R. F. MASSA.

SYSTEM OF REFRIGERATION.

APPLICATION FILED MAY 28, 1906.

912,866. Patented Feb. 16, 1909

2 SHEETS—SHEET 1.

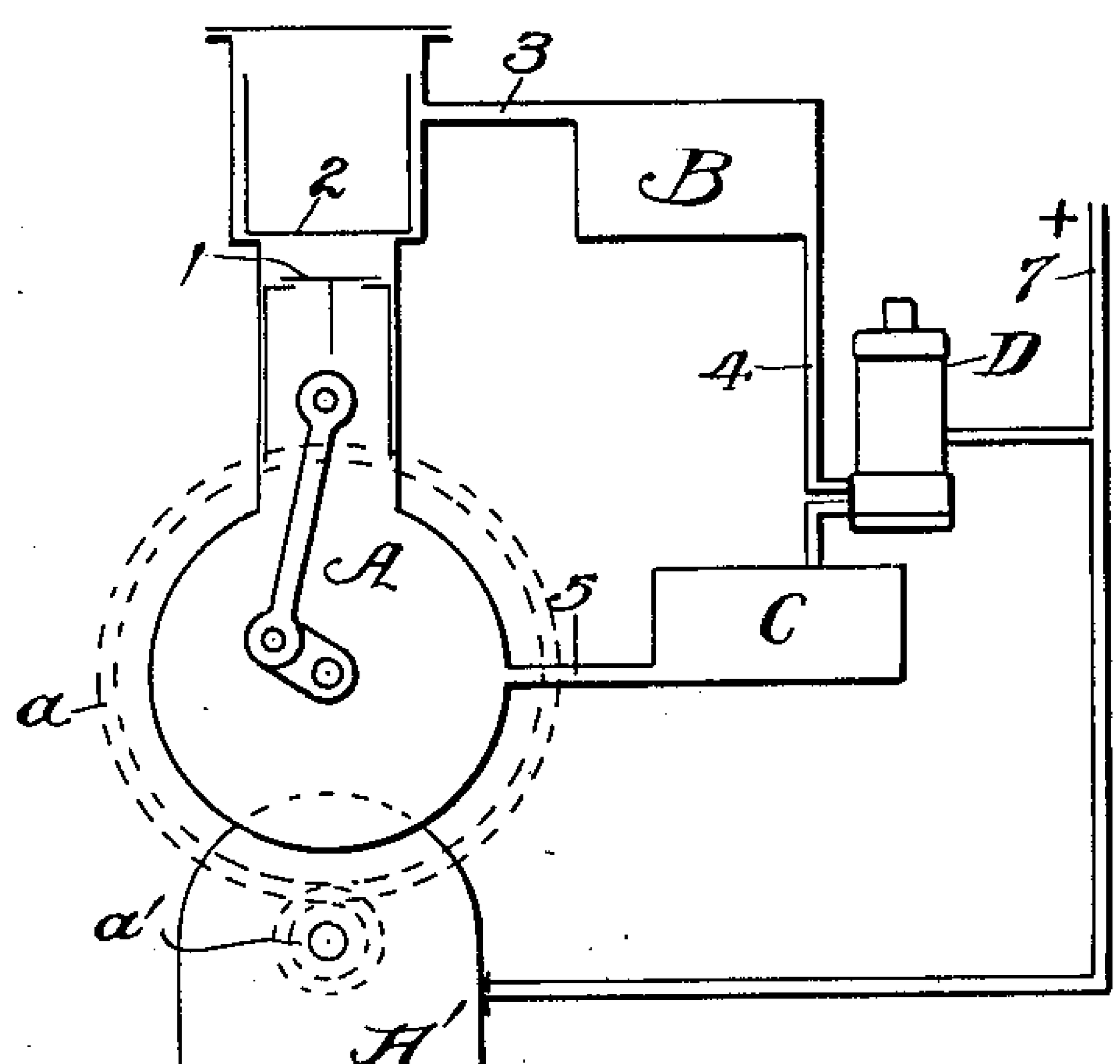

Fig. 1.

