P. FISCHBACHER.

COMPRESSOR FOR REFRIGERATING MACHINES.

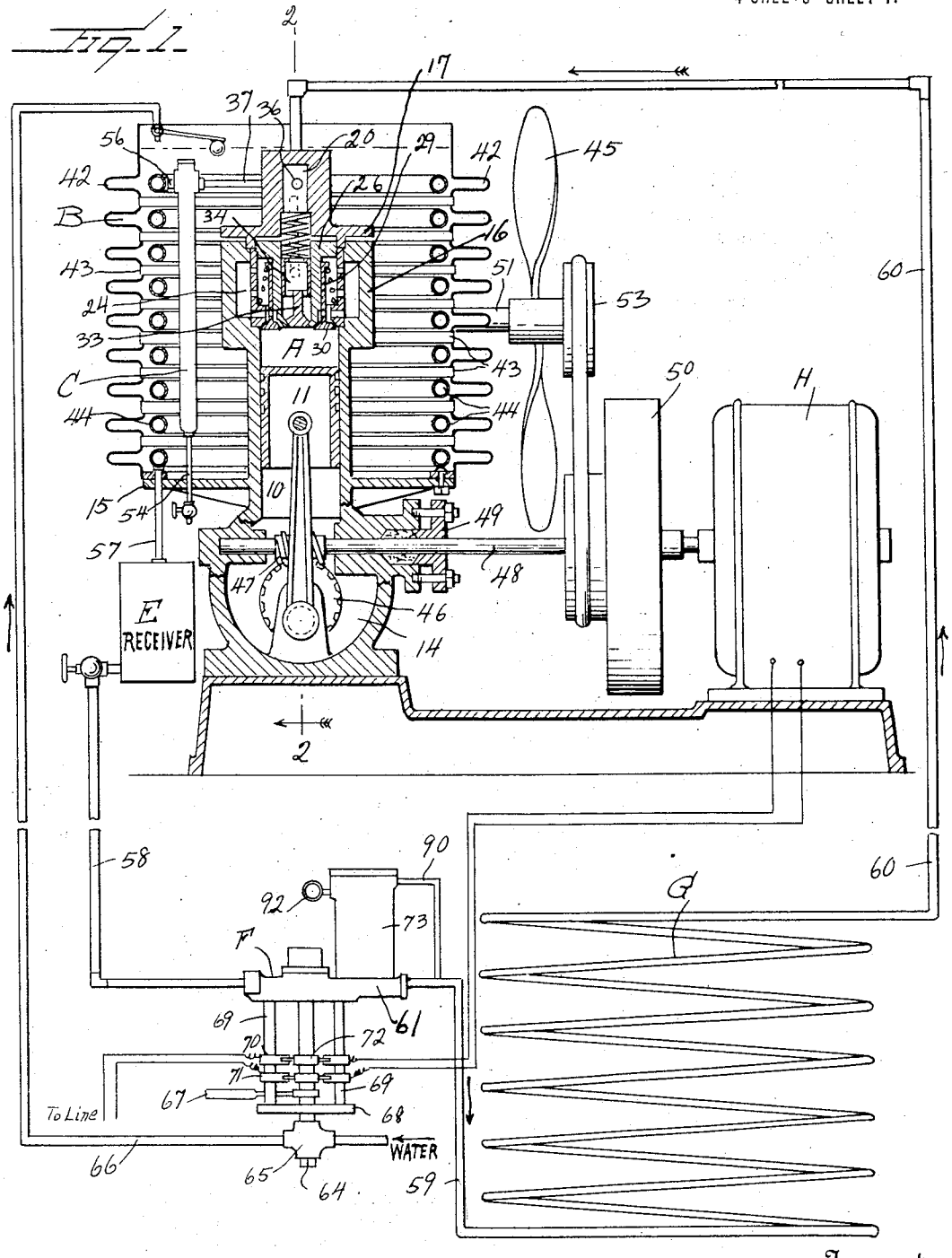
APPLICATION FILED JULY 30, 1919.

1,360,910.

