Oct. 31, 1933. E. O. SMITH 1,932,607

REFRIGERATING SYSTEM

Filed May 7, 1929 3 Sheets-Sheet 1

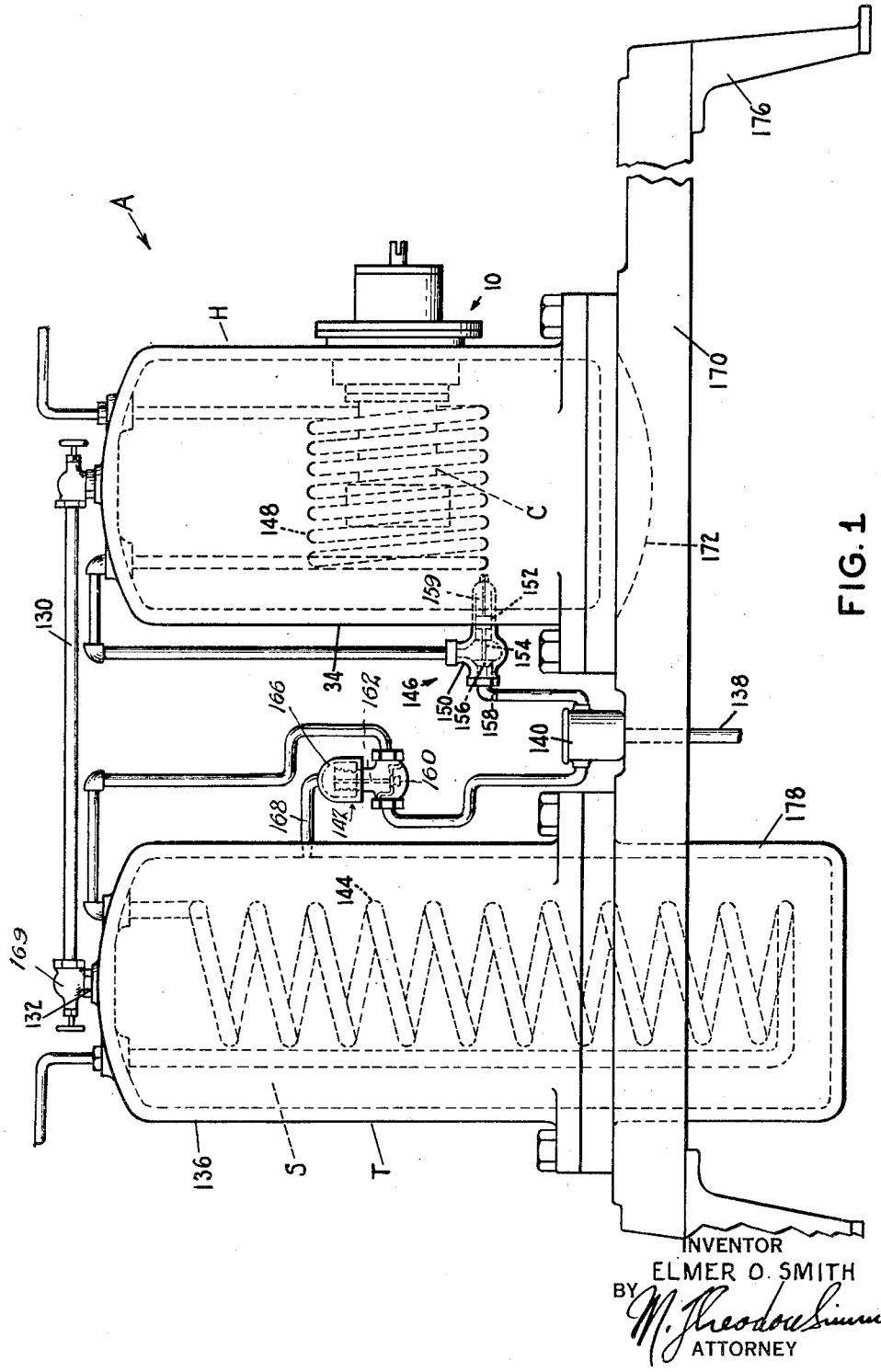