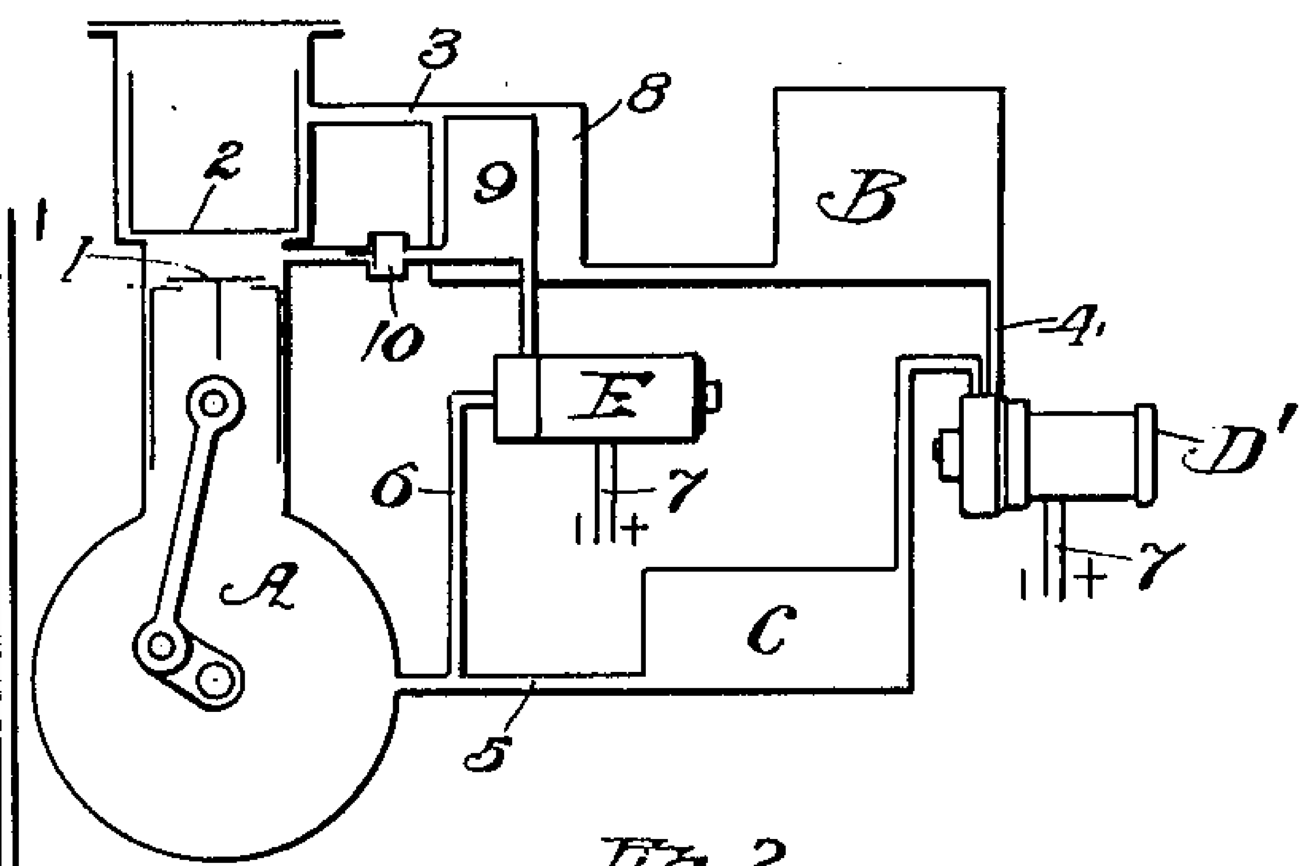

Fig. 2.

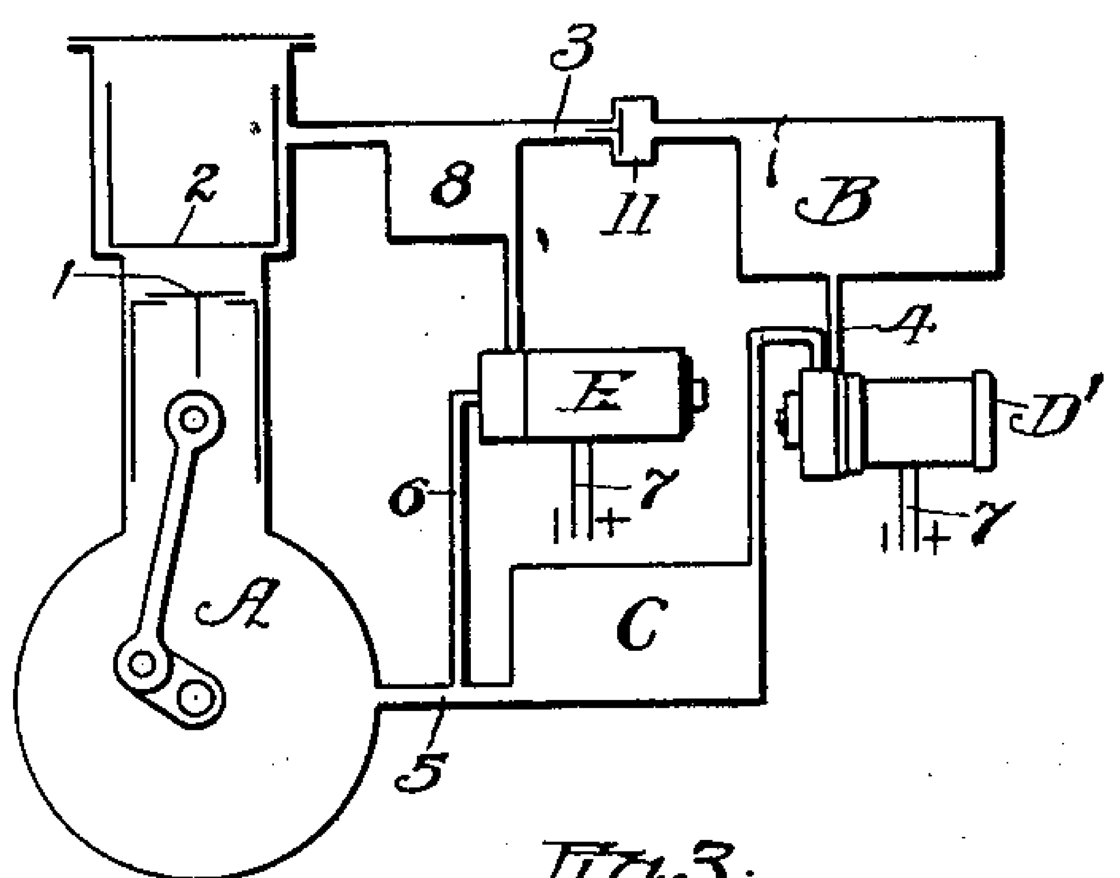

Fig. 3.

