No. 697,029. Patented Apr. 8, 1902.

W. F. SINGER.

REFRIGERATING SYSTEM.

(Application filed Nov. 15, 1900.)

(No Model.) 2 Sheets—Sheet I.

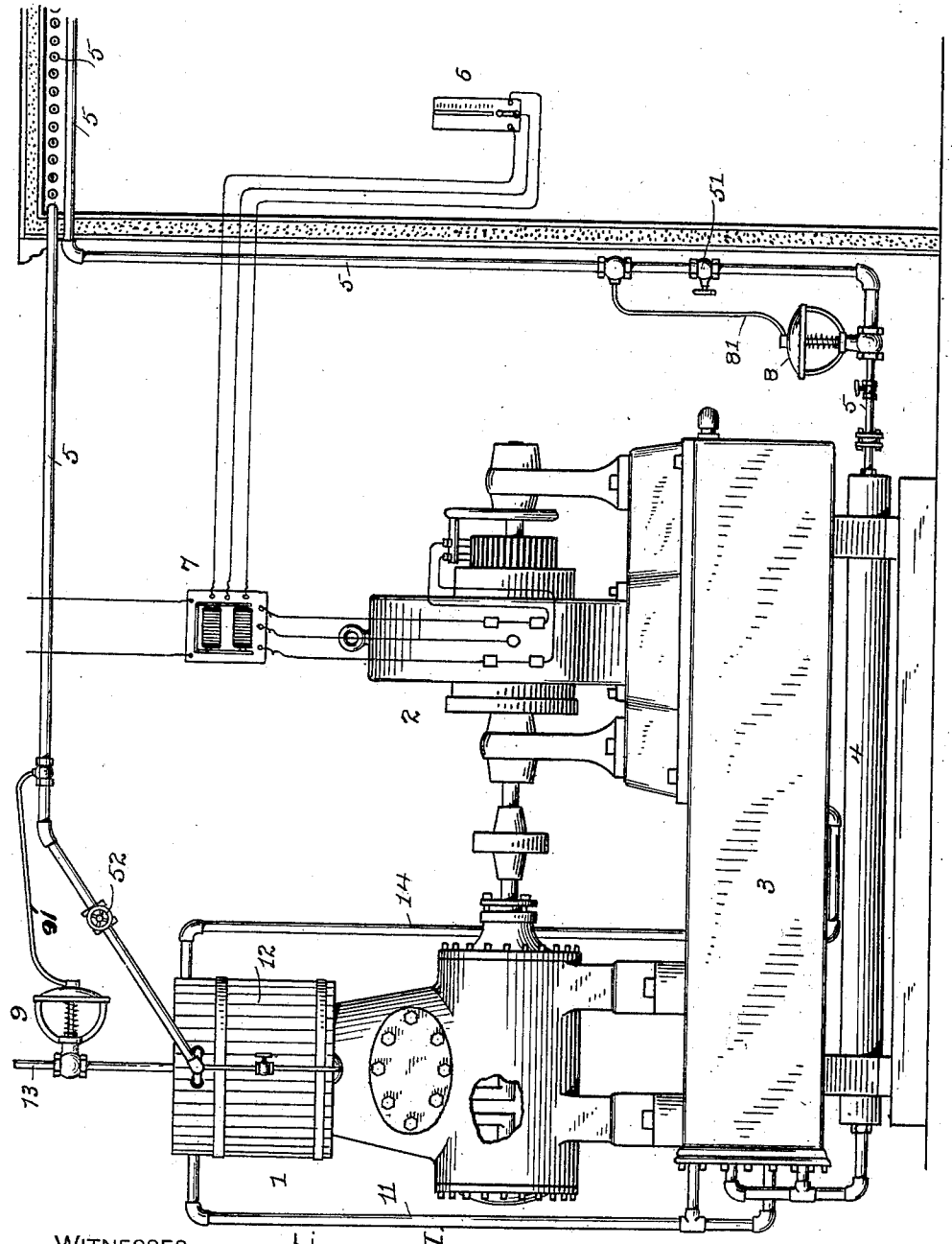


Fig. I.

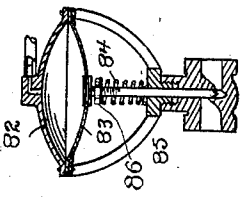


Fig. III.

WITNESSES.

H. A. Lamb.

B. L. Jones

INVENTOR.

William F. Singer

by Geo. L. Roper Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 697,029. Patented Apr. 8, 1902.

