

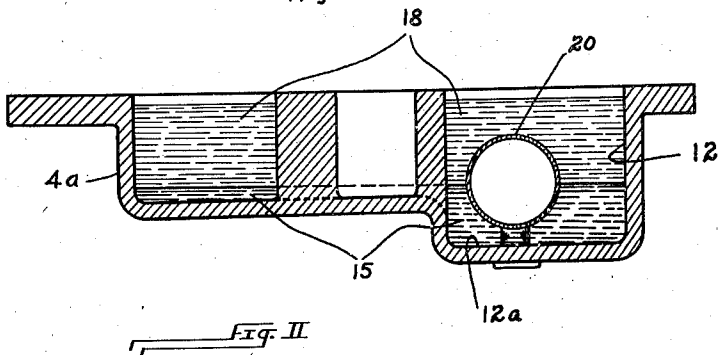
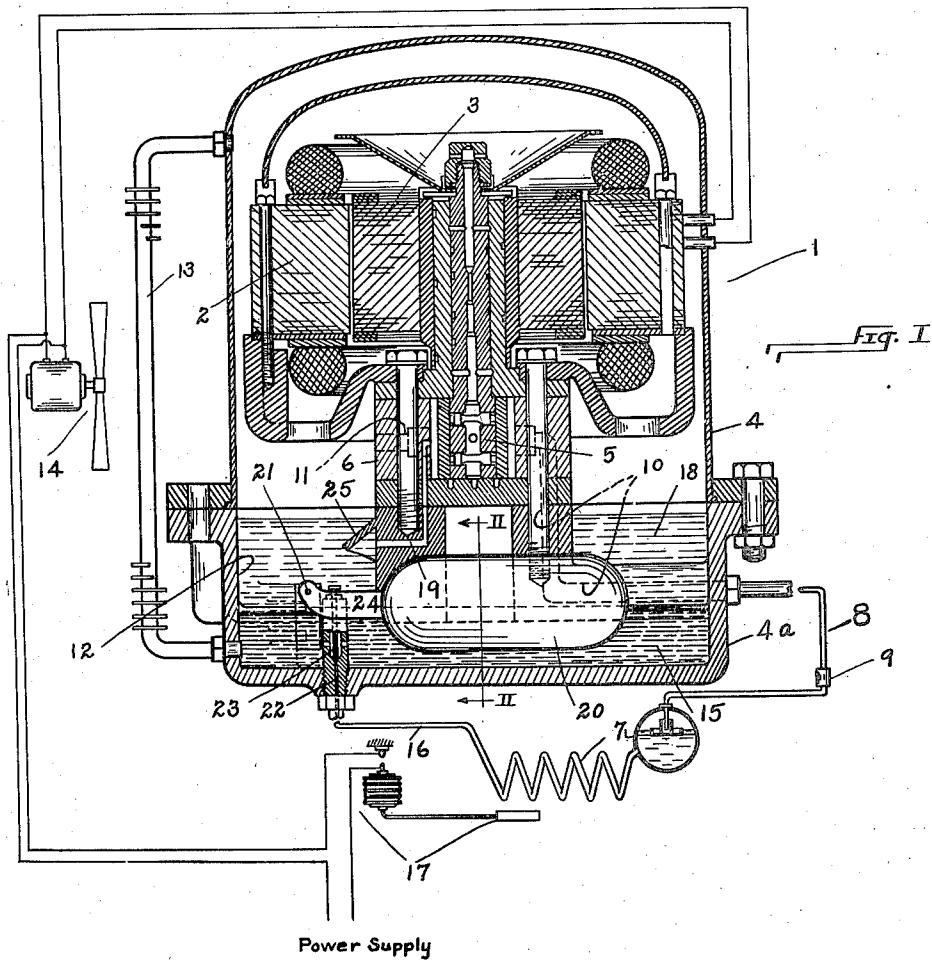
**July 14, 1936.**

F. H. STIENING

2,047,753

# REFRIGERATING APPARATUS

Filed Aug. 3, 1934



INVENTOR  
*Frank H. Steining*  
BY *Christy and Wharton*  
ATTORNEYS

## UNITED STATES PATENT OFFICE

2,047,753

## REFRIGERATING APPARATUS

Frank H. Stiening, Mount Lebanon, Pa., assignor  
of one-half to Elmer A. Hamburg, Pittsburgh,  
Pa.