FIG. 1

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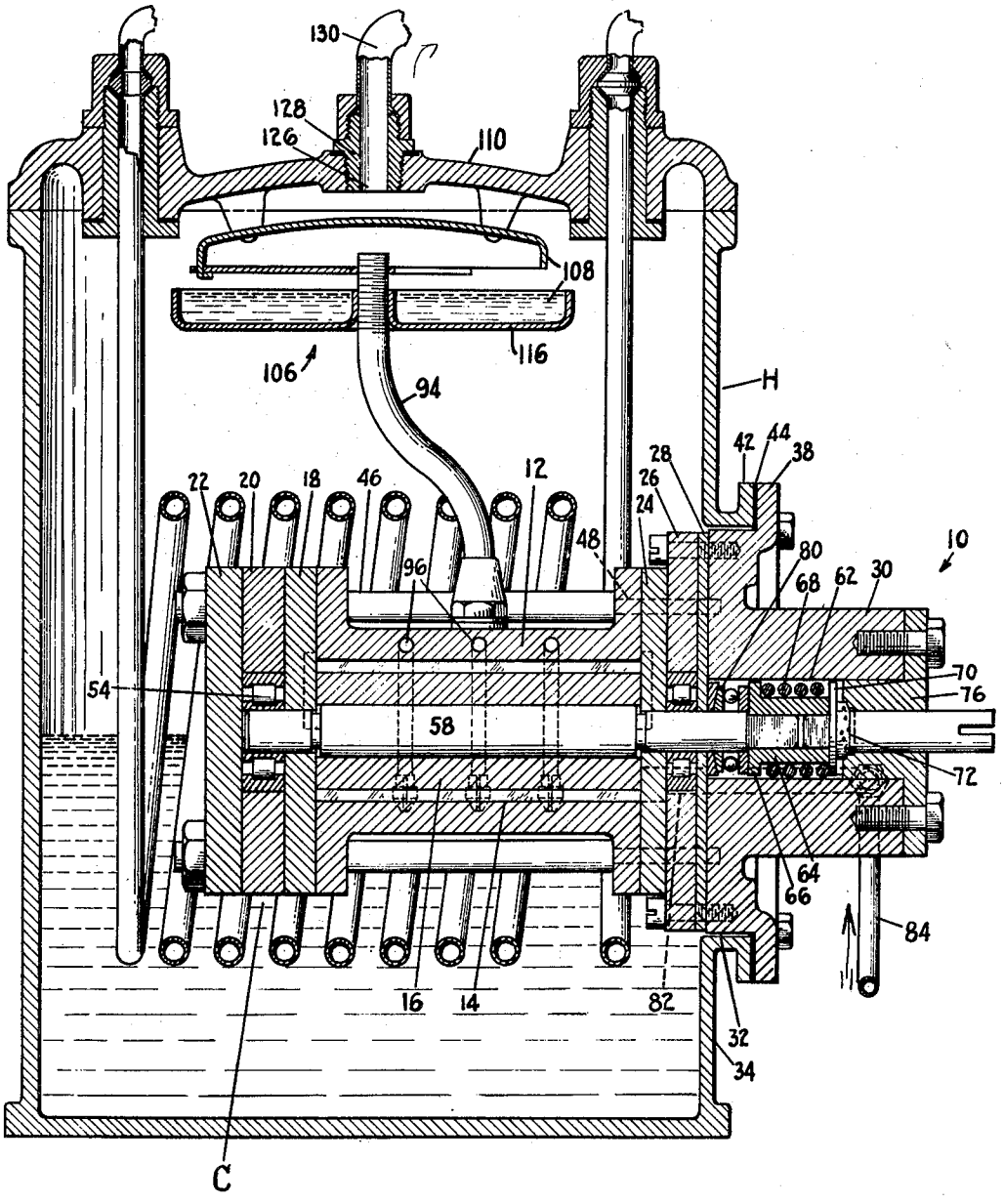

FIG. 2.

