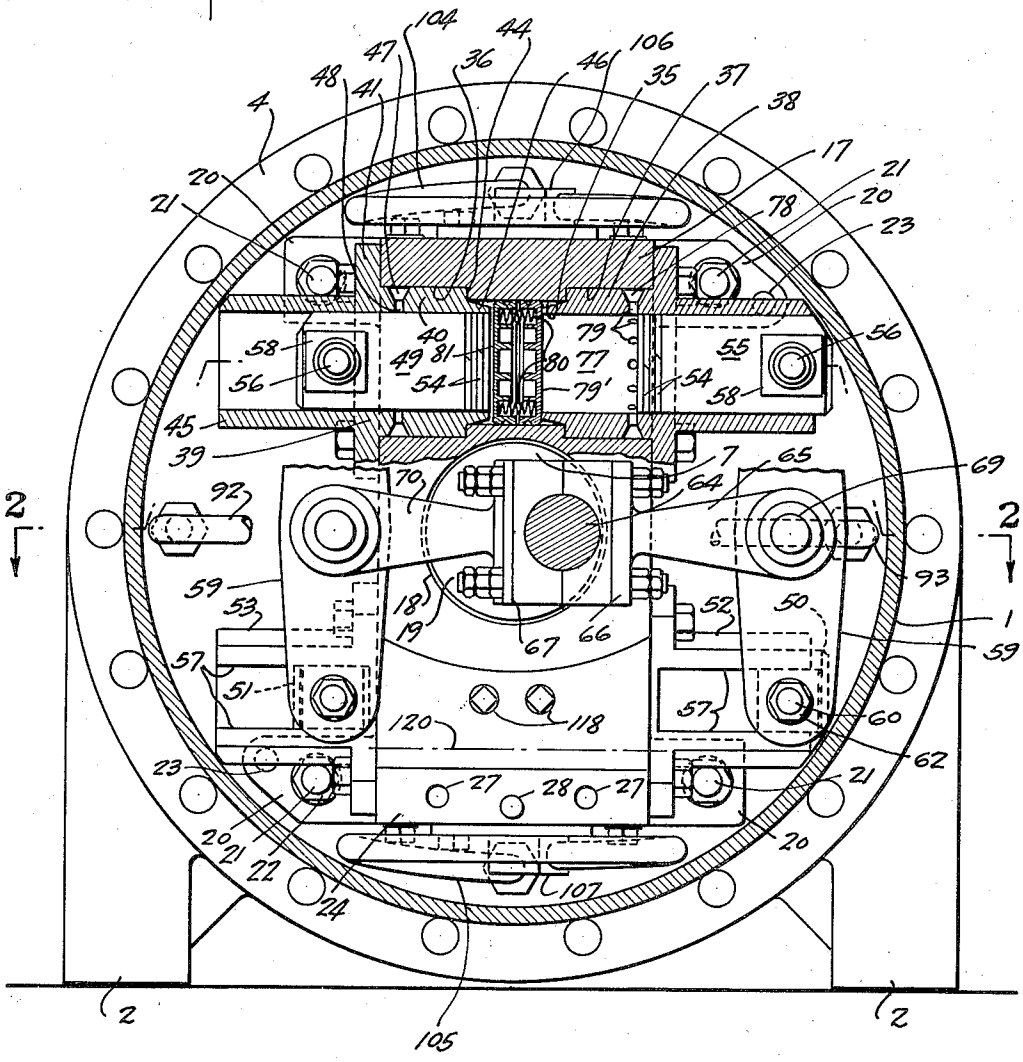
Dec. 10, 1935. W. FOURNESS 2,023,415

RECIPROCATING COMPRESSOR MECHANISM

Filed June 19, 1933 5 Sheets-Sheet 1

Fig. 1



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RECIPROCATING COMPRESSOR MECHANISM