Application August 3, 1934, Serial No. 738,225

3 Claims. (Cl. 62—115)

My invention relates to refrigeration, and more particularly is directed to refinements in refrigerating apparatus of the compression type.

Refrigerating apparatus of the sort with which I am primarily concerned includes in brief a motor-driven pump, a refrigerant, a condenser, an evaporator, a thermostatic control device, an expansion valve or a float valve, and a check valve. In service the pump compresses the refrigerant in gaseous state, and feeds it into the condenser, in which it is liquefied; subject to the control of either an expansion valve or a float valve, the liquid refrigerant is introduced into the evaporator; in the evaporator the refrigerant vaporizes, with the consequence and effect that heat is abstracted from the surrounding atmosphere and the desired refrigerating effect is produced; and the vaporized or gasified refrigerant is drawn from the evaporator, through the check valve, and into the pump. Thus, the refrigerant flows through a cycle; the operation of the apparatus is automatic, and, excepting the intermissions effected in known manner by the thermostatic control device, the operation is continuous.

Ordinarily the compression of the refrigerant is effected by a reciprocating pump, or a pump of the rotary vane type, and it has been realized, hitherto, that advantageously such pump and its propelling electric motor may be enclosed in a hermetically sealed casing or dome. Characteristically, the pump requires a relatively rapid circulation of lubricating and sealing oil, and to this end it has been the practice to provide an oil reservoir or sump in the sealed dome. During operation there is, within the dome, a continuous circulation of oil from the reservoir, through the pump, and back to the reservoir, and, in some cases, the passage of the oil from the pump to the reservoir is by way of external cooling coils or the like. The gasified refrigerant flowing from the evaporator is drawn immediately into the pump; the pump compresses the refrigerant and discharges it in gaseous state and at super-atmospheric pressure into the chamber of the dome lying above the oil reservoir, whence the refrigerant flows into the condenser; in the condenser the refrigerant is liquefied, and then fed by a return pipe into the reservoir, already mentioned. And from this reservoir the refrigerant, under the relatively high pressure existing in the dome, flows to the evaporator, subject, of course, to the flow regulation of an expansion valve or a float valve. The liquid refrigerant is of different specific gravity than the pump-lubricating

oil, and naturally the two liquids stratify in the reservoir, whereby it is possible to withdraw the oil and liquid refrigerant in independent streams. The refrigerant may comprise sulphur dioxide, which has a specific gravity of approximately 1.4 when in liquid state, and the lubricant may comprise a highly refined, colorless mineral oil of approximately .90 specific gravity. All this is known practice.

It is further common practice among some manufacturers to employ an expansion valve for the regulation of refrigerant flow into the evaporator. Certain objections, however, are found in such use of an expansion valve. For example, an expansion valve essentially is a relatively costly instrument—delicate and liable to failure. Frequently, an expansion valve will "stick" in service, allowing too much refrigerant to flow into the evaporator coils, in consequence of which the suction line of the compressor becomes frosted. Furthermore, the expansion valve essentially is mounted in the open, upon or adjacent the evaporator, and, accordingly, a truly sealed system cannot be obtained, since the valve necessarily includes gaskets, screwed unions, soldered unions, or other types of unions subjected to the open atmosphere and tending to leak. Additionally, in the use of an expansion valve, the evaporator coils are only partly filled with liquid refrigerant—the so-called dry system—and manifestly the heat exchange efficiency of the evaporator is correspondingly low, substantially as the efficiency of a boiler is low when its tubes are only partially filled with water.

Among other manufacturers it is the practice to use a float valve device for regulating the flow of refrigerant. The usual float valve device includes a container which is sealed in the feed line of the evaporator; in this container a pool of liquid refrigerant is maintained, and a float, responsive to the level of the pool, controls an outlet communicating with the evaporator. Manifestly, such structure admits of an absolutely sealed, economical construction; the float valve operates with the evaporator flooded or fully charged with liquid refrigerant, and eliminates the objections and difficulties attending the use of an expansion valve. Unfortunately, however, there is a tendency for the float valve to become "gas bound"; that is, in service it often happens that non-condensable gases collect in the float valve chamber and condenser, and restrict the flow of refrigerant into the float valve chamber, so that the float is prevented from functioning in its intended capacity.

