April 25, 1933. W. FOURNESS 1,905,933

HIGH SPEED COMPRESSOR

Filed May 12, 1930 3 Sheets-Sheet 1

Fig. 1

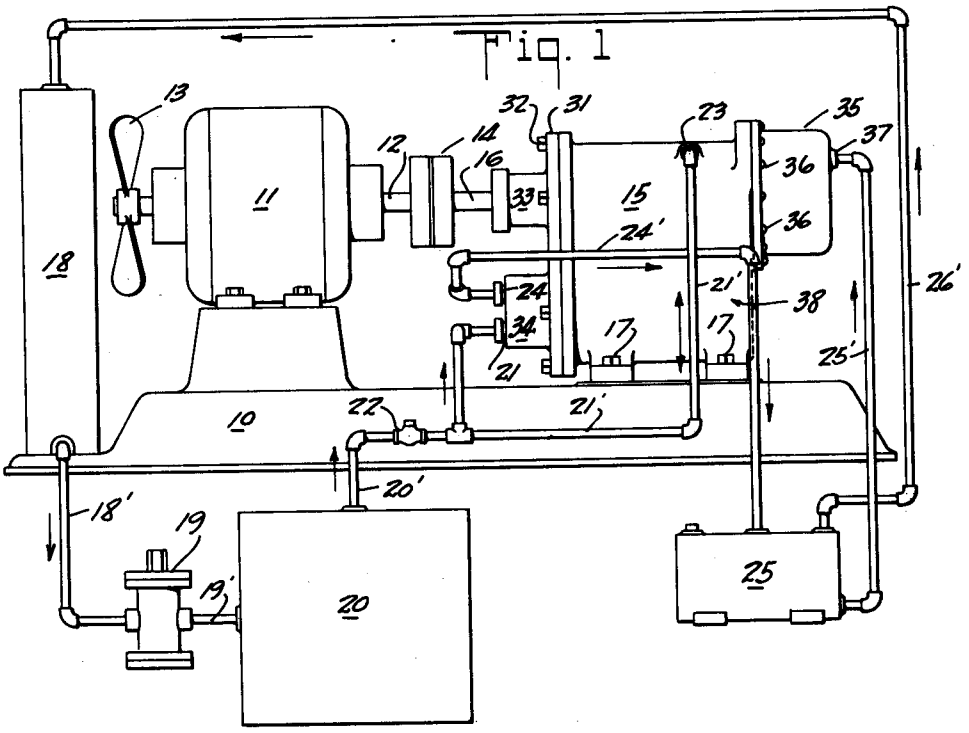
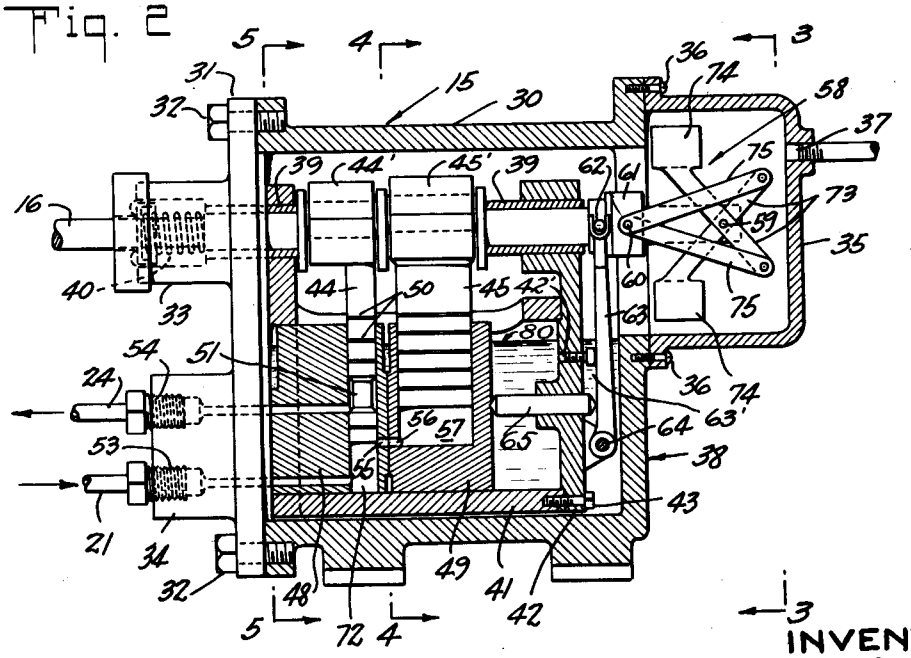