Patented Nov. 30, 1920.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

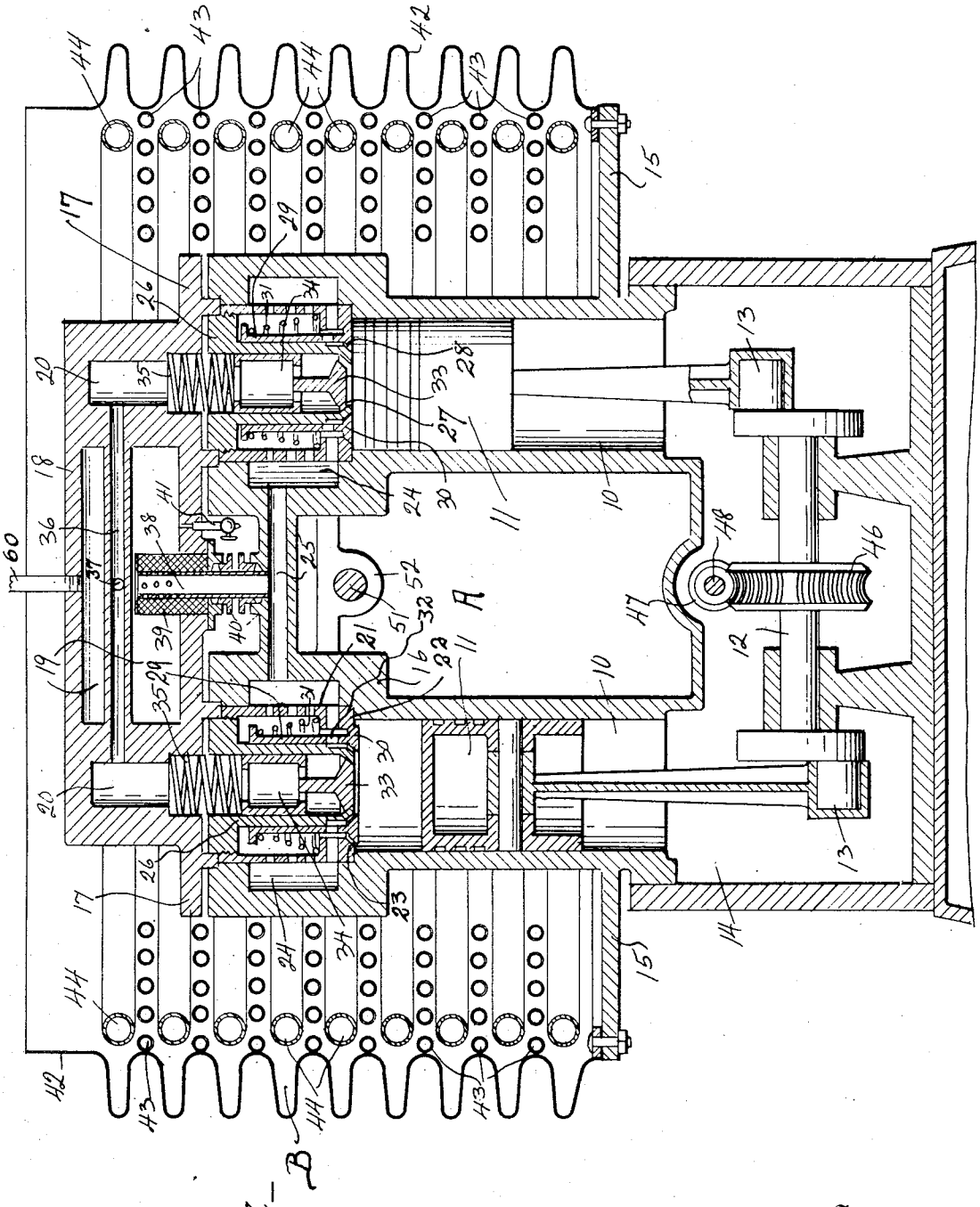


FIG. 2.

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4 SHEETS—SHEET 3.

Fig. 3.

