

Nov. 7, 1939.

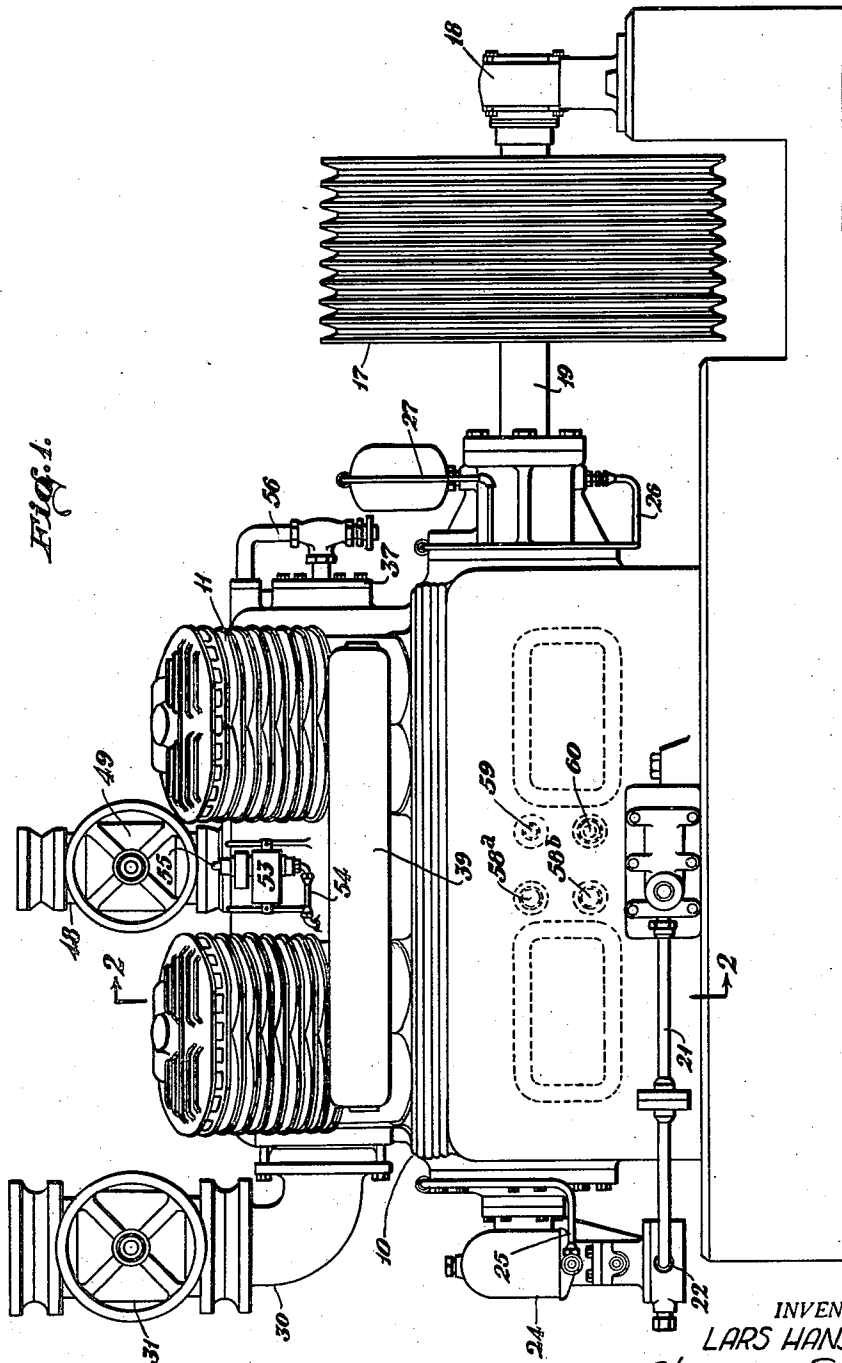
L. HANSON

2,178,662

FLUID COMPRESSOR

Filed July 24, 1937

5 Sheets-Sheet 1



INVENTOR.
LARS HANSON
BY *Herman Frid*
ATTORNEY.

Nov. 7, 1939.