Fig. 2



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Fig. 4

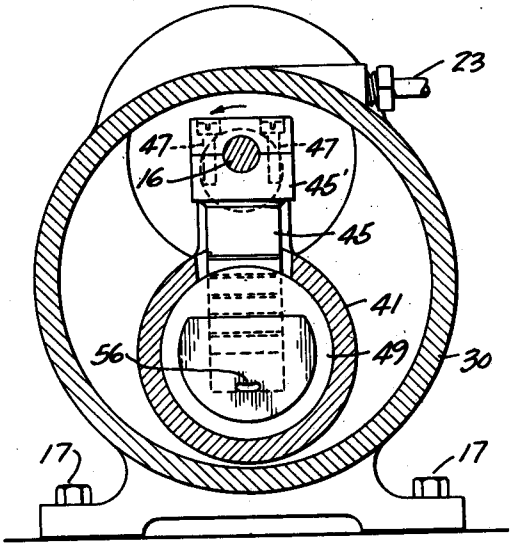


Fig. 3

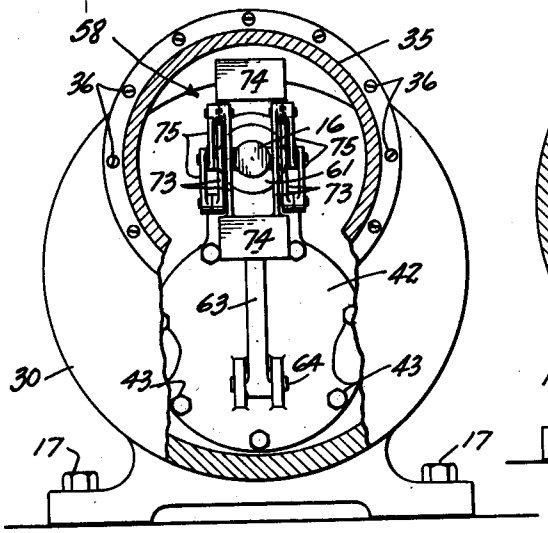


Fig. 5

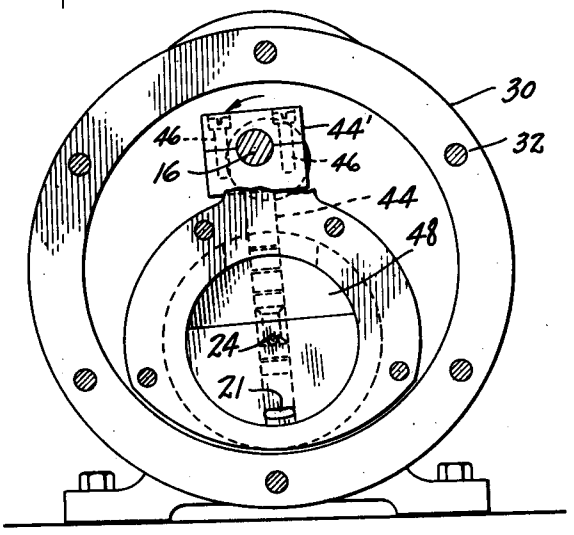
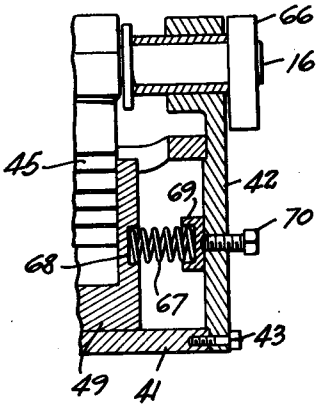