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FIG. 3

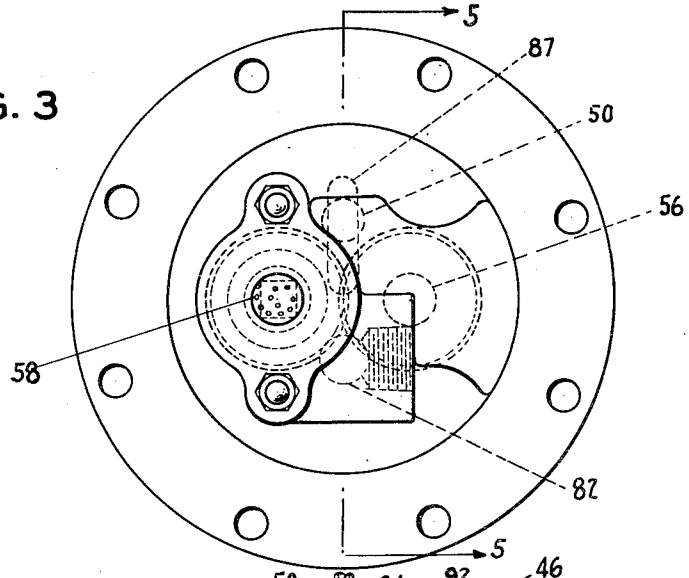


FIG. 4

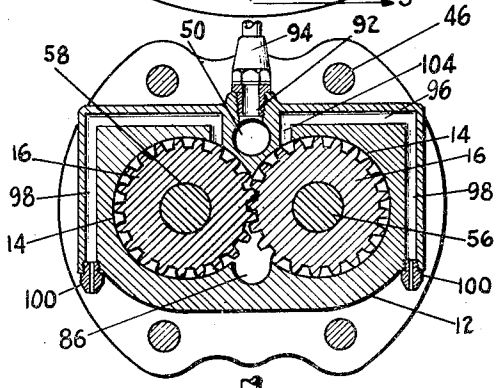
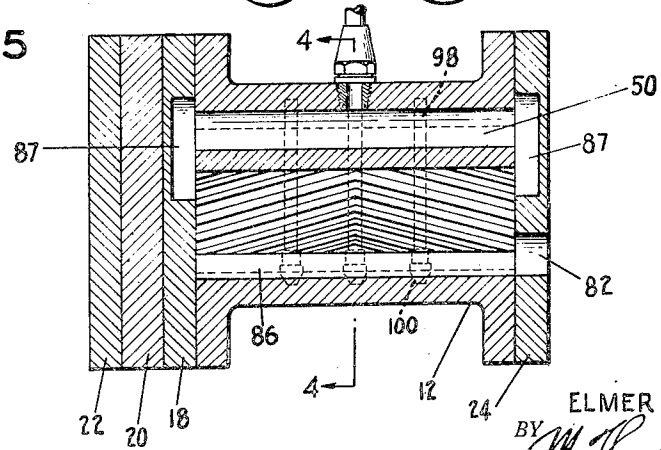


FIG. 5



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1,932,607

REFRIGERATING SYSTEM

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Application May 7, 1929. Serial No. 361,234

8 Claims. (Cl. 62—115)

This invention relates to mechanical refrigeration apparatus, particularly of the compressor type.

The specific invention described herein relates to that class of mechanical refrigerating devices in which a gear pump is used for the compressing operation. In such apparatus, the pump customarily is submerged in a bath of some oil, which is introduced into the pump casing and acts as a seal during the operation of the pump so that efficient compression of the gaseous refrigerant will take place for the purpose of liquefaction. The compressed refrigerant together with entrained oil is discharged from the compressor against a baffle, so that separation of oil and refrigerant takes place, permitting the free gaseous refrigerant to pass to the condenser. In such apparatus a level of oil has heretofore been maintained much above the compressor to insure the necessary sealing of the pump being effected. Likewise, oil has been introduced into the pump at a point much before that at which sealing is necessary, thus raising greater frictional drag on the compressor elements than necessary.