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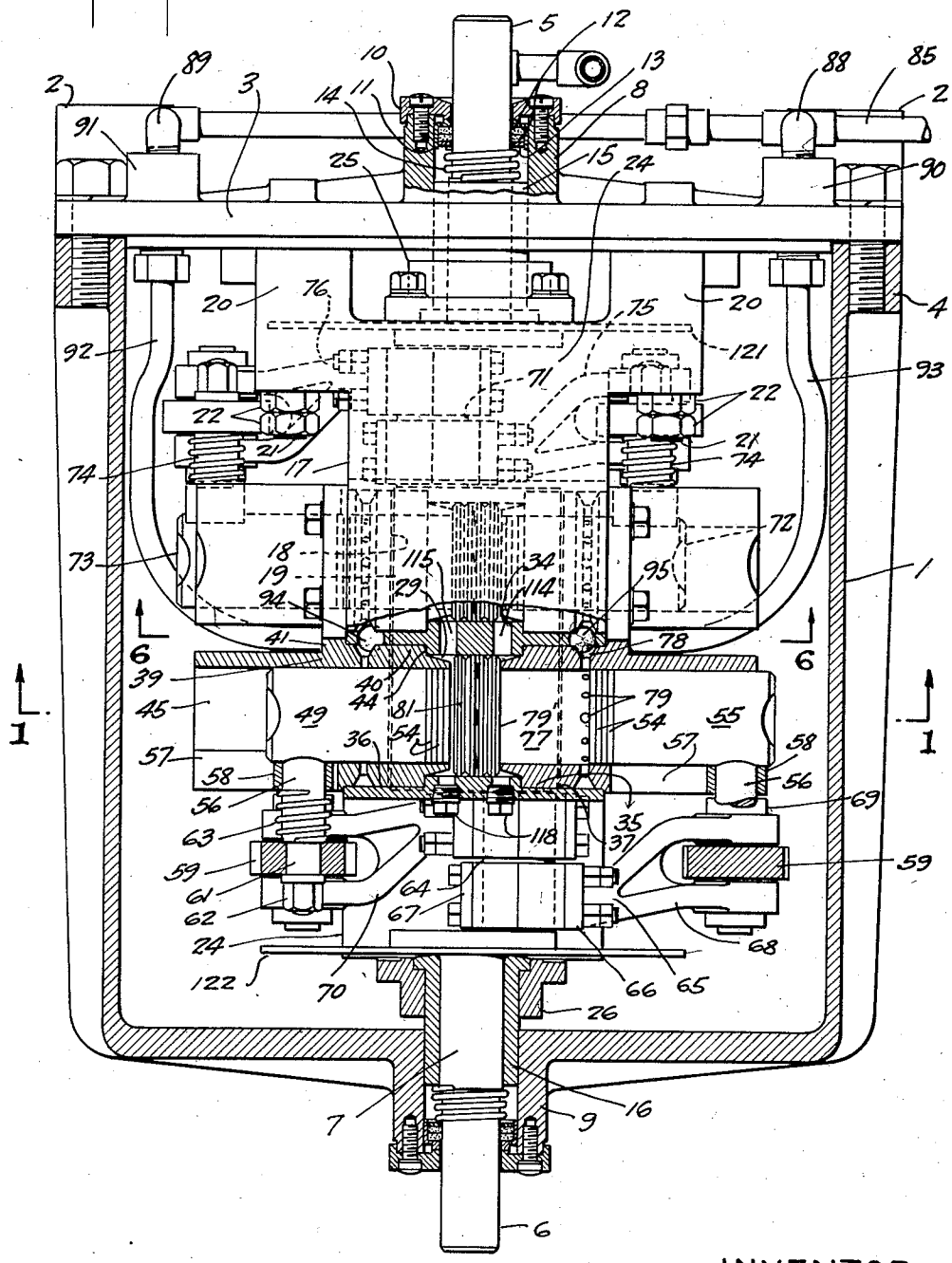
Fig. 2



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RECIPROCATING COMPRESSOR MECHANISM