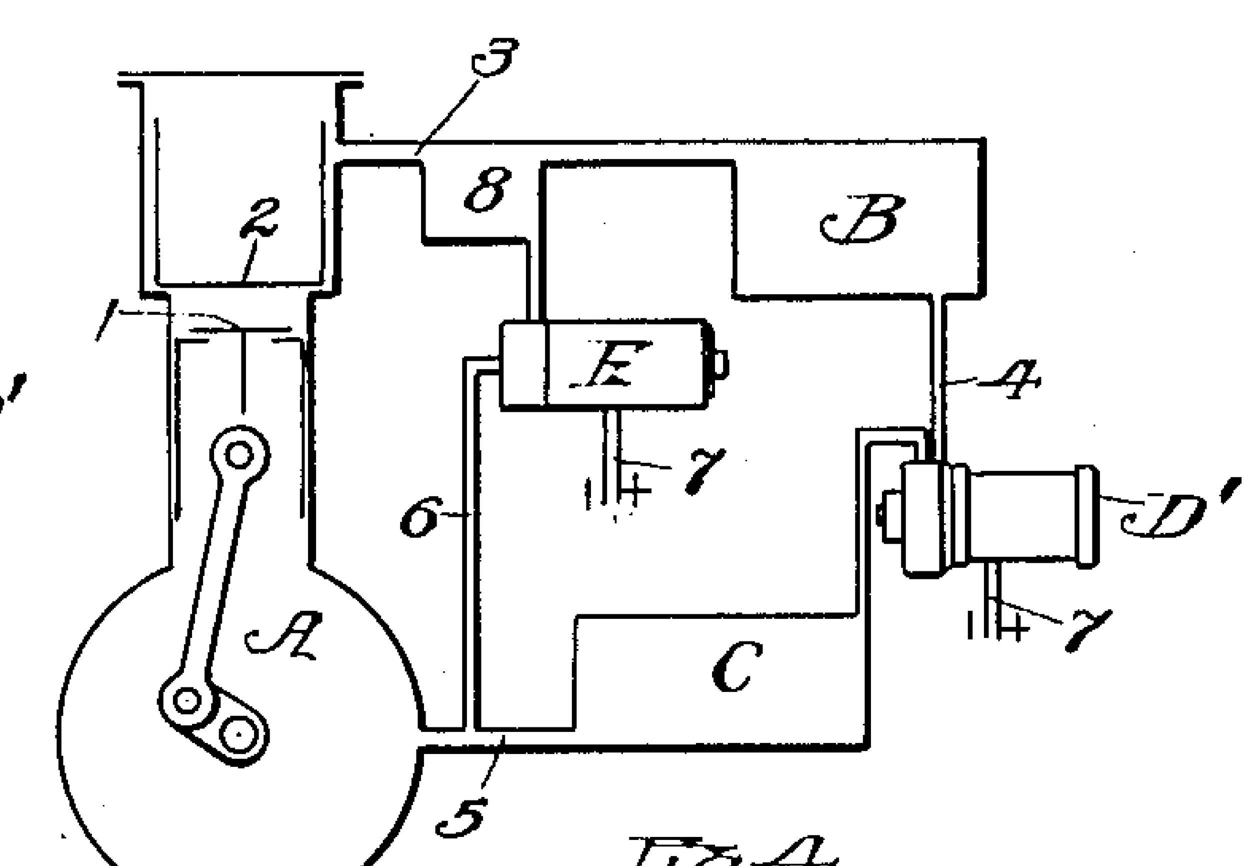

Fig. 4.