It is one object of this invention to provide in a refrigeration apparatus of the class above indicated a pump or compressor in which a sealing medium, such as oil, is introduced into the compressor at the point approximately where final compression of the gas begins.

It is an additional object of this invention to incorporate, in connection with apparatus of the type above set forth, means for delivering the sealing medium to its point of use, said means being of such construction that the level of sealing liquid maintained about the compressor casing is reduced to a minimum, with consequent advantages and savings.

It is a further object of this invention to arrange cooling means for the sealing liquid and for the compressor above described and control the same in such manner that both will be cooled in the most efficient manner.

It is a still further object of this invention to provide a novel gas seal for the shaft of the compressor, where it extends through a wall of the outer housing, to prevent the escape of refrigerant and at the same time provide a novel means for the lubrication of the bearing for said shaft, and eliminate the necessity for packing.

It is also an object of this invention to provide compartments adjacent each other for the compressor and the condenser respectively with means for cooling each compartment and means for independently controlling the cooling of each compartment.

It is also another object of this invention to provide a compressor and a condenser with means for cooling the same and a dual control for the cooling, namely, a thermostat and a pressure actuated control.

It is also a further object of this invention to provide a sectional condenser housing whereby identically the same mounting structure and other cooperating elements may be used with different capacity refrigerating units and condensers.

In the field to which my machine applies it is highly important to create new economies of construction together with efficiencies in operation to effect savings to manufacturer and purchaser alike as well as to provide fully automatic and fool-proof structures and controls, and it is to such improvements I have directed my attention in producing my improved refrigeration apparatus.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

Certain features of invention, shown and described herein, are shown, described and claimed in my copending application, Ser. No. 361,235, filed May 7, 1929, and are, therefore, not claimed herein.

With the above exception, the invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter described, and of which the scope of application will be indicated in the following claims.

In the accompanying drawings,

Figure 1 is a diagrammatic elevational view of one embodiment of a refrigeration system, into which the invention has been embodied.

Fig. 2 is a fragmentary vertical sectional view through a portion of a refrigeration system showing the arrangement of the compressor thereof, and the embodiment thereinto of features of the invention, a modified form of casing being illustrated.

Fig. 3 is an end elevational view of a portion of the compressor unit, as seen from the right-hand side in Fig. 2.

Fig. 4 is a sectional view, on the line 4—4 of Fig. 5, illustrating the arrangement of the sealing fluid feeding means.

Fig. 5 is a vertical longitudinal sectional view, on the line 5—5 of Fig. 3.

On the drawings, the liquefaction apparatus A is seen to comprise a compressor C, enclosed with-

in a housing H, and a condenser S, enclosed within a housing T, suitably interconnected in the system for operation in the manner hereinafter appearing.

The compressor C is supported from a wall of the housing H, as hereinafter described, and is provided with a novel sealing arrangement for the said compressor, together with a device for the separation of the compressed gaseous refrigerant and the liquid used for the sealing. The compressor comprises a compound cylinder 12, having intersecting bores 14 which are adapted to snugly receive the herring-bone gears 16, in intermeshed relation.

The inner end of cylinder 12 is closed by an outlet plate 18, a bearing plate 20, and the head 22, which are positioned in the order named; at the other end of cylinder 12 are positioned outlet plate 24, bearing plate 26, gasket 28, and head 30. Head 30 fits within an opening 32 in the wall of the casing 34 of the housing H; an outwardly turned flange 38 on said head is secured to the flange 42 formed around the opening 32, a suitable gasket 44 making the joint between said flanges liquid tight. The through bolts 46 retain cylinder 12, plates 18 and 20, head 22, and plates 24 and 26 in assembled position, while the dowel pins 48 locate the outlet plates 18 and 24 with respect to outlet passage 50, located in the casting of cylinder 12.