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Fig. 3

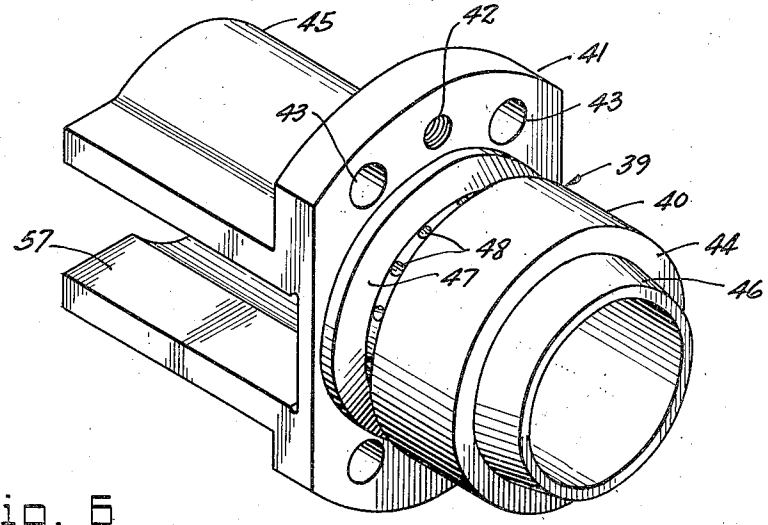


Fig. 6

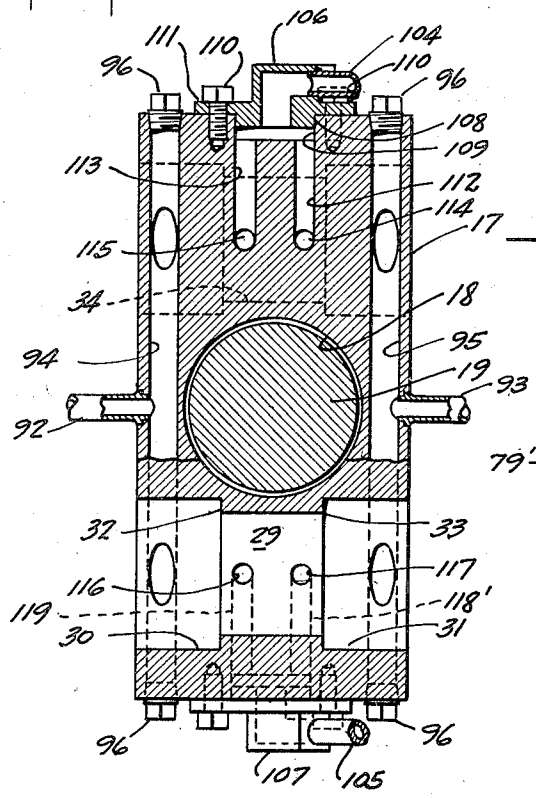


Fig. 4

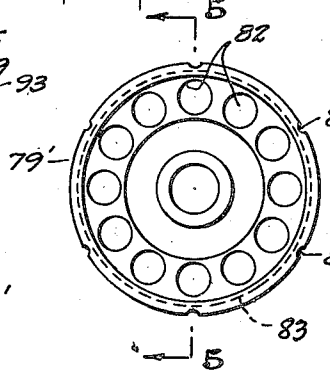
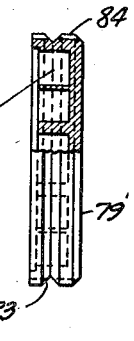


Fig. 5



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RECIPROCATING COMPRESSOR MECHANISM