L. HANSON

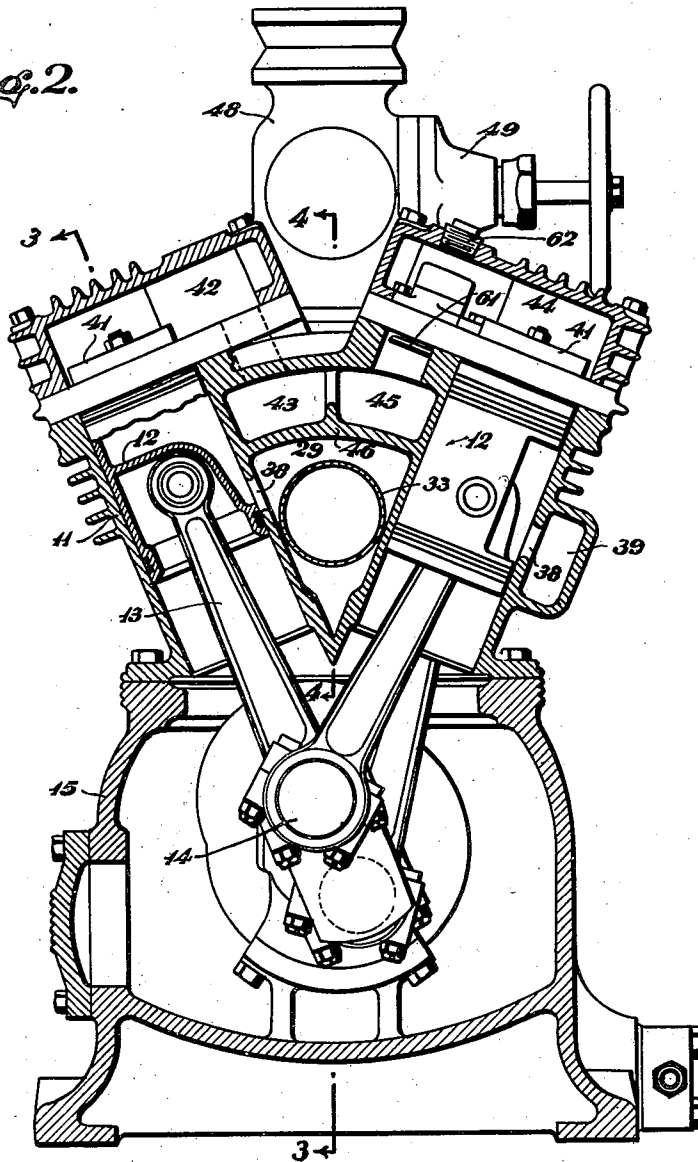
2,178,662

FLUID COMPRESSOR

Filed July 24, 1937

5 Sheets-Sheet 2

Fig. 2.



INVENTOR.
LARS HANSON
BY *Herman Srid*
ATTORNEYS.

Nov. 7, 1939.