W. F. SINGER.

REFRIGERATING SYSTEM.

(Application filed Nov. 15, 1900.)

(No Model.) 2 Sheets—Sheet 2.

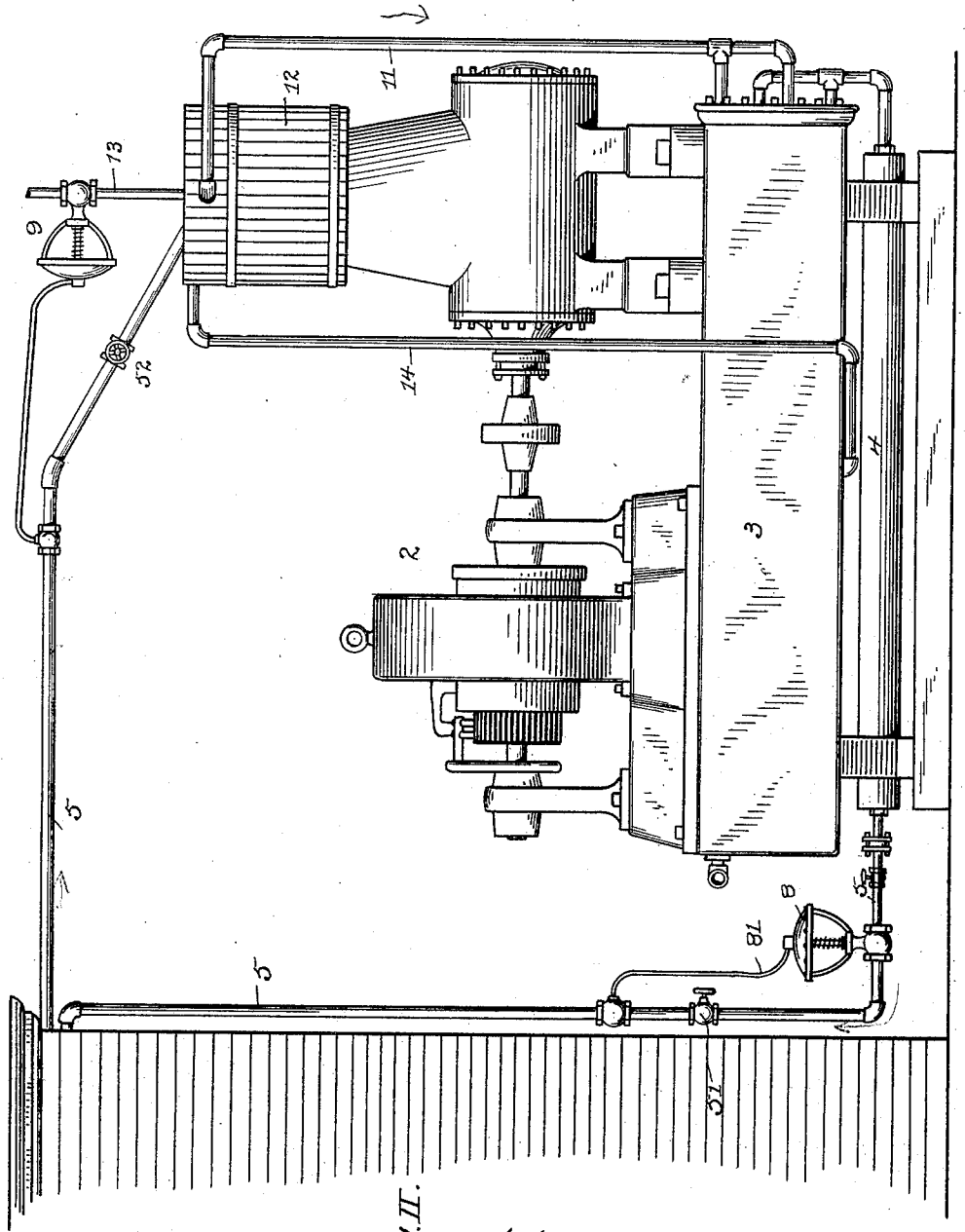


Fig. II.

WITNESSES.

H. A. Faulb.

R. G. Jones

William F. Singer INVENTOR.

by Geo. H. Strong Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM F. SINGER, OF NEW YORK, N. Y., ASSIGNOR TO THE SINGER AUTOMATIC ICE MACHINE CO., OF JERSEY CITY, NEW JERSEY.

REFRIGERATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 697,029, dated April 8, 1902.