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Fig. 7

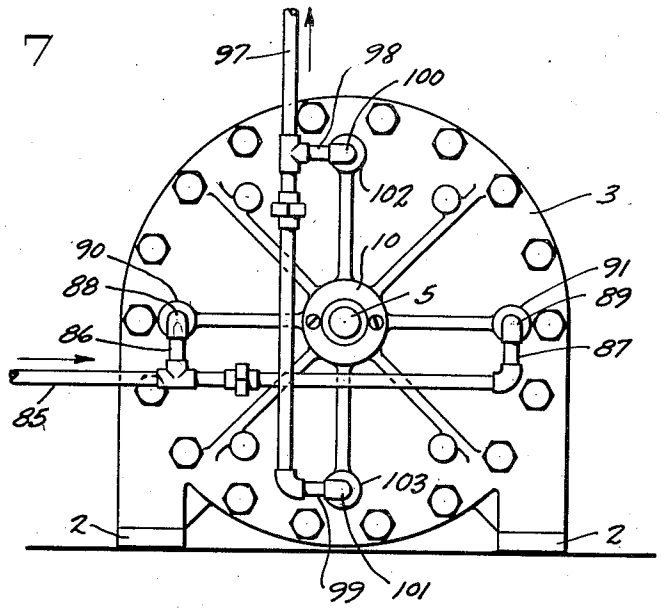
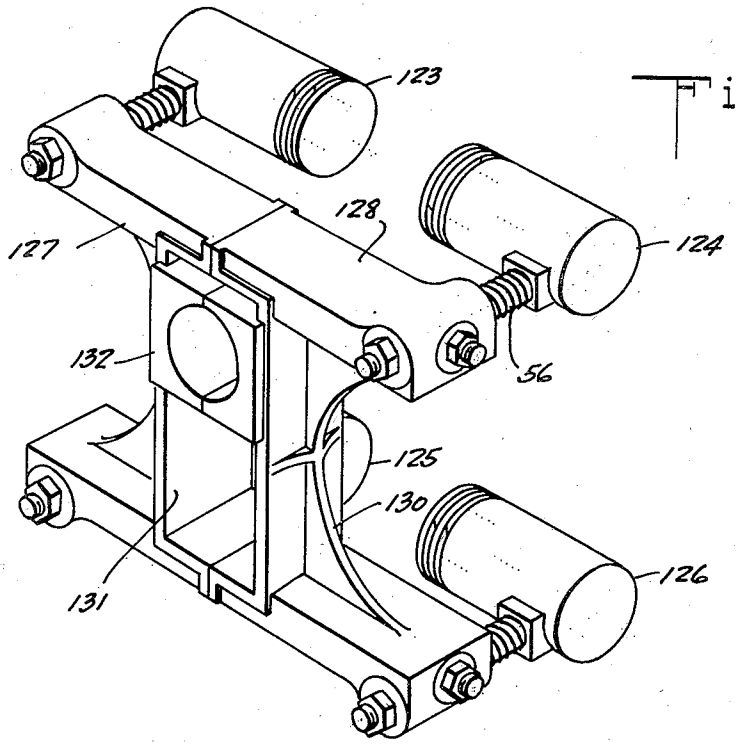


Fig. 8



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RECIPROCATING COMPRESSOR MECHANISM

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Fig. 9

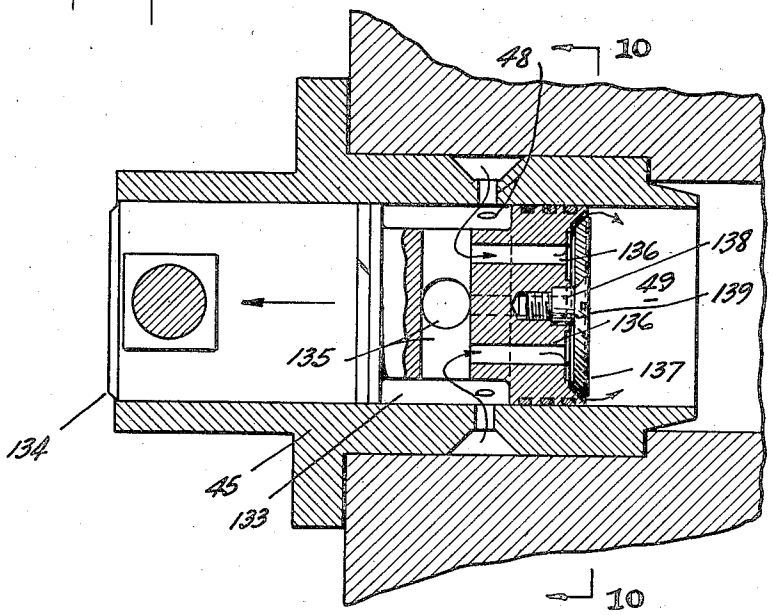
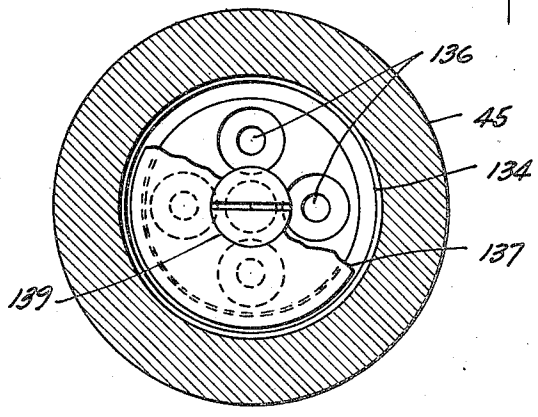


Fig. 10



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Patented Dec. 10, 1935 2,023,415

UNITED STATES PATENT OFFICE

2,023,415

RECIPROCATING COMPRESSOR MECHANISM

Wilfred Fourness, Oakland, Calif., assignor, by mesne assignments, to Edward G. Burghard, New York, N. Y.