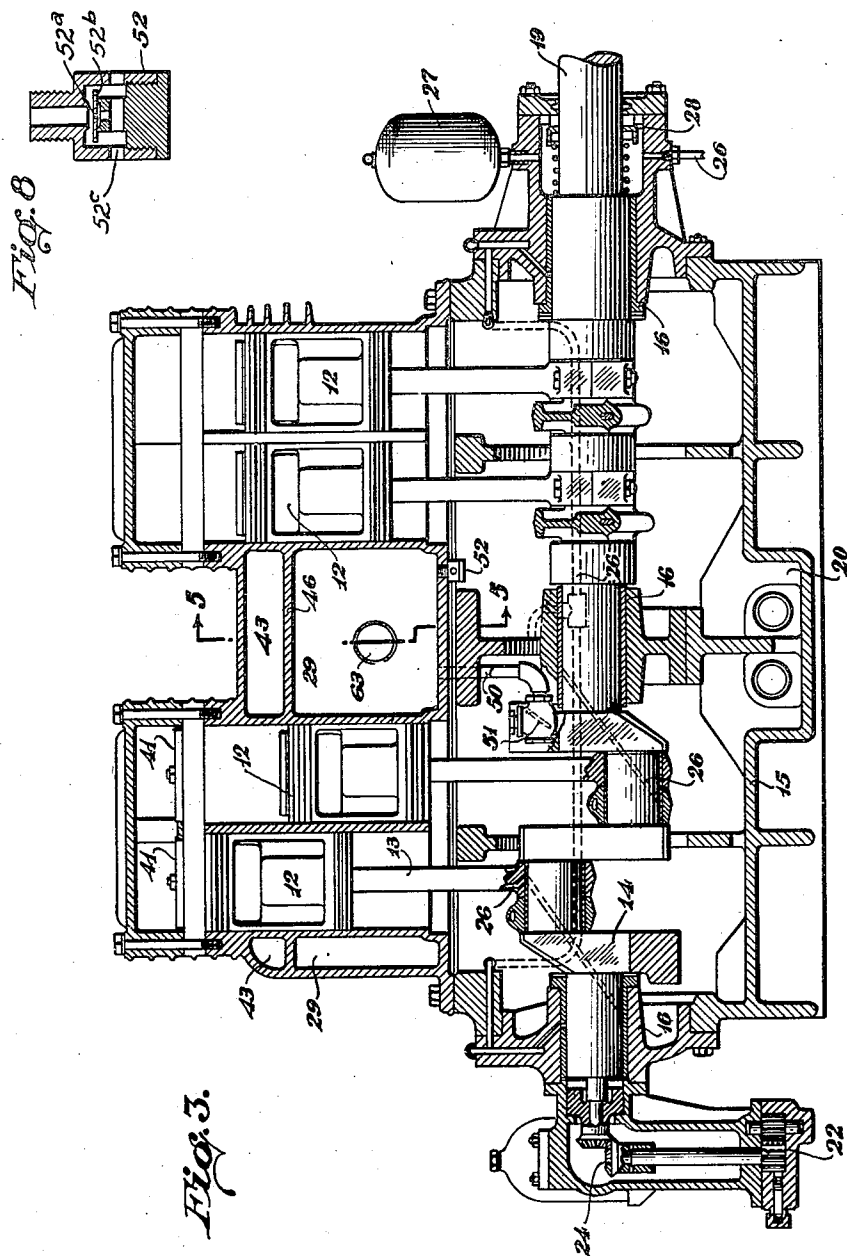
L. HANSON

2,178,662

FLUID COMPRESSOR

Filed July 24, 1937

5 Sheets--Sheet 3.



Nov. 7, 1939.

L. HANSON

2,178,662

FLUID COMPRESSOR

Filed July 24, 1937

5 Sheets-Sheet 4

Fig. 4.

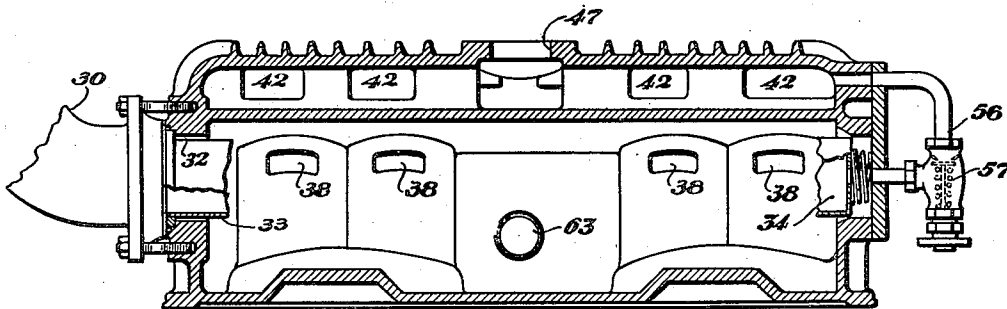


Fig. 5.

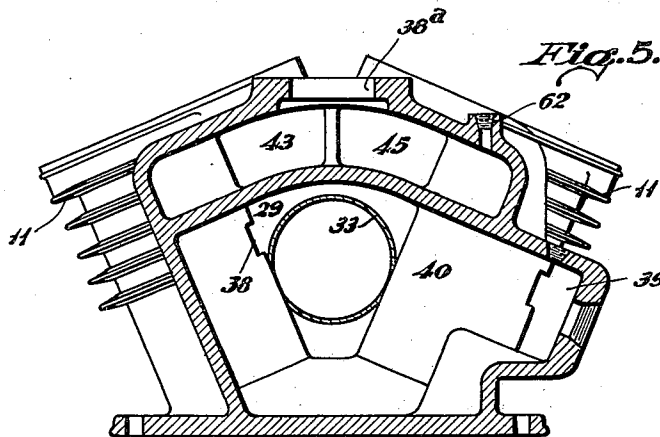
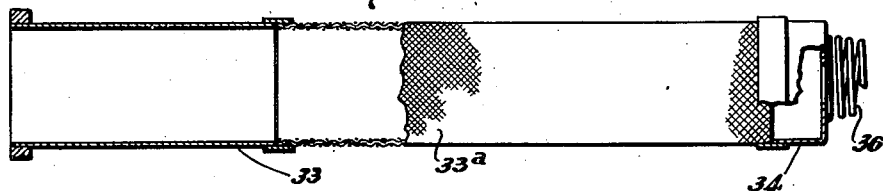


Fig. 6.



INVENTOR.
LARS HANSON
BY *Herman Frid*
ATTORNEY.

Nov. 7, 1939.