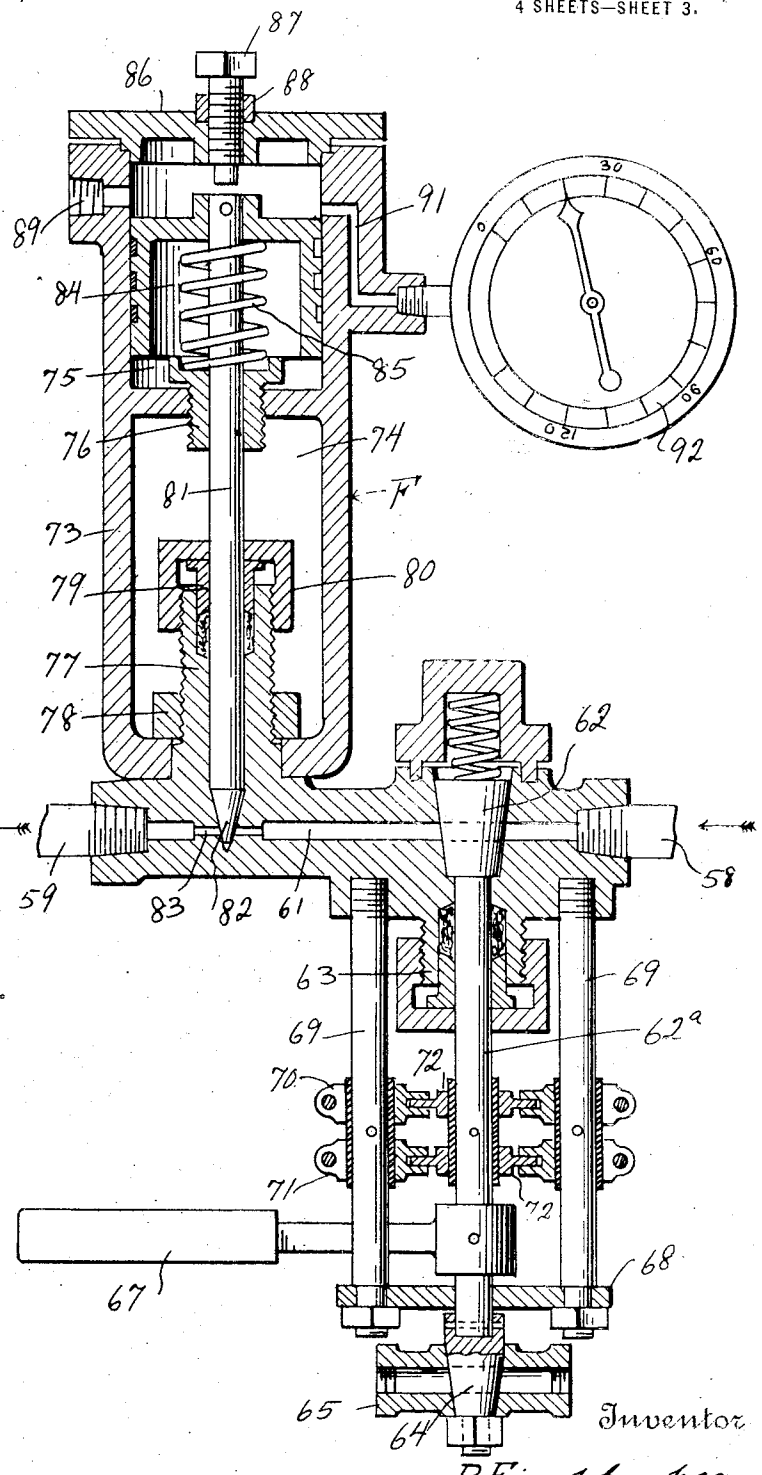
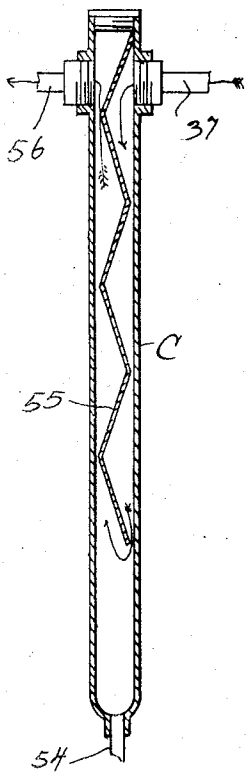


Fig. 4.



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4 SHEETS—SHEET 4.

Fig. 8.

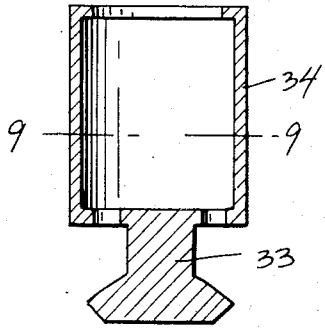
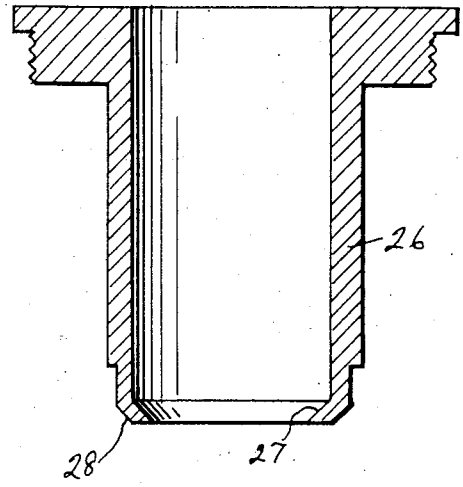


Fig. 6.