Suitable roller bearings 54 are provided in the bearing plates 20 and 26, for the shafts 56 and 58 upon which the intermeshing gears 16 are mounted. Shaft 58 of one of gears 16 extends outwardly through outlet plate 24, bearing plate 26, and head 30 and is to be connected with some suitable driving means such as an electric motor (not shown).

Head 30 is formed with an enlarged passage 62, within which is housed a flanged sleeve 64, the flange 66 of which provides one abutment for a coiled spring 68. The other abutment for spring 68 is provided by a collar 70, mounted on shaft 58 so as to be brought into pressure contact with the flat surface of a disk 72 which is loosely mounted on shaft 58. The opposite side of disk 72 is convex so as to cooperate with a concavity in the closure bearing 76, through which shaft 58 extends. The bearing 76 is secured to said head 30 by cap screws cooperating with the flange thereof. The several surfaces are ground for interfitting relation, and the contacting surfaces of collar 70 and disk 72 are ground to closely contact when in running relation.

The shaft 58 is lubricated in any suitable manner and the disk 72 is provided with a plurality of L-shaped pockets extending from both surfaces to the periphery of the disk 72 which pockets collect and distribute oil reaching the socket in bearing 76, and as the flange 66 is pressed against a ball bearing 80, which in turn is pressed against gasket 28 and bearing plate 26, it will be seen that the pressure of the ground surfaces, one against the other, and the contact thus maintained will operate in such manner as to provide an oil tight seal. This results in total elimination of the ordinary wick packing, or the other types of replaceable preliminarily oiled packings, and provides an exceptionally economical construction for accomplishing the desired result.

The foregoing description has been directed to one gear and its assembly, but this may be duplicated for the second gear 16.

A passage 82 is formed by aligned holes in outlet plate 24, bearing plate 26, gasket 28. This passage joins in head 30 with inlet pipe 84, which connects with the evaporator, (not shown), of the refrigerating system. An inlet passage 86 is located in the casing 12 at a position below the surfaces of the intermeshed gears 16, and communicates with passage 82. The gaseous fluid entering recess 82, will be transported by gears 16 to a point closely approximating that of the intermesh of said gears. After the intermesh of the apices of the teeth of said gears, the gaseous fluid will be driven toward the ends of the gear bodies, being compressed by this operation, and delivered into slots 87, in outlet plates 18 and 24 at the position the gear teeth will have reached when full intermesh has occurred. The compressed fluid is then led by means of outlet passage 50 into the upright conduit 92, to which is connected discharge tube 94.

In order to make the action of the compressor pump 10 effective in the handling of the gaseous fluid, some means is necessary to seal the spaces between the teeth of gears 16 and the walls of bores 14. I have found the efficiency of the compressor to be greatly decreased if the compressor gears are required to transport the sealing fluid the major part of the travel of the gears from the inlet to the outlet of the cylinder and that the efficiency is correspondingly increased if the sealing medium is introduced near the outlet opening and just ahead of the point where compression through the meshing of the gears begins. Likewise, I have found the efficiency of the system to be enhanced, as well as continuity of operation to be assured, if the compressor is not submerged and an arrangement is provided to nevertheless introduce the sealing fluid at the point just suggested.

For these purposes, a plurality of ducts 96 are provided, which may be formed in the walls of the cylinder 12, so that a downwardly directed portion 98 of each duct having nozzles 100 inserted therein for controlling the flow of sealing fluid, as hereinafter described. Each duct 96 is connected with a downwardly directed outlet segment 104 which opens into the bores 14 of cylinder 12 at points immediately above the point of intermesh of the gears 16.