Application June 19, 1933, Serial No. 676,464

14 Claims. (Cl. 230—185)

This invention relates to a compressor, and especially to a compressor mechanism adapted for use in a refrigerating system.

In such systems, a readily vaporizable liquid refrigerant is usually provided, which is allowed to evaporate in an expansion coil or the like, under low pressure. The process of expansion or evaporation absorbs heat, and a refrigerating effect is thereby secured. The evaporated refrigerant usually in a vapor or gas form or a mixture of gas and vapor, is then compressed, and later condensed to a liquid, after which the cycle of evaporation, compression and condensation can be repeated.

Since such refrigerating systems in general are now well-known, further description thereof is unnecessary. The present invention relates to the compressor mechanism used in such systems. The invention, however, may be utilized in general for compression of any gases or vapors, whether they are used for refrigeration or for any other purpose.

It is one of the objects of the invention to provide in general an improved form of reciprocating compressor.

It is another object of the invention to provide a multicylinder type of compressor that is compact and yet of large capacity, and operating at a high overall efficiency.

Contributing to these objects are various features of improved construction, such as the apparatus for operating the pistons and the relative arrangement of the plurality of cylinders. It is therefore another object of this invention to provide an improved organization of the reciprocating mechanism.

It is possible at times that a slug of liquid or oil is trapped in a cylinder. If of sufficient mass, such liquid or oil may readily cause excessive loads on the compressor, because ordinarily such slugs cannot pass out of the cylinder except through the restricted outlet ports. It is another object of the invention to make it possible to increase the size of the outlet or discharge port for ready egress of such slugs. This material increase in size is accomplished automatically, whereby the mechanism is relieved without the requirement of any personal or unusual attention.

It is still another object of the invention, to simplify in general, multiple cylinder compressors, in order to reduce the cost of manufacture.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown several forms in the drawings accompanying and forming part of the present specification. These forms shall now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a view mainly in section, taken along the plane 1—1 of Fig. 2, and in a direction transverse to the axis of the driving shaft;

Fig. 2 is a view mainly in horizontal section, taken along the plane 2—2 of Fig. 1;

Fig. 3 is a pictorial view of one of the cylinder blocks;

Fig. 4 is an end view of one of the valve closure members;

Fig. 5 is a side elevation thereof partially in section along the plane 5—5 of Fig. 4;

Fig. 6 is a detail section, taken mainly along plane 6—6 of Fig. 2, but omitting the cylinder blocks;

Fig. 7 is an end elevation of the compressor;

Fig. 8 is a pictorial view of a modified form of operating mechanism for the pistons;

Fig. 9 is a detail section of a cylinder block and piston, illustrating a modified form of piston; and

Fig. 10 is a sectional view taken along plane 10—10 of Fig. 9, and with a part of the mechanism broken away.

In the present instance, the compressor mechanism is enclosed in a casing 1 (Figs. 1, 2 and 7) for providing a fluid tight housing and for accommodating a body of lubricant. This casing can be of general cylindrical construction, having a horizontal axis, and provided with a plurality of supporting feet 2 for resting it on any appropriate base. One end of the casing 1 is closed by a cover 3 bolted tightly against a flange 4 of the casing 1.

The power for operating the compressor is arranged to be coupled at either end of the casing 1, to either one of the protruding portions 5 or 6 of the shaft 7, which extends entirely through the casing.

In order to maintain the casing 1 substantially fluid tight, care is taken to provide appropriate packing around each of the extensions 5 and 6. These packings are most clearly disclosed in Fig. 2, and since they are similar at each end of the casing but one of them will be described in detail.