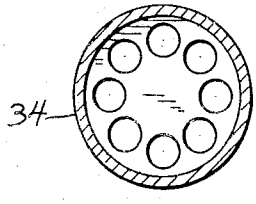
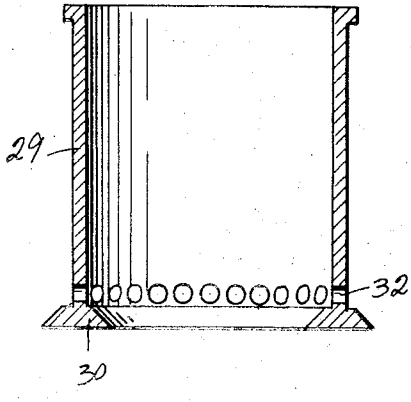
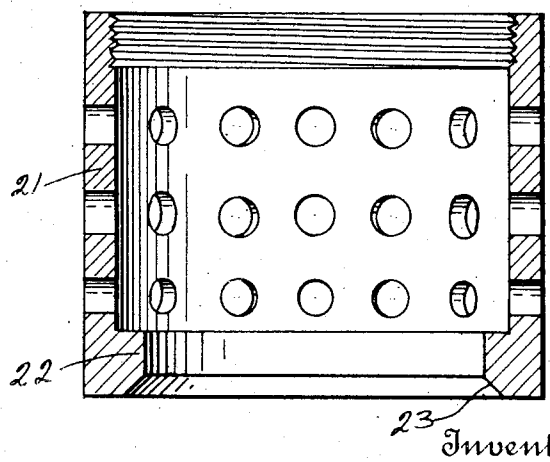


Fig. 9.

Fig. 5.

Fig. 7.





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UNITED STATES PATENT OFFICE.

PHILIP FISCHBACHER, OF QUINCY, ILLINOIS, ASSIGNOR TO AMERICAN SANITARY REFRIGERATION CO., OF OWENSBORO, KENTUCKY, A CORPORATION OF DELAWARE.

COMPRESSOR FOR REFRIGERATING-MACHINES.

1,360,910. Specification of Letters Patent. Patented Nov. 30, 1920.

Application filed July 30, 1919. Serial No. 314,222.

To all whom it may concern:

Be it known that I, PHILIP FISCHBACHER, a citizen of the United States, residing at Quincy, in the county of Adams and State of Illinois, have invented certain new and useful Improvements in Compressors for Refrigerating-Machines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to refrigerating machinery, and particularly to that form of refrigerating machinery wherein an element under pressure is allowed to expand within the refrigerating coils, and is then withdrawn therefrom to a compressor and is compressed therein, and then condensed, and then passes back through the expansion or refrigerating coils.

One of the objects of this invention is to improve the construction of the condenser whereby the gas is condensed after leaving the compressor, and particularly to provide means whereby the cooling water within the condenser may be kept cool by the passage of air through cooling tubes passing through the water and by the aid of fins forming part of the water containing tank.

Another object is to provide means for forcing air through these tubes and against the condenser jacket.

A further object is to improve and simplify the compressor, particularly as regards the mechanism for reciprocating the piston and the inlet and outlet valve mechanism.

A further object is to provide in connection with the compressor, an accumulator or accumulating chamber having a cubical content many times larger than the displacement of the piston or pistons of the compressor, whereby any liquid passing over to the compressor from the evaporation or expansion coils may be evaporated, thus preventing the knocking out of the cylinder head and other injuries to the compressor.

And a further object is to provide in connection with the accumulator, means whereby the refrigerating agent may be purified before passing to the compressor.

Another object in this connection is to provide means whereby the accumulator may be blown out, and to provide means whereby the screen used for separating the scale and other solid matters from the refrigerating agent and preventing these foreign matters from passing into the valve chamber of the compressor, can be quickly removed to clean them.

A further object is to provide an improved form of separator between the compressor and the condenser, whereby the oil and other impurities which may be carried over from the compressor to the condenser can be separated from the refrigerating agent and afterward blown out when desired.

Still another object is to provide an automatic expansion regulator controlling the passage of the refrigerating agent to the expansion or refrigerating coils, and so constructed that as soon as the back pressure or evaporating pressure in said coils reaches the desired point, the needle valve controlling the passage of the refrigerating agent to the expansion coils will be closed and that when this evaporating pressure within the expansion coils is reduced beyond a certain amount, the valve of the expansion regulator will again open.