Fig. 6



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HIGH SPEED COMPRESSOR

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Fig. 7

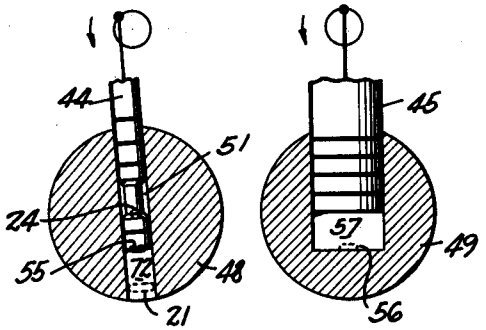


Fig. 8

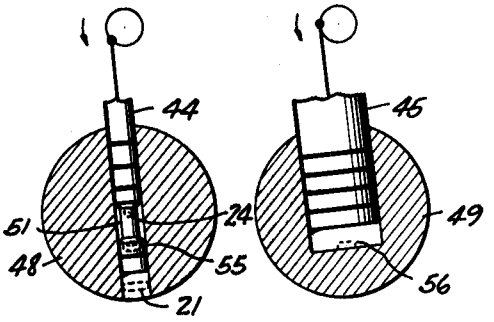


Fig. 9

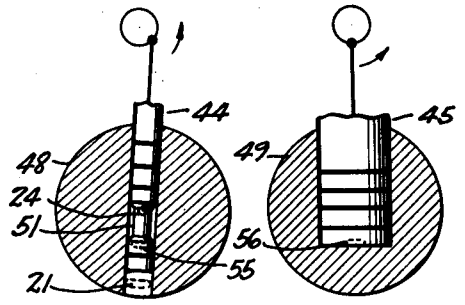


Fig. 10

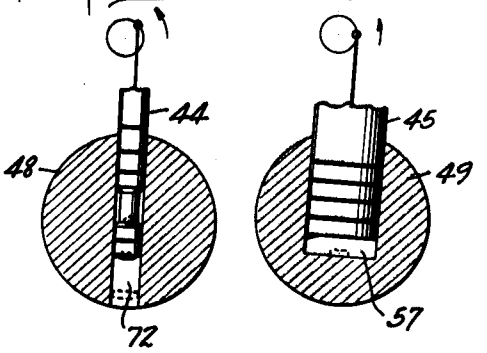
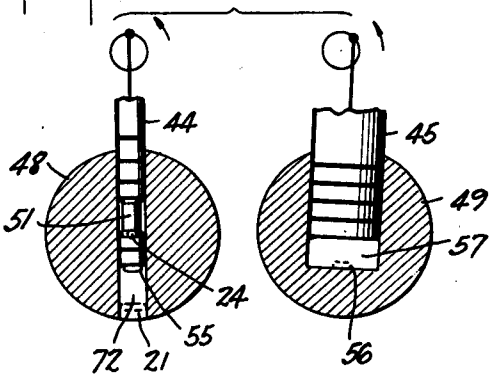


Fig. 11



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Patented Apr. 25, 1933

1,905,933

UNITED STATES PATENT OFFICE

WILFRED FOURNESS, OF OAKLAND, CALIFORNIA, ASSIGNOR TO FOURNESS DEVELOPMENT CORPORATION LTD., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

HIGH SPEED COMPRESSOR

Application filed May 12, 1930. Serial No. 451,824.

This invention relates to compressors, and more particularly to high speed compressors having an oscilating cylinder housing, in which a piston recriprocates for compressing a gas such as that used in refrigerating systems.

It is one object of my invention to provide a high speed compressor and to make possible the controlling of the intake and discharge ports in proper sequence by a positive valve action driven by the same source of power as the compressing mechanism, whereby a high degree of efficiency is secured.

It is another object of my invention to provide a simple assembly of the constituent parts, and to employ a minimum of moving parts, and accordingly reduce the friction to a minimum.

My compressor may include a member for supporting the cylinder blocks. This member can consist of a tubular member disposed parallel to the crank shaft that drives the compressor. This tubular member is adapted to accommodate both a main cylinder block and a valve cylinder block, which are separate members and are positioned adjacent to each other. In each cylinder block is a small opening or port establishing communication between these blocks and the outlet port. This passageway can be maintained only if the blocks are kept in close contact with each other and in alinement with the discharge port. An enclosing casing is provided for the working parts, and is subjected only to the intake pressure. There is provided a device for keeping these blocks in sealing contact under normal operating pressures. However, it is not an infrequent occurrence for the discharge port or any other part of the passageway leading from or connected to the discharge port, to become obstructed, such as may be due to the oil and sediment being drawn into it. This gives rise to an additional pressure, which if not relieved, would soon disrupt the entire compressor mechanism.

It is, therefore, another object of my invention to obviate this difficulty by the use of the device aforementioned which would permit the separation of the valve and cylinder blocks and thus relieve the excessive pressures which would then be encountered.

In refrigerating systems especially, the compressor is operated only intermittently; and when the compressor is started after an intermittent period of rest, the starting torque required from the electric motor or other source of power may be greater than it can readily furnish. This effect is indeed rendered still worse by an accumulation of pressure on the intake side due to the inaction of the compressor. It is accordingly another object of my invention to relieve the starting load of the motor, and especially by permitting the cylinder blocks to separate during the starting period, whereby the outlet port (normally forming a continuous passageway from one block to the other) is placed in communication with the intake pressure, existing in the external casing. Thus the work imposed on the motor is reduced, since the pressure gain obtained through the compressor is slight. As soon as the motor attains its running speed, the blocks are automatically urged into close contact to form a continuous outlet port.

It is a further object of my invention to provide a device above referred to, which will also impart to the shaft a uniform distribution of its weight and thus act in the capacity of a counterbalance.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of my invention. For this purpose I have shown a form in the drawings accompanying and forming part of the present specification. I shall now proceed to describe this form in detail, which illustrates the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagrammatic view of a refrigerating system embodying my compressor;

Fig. 2 is a longitudinal section of the compressor shown in Fig. 1;

Fig. 3 is a front view of the compressor with part of the casing removed;

Fig. 4 is a transverse sectional view taken along the plane 4—4 of Fig. 2;

Fig. 5 is a transverse sectional view taken along the plane 5—5 of Fig. 2;

Fig. 6 is a modified form of my unloading device; and

Figs. 7 to 11 inclusive are diagrammatic sections of the piston and valve showing the positions they assume on the suction and compression strokes.