Oil, or any other medium, suitable chemically and physically for operation in connection with the fluid to be compressed, is inserted into the casing 34 of housing H, and is brought up to a level substantially higher than that of the lower openings of nozzles 100, and substantially up to the axial center of the shafts 56 and 58. The last mentioned arrangement is not necessary for efficient operation, but is desirable for maintaining a suitable supply of the sealing medium during the operation of the compressor. If a suitable pressure now be applied to the medium contained within housing H, the oil or such like medium will pass up through nozzles 100 into the ducts 96, to be delivered into the outlet segments 104 and then into the bores 14, there to form the necessary seal for the operation of the compressor.

The sealing medium, together with the compressed gaseous fluid, will be discharged through discharge tube 94 against the separating baffles 106. Baffle 106 is formed of a pair of dished members 108, the upper one of which is secured to the under surface of the head 110 of the housing H, which in turn may be secured to the casing 34 in any suitable manner in the form shown in Fig. 2. The lower dished member may be

mounted upon the upwardly extending end of the discharge tube 94, and secured to the upper dished member, appropriate openings being provided between the members.

The mixture of gaseous fluid, sealing medium, and any of the gaseous fluid which may have become liquefied by the compressive action, will be discharged against the upper member 108 and the liquid portions will be separated and received in the lower dished member 108, the gaseous fluid passing out into the interior of the casing 34 of the housing H. Excess sealing medium, accumulating on the lower dished member 116 will overflow into the reservoir formed by casing 34, while any liquefied refrigerant may be evaporated by the heat arising from the compressor and from the accumulated body of sealing medium in the casing 34, to then pass off with the rest of the compressed fluid.

Gases which have been separated from the sealing medium at the baffles 108 will pass outwardly of housing H through an opening 126 in the head 110, at which point any suitable packing gland 128, or the like, may be provided for making a gas-tight connection with the delivery pipe 130. Pipe 130 leads to a corresponding inlet opening 132 in the head 134 of the casing 136 of the condenser S.

The condenser and evaporator are cooled as follows: water or other cooling fluid is led through a main supply pipe 138 to a junction 140, from which point flow is controlled by a pressure controlled valve 142, located in the line leading to a coil 144 within the condenser S, and by a thermostatic valve 146, in the line leading to a coil 148 within the housing H. Coils 144 and 148 are carried by the heads 136 and 34 respectively, in any manner suitable, and in my machine are suspended therefrom. However, while coil 144 may be suspended in the housing T in any suitable manner, coil 148, within housing H, is mounted so that it is substantially concentric with the compressor C, and partially surrounding the same, being thus but partially submerged in the sealing fluid in casing 34, (Fig. 2) to cool the same and maintain the compressor at an efficient temperature.

Since it is desired to reduce the frictional effect of the sealing medium particularly when starting operation, the thermostatic valve 146 is arranged so that it becomes operative when the temperature of the sealing medium is such that efficient operation of the pump will not be interfered with. Thermostatic valve 146 may take any conventional form for this purpose; it is here shown to comprise a chamber 150, having one portion inserted through a wall of casing 34 into the sealing medium. A piston 152, or like device, has attached thereto the stem 154 of a valve member 156, which is adapted to cooperate with seat 158 in the control of the flow of liquid from the supply pipe 138 to the coil 148, in accordance with the movements of the heat responsive element 159 located so as to be subject to the temperature of the sealing medium.

In like manner, the supply to coil 144 is controlled according to the presence of a pressure of predetermined value in condenser S. The operation of the cooling system for the condenser S is thus automatic and assured whenever the compressor supplies gas for the action of the condenser.

Valve 142 may be of any general pressure actuated type suitable for the purposes set forth, and is here shown diagrammatically to consist of a valve member 160, the stem 162 of which is connected to a piston bellows 164, which is movable in a housing 166, a passage 168 from which is connected with the interior of the condenser S.

The valve may be provided with the usual regulator valve 169 for governing the passage of gas to the condenser in accordance with the requirements of the system. Of course, the operation of the system as a whole is controlled by a thermostat, etc., as is well known in this art.