Still another object is to provide an expansion regulator which is provided with a handle operating the valve controlling the passage of the refrigerating agent into the expansion regulator, this handle also operating a valve controlling the passage of water from a source of supply to the jacket of the condenser, and this handle further operating a switch whereby the passage of current to the electric motor running the compressor is controlled.

Other objects have to do with the details of construction and arrangement of parts, as will be hereinafter more fully explained.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is an elevation of a refrigerating system constructed in accordance with my invention, the compressor and the condenser being shown in section;

Fig. 2 is an enlarged transverse sectional view of the condenser and the compressor taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view of the expansion regulator;

Fig. 4 is a vertical sectional view of the separator;

Fig. 5 is a sectional view of the outer valve cage of the compressor;

Fig. 6 is a vertical sectional view of the interior valve cage;

Fig. 7 is a vertical sectional view of the induction valve;

Fig. 8 is a vertical sectional view of the outlet valve; and

Fig. 9 is a section on the line 9—9 of Fig. 8.

Referring to these drawings, particularly to Fig. 1, it will be seen that I have illustrated in this figure a complete refrigerating plant. In these drawings, A designates generally the compressor, B the condenser, C the separator, E the receiver, F the expansion regulator, G the expansion or refrigerating coils, and H the electric motor driving the condenser. It will be seen that I have illustrated a double cylinder compressor, that is a compressor having two parallel cylinders 10. Operating within each cylinder is the piston 11 operated by a double crank shaft 12, having oppositely extending cranks 13 engaging the piston rods. The crank shaft 12 operates within the crank case 14. The cylinder casting rests upon this crank case or is connected thereto in any suitable manner and is provided with the outwardly projecting flange 15. Each cylinder is enlarged at its upper end, as at 16. These upper ends of the cylinders are closed by heads 17 which are cast in one piece, this casting 18 between the heads being formed to provide an accumulator chamber 19. Each head 17 is formed to provide a chamber 20 coincident with the longitudinal axis of the corresponding cylinder.

Disposed within each enlarged portion 16 and resting upon a shoulder formed at the base of this enlarged portion is a cage 21 having an inwardly extending flange 22 at its lower end, and formed upon this lower face with a valve seat 23. The wall of this cage is provided with a plurality of perforations.

The enlarged head 16 forms an annular chamber 24 surrounding the cage 21, and these chambers 24 are connected by a duct or passage 25 extending through the web connecting the enlarged portions of the cylinders. This passage 25, it may be said in passing, is connected to the accumulator chamber 19. Disposed inward of and concentric to the cage 21 is a cylindrical, imperforate cage 26, the upper end of which is enlarged or flanged and exteriorly screw-threaded for engagement with the interior screw-threads on the upper end of the cage 21. The lower end of this cage 26 is downwardly and centrally beveled on both faces to form an inner valve seat 27 and an outer valve seat 28. Disposed exterior to the cage 26 and having a sliding fit therewith is a cylindrical valve 29, whose lower end is flanged or headed, as at 30, to provide a valve proper having oppositely beveled faces coacting with the seats 23 and 28. The upper end of the tubular shank of this valve 29 is flanged, and a spring 31 bears against this flanged end and urges the tubular shank of the valve upward and the valve to its seats. This valve 29 constitutes the inlet valve of the compressor and the cylindrical body or shank of the valve is perforated, as at 32, to permit free passage of gas into the upper end of the cylinder upon the suction stroke of the compressor. Disposed within the annular or cylindrical member 26 is an outlet valve 33 whose lower end is beveled to fit the seat 27, this valve being connected to a hollow, cylindrical body 34, open at its bottom and top and having a sliding fit within the member 26, the valve being held to its seat by a spring 35 in the chamber 20. It will be obvious that upon the downward movement of a piston, the inlet valve 30 will open, permitting the passage of the refrigerating agent from the accumulator 19 into the compressor, and that upon the upward movement of the compressor, this inlet valve will close, and that after the refrigerating agent has been compressed to a certain degree, the outlet valve 33 will open, permitting the passage of the compressed refrigerating agent into the chamber 20. Both of these chambers 20 are connected by a duct or passage 36, which extends through the accumulator chamber 19, and from this duct or passage 36 leads a pipe 37.

Preferably, a screen or filter is disposed between the duct 25 and the accumulator chamber 19 in order to separate the foreign particles from the refrigerating agent, and to this end I have shown a pipe 38 as extending from the duct 25 into the accumulator chamber, this pipe being perforated at its upper end and surrounded by a screen 39. This pipe and screen are removable for cleaning, and leakage is prevented by the stuffing boxes 40. Extending from the accumulator chamber 19 at one side of this pipe 38 is a blow-off valve or cock 41, whereby impurities may be blown out of the accumulator chamber from time to time. It is preferable that the accumulator chamber shall be provided at one side in its wall with a sight glass whereby the interior of the accumulator chamber may be inspected from time to time.