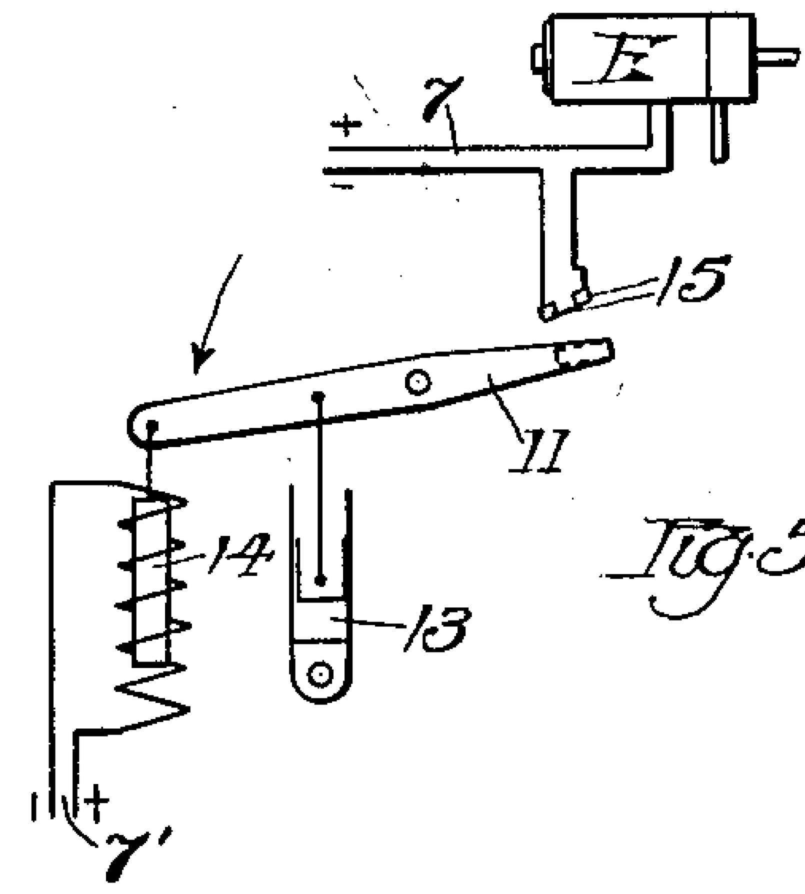

Fig. 5.

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2 SHEETS—SHEET 2.

Fig. 6.

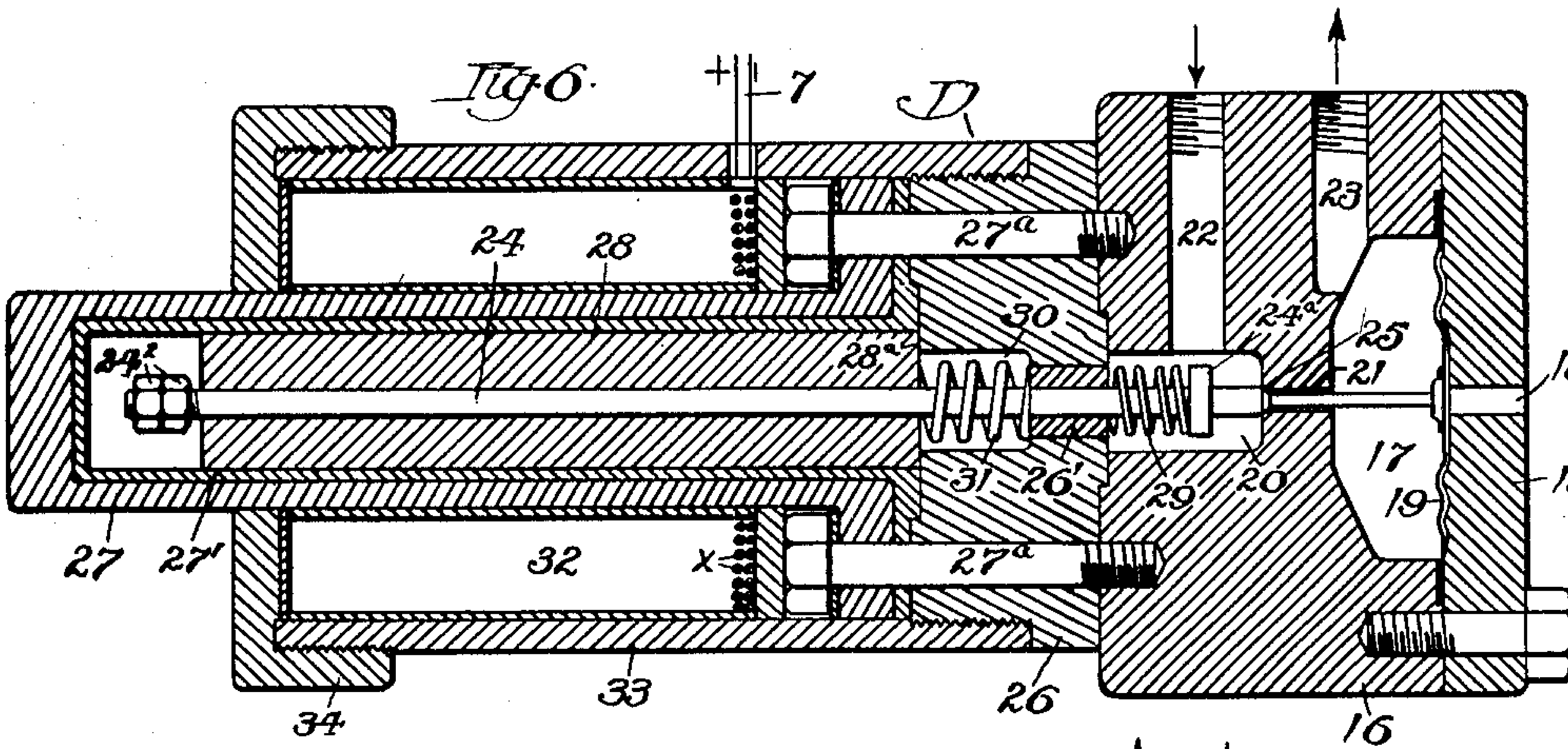


Fig. 7.