Application filed November 15, 1900. Serial No. 36,615. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. SINGER, a citizen of the United States, residing at Fourth avenue and Twenty-eighth street, New York city, State of New York, have invented a new and useful Improvement in Refrigerating Systems, of which the following is a specification.

My invention relates particularly to circulatory systems in which a gas is condensed or liquefied, the heat of condensation abstracted, and the fluid admitted under reduced pressure to a coil of pipe or the like, where it rapidly absorbs heat units from the surrounding atmosphere or other fluid. It is intended to render such systems automatic in their action and generally to conduce to their economy and efficiency.

In the accompanying drawings, Figures I and II represent in elevation opposite sides of a refrigerating system embodying my invention. Fig. III is a vertical section of a part of my device on an enlarged scale.

In the example of my invention illustrated the pump 1 is of any desired or well-known form and is provided with a gas-outlet pipe 11 and water-jacket 12. The jacket is fed through pipe 13 and the water led therefrom by pipe 14 to the condenser-tank 3. The motor 2 is shown as directly connected with the pump, both standing on the condenser-tank 3 as a base. Beneath the condenser-tank is a gas-container 4, from which leads a service-pipe 5. The pipe system 5 may be a coil or series of coils and may be placed in a refrigerator, as shown. For that portion of the pipe system 5 within the refrigerating-compartment may be substituted any other well-known form of expansion-chamber, to which the portion of the pipe system which leads from the compartment or chill-room would serve as an exhaust-pipe. The pipe system 5 returns and feeds the pump 1, as shown. A hand-operated pressure-reducing valve 51, which I will hereinafter designate as an "expansion-valve," is placed in the pipe 5 near the container 4. A similar hand-valve 52 may be used near the pump-feed. A thermostat 6 is placed within the cool room and wired to the switch 7, which is in turn wired to the motor 2. An automatic fluid-controlling valve 8 is placed in the pipe 5 near the container 4 and connected by a tube 81 to the pipe system above the reduction-valve 51. The valve 8 is clearly shown in Fig. III of the drawings. It consists of a dome 82, suitably supported, a flexible diaphragm 83, secured at its periphery to the dome and forming therewith a fluid-chamber, a stem 84, whose end enters the valve-seat, a lifting-spring 85, and a nut 86. A similar valve 9 is connected with the water-supply tube 13 and is also connected by means of a tube 91 with the end of the pipe system 5 near its entrance to the pump 1.

The operation of my device will be readily understood from an inspection of the drawings.

As the particular construction of the pump 1 forms the subject of certain applications for patents concurrent herewith, I have not here particularly described it.

It is clear that when the motor 2 is running the pump 1 will compress in practice to the point of liquefaction the refrigerating-gas employed and will deliver the fluid through the pipe 11 to the condenser 3. Thence the fluid passes through the container 4 and through the circulatory pipe system 5 5 back to the pump 1, and so on in continuous circulation. By nearly closing the expansion-valve 51, so as to permit the passage of a very small volume of the refrigerating fluid, it instantly expands into a gas or vapor, so that the portion of the pipe system 5 beyond the valve 51 is thus converted into a refrigerating coil or gas-chamber. The hand-valve 52 may be closed when it is desired to disconnect any part of the pipe system 5. The function of the thermostat 6 is to operate the switch 7 so as to stop and start the motor 2 as the temperature of the cool room lowers to its predetermined minimum or rises to its maximum point. As a further preventive of a dangerous increase of temperature in the cool room the fluid-controlling valve 8 is interposed between the container 4 and the expansion-valve 51. The gas-chamber of the valve 8 is connected, as shown, by means of the tube 81, with the portion of the pipe 5 beyond the valve 51, so that any alteration of the reduced or cool-room pressure acts to raise or lower the diaphragm 83. It is clear that

the greater the reduction in gas-pressure from the container 4 to the pipe system 5 the more rapid will be the absorption of heat in the cool room. In other words, the pressure in the container being practically constant the temperature of the cool room or brine-bath will vary inversely as the pressure in the pipe system beyond the valves 8 and 51. It is clear that an outward movement of the diaphragm 83, acting against the thrust-spring 85, will partially close the valve by means of the stem 84, and that, conversely, a decrease of pressure in the system 5 will act to raise the diaphragm and open the valve. At the same time a similar automatic valve 9 serves to regulate—*i. e.*, increase or decrease—the supply of cooling-water to the pump-jacket 12 and condenser 2 as the demand varies. In other words, the entire or partial closing of the fluid-controlling valve 8, serving to cut off or to decrease the fluid flow through the pipe system 5, necessarily takes away or reduces the duty of the compressor 1 and the demand for a supply of cooling-water. The valves 8 and 9 being connected to the same pipe system 5 and subjected to the same pressure act together, the one incidentally to lessen the demand for cooling-water, the other to reduce its supply. Adjusting-nuts on the valves 8 and 9, respectively, and occupying a position corresponding to the nut 86, Fig. III, serve to vary the tension of the springs against which the diaphragms operate.