Disposed around one or both of the cylin-

ders is a cooler jacket 42. This jacket is formed of thin, corrugated metal and is riveted or otherwise attached at its bottom upon the flange 15. The side wall of the jacket is very deeply corrugated so as to give a relatively large cooling area, and extending through the interior of the cooling jacket and opening upon the outer face of the cooling jacket are a plurality of thin metal pipes 43, these pipes being open at their opposite ends. Extending spirally around the cylinders of the compressor and submerged within the cooling jacket is a condensing coil 44, and it will be noted from Fig. 1 that the tubes 43 are disposed between these coils to space the coils apart. Mounted in suitable bearings on one side of the compressor is a blower or air propeller 45 which forces cool air positively against the cooling jacket and through the pipes 43 so that constant currents of cold air are being made to continually traverse these pipes 43.

The crank shaft 12 carries thereon a worm wheel 46 which is driven by a worm 47 on a worm shaft 48. This shaft passes through a suitable stuffing box 49 in the crank case 14 and at its outer end is driven by the motor H. This shaft also carries upon it a combined band and fly wheel 50. The air propeller 45 is mounted upon a shaft 51 which, at its inner end, is supported in bearings 52 formed between the cylinders, and this shaft carries upon it a band wheel 53 to which power is transmitted from the band wheel and fly wheel 50 by means of a belt or in any other suitable manner.

The pipe 37 leads into the separator C, which comprises a vertically extending, tubular member closed at its upper end and having at its lower end a discharge tube 54 provided with a purge valve. The interior of this separator C is divided for a portion of its length into two parts by means of a zigzag plate 55 constituting a baffle wall. This plate extends from the top of the separator nearly to the bottom thereof, and the upper end of the separator is connected to the upper end of the coil 44 by means of a pipe connection 56. The separator C, of course, is designed for the purpose of separating oil from the refrigerating agent and operates in the usual manner. Thus oil and other impurities may be removed from the separator by blowing out through the pipe 54.

A pipe 57 leads from the lower end of the coil 44 to the receiver E and from the receiver extends a valved pipe 58 which opens into the expansion regulator F, which will be later described. From the expansion regulator leads a pipe 59 leading to the expansion or refrigerating coils G, and from these coils extends a pipe 60 which discharges into the accumulator 19.

The expansion regulator is designed to automatically control the passage of the condensed refrigerating agent from the pipe 58 into the expansion coil and to be controlled by the evaporation pressure or back pressure within the expansion coils. The expansion regulator comprises a tubular body 61 whose inlet end is connected to the pipe 58 and hence to the receiver E, and whose outlet end connects by pipe 59 to the expansion coils. Disposed within this tubular body and adjacent its inlet end is a rotatable cut-off valve 62 having a stem extending downward through a stuffing box 63 formed on the body 61, and this stem at its lower end carries a rotatable valve or cock 64 carried within a valve casing 65 forming part of the pipe connection 66 by which water is conducted from a source of water to the jacket 42 to make up for loss due to evaporation. The valve stem 62^a is provided with a handle 67 whereby it may be rotated, and the valve stem is rotatably mounted in a stuffing box 63 at one end and at the other is rotatably mounted in a plate 68 connected to the body 61 by means of longitudinally extending rods 69.

Mounted on these rods are the electric switch terminals 70 and 71 and carried upon the valve spindle 62^a are the rotatable switch elements 72, which coact with the terminals 70 and 71, and which, when they are turned in one position, connect said terminals, and in the other position disconnect them. Suitable conductors lead from the switch terminals 70 and 71 to the electric motor H, and are connected thereto in an obvious manner, and feed conductors lead from a source of energy to these terminals 70 and 71. Thus, it will be seen that when the valve spindle 62^a is rotated a quarter turn, the valve 62 will be opened to permit the flow of refrigerating agent from the receiver E to the expansion coils, the valve 64 will be opened to permit the flow of water from the water supply to the jacket 42, and the motor H will be connected to a source of current.