Contrary to such practice, I organize the means for controlling the flow of refrigerant to the evaporator in immediate association with the motor-compressor unit, in such manner that the above-noted objections are eliminated. And in consequence of such organization, together with certain refinements to be described, I obtain substantial economies in the construction and operation of refrigerating apparatus.

In the accompanying drawing, Fig. I illustrates, partly in vertical central section and partly in side elevation, a motor-compressor unit embodying the invention; the inlet and exhaust ports and passages of the unit are indicated schematically, and, for purposes of illustration, the refrigerating elements ordinarily combined with the unit are indicated diagrammatically on smaller scale. Fig. II is a sectional view of the base of the unit, as it appears on the plane II—II of Fig. I.

Referring to Fig. I, the reference numeral 1 indicates in general a sealed motor compressor unit. In accordance with usual practice alluded to, an electric motor, including a stator 2 and rotor 3, is mounted within a dome or casing 4, and is adapted to drive the rotor 5 of a compressor or pump 6. Under the action of the pump 6, the gaseous refrigerant ( $\text{SO}_2$ ) is drawn from the evaporator 7, through suction line 8, check valve 9, inlet passage 10, and into the pump. The pump compresses the refrigerant and discharges it in gaseous state through port 11 and into the interior of the dome 4. Upon entering the dome 4, the compressed gaseous refrigerant passes into the upper end or portion of a condenser 13, which is pneumatically cooled, by a fan 14, or by natural draft. The refrigerant is liquefied in the condenser 13, and then it flows into a reservoir or sump 12, providing a pool 15 of liquid  $\text{SO}_2$ . In regulated amounts the liquid refrigerant is fed from the pool 15 and into the supply pipe 16 of the evaporator 7. Upon entering the evaporator the refrigerant vaporizes and abstracts heat from the atmosphere surrounding the evaporator, thereby producing the desired refrigerating effect. In known manner a thermostatic control device 17, responsive to the temperature of the evaporator, or of the atmosphere surrounding the evaporator, is effective automatically to control the energizing of the fan 14 and motor 2, 3, whereby the desired temperature of the refrigerated atmosphere is automatically maintained.

A continuous circulation of lubricant is required during the operation of the rotary compressor 6, and to this end a pool 18 of lubricant is provided in the sump 12. As has been above indicated, the lubricant may comprise a colorless mineral oil of approximately .90 specific gravity, while the liquid  $\text{SO}_2$  has a specific gravity of 1.4. Accordingly, the two liquids stratify—the oil pool 18, of course, lying upon the pool 15 of liquid  $\text{SO}_2$ . It so happens that the two liquids are more or less soluble in one another, the degree of solubility being variable with pressure and temperature. Accordingly, the upper pool 18 more accurately may be said to comprise an oil-rich body, and the lower pool 15 an  $\text{SO}_2$ -rich body.

Lubricant from the upper pool 18 flows through a passage 19 into the compressor, and in known manner serves to lubricate the moving parts of the motor and compressor. The lubricant is drawn between the relatively moving parts of the unit, and "seals" the compression chamber of the compressor, whence it is fed back to the

pool 18. It may be remarked that the relative positions of the passages 10, 11, and 19 circumferentially of the compressor chamber, have been conventionally modified for purposes of illustration in the drawing.

Advantageously, the feeding of liquid refrigerant to the evaporator 7 is controlled by means of instrumentalities organized within the dome 4, and advantageously such instrumentalities include a float 20 mounted on an arm 24 in the reservoir to swing in vertical plane about a pivot 21. While the float is naturally affected by the compound effect of the buoyancies of the two bodies of liquid 15, 18, it is so constructed as to be more responsive to the level of the  $\text{SO}_2$ . That is, I so design the float that it sinks or submerges in the oil-rich liquid 18 and rides or floats on the  $\text{SO}_2$ -rich liquid 15, with the consequence and effect that, regardless of the depth of the oil-rich stratum, the float will rise and fall with the raising and lowering of the level of the  $\text{SO}_2$ -rich stratum.