L. HANSON

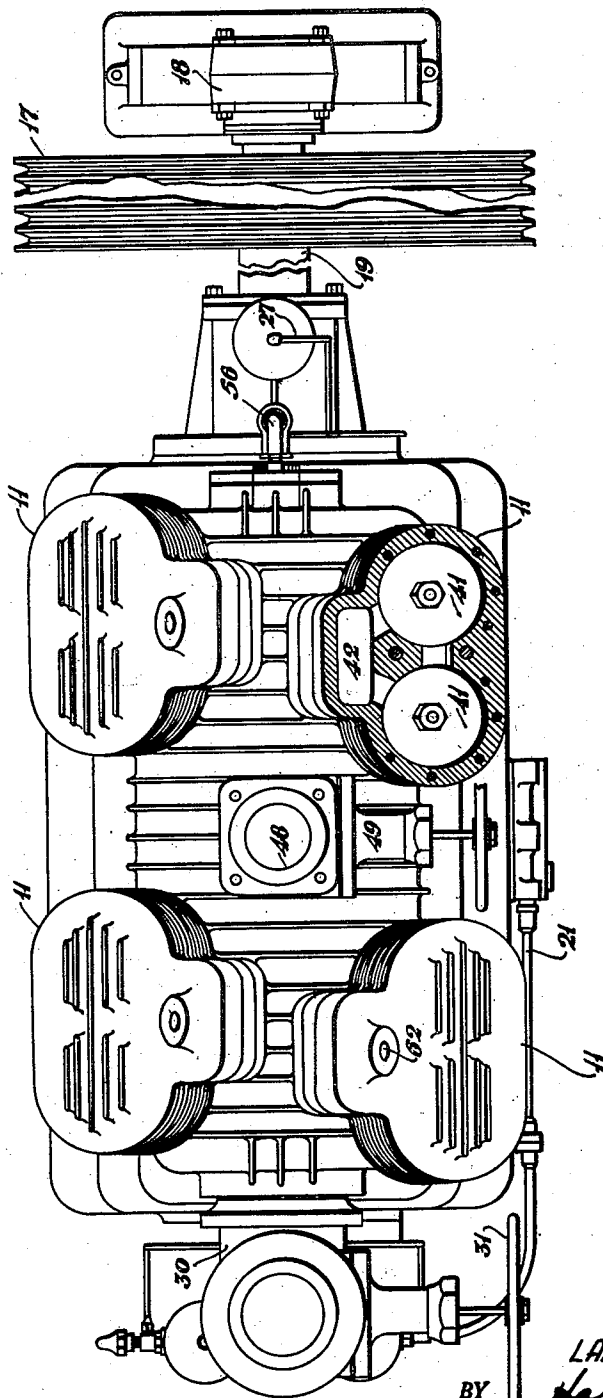
2,178,662

FLUID COMPRESSOR

Filed July 24, 1937

5 Sheets-Sheet 5

Fig. 7.



BY

INVENTOR.
LARS HANSON
Herman Seid
ATTORNEY.

UNITED STATES PATENT OFFICE

2,178,662

FLUID COMPRESSOR

Lars Hanson, Cranford, N. J., assignor to Carrier Corporation, Newark, N. J., a corporation of Delaware

Application July 24, 1937, Serial No. 155,416

8 Claims. (Cl. 230—187)

This invention relates to fluid handling apparatus, and more particularly to compressors.

The general object of the invention is to provide an improved compressor of the V-type.

It is another object of the invention to provide a compressor of the multi-cylinder type having an improved gas manifolding arrangement.

It is another object of the invention to provide a compressor of the multi-cylinder type in which provision is made for the separation of gas and liquids such as oil, before the gas is supplied to the cylinders of the compressor and in which the separated oil is drained and returned to the oil circulating system of the compressor.

It is another object of the invention to provide an improved compressor of the multi-cylinder type in which provision is made for returning to the gas circulating system vapors entrapped in the crank case of the compressor.

It is another object of the invention to provide a compressor particularly well adapted for use in refrigerating systems of relatively large capacity.

It is another object of the invention to provide a compressor of the multi-cylinder type which is relatively compact and inexpensive to build, yet thoroughly sturdy and efficient in operation.

A feature of the invention resides in the provision of a V-type multi-cylinder compressor having a chamber formed within the V-shaped area between rows of cylinders, and utilizing said chamber as an intake manifold for gas supplied to the cylinders.

Another feature of the invention resides in providing, in combination with a multi-cylinder compressor, an intake manifold having a relatively large volume. When compressor apparatus is used as part of a refrigerating system, and in various other applications, gas supplied to the compressor generally carries with it entrained oil and the like. By providing an intake manifold of relatively large volume, the velocity of gas supplied to the compressor is considerably reduced. This reduction in velocity permits the natural separation by gravity from the gas of liquid particles such as oil entrained therein. The droplets of oil thus separated fall to the bottom of the intake manifold, whence they are drained to the crank case of the compressor.

Another feature of the invention resides in the provision of a V-type multi-cylinder compressor having a main intake manifold of relatively large volume and an auxiliary intake manifold of smaller volume in communication with the first and larger manifold, the first manifold being

adapted to supply gas directly to cylinders comprising one portion of the V and being adapted to supply gas to the auxiliary manifold, this latter gas then being supplied from the auxiliary manifold to the cylinders forming the other side of the V.

Another feature of the invention resides in the provision of novel means for supplying to the crank case of a compressor oil separated from gas at the intake manifold of the compressor.