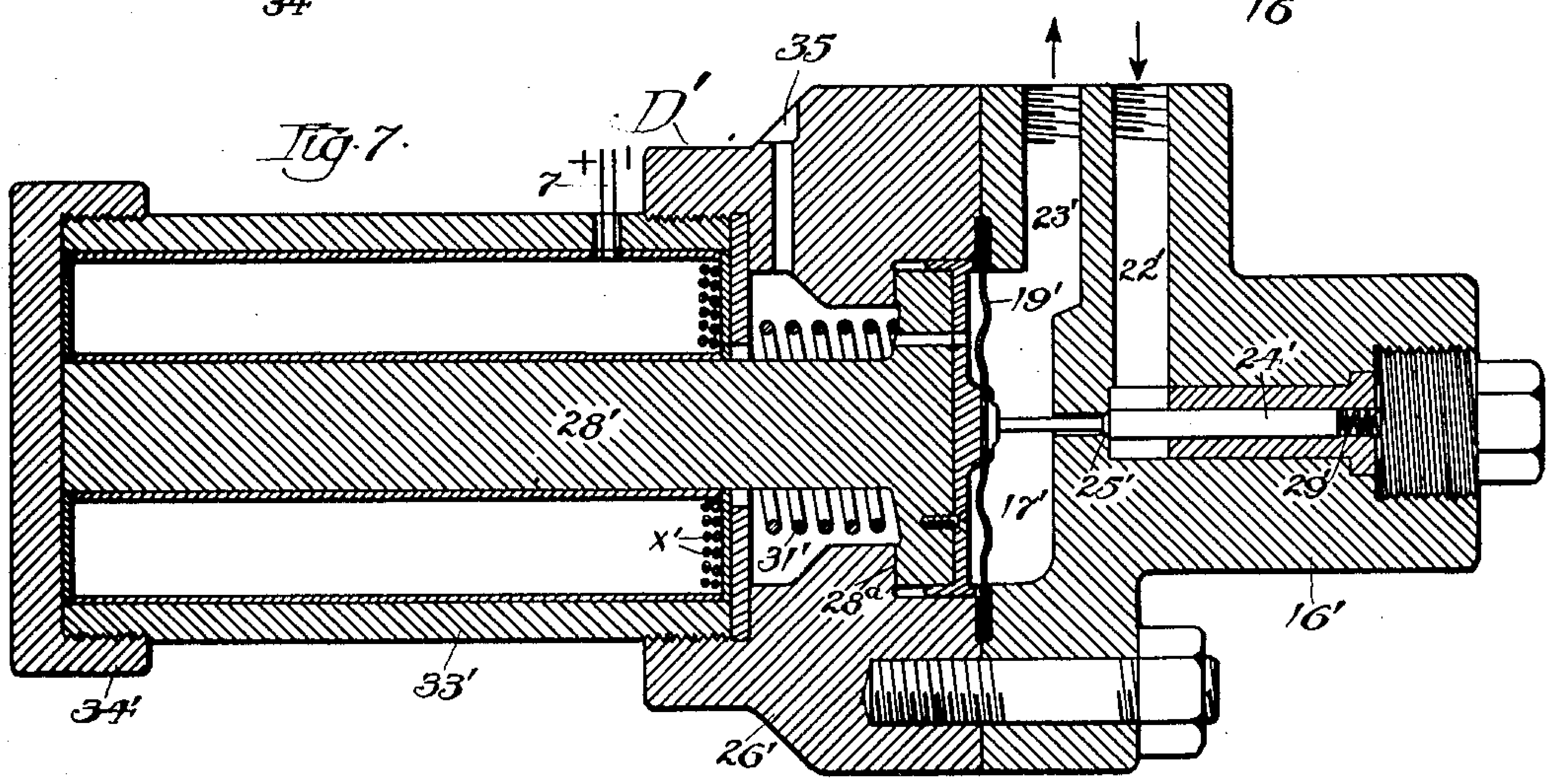
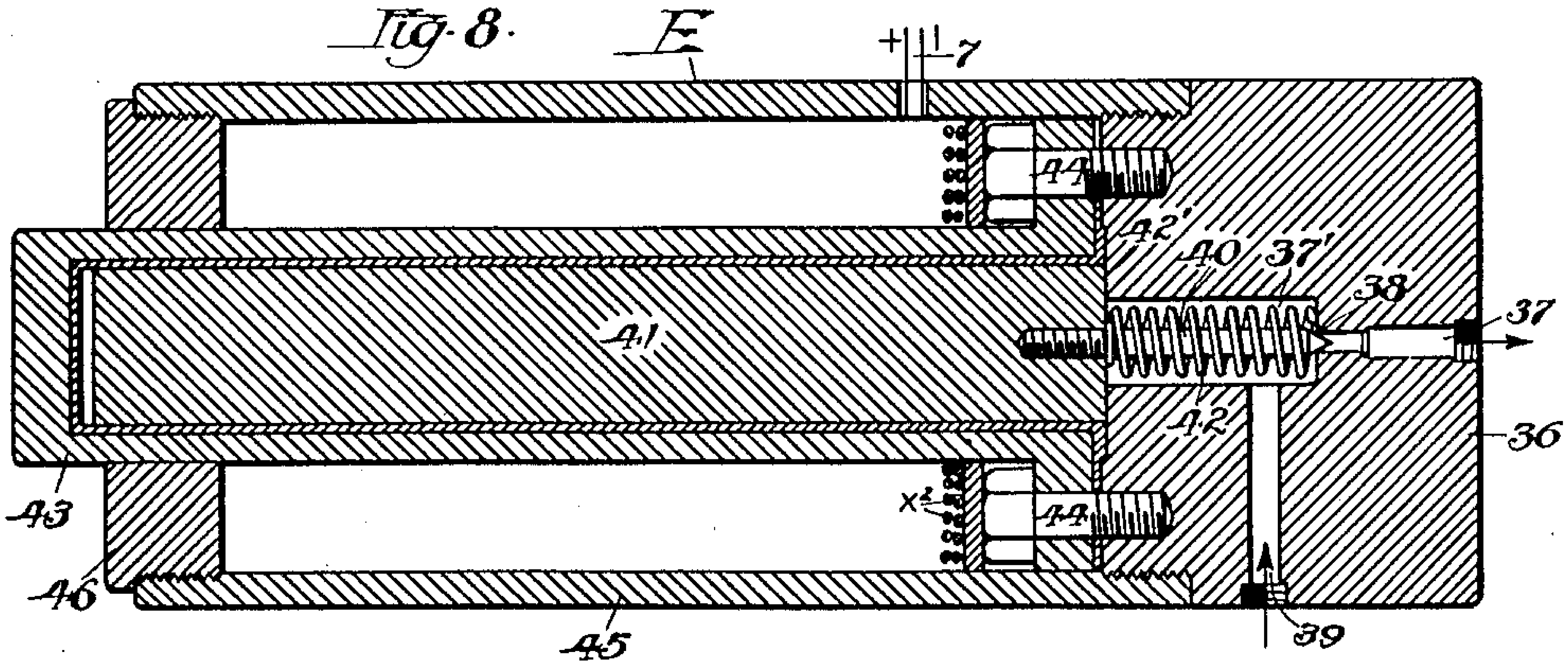