Referring to Fig. 1, compressor housing H and condenser housing T are mounted upon a common base 170 to which the respective housings are bolted. It will be noted in the form in this figure the head and side walls of the compressor housing H have been combined and a shallow base 172 provided which fits into a suitable hole in the base 170.

For certain sizes of installations, such as one ton, it is only necessary to use the upper portion of the condenser housing T shown in Fig. 1 with an appropriate size cooling coil. In this event the condenser housing T is constructed, closed and mounted as shown and described for the compressor housing.

When it is desired to install a two ton plant, for example, or convert a one ton plant to a two ton capacity, with my improved apparatus it is only necessary to install a larger capacity compressor in housing H and to enlarge the condenser S. This is accomplished by mounting the base 170 upon detachable legs 176 and providing a deep base section 178 for the condenser housing T, which base portion is mounted in an appropriate aperture in the base 170 and bolted to the base. Then by providing a larger cooling coil 144, and appropriate adjustments throughout the system, the same is complete and ready for use to fill the larger capacity requirements.

It will thus be seen that there are provided devices by which the several objects of this invention are achieved and which are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In liquefaction apparatus, a compressor, a condenser, a housing for said compressor, cooling means in said housing and for said condenser, and means rendering the cooling means for said compressor inoperative until a predetermined temperature is attained in said housing.

2. In refrigerating apparatus, the combination with a compressor, lubricating and sealing fluid therefor, and a condenser to which the compressor is connected, of cooling means for the fluid and condenser respectively, a thermostat for controlling the operation of the cooling means for one of said elements, and a pressure actuated device for controlling the operation of the cooling means for the other of said elements.

3. In refrigerating apparatus, the combination with a compressor, lubricating and sealing fluid therefor, and a condenser, of cooling means for the fluid and condenser respectively, a thermostat for controlling the operation of the cooling means for the fluid and a pressure actuated device for controlling the operation of the condenser cooling means.

4. In refrigerating apparatus, the combination with a compressor, lubricating and sealing fluid therefor, and a condenser, of a cooling coil for the fluid, a separate cooling coil for the condenser, and means for automatically controlling the admission of cooling medium to each coil independently of the other and operating in accordance with conditions of the fluid and condenser.

5. In refrigerating apparatus, the combination with a housing, a compressor mounted therein lubricating and sealing fluid therefor, and a condenser casing, of a cooling coil for the fluid suspended from said housing, a second cooling coil within the condenser casing and suspended from said casing, a thermostatic valve controlling the admission of cooling medium to the coil in the fluid, and a pressure actuated valve controlling the admission of cooling medium to the condenser coil.

6. In a refrigerating system, the combination with a base, a housing mounted thereon, a compressor mounted in the housing and having an inlet thereto, of a two part condenser housing connected to the discharge from said compressor, said parts being adapted so that one or both thereof may be mounted on said base whereby condensers of different capacities may be mounted upon said base and connected to said compressor, and means for cooling the condenser.

7. In a refrigerating system, the combination with a base having a plurality of apertures therein, a housing mounted thereon, a compressor mounted in the housing and having an inlet thereto, and a bottom plate mounted in one of said apertures and closing said housing, of a condenser housing mounted on said base and connected to the discharge from said compressor, a bottom plate mounted in another of said apertures and closing the condenser housing, a cooling coil for each housing and independent connections from a source of cooling fluid to each of said coils.

8. In a refrigerating system, the combination with a base having a plurality of apertures therein, detachable legs mounted on said base, a housing mounted thereon, a compressor mounted in the housing and having an inlet thereto, and a bottom plate mounted in one of said apertures and closing said housing, of a condenser housing mounted on said base and connected to the discharge from said compressor, a second condenser housing mounted in another aperture in said base and cooperating with the first condenser housing to close the same, a cooling coil for each housing and connections from a source of cooling fluid to each of said coils.

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