As is well known, oil passing to the crank case, as above described, carries with it a relatively small amount of the fluid intended to be circulated through the compressor. Some of this fluid in gaseous form is entrained and some of the fluid in liquid form is absorbed in the oil, in cases where the fluid is miscible with the oil. Upon delivery of oil to the crank case of the compressor the oil is heated, and this heating results in liberation of fluid contained in and entrained by the oil, the liberated fluid being in gaseous form. Were such gas allowed to accumulate to any appreciable extent in the crank case, the intended operation of the system would be seriously impaired.

Accordingly, another feature of the invention resides in the provision of means for returning to the gas circulating system of the compressor gas which has been liberated from oil in the crank case of the compressor.

Another feature of the invention resides in the provision of a multi-cylinder compressor having a relatively large intake manifold within which is located means for providing equal supply of gas to the different cylinders of the device, and for removing particles of foreign matter from gas supplied to the cylinders of the compressor.

Another feature of the invention resides in the provision of a fluid compressor having an intake manifold and a discharge manifold so arranged that fluid passing to the cylinders of the compressor and fluid passing from the cylinders of the compressor will be in heat exchange relation. Thus, when the compressor is used as part of a refrigerating system, condensation of the refrigerant discharged from the cylinders of the compressor will be facilitated by removal of heat therefrom at the heat interchange step and prior to the main condensing step of the refrigerating cycle. Moreover, the heating of gas being passed to the cylinders is of advantage. As is well known, refrigerant gas delivered from the evaporator of a refrigerating system often carries along with it particles of liquid refrigerant. These liquid particles may result in serious damage to

the compressor if supplied to the cylinders thereof. Heating of the suction fluid vaporizes the liquid refrigerant particles and thus avoids damage to the compressor from this source. Moreover, certain refrigerants are miscible with oil. The degree of miscibility is an inverse function of temperature, so that as the temperature of the fluids is increased, the refrigerant and oil are increasingly separated out. Thus, heating of the fluid supplied to the compressor facilitates separation of the refrigerant fluid and the oil, which may then be drained to the crank case of the compressor.

Other objects, features and advantages of the invention will be more apparent from the following description to be read in connection with the accompanying drawings, in which

Fig. 1 is a side elevational view of a compressor in accordance with the invention;

Fig. 2 is a transverse sectional view, taken on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal sectional view, taken on the line 3—3 of Fig. 2;

Fig. 4 is a sectional view, taken on the line 4—4 of Fig. 2;

Fig. 5 is a transverse sectional view, taken on the line 5—5 of Fig. 3 showing the connection between the main supply manifold and the auxiliary supply manifold;

Fig. 6 is an elevational view, taken partly in section of the baffle and strainer device positioned within the main supply manifold;

Fig. 7 is a plan view of the compressor, partly broken away; and

Fig. 8 is a sectional view of the gas relief valve.

Referring now to the drawings, numeral 10 designates generally a compressor of the multi-cylinder type having a number of cylinders 11 arranged in V formation. As illustrated, compressor 10 comprises eight cylinders with four on each side of the compressor, but it will be understood that any number of cylinders may be used within the purview of the invention. The cylinders on each side of the compressor are preferably slightly staggered with respect to each other, to simplify connections to the crankshaft. Each cylinder 11 is provided with a piston 12 driven through connecting rod 13 by crankshaft 14. Crankshaft 14 is carried within crank case 15 by bearings 16 of any desired type and design, and crankshaft 14 is adapted to be driven through pulley 17 by belts or the like (not shown), connected to any suitable prime mover, such as an electric motor. Outboard bearing 18 supports shaft 19, constituting an extension of crankshaft 14. Crank case 15 is provided with a sump 20 from which oil is withdrawn through line 21 by oil pump 22 driven through gears 23 by rotation of the crank shaft. Oil delivered from pump 22 is filtered in filter 24 and is then passed through supply line 25 for use in lubricating the crankshaft and pistons in a manner well known in the art. Since the use of drilled shafts and the like are well known, no attempt is here made to illustrate or to describe in detail the lubrication system of the compressor, but oil passages 26 are shown generally to indicate the oiling system. It will be understood that the moving parts of the compressor may be lubricated in any desired manner without departing from the invention. Preferably, however, the oiling system includes an oil reservoir 27 for maintaining a head of oil upon the packing 28 during shut-down periods. Since the provision of such reservoir is well understood in the art, no further description is

deemed required here. Packing 28 similarly may be of any desired formation, the provision of shaft packing means being well understood by those versed in the art.