Mounted upon and forming part of the body 61 is a cylinder 73 formed to provide a lower chamber 74 and an upper chamber 75 separated from each other by an annular web. Disposed in this annular web is a stuffing box 76. The lower end of the chamber 74 is open and the body 61 is provided with a central, upwardly extending hub 77 exteriorly screw-threaded for engagement by a nut 78, this hub being recessed for a gland 79, and there being a cap 80 fitting over this gland and engaging the exterior screw-threads on the hub. The parts 77 to

80 constitute a stuffing box through which passes the rod 81 whose lower end is tapered to form a valve 82 extending through the hub 77, and which may extend across the contracted portion 83 of the central bore of body 61.

For the purpose of shifting the valve 82, I provide within the chamber 75 a piston 84 which is urged upward by means of a compression spring 85 and which is attached to the upper end of the rod 81. The head 86 of chamber 75 is provided with a central screw 87 which may be turned down to limit the upward movement of the piston and is held in its adjusted position by a lock nut 88, this screw providing means for adjusting the expansion valve. Leading into the upper end of the chamber 75 above the piston is a duct 89 connected by a pipe 90 to the pipe 59 and, therefore, connected to the "suction line," and the opposite wall of the chamber 75 is provided with a duct 91 leading from the upper portion of the chamber 75 above the piston and leading to a pressure gage 92 of any ordinary and usual construction.

In practical use, assuming that the valve 62 is open, then as soon as the back pressure or evaporating pressure in the evaporating coils G attains a predetermined degree, this pressure will be transmitted to the oil in the upper portion of the chamber 75 and this oil will force the piston 84 downward against the force of the spring 85, thus causing the valve 82 to close the passage through the body 61, in other words prevent the passage of refrigerant from the receiver E to the expansion coils. When this back pressure is relieved, however, then the spring 85 moves the piston 84 upward a degree depending upon the adjustment of the screw 87, and then the valve 82 permits the passage of refrigerant to the expansion coils. The valve stems and valves of the automatic expansion regulator are made of non-corrosive metal, and self-lubricating metal packing is used for the stuffing boxes 63, 76 and 77 to prevent any sticking or wearing. This construction does away with the use of a diaphragm for controlling the valve 82, which diaphragm has been found to be unreliable. This expansion regulator eliminates danger of explosions and also damage due to overflowing the refrigerating system with liquid and in turning the water on for the condenser, as the refrigerant can not be allowed to flow to the expansion and refrigerating coils without the water cock 64 having also been turned on. It is to be understood that water is only supplied in small amounts to the jacket 42 in order to take care of evaporation, and that there is no necessity of causing cold water to flow through the jacket 42, as the cooling jacket with its tubes or pipes 43 and the fan or propeller 45 takes entire care of condensation of the incoming gases and keeps the water cool for this purpose. A float valve may be used to control the flow of water from the pipe 66 into the jacket.

The operation of this system will be obvious to those skilled in the art. The liquid refrigerant runs from the receiver E to the automatic expansion regulator, and from thence into the expansion coils and from there expanded gas is drawn up in the accumulating chamber 19, thence into the pressure cylinders. The cylinders discharge the gas into the separator wherein oil and other impurities are separated, and from thence it passes into the cooling coil 44 of the condenser, from which condensed gases flow as a liquid into the receiver, thus completing the cycle of operation.

It is to be particularly noted that the accumulator chamber 19 is many times larger than the displacement of the pistons. The discharge from pipe 60 runs through this accumulator chamber and in its passage through the accumulator chamber all liquid refrigerant which may be carried over from the low pressure or expansion side is evaporated. This prevents the knocking out of the cylinder heads and other injuries to the compresser. Furthermore, this evaporation acts to purify the refrigerating agent and thus a continuous purifying action takes place when the system is in operation.

It is also to be pointed out that the outside valve cage 21 has a relatively large area and that there is a large inlet surface formed by the double seated inlet valve 30, and that the large area in the accumulator and the large area outside the valve cage 21 and the large inlet surface of the double seated valve, permits the compressor to have an extremely high speed with the cylinders always filled with pure gas for discharge. Therefore, I secure a relatively great efficiency from a relatively small and cheap machine, using considerably less power and less water.

It will be understood that in the accumulating chamber 19, the cold incoming gases accumulate and the discharge gases flow through this accumulating chamber by the pipe 36. The discharge gases raise the temperature of the accumulating gases in chamber 19 and thus separate the liquid and other foreign matters which would be otherwise drawn over onto the low pressure side of the system. The pure ammonia vapor passes through the inlet port in the cylinder upon the down stroke of the piston and the unevaporated liquid which can not pass through the filler 39, collects in the bottom of the accumulator until blown out through valve 41, and this accumulator or accumu-

lating chamber is made large so that the liquid which collects in the bottom of the chamber can have the ammonia therein evaporated therefrom without the liquid passing over into the inlet pipe.