Referring to Fig. 1, I show a standard or base 10 to which an electric motor 11 is rigidly secured at its forward end. This motor is of the conventional high speed type, and current is supplied to it from any suitable source. The motor 11 drives a shaft 12, the forward end of which protrudes from the motor and rotates a fan or blade 13, which is securely attached to the shaft 12. The rear end of the shaft 12 is connected to a coupling 14 which is situated between the motor 11 and my compressor 15. The motor 11 through the coupling 14 drives a crank shaft 16 of the compressor. As shown, the compressor 15 is rigidly secured to the base 10 by screw threaded bolts 17.

In front of the fan 13, I show a condenser 18 connected to the base 10. The structure of this chamber 18 is similar to the conventional radiators used on automobiles, but capable of standing higher pressures as used in refrigeration. From the lower end of the condenser 18, I show a connection 18′ leading to an expansion valve 19. From this expansion valve a connection 19′ leads into a refrigerating unit 20. From the refrigerating unit, I show a connection 20′ leading to the suction intake port 21 of the compressor 15. Intermediate the refrigerating unit 20 and the inlet port 21, I provide a check valve 22, the function of which will be later explained. The connection 20′ from the refrigerating unit 20 also leads into the compressor 15 at its upper extremity as at 23. The portion 21′ of the connection 20′ between the suction intake 21 and the point of entry 23 to the compressor 15 acts as an equalizer. From the discharge port 24 of the compressor 15, I show a connection 24′ leading to an oil separator 25. From the lower end of the oil separator 25, I show a connection 25′ leading into the upper end of the compressor 15. From the upper end of the oil separator, I show a connection 26′ leading to the condenser 18 at its upper extremity.

The operation of this refrigerating system is readily apparent from the following. The motor 11 by the aid of a compressor 15 forces compressed gas, such as sulphur dioxide, into condenser 18. The condensed refrigerant, contained in the condenser 18 then flows in the direction of the arrow to the expansion valve 19, where due to the sudden expansion of the liquid, it vaporizes and enters into the refrigerating unit 20 in the form of a gas. There the gas absorbs the heat from the refrigerating unit 20 and cools the contents thereof. From the refrigerating unit, the expanded gas is pulled by suction into the suction intake port 21. The gas is compressed by compressor 15, which forces the compressed gas through the discharge port 24 and into the oil separator 25. The function of the oil separator is to separate any oil carried with the gas and to return the oil through a float valve or similar appliance within the separating chamber, back into the upper extremity of the compressor 15 through the connection 25′. The gas separated from the oil continues in a direction of the arrow through the connection 26′ until it reaches the condenser 18, where by the cooling action of the fan 13, it is again condensed to a liquid and the operation as above described, is repeated.

The check valve 22 above referred to prevents the backward flow of the gas and oil from the compressor 15 when the machine is not in operation. The equalizer 21′ functions as a means of keeping the pressure of the gas between the oil level and the top of the compressor housing equal to the pressure of the incoming gas, thus preventing excess flow of oil into the compressor cylinders.

It is quite generally recognized, that cool oil functions more efficiently as a lubricant than warm oil. By means of the arrangement of the elements embodying the applicant's invention, the cooling of the oil in the compressor is made possible as follows. The separator 25 does not remove all of the compressed refrigerant absorbed by the oil, and accordingly the unremoved refrigerant produces a slight refrigerating effect sufficient to cool the oil, due to the evaporation of the refrigerant from the oil in the connection 25′ leading from the oil separator 25 to the space above the oil level. This is due to difference in pressure between the compressed gas and oil in the oil separator 25 and the space above the level of oil in the compressor. The large differential of pressure existing between the spaces connected by the connection 25′, permits the evaporation of the unseparated refrigerant from the oil returned to the compressor from the oil separator. This cooled oil, mingling with the oil in the compressor causes the temperature of the oil in the compressor to decrease.

Referring to Fig. 2, the external cylindrical casing 30 of the compressor 15 is closed at the forward end by a plate 31 securely affixed to the casing 30 by means of screw-threaded bolts 32 arranged near and about the periphery of the plate 31. The plate 31 has two tubular extensions 33 and 34 integral therewith. The rear end of the cas-

ing 30 is closed by a cup-shaped member 35 firmly secured to the casing 30 by screw-threaded bolts 36. The end of the member 35 has an opening 37 for the admission of the pipe leading from the lower end of the oil separator 25. Thus it is apparent that the casing, now referred to as a whole, as by 38, forms a fluid tight shell adapted to house the compression mechanism which is surrounded by a lubricant, such as oil. Enough space is left between the oil level and the upper part of the casing 38 to allow for the expansion of the oil and the accumulation of foam due to heat and agitation respectively.