It is found in practice that the combination of the hand-operated expansion-valve 51, by means of which the condensed fluid is permitted to expand into a refrigerating chamber or coil, and the automatic valve 8, by which the variations of pressure in the refrigerating-coil operate to instantly vary the volume of fluid furnished for refrigeration, an exactness of temperature in the cool room may be maintained which is impossible where either a hand-valve or an automatic governor alone is employed. It is clear that this advantage is gained by positioning the automatic fluid-controlling valve 8 so that it acts to check the flow of the fluid under condenser-pressure and is itself acted upon by the fluid under reduced or chill-room pressure—*e. g.*, so that the expansion-valve 51 is between the seat of the fluid-controlling valve 8 and the tube 81, by which pressure is conveyed to the outer side of its diaphragm 83. If it were so placed that both sides of the diaphragm were exposed to either the compressor or to the chill-room pressure, the valve would of course be inoperative.

To avoid waste of condensing-water, which is a considerable item of cost in refrigeration, it is of great importance that the water-supply valve be closed simultaneously with the gas-controlling valve immediately the compressor is stopped. It is a feature of my invention that these two valves are opened and closed by precisely the same means. This, as shown, is an equal fluid-pressure in an integral pipe system. For convenience I have used as a unitary or integral means of maintaining this variable but equal pressure on the two valves the expansion portion of the pipe system 5. In a prior construction valves having a similar function are connected one to the expansion the other to the compression side of the system. The cardinal objection to this arrangement is that the pressures on these two sides are not only unequal, but that they have no constant relation to each other—*e. g.*, their sum is not a constant. This is due to losses of fluid, both by leakage and, in the case of ammonia, by disassociation. In practice these losses would be quite sufficient to require frequent adjustments of one or both valves to secure even an approximation to simultaneous action. As the valves are delicate of adjustment and as they are themselves sources of possible leakage, it is desirable that they be interfered with as little as possible.

What I claim is—

1. In a refrigerating system and in combination, a gas-compressor, a circulatory pipe system leading into said compressor, means for removing the heat of compression, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber and means interposed between said compressor and said expansion-valve and connected with and operated by the reduced pressure in said refrigerating-coil for regulating the flow of fluid through said system, substantially as described.

2. In a refrigerating system and in combination, a gas-compressor, a circulatory pipe system leading into said compressor, means for removing the heat of compression, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber, a fluid-controlling valve in said pipe system between said compressor and said expansion-valve and a tube connecting said refrigerating-coil with said fluid-controlling valve whereby the flow of fluid through said system is automatically regulated by variations of pressure in said refrigerating-coil, substantially as described.

3. In a refrigerating system and in combination, a gas-compressor, a circulatory pipe system leading into said compressor, means for removing the heat of compression, an expansion-valve in said pipe system whereby expansion of the controlled fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber, a fluid-controlling valve in said pipe system between said compressor and said expansion-valve, a diaphragm operating said fluid-controlling valve and a tube connecting said refrigerating-coil with the diaphragm-chamber of said fluid-controlling valve where-

by the flow of fluid through said system is automatically regulated by variations of pressure in said refrigerating-coil acting upon said diaphragm, substantially as described.

4. In a refrigerating system and in combination, a gas-compressor, a cooling-jacket surrounding said compressor, a circulatory pipe system leading into said compressor, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber and means automatically operated by variations of pressure in said refrigerating-coil for regulating the supply of water to said cooling-jacket, substantially as described.

5. In a refrigerating system and in combination a gas-compressor, a cooling-jacket surrounding said compressor, a condenser, a pipe leading from said cooling-jacket to said condenser, a circulatory pipe system leading into said compressor, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber and means automatically operated by variations of pressure in said refrigerating-coil for regulating the supply of water to said cooling-jacket and condenser, substantially as described.