The concentric valve mechanism which I have illustrated is particularly valuable as the suction valve, that is the valve 30, is the most important valve on a refrigerating machine. This suction valve must have a very large area on a high speed machine in order to fill the cylinder full of gas. The suction valve seat is relatively wide and has a diameter nearly that of the bore of the cylinder, and the suction valve has a larger bearing or guide portion 29 than is possible with an ordinary puppet valve. Therefore, not only this, but a larger, more flexible spring can be used and a quicker opening and closing can be secured, therefore an extremely high speed can be developed with less cost than is possible in the old type of puppet valve.

The water supply valve 64 is to compensate for loss of water from the jacket by evaporation or from other causes. The water level in this jacket is kept above the accumulator chamber 19. Of course, the object of the zigzag separator plates 55 is to secure the greatest possible area for separating impurities of the discharge gases. These inclined plates tend to impede the movement of the foreign particles without impeding the movement of the fluid passing through the separator.

I claim:—

1. In refrigerating machinery, the combination with a compressor having a compressor cylinder, a piston operating therein, and inlet and outlet valves therefor, of an accumulating chamber, an outlet pipe leading from the accumulator chamber and perforated therein, a screen disposed around the perforated end of the outlet pipe, and a blow-off valve opening from the accumulator chamber.

2. A refrigerating machine including in combination a pair of compressor cylinders, each cylinder having inlet and outlet valves formed to provide an inlet duct communicating with both cylinders and an outlet duct leading from both cylinders, a crank case upon which the cylinders are mounted, a crank shaft therein having oppositely disposed cranks engaged with pistons in the compressor cylinders, a worm gear carried upon the crank shaft, and a driving shaft having a worm extending into the crank case and engaging said worm gear.

3. A refrigerating compressor including in combination a compressor cylinder enlarged at one end, a piston operating within the cylinder, an annular inlet valve having oppositely beveled faces operating within the enlarged portion of the cylinder, the enlarged portion of the cylinder being formed with double annular seats for said valve, a spring holding said valve closed but permitting the opening of the valve upon the intake stroke of the piston, and a centrally disposed discharge valve yieldingly urged to its seat.

4. A compressor for refrigerating machinery including in combination a compressor cylinder enlarged at one end and having an inlet duct opening into this enlarged end, a piston operating within the cylinder, an annular cage disposed within the enlarged end of the cylinder and having perforated side walls and a beveled under face, an inner, cylindrical imperforate cage concentric to the first named cage but spaced therefrom and defining an outlet passage and formed at one end of said passage with an inwardly inclined, annular valve seat, and exterior of this valve seat with a second downwardly and centrally extending annular valve seat, the first named cage being formed at its lower end with a beveled valve seat, an annular valve having double faces coacting with the two last named valve seats and having a tubular body sliding upon the second named cage, said body being formed with transverse perforations above the valve, a spring urging the last named valve to its seats, a centrally disposed discharge valve slidingly mounted within the second named cage, and a spring urging the discharge valve to its seat.

5. A refrigerator compressor including in combination a plurality of cylinders each enlarged at one end, pistons operating within said cylinders, a common crank shaft for all of said cylinders, a member formed to provide heads for the several cylinders, each head having an outlet chamber, a duct formed in said member and into which all of said outlet chambers discharge, and inlet and outlet valves disposed in the enlarged portion of each cylinder and removable through the ends of said enlarged portions of the cylinders when the member forming the heads of the several cylinders is removed.

6. A compressor for refrigerating machinery including in combination a plurality of cylinders enlarged at one end, pistons operating the cylinders, the enlarged ends of the cylinders being connected by an inlet duct common to all of the cylinders, a member formed to provide heads for each cylinder, each of said heads being formed with an outlet chamber, said member being formed to provide an accumulator chamber connected to the first named duct and adapted to receive refrigerant, and the outlet chambers of the several heads being connected by a duct passing through said accumulator chamber and extending out therefrom.

7. A compressor for refrigerating machinery including in combination a head for the compressor having a centrally disposed outlet duct, an annular inlet duct separated from the outlet duct by an annular wall, an annular wall surrounding the first named wall, said walls at the lower end formed to provide annular, downwardly flaring valve seats, an outlet valve disposed within the first named duct, and an inlet valve having a shank surrounding the first named wall and having at its lower end a double head coacting with the two valve seats, and a spring urging said suction valve to its seats.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

PHILIP FISCHBACHER.

Witnesses:
S. S. DEATHERAGE,
SILAS ROSENFELD.