The oil level can be placed at any convenient height, sufficient at any rate to approach the center or axis of shaft 16. This level is indicated at 80 in Fig. 2.

The shaft 16 for operating the compressor is journaled inside the casing and adapted to rotate in the bearings 39. I show at 40 a spring packing to prevent the oil from the casing 38 from escaping along the periphery of shaft 16. In the casing 38, I show a cylindrical vessel 41 having a cover plate 42 firmly bolted to one end thereof by screw bolts 43. The other end of the cylindrical vessel 41 has a cover plate similar to the plate 42 in design, but integral with the vessel 41. This cover plate is adapted to abut against the wall 31 of the external casing 38, and thus establish a discharge port which will hereinafter be described. The upper ends of these cover plates 42 have openings therein which are adapted to support the bearings 39. This vessel 41 is restrained against movement relative to casing 38.

The cylindrical vessel 41 has an opening in its upper portion, and contains a valve block 48 and a cylinder block 49, the one adjacent to the other. Adapted to reciprocate respectively in these cylinder blocks are piston valve 44 and a main piston 45. The main piston 45 is connected to the crank shaft 16 by means of a cross head 45′. The piston valve 44 is similarly connected to the crank shaft, as by the head 44′ (Fig. 5). The cranks on shaft 16 are so arranged angularly thereon that in the rotation of the crank shaft, the piston valve 44 will be slightly ahead in phase of the main piston 45. Referring to Figs. 4 and 5, it is readily seen that the valve block 48 and the piston block 49 are so housed in the vessel 41 as to permit their ready movement or oscillation inside the member 41 to compensate for the angularity of the pistons. By referring specifically to Fig. 5, this movement is clearly shown and is due to the position of the cranks during rotation thereof.

In the past it was the common practice to connect the valve and piston to the crank shaft through the medium of a connecting rod. I dispense with this conventional arrangement and provide a positive acting valve and piston, which are directly connected and pivoted to the cranks on shaft 16. I provide these connections by means of the cross heads 45′ and 44′ above referred to, which are securely retained in place, as by countersunk screw bolts 46—46 and 47—47, respectively. The piston valve 44 contains the conventional oil grooves 50 and has a reduced portion 51. Referring to Figures 2 and 5, I show the piston valve 44 with this reduced portion above the outlet port 24 and thus interrupting communication between the cylinder blocks and the outlet. The piston valve 44 is adapted to move into the cylinder block 48 until the reduced portion is opposite the passage formed by openings 55 and 56, between the cylinder blocks 48 and 49, thus establishing communication between these blocks and the outlet port. The piston 45, like the piston valve 44, contains the conventional oil grooves.

It is to be understood that the reciprocations of the piston valve 44 and piston 45 cause the cylinder blocks to slide one with respect to the other, but only between such limits as to ensure the maintenance of a continuous passageway therebetween. This continuous passageway is formed between the ports 55, 56 respectively leading to the contiguous faces of the two blocks 48, 49. The pressure within the compressor cylinders and in the ports tends to separate the cylinder blocks 48 and 49 and in this manner break the seal or passageway between the cylinder blocks. In order normally to provide a continuous passageway, I provide a device which tends to keep these ports leading to the surfaces between the cylinder blocks 48 and 49 in contact. This device will hereinafter be explained.

In order to understand the cycle of action of my compressor, I will refer to Figs. 2 and 7 to 11 inclusive.

The piston valve 44 and the piston 45 are so arranged on the crank shaft 16 that the former will be rotated downwardly to close the discharge port 24, in the position of Figs. 2 and 7. In this position, the gas is sucked through the suction intake port 21 into the valve cylinder 72 through openings 55, 56 connecting the cylinders 72 and 57. This is the full suction position. The piston valve 44 and the piston 45 are rotated on the crank shaft 16 in a counter-clockwise relation, and the former being slightly in advance of the latter, moves downwardly towards the opening 56. This position is shown in Fig. 8, and indicates a half compression of the gas in the cylinder 57 by the piston 45. Openings 55 had previously been closed shortly after the position of Fig. 7 was reached, thereby interrupting communication between intake 21 and cylin-

der 57. Fig. 9 indicates the full compression of the piston 45, and in this position the piston valve 44 has previously been depressed until the reduced portion 51 is opposite the opening or port 55, and thus permits the gas to be forced from the cylinder 57 through the openings 55, 56, around the reduced portion 51 and thence to the discharge port 24. In Figs. 10 and 11, I diagrammatically indicate the positions of the piston valve 44 and the piston 45 in their upward or suction periods. Fig. 10 indicates the "half suction" period and Fig. 11 indicates the "three-quarter suction" period. Thus it is readily apparent that the cylinders 48 and 49 are moved by the crank shaft 16 in a to and fro direction. These cylinders are rocked or oscillated in opposite directions within such limits as will keep the port 56 always open, as by making this port slightly oval.