Fig. 8.



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UNITED STATES PATENT OFFICE.

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SYSTEM OF REFRIGERATION.

No. 912,866. **Specification of Letters Patent.** **Patented Feb. 16, 1909.**

Application filed May 28, 1906. Serial No. 318,991.

To all whom it may concern:

Be it known that I, ROBERT F. MASSA, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Systems of Refrigeration, of which the following is a complete specification.

This invention applies to refrigerating machines and is particularly applicable to such machines when automatically and electrically driven but will apply also when they are mechanically driven whether automatically or otherwise. One of the principal objections prevalent in such devices as heretofore constructed is found to be the difficulty encountered in starting the compressor against the normal high pressure of the condenser.

The object of the present invention is to overcome the above mentioned objection and the advantage resulting is first; a system in which the compressor will start against no load and take up the full load when at practically normal speed; second, in types indicated in Figs. 2 and 3 the pressure in the condenser will be sustained while the compressor stops; and third, provision is made for automatically opening the valves for cleaning same as well as to equalize the pressure whenever the machine stops. Another advantage is the passing of oil collected in the oil separator back to the compressor without the necessity for its passing through the refrigerator.

The particular features of the invention will be hereinafter described, pointed out in the appended claims and illustrated in the accompanying drawings in which—

Figures 1 to 5 inclusive are diagrammatic views illustrating the application of the improvement to various types of refrigerating systems. Fig. 1 showing the application to a system in which no by-pass is employed. Figs. 2, 3 and 4 showing the special valve interposed in the by-pass connection between the high and low pressure sides of the system and with various modifications of the auxiliary chambers, and Fig. 5 illustrates the application of the current to the special valves through a lever actuated by a solenoid and controlled by a dash-pot, the object being to cause the valve to delay closing and thus facilitate starting. Fig. 6 represents a longitudinal section of the type of special valve employed in Fig. 1. Fig. 7 is a corresponding view of a slightly modified form of electrically controlled valve used as an expansion valve, and Fig. 8 represents the special form of electrically controlled valve employed in the by-pass.

In the drawings A designates the compressor, 1 the valve in the plunger thereof and 2 the valve at the discharge end of same. B is the condenser and C the refrigerating chamber. A high pressure or compressor discharge pipe 3 leads from the compressor A to the condenser B, the condenser and refrigerating chamber C are connected by the pipe 4 and the return or suction pipe 5 leads from the chamber C, back to the compressor A. An electrically controlled expansion valve D is interposed in the run of pipe 4 between the condenser and refrigerator chamber C, this expansion valve being preferably of the construction shown in Fig. 6, and in which the valve is held momentarily open when the current stops in a manner hereinafter more fully explained.

A by-pass 6, which with the valve in connection therewith constitutes the principal novel feature of this invention, connects the high with the low pressure side of the system, the connection being made at points to be specified. In this by-pass 6 is interposed a special form of automatic electrically controlled valve E (see Fig. 8) in which the current acts through an electro magnet to hold the said valve closed as will be presently described. The function of the by-pass and valve is to relieve the pressure temporarily on the discharge side of the compressor to facilitate the frequent starting and, incidentally, in some instances, to drain any oil that may have collected, back to the compressor. In Fig. 1 the special form of valve shown in Fig. 6 is used, the valve being automatically and electrically controlled by the current connections 7. This valve acts as a pressure reducing valve when the compressor is in operation and opens when the compressor stops. The current connections 7 to both the valves D and E may be fed either from a source which supplies power to the compressor or they may be fed from an independent source controlled mechanically from some moving part of the machine. The connection of the conductors 7 with the motor which drives the compressor is shown diagrammatically in Fig. 1 in which A^1 represents the motor. The motor drives the compressor A through the pinion a^1 on the motor shaft and the gear a on the compressor shaft, which meshes with said pinion.