6. In a refrigerating system and in combination, a gas-compressor, a cooling-jacket surrounding said compressor, a circulatory pipe system leading into said compressor, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber, a feed-pipe leading to said cooling-jacket, an automatic valve in said feed-pipe and a tube connecting said refrigerating-coil with said valve whereby the supply of water to said cooling-jacket is automatically regulated by variations of pressure in said refrigerating-coil, substantially as described.

7. In a refrigerating system and in combination, a gas-compressor, a cooling-jacket surrounding said compressor, a condenser, a pipe leading from said cooling-jacket to said condenser, a circulatory pipe system leading into said compressor, an expansion-valve in said system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve converted into a refrigerating coil or chamber, a feed-pipe leading to said cooling-jacket, an automatic valve in said feed-pipe and a tube connecting said refrigerating-coil with said valve whereby the supply of water to said cooling-jacket and condenser is automatically regulated by variations of pressure in said refrigerating-coil, substantially as described.

8. In a refrigerating system and in combination, a gas-compressor, a circulatory pipe system leading into said compressor, a cooling-jacket surrounding said.compressor, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve is converted into a refrigerating coil or chamber, means interposed between said compressor and said expansion-valve for automatically regulating the flow of fluid through said system and means for automatically regulating the flow of water for cooling and condensing the refrigerating-gas, both said means being connected with and operated by variations of pressure in said refrigerating-coil, substantially as described.

9. In a refrigerating system and in combination, a gas-compressor, a circulatory pipe system leading into said compressor, a cooling-jacket surrounding said compressor, an expansion-valve in said pipe system whereby expansion of the contained fluid is permitted and the portion of said pipe system beyond said valve is converted into a refrigerating coil or chamber, an automatic valve interposed between said compressor and said expansion-valve for regulating the flow of fluid through said system and an automatic valve for regulating the flow of water for cooling and condensing the refrigerating-gas, both said valves being connected with and operated by variations of pressure in said refrigerating-coil, substantially as described.

10. In refrigerating apparatus the combination with a compartment of an expansion-chamber within said compartment, valve mechanism for controlling the entrance of fluid to said expansion-chamber, an exhaust-pipe leading from the expansion-chamber, a pump connected to said exhaust-pipe, a regulator also connected to said exhaust-pipe, a condenser, a tank in which said condenser is located, means for supplying water to said tank, a valve in the water-supply means and devices controlled by the regulator for actuating said valve.

11. A refrigerating system comprising a gas-compressor, an expansion coil or chamber, a pipe adapted to convey refrigerating fluid to said expansion-coil, a pipe adapted to convey water to cool and condense the gas, valves in each of said pipes and an integral means acting simultaneously and equally upon said valves whereby the flow of refrigerating-gas and the flow of water may be stopped and started automatically and at substantially the same time.

12. A refrigerating system comprising a gas-compressor, an expansion coil or chamber, a pipe adapted to convey refrigerating fluid to said expansion-coil, a pipe adapted to convey water to cool and condense the gas, diaphragm-valves in each of said pipes the diaphragm-chambers of said valves being connected to the same portion of a pipe system and means acting simultaneously upon said valves through said pipe system whereby the flow of refrigerating-gas and the flow of water may be stopped and started automatically and at substantially the same time.

13. A refrigerating system comprising a gas-

compressor, an expansion coil or chamber, a pipe adapted to convey refrigerating fluid to said expansion-coil, a pipe adapted to convey water to cool and condense the gas, valves in each of said pipes operatively connected to a single fluid-container so as to be equally subject to variations of pressure therein and thermostatically-controlled means for varying the pressure in said container whereby the flow of refrigerating-gas and the flow of water may be stopped and started automatically and at substantially the same time.

14. A refrigerating system comprising a gas-compressor, an expansion coil or chamber, a pipe adapted to convey refrigerating fluid to said expansion-coil, a pipe adapted to convey water to cool and condense the gas, valves in each of said pipes and connected with said expansion-coil whereby a variation of pressure in said coil caused by the starting or stopping of said compressor acts to open or close said valves at substantially the same time.

15. A refrigerating system comprising a gas-compressor, a compartment, an expansion coil or chamber in said compartment, means operated by a thermostat in said compartment for starting and stopping said compressor, a pipe adapted to convey refrigerating fluid to said expansion-coil, a pipe adapted to convey water to cool and condense the gas, valves in each of said pipes and connected with said expansion-coil whereby a variation of pressure in said coil caused by the starting or stopping of said compressor acts to open or close said valves at substantially the same time.

WILLIAM F. SINGER.

Witnesses:
GEO. L. COOPER,
B. G. JONES.