As one means for keeping the cylinders 48 and 49 in close contacting relation, I provide a centrifugal governor indicated as a whole as by 58 (Fig. 2) contained in the housing 35. Crossed links 73 carrying the governor weights 74 are pivotally secured to the shaft 16 near its extremity, as at 59. Connecting links 75 of the governor 58 are secured at 60 to a collar 61 slidable along the shaft 16. Collar 61 is capable of moving axially along shaft 16. It translates this axial motion upon a projecting pin 62 which is capable of acting against a forked lever 63 pivoted at 64 near the lower extremity of the cover plate 42. Engaging in a depression of the wall of the cylinder 49, I provide an axially movable pin 65 extending through the cover plate 42 and abutting the forked lever 63. Thus the motor acting on the crank shaft 16 must first act on the weights 74 and cause them to separate by centrifugal force. As the speed of the motor increases, the links 75 will act on the collar 61 and cause it to move along the shaft 16, and in this manner act against the forked lever 63 and thus exert a pressure on the pin 65 sufficient to keep the cylinders 48 and 49 in close contact. In order to assure the return of the governor 58 to its normal position when the motor is stopped, I provide a bolt 42′ in the cover 42 exerting a continual pressure against the lever 63 as by means of the spring 63′. Thus prior to attainment of normal speed, the ports 55, 56 are not pressed together and the output of the cylinder is merely passed back into casing 38, which is at intake pressure. The motor is, therefore, unloaded during the starting period. In addition, during the starting period, the cylinders 57 and 72 are scavenged of oil, due to the separation of the cylinder blocks 48 and 49. Only after the scavenging of the oil from the cylinders has been accomplished, does the compression and refrigerating function of the compressor take effect.

If the port 24 becomes clogged, as has been heretofore brought out, the harmful pressure set up in the various ports also causes a separation thereof, and the harmful pressure is thus dissipated in the casing 38.

A brief explanation of the operation of the compressor, when it is started from an inactive period, can now be clearly set forth. Assume that the system has been shut down for a period, and that some refrigerant such as sulfur dioxide, has remained in the expansion coils. The coils absorb heat and cause the gas pressure in the coils to rise. This raise in pressure has been communicated to the interior of housing 30, by way of connections 21 and 21′ (Fig. 1). The blocks 48 and 49 are not in sealing relation, because shaft 16 is at a standstill, and governor 58 is at rest, keeping collar 61 and lever 63 (Fig. 2) in their extreme right hand positions. Accordingly, the discharge 24 is in communication with the interior of casing 30.

The foregoing represents the condition of affairs prior to starting. The gas pressure in the casing is quite high due to evaporation of the refrigerant; and the oil in the casing having been for a long period in contact with the gas, carries a considerable amount of the gas. Cylinders 72 and 57 are flooded with this oil.

Now, when the compressor is started, blocks 48, 49 are for a short period kept separated. Accordingly, the first few strokes of the compressor pistons purge the oil from the cylinders directly into the casing. If any gets into the outlet 24, it is immediately passed to the separator 25 by way of connection 24′. Furthermore, due to the provision of equalizer 21′, the gas in casing 30 is immediately available for compression as it passes via connections 21′ and 21 into the cylinder 57 for compression.

During normal operation, the blocks 48, 49 are urged together, and oil and gas is passed to separator 25 through connection 24′. Oil, carrying a little gas, then passes back by way of connection 25′ to the housing 30. The gas going to a region of lower pressure, produces a slight refrigerating effect and cools the oil and the casing. The separator 25 also acts as a slight primary condenser because the mixture of oil and gas stay for a short time in the separator and is cooled slightly. This period of rest is sufficient to reduce the superheat of the gas, which is then approximately a saturated gas, which can be much more readily condensed by the condenser.

Because the compressor is driven at a high speed, the passage of the gas into the compressor is more uniform, without large periods of rest between charges. This mate-

rially reduces the absorption of heat by the gas.

It may sometimes happen that the expansion coils in compartment 20 frost back, and into pipe 20'. This is an indication that the cooling effect is greater than normal, and that the gas from the expansion space is taken out too rapidly by the compressor. With the use of the equalizer 21', and the separator 25, this condition is remedied automatically. Thus the pressure of the gas and oil returned from separator 25 through connection 25' is somewhat greater than the pressure in space 20, and this tends to raise the pressure in the casing 30. The gas from element 20 is thus held back, and instead, the equalizer 21' passes the confined gases above the oil in compressor 15 directly to the inlet 21. This prevents flooding of the compressor, as the pressure in the housing must be reduced to that in the expansion space before any material amount of gas will flow from the expansion space 20 to the compressor 15.