In Fig. 2 an auxiliary chamber 8 which may serve also as an oil separator is placed in the compressor discharge pipe 3 and the by-pass 6 leads from a point operatively speaking in advance of the compressor discharge valve 2 and extends to the suction or low pressure pipe 5. The special form of valve set forth in Fig. 8 is here employed in the by-pass and a secondary auxiliary chamber 9 located within the chamber 8 is interposed in said by-pass connections above the valve E. A check valve 10 between the chamber 9 and the compressor A prevents the return of the refrigerating medium to said compressor.

The operation of the arrangement as shown in Fig. 2 is as follows: Assuming that the compressor is in operation and, through suitable means, thermostatic or otherwise, the current is shut off, the valve D^1 will open momentarily, and then close and the valve E will also open. Approximately normal pressure will be maintained in the condenser B and in the chamber 8 but the fluid in the chamber 9 will escape through the valve E to the low pressure side of the apparatus. In again starting, the compressor will work against no initial pressure as the charge will first pass into the chamber 9 and as the valve E closes in starting the pressure will gradually rise until the pressure in the said chamber 9 equals that in the condenser B, at which time the refrigerating medium will begin to pass through the valve 2 into the chamber 8 and on to the condenser B through its usual path. The chamber 9 is of sufficient capacity to enable the compressor to attain practically normal speed before encountering normal resistance. Since the chamber 9 is placed within the chamber 8 its temperature will be maintained equal to that in the chamber 8 and hence condensation in the former is prevented. The check valve 10 prevents the compressed refrigerating medium escaping in the wrong direction. The action of the valve D^1 in the above described arrangement is essentially that of an ordinary expansion valve.

In the system shown in Fig. 3 the principle involved is the same but the secondary chamber 9 is omitted and a check valve 11 is introduced between the chamber 8 and the condenser B to prevent the return of the refrigerating medium from the latter to the compressor. In the arrangement shown in Fig. 2 the valve 2 in the compressor serves the function of the check valve 11 in Fig. 3. In Fig. 4 the same arrangement prevails as in Fig. 3 except for the check valve 11 which is not employed. With slight qualifications the preceding description of the operation of the system shown in Fig. 2 will also apply to that shown in Figs. 3 and 4. In Fig. 3 in starting it is obvious that the compressor starts against no pressure in the chamber 8 and raises this to normal pressure after which the refrigerating medium passes through the condenser B at normal pressure as usual. The valve E closes on starting and opens on stopping as before described, while the valve D^1 opens momentarily and then closes. In the diagram shown in Fig. 4 the pressure is allowed to drop in both the condenser B and the auxiliary chamber 8, the check valve 11 of the preceding figure being omitted, while the chamber 8 acts merely as an oil separator.

In Fig. 5 is illustrated a diagram in which the electrical connection 7 is effected by means of a lever 11 controlled by a dash-pot 13 and actuated by a current 7^1 and the solenoid 14 the end of the lever 11 engaging the contact points 15. By such means the closing of the valve E is thus delayed, thus facilitating the starting. The adoption of such device is arbitrary but may be used in connection with any of the valves.

The preferred form of the different types of valves employed is illustrated in Figs. 6, 7 and 8 which represent respectively the valves D, D^1, and E. The valves D consist of the base 16 in the face of which is formed a chamber 17 and on this face is bolted the base plate 18, the diaphragm 19 being placed between said base and base plate and made to extend across the chamber 17. A second and smaller chamber 20 is formed in the opposite side of the base 16 and the valve opening 21 connects the two chambers 20 and 17. The inlet port 22 conducts the high pressure refrigerating medium from the condenser to the chamber 20 while the port 23 leads from the low pressure chamber 17 to the refrigerating chamber. The valve opening 21 is controlled by the axially arranged valve stem 24, the said stem projecting beyond the valve seat 25 and contacting the diaphragm 19. A cap piece 26 is bolted to the base 16 by means of the bolts 27^a, these same bolts also fastening the hollow cylindrical brass cap 27 to the cap piece 26. Within this cap 27 is placed the armature 28 in which adjustably fits the valve stem 24, a Babbitt lining 27^1 being interposed between said cap and armature; the valve stem 24 has a bearing in the bushing 26^1 of the cap 26 and is provided with a shoulder 24^a within the chamber 20. A spring 29 is placed within the chamber 20 and reacts between the said shoulder 24^a and the bushing 26^1, the tendency of this spring being to hold the valve stem on its seat 25. Within the cap piece 26 is formed a recess 30 adjacent to the armature 28 and a coil spring 31 stronger than the spring 29 operates to lift the armature 28 from its seat against the action of said spring 29. The nuts 24^2

on the outer end of the valve stem make the valve stem adjustable longitudinally and when the armature 28 is not energized the spring 31 will lift said armature from its seat 28^a and will also lift the valve stem 24 and open the valve. The coil x is placed within the space 32 its connections with the circuit being at 7. A sleeve 33 screws on to the cap piece 26 which with the cap 34 inclose the coil. An opening 18^1 through the base plate 18 subjects the outer side of the diaphragm 19 to atmospheric pressure. The operation of this valve is as follows: Assuming that the system is in operation and a current is passing through the coil x the armature 28 will be drawn to its seat 28^a and the valve stem 24 will be forced by the spring 29 against its seat 25 thus stopping the flow of the refrigerating medium. When the pressure in the chamber 17 has fallen below atmospheric pressure the diaphragm 19 will be pressed by the air inwardly and pressing against the stem 24 of the valve will open same until the pressure on the two sides of the diaphragm is equalized. The diaphragm 19 will thus operate to maintain a constant pressure in the chamber 17 and in the rear refrigerating chamber C. As soon as the current is shut off the spring 31 will press the armature 28 and valve stem away from their seats and hold the valve open as long as the current is off. This valve is employed when the arrangement is as shown in Fig. 1.