Formed within the V of the compressor is a chamber 29 which is of relatively large volume and which extends substantially completely throughout the length of the compressor. Gas is adapted to be delivered to the compressor through inlet conduit 30 under the control of valve 31. Conduit 30 delivers gas into the chamber 29, which constitutes the main suction manifold, through opening 32 formed in one end of the compressor casing. In a preferred form of the invention a baffle and strainer member 33 is positioned within the chamber 29 in such manner that all of the fluid supplied to the compressor through conduit 30 and opening 32 will be delivered within the interior of member 33. While member 33 may be of any desired shape or construction, it is preferably cylindrical in cross-section and extends substantially completely throughout the length of chamber 29. The inlet end portion of the member 33 is preferably imperforate, while the remaining portion of member 33, designated 33a, is preferably formed of relatively fine wire mesh. The advantages flowing from this construction are several. Firstly, it will be noted that all of the fluid conveyed to the compressor is relieved from the member 33 only at the perforate portion thereof. Thus, there is substantially equal distribution of inlet gas to all of the cylinders 11 of the compressor, and any tendency to supply excessive volumes of gas to the cylinders at the inlet end of the compressor is effectively overcome. Moreover, this construction insures the straining of all fluid supplied to the compressor. Thus, particles of foreign matter which might cause damage to the pistons and cylinders of the compressor are removed before the fluid is supplied to the cylinders. The far end of member 33 is provided with a collar 34 adapted to be snugly received within an opening 35 formed at the far end of suction manifold 29. To eliminate the necessity for great accuracy in sizing member 33, there is preferably provided a spring 36 at the far end of member 33 abutting closure member 37. Thus, spring 36 compensates for any slight inaccuracies in the length of member 33, by forcing the member 33 toward the inlet end of the compressor, and at all times gives assurance that all of the gas supplied through conduit 30 will be delivered through the interior of member 33 and will not leak around the member 33 into suction manifold 29. Further, the spring 36 facilitates the removal of the member 33 from within suction manifold 29, for cleaning, replacement or repair.

Each of the cylinders 11 is provided with an inlet port 38. As seen in Fig. 2, each of the cylinders on the left-hand side of the compressor has its port 38 in direct communication with inlet manifold chamber 29, and thus each cylinder on the left-hand side of the compressor is adapted to receive gas directly from the inlet manifold 29. The cylinders on the right-hand side of the compressor, as seen in Fig. 2, receive gas from an auxiliary inlet manifold 39, which is adapted to receive gas from chamber 29 through passage 40 which connects manifolds 29 and 39 at the central portion of the right-hand side of the compressor. It will be understood that other means may be provided for supplying gas to each of the cylinders, but the arrangement above described is preferred inasmuch as it permits the

cylinders and pistons to be constructed and operated in complete uniformity and since it provides for the equal distribution of gas to each of the inlet ports 38 of the various cylinders.

5 Gas is discharged from each of the cylinders through a suitable valve 41 at the head thereof. The cylinders at the left-hand side of the compressor discharge into a plurality of passages 42 which communicate with an exhaust chamber 10 43 and the cylinders at the right-hand side of the compressor discharge into a plurality of passages 44 which discharge into exhaust chamber 45. Adjacent cylinders on each side of the compressor discharge into the exhaust chambers 15 through common exhaust passages. Thus, as best seen in Fig. 7, there are two passages 42 on the left-hand side of the compressor, each serving two cylinders, and two passages 44 on the right-hand side of the compressor, each serving two cylinders. Exhaust chambers 43 and 45 communicate with each other to form, in effect, a single 20 discharge manifold. Chambers 43 and 45 are formed within the V of the compressor and are separated from supply manifold 29 by partition 25 46. While partition 46 is of such mechanical strength as to withstand the pressure differential existing between the inlet and outlet of the compressor and to withstand the mechanical strains to which the compressor is subjected, the partition 30 46 is preferably of heat-conducting material and designed to facilitate heat transfer between the relatively hot gas in chambers 43 and 45 and the relatively cold gas in inlet manifold 29. Heat transfer between gas supplied to and gas supplied 35 from the cylinders reduces the temperature of gas leaving the compressor and thus facilitates condensation of the gas prior to its reevaporation. Furthermore, such heat transfer increases the temperature of fluid being supplied to the 40 cylinders, thus evaporating entrained particles of liquid refrigerant contained in the fluid supplied to the compressor and facilitating the separation of refrigerant and oil, as hereinabove described. Exhaust manifolds 43 and 45 extend substantially 45 completely throughout the length of the compressor and are adapted to discharge gas through an opening 47 into conduit 48 connected to the compressor 10 proximate the central portion thereof. If desired, a valve 49 of any desired 50 type may be provided to control the flow through conduit 48.

As noted above, the volume of inlet manifold 29 is relatively large. Thus, gas supplied to the compressor through conduit 30 is subject to a 55 relatively great decrease in velocity when it is released within the manifold 29. This sudden and relatively great decrease in velocity has the effect of releasing from the gas entrained particles of oil and the like. These particles fall to 60 the bottom of chamber 29 and thence pass into a tube 50 connected to the bottom of chamber 29. At the bottom of tube 50 is provided a flap valve 51. The valve 51 is so arranged that it will open when a predetermined amount of liquid 65 has collected in the tube 50, so that the liquid thus accumulated will be discharged into the crank case 15 of the compressor. If desired, the flap valve 51 may be spring-controlled in a manner well understood in the art.