Since no piston rings are used on pistons 44 and 45, a large amount of oil is continually passing between these pistons and the corresponding cylinder walls. This has a sealing effect and also flushes the cylinders, whereby the walls are kept clean and obviating gumming or sticking. Such gumming or sticking, especially with sulfur dioxide, can cause serious overheating. The continual oil circulation through the cylinder spaces also carries away excess heat.

In Fig. 6, I show a modification of the means for keeping the cylinders 48 and 49 in contact. Instead of the governor 58, I use a counterweight 66 secured to the shaft 16. In this form of my invention, I house a spring 67 in a recess 68 of the block 49 and in a cup 69 adjacent to the cover 42. The pressure necessary to keep the cylinders 48 and 49 in close contact is provided by means of this spring 67 which is kept under tension by bolt 70 acting against the cup 69 through the cover plate 42. In this form, no unloading of the motor during starting is provided; but harmful pressures are avoided as before, since spring 64 can be compressed by any excessive pressure in the cylinders.

The weights 74 of the centrifugal device can be so arranged as to balance the other parts of the mechanism connected to the shaft 16.

Although I have described my invention as limited to one piston, it is to be understood that it would involve a matter of mechanical skill to use two pistons either in line or opposed to each other on the same shaft. It is also to be understood that it is possible to build my machine by the use of two valves for each piston, one acting as the suction and the other as the discharge.

I claim:

1. In a compressor, a plurality of oscillating cylinders having a passageway therebetween for the flow of a fluid, one of said cylinders containing a piston and the other a sliding valve, and means for keeping said passageway continuously open and to obviate escape of fluid from the passageway directly to the exterior of the cylinders.

2. In a compressor, a cylinder, a piston and a sliding piston valve, means to oscillate said valve and piston, a cylinder for said valve, and means forming a passageway between said cylinders for permitting the flow of a fluid from one into the other, said valve and piston being so arranged on said means to oscillate them so as to insure communication between said cylinders.

3. In a compressor, a piston, a piston cylinder, a valve and a valve cylinder, means to oscillate said cylinders, means forming a passageway between said cylinders, said means to oscillate said cylinders acting on said valve and piston to suck a fluid into said cylinder through the passageway, and said means acting on said cylinder and said valve cylinder to insure communication therebetween.

4. In a compressor, a piston, a piston cylinder, a valve and a valve cylinder, a crank shaft to oscillate said cylinders, means forming an inlet and outlet port, and means forming a passageway between said cylinders, said crank shaft acting on said valve and piston to effect communication between the inlet and the cylinder during one period of its rotation, and to effect communication between the outlet and the cylinder during the other period of its rotation, said crank shaft limiting the oscillation of said cylinders to insure communication therebetween.

5. The combination as set forth in claim 3, and means to insure an intimate contact of said cylinders.

6. The combination as set forth in claim 4, and means to insure an intimate contact of said cylinders, said means comprising a centrifugal governor.

7. In a compressor, a plurality of oscillating cylinders, means for causing said cylinders to oscillate, and a positively driven valve operating in one of said cylinders.

8. In a compressor, a compression element, a positively driven valve slidable in a cylinder, a crank shaft, means forming a passageway establishing communication between said cylinder and compression element, and means for maintaining said passageway by keeping the walls of the cylinder and compression element in close contact.

9. In a compressor, a compression element, a valve and a valve cylinder, means forming a passageway between said valve cylinder and the compression element, means forming an inlet and an outlet, means operating on the

valve and compression element for opening and closing of the inlet and outlet in timed sequence, and means to insure the contact of the valve cylinder and the compression element to maintain the passageway or seal, and to permit the breaking of the seal in case of any abnormal internal pressures.

10. In combination, a compressor having a casing subjected normally to substantially low intake pressure of the compressor, a plurality of members forming a discharge port, said members when urged together rendering said port continuous and means to render the discharge port between the members discontinuous during the starting of the compressor.

11. In combination, a compressor having a casing subjected to substantially low intake pressure of the compressor, a plurality of members forming a discharge port, means to urge said members together to render said port continuous and means to render the discharge port between the members discontinuous during the starting of the compressor.

12. The combination as set out in claim 11 in which said members comprise cylinder blocks.

13. The combination as set out in claim 11 in which said members comprise oscillating blocks.

14. The combination as set out in claim 11 in which said first named means comprise a governor.

15. The combination as set out in claim 11 in which said second named means comprises a positively driven valve.

16. In combination, in a compressor, an oil tight casing for holding a body of lubricant, a plurality of oscillating cylinders in said compressor, said cylinders being submerged in the lubricant, an intake for said compressor, and means connecting the space above the body of lubricant and the intake whereby the pressure of a refrigerant above the body of liquid is maintained substantially equal to the pressure of refrigerant entering the intake.

