present invention has no reference to such machines, because the measuring of compressed air to a cooling chamber would not accomplish the result of my present invention, nor would it effect substantially the essential operation thereof. By my invention as already stated, I adjust by a positive operation the quantity of the liquefied refrigerant supplied to the evaporator or expansion coils in such a way that its conversion into a vapor in the said expansion coils is insured and its accumulation therein in a liquefied condition prevented, and I thus insure always, irrespective of the speed of the machine, the conditions necessary for an effective absorption of heat by the act of vaporization. In refrigeration by compressed air there is nothing corresponding to the difference between the liquid and vapor conditions of the refrigerant. There is no latent heat of vaporization involved, nor any such necessity for a determinate amount of vacuum in the expansion coils as is involved in the use of a liquefied vapor for the refrigerant. The mere expansion of compressed air would not effect a lowering of temperature and any cooling effect which may be produced by causing the air to perform exterior work is something which would not depend directly upon the measurement of compressed air to the expansion coil and which would be entirely irrelevant to the present invention. It will also be understood that I combine the measurer or measuring device with elements other than those in use in air machines, as well as adapt it to the special functions it has to perform, so that my apparatus as a whole differs essentially from an air machine in its parts as well as in its mode of operation, and in the new results attained thereby.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a side elevation of the entire apparatus partly in section. The remaining figures show portions on a larger scale. Fig. 2 is a view corresponding to Fig. 1. Fig. 3 is a plan view. Fig. 4 is a horizontal section, and Fig. 5 is a vertical section on the line x x in Fig. 4.

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

A is the fixed frame-work which supports the compressor pump B and the actuating engine, which latter is indicated by C. These parts may be of any ordinary or suitable construction.

D is the shaft of the refrigerating machine which may be understood to be revolving, in ordinary summer weather, at about sixty revolutions a minute. The compressed and consequently hot ammonia is delivered through the pipe E, and through a separator F into the condenser G, in which it is subjected to the cooling influence of a shower of water; or is cooled by blowing with air or by both these means, or by any other available means, and assumes the desired condition of a dense liquid. This flows through the pipe H, and is ready to be evaporated.

I is the casing of my measurer or measuring device. Its interior is accurately bored to receive a tapering plug J having a neck J′ extending out through a stuffing box I′. On the outer end of the neck J′ is a worm-wheel J^2, through which the plug receives a slow rotary motion from a worm-shaft K, actuated by gearing K′, D′. The plug J, J′, is urged axially by a coiled spring L pressing against its larger end. Its end motion is restrained by an adjusting screw M which is tapped through a yoke connected rigidly to the case I. In the plug J is a deep cavity j. At each revolution this cavity is at one period presented horizontally to the retainer for the liquefied refrigerant, and is filled with ammonia from the pipe H. At a later period in each revolution the measure of liquid ammonia contained in cavity j is presented to the connection O which leads to the evaporator or expansion coil P into which it is instantly projected not only by gravity but also by the expansion of a portion into a gaseous condition. The compressor by its action maintains a low pressure in the evaporator or expansion coil P and the remaining liquid ammonia now evaporates and extracts the

heat from the fluid which surrounds the evaporator or expansion coil. The ammonia ultimately returns as a gas, at a predetermined pressure, to the compressor to be again compressed and the round of operation is repeated.

Modifications may be made by any good mechanic without departing from the principle or sacrificing the advantages of the invention. There may be the ordinary or any suitable provisions for disposing of the oil in the separator F. There may be any ordinary or suitable provisions for regulating the speed of the compressor, so that it may be worked more rapidly when required. By effecting the revolutions of my measurer or measuring device by gearing from the compressor, it follows that when the rate of the latter is raised or lowered, the measurer or measuring device will deliver at correspondingly varied intervals. I can vary the size and relation of the gear wheels connecting the cock with the compressor so as to revolve the cock once, twice or any other number of times for each revolution of the main shaft. Or I can if desired operate it successfully so geared as to make only one revolution of the cock and consequently only one delivery of the volatile fluid for two or any other number of double strokes of the compressor. I can use other refrigerating liquid in lieu of ammonia. There may be any ordinary or suitable measurer or measuring device in lieu of the cock.

In order to supply the liquefied ammonia or analogous liquefied gaseous refrigerant from its retainer to the evaporator by periodically filling a measuring device with the liquefied refrigerant from said retainer and emptying the contents into the evaporator, there must be operating means; since the measurer, unlike the expansion cock, requires movement for feeding. Such means must be adapted to operate the measuring device at a proper rate. The fact that the measurer requires to be operated in order to feed, that it is certain to feed and that the rate of feed can be regulated by controlling its speed make its use a great improvement in machines for refrigerating by liquefied gaseous refrigerants.

I claim as my invention—

1. In a refrigerating machine of the character specified, the combination with the retainer for the liquefied refrigerant, the evaporator, and the compressing mechanism, of a measuring device located between the retainer and evaporator, and mechanism for operating the measurer at the rate of the compressor mechanism, substantially as and for the purpose set forth.

2. In a refrigerating machine of the character specified, the combination with the retainer for the liquefied refrigerant, the evaporator, and the compressing mechanism, of a measuring device located between the retainer and evaporator, and means for operating the measurer connected with and operated by the compressor mechanism, substantially as and for the purpose set forth.

3. The herein described refrigerating machine operating by means of liquefied gaseous refrigerant, such as ammonia, and comprising a set of closed vaporizing coils, a compressor, or equivalent means for compressing the volatilized refrigerant, a surface condenser, a measurer such as the plug J *j*, for the liquefied refrigerant, a connection between the liquid space of said condenser and the said measurer, a connection between the said measurer and the said vaporizing coils, a connection between the said vaporizing coils and the said compressor, a connection between such compressor and the condenser, and mechanical means for operating the said measurer to transfer the liquefied refrigerant at intervals varying in frequency with the speed at which the machine is run, the capacity of said compressor for removing and compressing vapor for each such transfer being as much greater in volume than the size of said measurer as the density of the said liquefied refrigerant is required to be greater than the density of the said vapor under the low pressure necessary to insure vaporization at the low temperature obtaining, whereby the pressure in said vaporizing coils is without requiring careful manipulation, kept within the limits of effective refrigeration with the liquefied gaseous refrigerant, said pressure being always low enough to insure the vaporization of the said liquefied refrigerant at the low temperature obtaining, and its delivery in the aeriform condition to the compressor at the different speeds of the said machine, substantially as set forth.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

LOUIS BLOCK.

Witnesses:
CHAS. W. LAHR,
ALFRED SIEBERT.