The passage 22 for feeding liquid  $\text{SO}_2$  to the evaporator includes a valve—conveniently a needle valve 23—which is so organized with the float 20 that, as the float 20 rises and falls, the valve is opened and closed. Accordingly, the feeding of refrigerant to the evaporator is automatically controlled and harmonized with the functioning of the other elements of the apparatus. Clearly, such structure cannot become gas bound in service.

In accordance with my invention I provide in the reservoir of the above-described apparatus a depressed region 12a (Fig. II), whereby, in the region wherein the float 20 is operable, the liquid  $\text{SO}_2$  is concentrated, or of greater depth and of more buoyant effect than elsewhere. Thus, the quantity of refrigerant required is minimized, while the effective buoyancy upon the float is concentrated, providing more accurate operation of the valve 23 in keeping the evaporator 7 flooded with liquid refrigerant.

I contemplate that the motor-enclosing walls of the dome 4 may be formed of metal of high conductivity and may be so extended in area that all of the compressed gaseous refrigerant discharged by the compressor 6 may be condensed within the dome, thereby eliminating auxiliary external condensing means, such as are indicated at 13. In any case, however, much of the compressed refrigerant condenses immediately upon leaving the compressor, and rains upon the pool 18 of lubricant. These globules of liquid  $\text{SO}_2$  slowly sink through the pool 18 and find their kindred pool 15. The liquid  $\text{SO}_2$  is of little or no value in sealing the pump, and for this reason it is desirable that as little as possible of the  $\text{SO}_2$  small enter the compressor with the lubricant, and thereby reduce its efficiency. I have observed a tendency for the precipitated liquid  $\text{SO}_2$ , sinking through the pool 18, to be entrained with the lubricant entering the passage 19, and this accounts for the fact that in many cases the compressor efficiency is lower than it should be. Advantageously, I provide a shed 25, or other inlet-guarding means, over the mouth of passage 19, whereby the  $\text{SO}_2$  globules sinking through the oil-rich pool 18 in the vicinity of such mouth are deflected. Accordingly, the liquid entering the passage 19 is relatively free from  $\text{SO}_2$ , and so far as possible conditions of operation are maintained uniform and efficient.

It may be remarked that the lubricant which is carried with the  $\text{SO}_2$ -rich liquid into the 75

evaporator 7 is returned to the unit 1 by means of instrumentalities well-known to the art, and it is considered unnecessary to involve the present specification with these and other details of common knowledge.

I claim as my invention:

1. In refrigerating apparatus including in unit assembly within a sealed casing a motor, a compressor, a reservoir including a lower stratum of liquid refrigerant and an upper stratum of lubricant, a passage for leading lubricant from said upper stratum to said compressor, a passage for leading refrigerant from said lower stratum, a valve controlling said last-mentioned passage, and a float responsive mainly to the level of said lower stratum for operating said valve; the combination of means for protecting the mouth of said first-mentioned passage from precipitated quantities of refrigerant that tend, as described, to entrain with the lubricant flowing into said passage, and a depressed region in said reservoir for concentrating the body of liquid refrigerant beneath said float.
2. In refrigerating apparatus including in unit assembly within a sealed casing a motor, a compressor, a reservoir including a lower stratum of liquid refrigerant and an upper stratum of lubricant, a passage for leading lubricant from

said upper stratum to said compressor, a passage for leading refrigerant from said lower stratum, and a valve controlling said last-mentioned passage; the combination of a float pivotally mounted and angularly movable in response to variations in the level of said lower stratum for operating said valve, and a depressed region in said reservoir affording clearance for the angular movement of said float, while providing a concentration of the liquid refrigerant effective upon the float.

3. In refrigerating apparatus including in unit assembly within a sealed casing a motor, a compressor, a reservoir including a lower stratum of liquid refrigerant, and an upper stratum of lubricant, a lubricant passage leading from said upper stratum to said compressor, a refrigerant passage leading from said lower stratum, a valve controlling said refrigerant passage, and a float for controlling said valve; the combination of means co-operating with the entrance of said lubricant passage (below the surface of said upper stratum and above said lower stratum) for inhibiting precipitated refrigerant, as it rains upon and settles through said upper stratum, from entering said lubricant passage.

FRANK H. STIENING.