70 The oil delivered to crank case 15 will carry with it quantities of fluid from the gas circulating system. A portion of this fluid will be entrained by the oil, while another portion of the fluid will be absorbed by it when the fluid and 75 oil are miscible. Due to the high temperature

obtaining within the crank case, refrigerant entering the crank case absorbed by the oil will be released in gaseous form, and entrained refrigerant will also be released in gaseous form. The accumulation of this released gas and its increase 5 in temperature will cause gas pressure to obtain within the crank case. This pressure will cause flap valve 51 to close after the pressure, due to accumulated liquid within the tube 50, has been 10 dissipated by discharge of this liquid into the crank case. To prevent the gas pressure in the crank case from reaching too high a value, and to maintain the pressures in the suction manifold and the crank case substantially the same, there is provided a relief valve 52. Orifice 52a 15 in the disc 52b permits gas to flow from the crank case to the inlet manifold 29. Any oil which may be carried along by this gas may flow back around the edges of disc 52b and then through openings 20 52c without interfering with gas flow from the crank case. Ordinarily, gas pressure will raise disc 52b against the upper seat and the disc will fall when accumulated oil forces it down.

As will be understood, suitable gas inlet valves are carried by each of the pistons 12 for admitting 25 gas to each of the cylinders. Since the provision of such valves is no part, per se, of the invention, and since such valves are well understood in the art, no further description of them is deemed required here, it being understood that 30 any suitable valves may be employed without departing from the invention.

It will be noted that the sump 20 of crank case 15 is appreciably lower than the remainder of the crank case. The purpose of this arrangement 35 is to insure an accumulation of oil within the sump 20 at all times so that there will be no cavitation of the pump 22, as might happen if no sump were provided and the compressor were not maintained on an even keel at all times. In 40 marine and similar applications, this feature is of particular importance in assuring proper operation of the compressor at all times.

In Fig. 1, 53 designates a control device connected through tube 54 to manifold 29 and 45 through tube 55 to discharge conduit 48. Control device 53 may be of any desired construction enabling it to interrupt the operation of the compressor whenever the pressure in manifold 29 falls below a predetermined point, or whenever 50 the pressure in discharge conduit 48 rises above a predetermined point. Control device 53, for example, may be arranged to interrupt the supply of electric current to an electric motor driving the compressor through pulley 17. Since such devices 55 and control arrangements are well known, no detailed description of control device 53 is deemed necessary here.

Another feature of the invention making for safety in operation comprises relief passage 56, 60 providing communication between the end of manifold 29 and the end of the discharge manifold formed by chambers 43 and 45. Valve 57 in line 56 is adapted to open whenever the pressure in the discharge end of the compressor rises above 65 a predetermined point and to relieve gas from the high pressure side of the compressor to the suction side thereof.

When two or more compressors are operated together in parallel arrangement, it is desirable 70 that there be provided equalizer connections therebetween. In Fig. 1, 58a designates a connection for an equalizer line located above the normal oil level in crankcase 15, and 58b designates a connection for an equalizer line below the normal 75

oil level in the crankcase 15. Thus, these connections provide for equalization of both gas pressure and oil levels within the crankcases of compressors operated together. 59 designates an oil plug and 60 designates a sight glass for determining the level of oil within the crankcase.

In application Serial No. 71,837, filed March 31, 1936, there is disclosed a cylinder cut-out system for reducing the capacity of compressors when the load decreases. In brief, this system calls for reducing the capacity of a compressor comprising two or more cylinders by re-routing gas discharged from at least one of the cylinders to the inlet side of the compressor whenever the load on the compressor falls below a predetermined point, and preventing the flow of gas discharged from a cylinder operating in the normal manner to a cylinder which is discharging into the compressor intake, such flow being prevented by means of a check valve or the like. According to the present invention, the check valve required to operate this system of capacity reduction may be built into the compressor as indicated at 61 in Fig. 2. Thus, if the compressor is operated in the normal manner, the gas discharged from all of the cylinders will be passed through exhaust passages 43 and 45. If, however, it is desired to reduce the capacity of the compressor, a line connecting outlet plug 62 with the intake of the compressor may be opened by opening a valve located therein. In such case, fluid discharged from cylinders on the right-hand side of the compressor will be routed to the suction side of the compressor (to the intake conduit 30, or, preferably, directly to the suction manifold 29 through connection 63), while gas discharged from cylinders on the left-hand side of the compressor will be discharged in the normal manner; and check valve 61 will prevent the passage of gas discharged from the left-hand cylinders to the intake of the compressor.