17. In a compressor, a casing having an inlet and an outlet, mechanism in the casing for compressing a gas, said casing containing a lubricant, means whereby the space above the lubricant is maintained substantially at intake pressure, and an oil and gas separator connected to the casing for returning lubricant, in which gas may be absorbed, flowing out of the outlet of the compressor.

18. In a compressor, a casing having an inlet and an outlet, mechanism in the casing for compressing a gas, said casing containing a lubricant, means whereby the space above the lubricant is maintained at substantially intake pressure, and an oil and gas separator connected to the outlet and the space above the lubricant for returning lubricant flowing out of the outlet.

19. In a compressor, a casing having an inlet and an outlet, mechanism in the casing for compressing a gas, said casing containing a lubricant, means whereby the space above the lubricant is maintained at substantially intake pressure, said means consisting of a connection between the inlet and the space above the lubricant, and an oil and gas separator connected to the outlet and the space above the lubricant for returning lubricant flowing out of the outlet.

20. In a compressor, a plurality of oscillating cylinders having a passageway therebetween for the flow of a fluid, and means for keeping said passageway continuously open.

21. In a compressor, a plurality of oscillating cylinders having a passageway therebetween for the flow of a fluid, one of said cylinders containing a piston and the other a sliding valve, and means for keeping said passageway continuously open.

22. In combination, in a compressor, a casing subjected normally to substantially low intake pressure of the compressor, an oscillatable cylinder, a piston working in said cylinder, means for reciprocating the piston with respect to the cylinder, said reciprocating piston acting on the cylinder to cause it to oscillate, and a valve mechanism also operated by said means.

23. In combination, in a compressor, a casing subjected normaly to substantially low intake presure of the compressor, an oscillatable cylinder, a piston working in said cylinder, means for reciprocating the piston with respect to the cylinder, said reciprocating piston acting on the cylinder to cause it to oscillate, and a valve mechanism also operated by said means, said valve mechanism including a pair of relatively movable parts.

24. In combination, in a compressor, a casing subjected normally substantial low intake pressure of the compressor, an oscillatable cylinder, a piston working in said cylinder, means for reciprocating the piston with respect to the cylinder, said reciprocating piston acting on the cylinder to cause it to oscillate, and a valve mechanism also operated by said means, said valve mechanism comprising an oscillatable cylinder and a piston valve which is reciprocated by the means reciprocating the first named piston.

25. In a compressor, a piston, a cylinder therefor, means causing said cylinder to oscillate during operation of the piston, means for operating the piston, and a two part valve mechanism for the cylinder and connected to said operating means to be operated thereby independently of said cylinder.

26. In a compressor mechanism for a gaseous refrigerant, a fluid tight casing for said mechanism, said mechanism having an inlet and an outlet, said casing carrying a lubricant for the mechanism, a separator for the lubricant and the refrigerant, connected to

the outlet, and means for returning the separated lubricant to the casing.

27. In a compressor mechanism for a gaseous refrigerant, a fluid tight casing for said mechanism, said mechanism having an inlet and an outlet, said casing carrying a lubricant for the mechanism, a separator for the lubricant and the refrigerant, connected to the outlet, means for returning the separated lubricant to the casing, and means for connecting the interior of the casing with the inlet.

28. In a compressor, a cylinder block, a piston, means forming an outlet passageway from the cylinder, said means including a member urged against the cylinder block, and means responsive to pressure conditions in the outlet for causing said member and block to separate for relieving the pressure in the passageway.

29. In a compressor, a cylinder block, a piston, means forming an outlet passageway from the cylinder, said means including a member in contact with the block, and means whereby said member is maintained in contact in response to the operation of the mechanism.

30. In a compressor, a cylinder block, a piston, means forming an outlet pasageway from the cylinder, said means including a member urged against the cylinder block, means responsive to pressure conditions in the outlet for causing said member and block to separate for relieving the pressure in the passageway, and a casing to which the said cylinder outlet connects when the member and block separate.

31. In a compressor, a cylinder block, a piston, means forming an outlet passageway from the cylinder, said means including a member in contact with the block, means whereby said member is maintained in contact in response to the operation of the mechanism, and a casing surrounding the member and the block for confining any escaping fluid from the outlet.

32. In a compressor mechanism, a cylinder block, a member contacting with said block and forming an outlet passageway from the cylinder, a device for urging the member and block together, said member and block being otherwise freely separable, a casing surrounding the compressor block and the member, to confine any fluid escaping between the block and the member, and a connection between the interior of said casing and the intake of the compressor mechanism.

In testimony whereof I have hereunto set my hand.

WILFRED FOURNESS.