The valve D^1 illustrated in Fig. 7 is very similar to the preceding one. A cap piece 26^1 is bolted to the base 16^1, the base having in its face the chamber 17^1, the diaphragm 19^1, the inlet port 22^1, the outlet port 23^1 the valve stem 24^1, the valve seat 25^1 and the armature 28^1. The valve stem 24^1 however instead of being held open positively by means of the armature 28^1 is not directly connected with said armature but is held yieldingly in contact with its seat 25^1. The spring 31^1 operates to hold the armature 28^1 in contact with the diaphragm 19^1 when not counteracted by the said armature when energized. The air has access to the armature side of the diaphragm through the opening 35 in the cap piece 26^1. The operation of this valve is as follows: Assuming the system to be in operation and the armature 28^1 energized through the coil X^1 the said armature will be held on its seat 28^a against the pressure of the spring 31^1. As soon as there is a deficiency of pressure in the chamber 17^1 the atmospheric pressure acting against the opposite side of the diaphragm 19^1 will lift the valve stem 24^1 off its seat 25^1 until the pressures on the two sides of the diaphragm are equalized. The diaphragm will then drop back and the spring 29^1 will close the valve. A practically constant pressure in the chamber 17^1 and refrigerating chamber is thus maintained. When the current is turned off the spring 31^1 will at once press the armature down in contact with the diaphragm and open wide the valve 25^1 with the result that the pressure will quickly rise in the chamber 17^1 as well as in the refrigerator and press the diaphragm back against the spring 31^1 and permit the valve to again close. In this manner the valve is held momentarily open and a thorough cleaning of same is effected. As soon as the current is again turned on the diaphragm is relieved from the action of the spring 31^1 and the said diaphragm is again subject to the action of the atmosphere on one side and the low pressure of the system on the other side. This form of valve is used as the expansion valve in Figs. 2, 3 and 4.

In Fig. 8 is shown the special form of valve used in the by-pass connections 6. This valve as well as the other is automatically and electrically controlled. No diaphragm is employed. A base block 36 is provided with an axial opening 37, enlarged at its inner end 37^1 and provided with the valve seat 38. 39 is the inlet port and 37 is the outlet port. A valve stem 40 is adjustably threaded in the base of the armature 41 and the spring 42 acts to press the said armature from its seat 42^1. A Babbitt lined non-magnetic cap 43 is fastened to the base block 36 by means of the bolts 44. The armature 41 like the armature 28^1 and 28 is longitudinally movable in said cap, and the coil x^2 is inclosed by sleeve 45 and cap 46. The insulation, magnetic and non magnetic parts, the linings, etc., are common to electrically operated valves and hence such details will not be dwelt upon. The operation of this valve is very simple. While a current is passing through the coils x^2 the armature 41 will be held down pressing the valve upon its seat 42 and the valve opening 38 will be held closed but when the current is shut off the spring 42 will lift the armature and with it the valve stem 40. This form of valve is the type preferably used in the by-pass 6

What I claim as my invention and desire to secure by Letters Patent is:

1. In an automatic system of refrigeration, in combination, a compressor, a condenser, a refrigerating chamber, an expansion valve interposed between the condenser and refrigerating chamber, a by-pass connection between the high and low pressure sides of the system, and an electrically controlled valve interposed in said by-pass between the high and low pressure sides of the system.

2. In an automatic system of refrigeration, in combination, a compressor, a condenser, a refrigerating chamber, an expansion valve interposed between the condenser and chamber, a by-pass connection between the suction and discharge sides of the com-

pressor, and an automatically and electrically controlled valve interposed in said by-pass between the suction and discharge sides of the compressor.

3. In a system of refrigeration, in combination, a compressor, a condenser, a connection therebetween, an auxiliary chamber and a check valve, interposed in said connection, a refrigerating chamber, having a connection with said condenser located in said last mentioned connection, a suction pipe leading from the refrigerating chamber to the compressor, a by-pass connecting said auxiliary chamber and suction pipe, and an automatic and electrically controlled valve interposed in said by-pass.

4. In a system of refrigeration, in combination, a compressor, a condenser, a connection therebetween, an auxiliary chamber and a check valve, interposed in said connection, a refrigerating chamber, having a connection with said condenser, an expansion valve located in said last mentioned connection, a suction pipe leading from the refrigerating chamber to the compressor, a by-pass connecting said auxiliary chamber and suction pipe and an automatic and electrically controlled valve interposed in said by-pass, the said valve being held normally closed by a current passing therethrough when the system is in operation.

5. In an automatic system of refrigeration, in combination, a compressor, a condenser, and a refrigerating chamber, connections therebetween, an electrically controlled expansion valve interposed in the connection between the condenser and the refrigerating chamber, said valve adapted to open momentarily when the current ceases passing therethrough, a by-pass connecting the high and low pressure side of the system, and an automatic and electrically controlled valve interposed in said connection, said valve adapted to be held normally closed when the current is passing therethrough.

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Witnesses:
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