Since many changes may be made in the invention without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not in a limiting sense, applicant limiting himself only as indicated in the appended claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a multi-cylinder gas compressor of the V-type, means forming a relatively large chamber in the area between the angularly disposed cylinders of said compressor, means for supplying to said chamber fluid to be compressed containing entrained oil particles, said chamber being of sufficient size to reduce the velocity of fluid supplied thereto to such a point that oil entrained by said fluid will be precipitated and separated by gravity from said fluid and fall to the bottom of said chamber, means for supplying from said chamber to the cylinders of said compressor fluid which is relatively free of entrained oil, and means for discharging from the compressor fluid compressed in the cylinders thereof.

2. In an apparatus of the character described, a plurality of compressed cylinders arranged in a pair of rows to provide a V formation, the cylinders of each row being angularly disposed with respect to the cylinders of the other row, a crank shaft, a piston within each of said cylinders operatively connected to said crank shaft, a relatively large supply chamber formed in the area between said rows of cylinders, means for supplying fluid

to be compressed to said chamber, means for supplying fluid to be compressed from said chamber to said cylinders, means forming a discharge chamber in the area between said rows of cylinders, and means for discharging fluid from said cylinders to said discharge chamber, said supply chamber and said discharge chamber being located one above the other and being substantially coextensive, and being separated by a metallic partition having a relatively high heat conductivity to effect substantial heat interchange between fluid in said supply chamber and fluid in said discharge chamber.

3. In a multi-cylinder gas compressor of the V-type, means forming a supply manifold in the area between the rows of cylinders forming the V of the compressor, a plurality of ports providing communication between said supply manifold and the cylinders of one of said rows, means forming an auxiliary supply manifold positioned at the outside of the other of said rows of cylinders, means providing communication between said first-mentioned supply manifold and said auxiliary supply manifold, and port means providing communication between said auxiliary supply manifold and the cylinders of said other row.

4. In a multi-cylinder gas compressor of the V-type, means forming an intake manifold chamber in the area between the rows of cylinders of said compressor, perforate conduit and means within said chamber for equalizing the rate at which said fluid is supplied to the various cylinders of the compressor, and means for supplying fluid within said conduit means through an end of said intake manifold chamber, said perforate conduit means being adapted to supply fluid to the various cylinders of said compressor.

5. In a multi-cylinder gas compressor of the V-type, means forming an intake manifold between the rows of cylinders of said compressor, conduit means disposed lengthwise within said intake manifold, means for supplying fluid within said conduit means proximate an end thereof, the inlet portion of said conduit means being imperforate, at least another portion of the conduit means being perforate and adapted to supply fluid received therewithin to said intake manifold, means for supplying fluid from said intake manifold to the cylinders of said compressor, and means for discharging fluid compressed in said cylinders.

6. In a multi-cylinder gas compressor of the V-type and having a crank case serving to contain oil utilized in the lubrication of said compressor, means forming a relatively large suction chamber in the area between the rows of angularly disposed cylinders of said compressor, means for supplying to said chamber fluid which contains entrained oil particles, said chamber being of sufficient size to reduce the velocity of fluid supplied to said chamber to such a point that oil particles entrained by said fluid will be precipitated and separated by gravity from said fluid and fall to the bottom of said chamber, means for supplying from said chamber to the cylinders of said compressor fluid which is relatively free of entrained oil, means for discharging from the compressor fluid compressed in the cylinder thereof, and means for supplying said separated oil from the lower portion of said suction chamber to said crank case.

7. In a multi-cylinder gas compressor of the V-type having an oiling system, means forming a relatively large suction chamber in the area between the angularly disposed cylinders of said

compressor, means for supplying to said chamber fluid which contains entrained oil particles, said chamber being of sufficient size to reduce the velocity of fluid supplied to said chamber to such a point that oil particles entrained by said fluid will be precipitated and separated by gravity from said fluid and fall to the bottom of said chamber, means for supplying from said chamber to the cylinders of said compressor fluid which is relatively free of entrained oil, means for discharging from the compressor fluid compressed in the cylinders thereof, means for accumulating said separated oil, and means for supplying said oil to the oiling system of said compressor whenever a predetermined amount of said separated oil has been accumulated, said last mentioned means including a passageway connecting said suction chamber and the crankcase of said compressor, and a normally closed valve in said passageway adapted to be opened whenever a

predetermined amount of separated oil has been accumulated.

8. In an apparatus of the character described, compression means, means forming a supply chamber, means for supplying to said chamber a fluid containing entrained particles of oil, said chamber being sufficiently large to effect separation of oil particles from the fluid supplied thereto due to reduction of fluid velocity therein, a crankcase, means for supplying said separated oil from said supply chamber to said crankcase, and other means providing communication between said crankcase and said chamber, said other means being adapted to pass fluid in gaseous form from said crankcase to said chamber, said chamber being adapted to supply gaseous fluid to said compression means, and means for discharging compressed fluid from said compression means.

LARS HANSON. 20