Thus each end of the casing 1 carries a hollow

boss 8 or 9. The extensions 5 and 6 project beyond these bosses. Referring to boss 8, a cover 10 is fastened to the boss and is provided with an aperture for free rotation of extension 5. It is to be understood of course that appropriate gaskets can be provided between cover 10 and boss 8 as well as between cover 3 and flange 4. A cup 11 is freely slidable inside of boss 8 and its end surface contacts with the inner surface of cover 10. Disposed in the cup 11 are one or more packing washers 12, such as of felt or equivalent material. Pressure is exerted upon these washers 12 to hold them firmly in the bottom of the cup 11, as by the aid of a metal washer 13, disposed over the washers 12, resiliently urged toward the end of the cup as by a compression spring 14. This compression spring 14 at its other end abuts against a stationary bearing sleeve 15 which extends partially into the hub 8. It is apparent that the compression spring 14 holds the packing washers 13 firmly in place.

It is of course possible to substitute equivalent forms of packing in place of that shown.

The manner in which the bearing bushing 15, as well as the opposite bearing bushing 16 are supported will now be described. For this purpose, the main support or frame for the operating parts of the compressor will be described. This frame or support can best be described in connection with Figs. 1, 2 and 6, to which attention is now directed.

This frame has a substantially rectangular body portion 17 through which extends an aperture 18 for the accommodation of an enlarged portion 19 of shaft 7. This body portion 17 is supported entirely on the cover 3, as by the aid of the legs 20. Projecting through these legs are the studs 21, permanently joined to the cover 3 and upon which are threaded the tightening nuts 22. Several of the legs 20 can, in addition, be provided with dowel pins 23; two of these dowel pins being indicated at diagonally opposite corners of the frame in Fig. 1.

In order to provide bearing brackets at each end of the body portion 17, this body portion is provided with the projecting integral brackets 24. There are a pair of these brackets at each end of the body portion 17, and they extend one above and one below the clearance aperture 18. To these brackets are bolted the transverse bearing supports 25 and 26. If desired, appropriate dowel pins can be provided in addition to the bolts. This is indicated clearly in the lower portion of Fig. 1 in which the apertures 27 are the threaded apertures for the bolts and aperture 28 is provided for the intermediate dowel pin.

The bearing sleeves 15 and 16 are secured firmly inside of the supports 25 and 26 respectively.

The removal of the entire mechanism from the casing 1 can be accomplished by simply removing the cover 3 with its attached supporting frame 17.

In the present instance a plurality of cylinders and pistons are shown for providing a multiple cylinder construction. Thus there are eight such cylinders shown in two sets of four each. The axes of all of the cylinders are at right angles to the axis of shaft 7, and the cylinder structures are supported in body 17.

For this purpose the body 17 is provided with four transverse apertures, the axes of which are all parallel and non-intersecting with the axis of shaft 7. Two of these apertures are indicated most clearly in Fig. 6 in the upper and lower part thereof. Thus in the lower part of Fig. 6 the aperture 29 is shown having enlarged portions 30 and 31 forming shoulders 32 and 33. Immediately above aperture 29 there is an aperture 35 (Fig. 1). The axis of this aperture 35 is symmetrical with respect to the axis of aperture 29, and parallel thereto. This aperture 35 also has the enlarged portions 36 and 37, forming shoulders similar to shoulders 32 and 33.

Back of the two apertures 29 and 35 there is another set of two apertures similarly spaced and similarly constructed. The top aperture of this second set is indicated by reference character 34 in Figs. 2 and 6.

Each of these four apertures such as 29 forms a recess for the accommodation of a pair of cylinder blocks. Since all of the cylinder blocks are alike in construction, only those shown in aperture 35 (Figs. 1 and 2) will be described.

Thus in these figures the cylinder blocks 38 and 39 are shown. Cylinder block 39 is shown to best advantage in Fig. 3. There it is seen that the cylinder block has a cylindrical body portion 40 which fits snugly into the enlarged portion 36 of aperture 35. It is provided with a flange 41 by the aid of which it may be bolted tightly against the surface of supporting body 17. If desired, appropriate dowelling means may be provided for the cylinder blocks, the dowel pins being accommodated in apertures 42 intermediate the bolt apertures 43.

The inner end of the cylindrical body 40 has a shoulder 44 adjacent the shoulder in the bottom of the enlarged aperture 36. The cylinder body 40 also has an external extension 45 forming a long guide for the piston which works inside of the cylinder. The inner end of each cylinder block is entirely open and is formed by an externally tapering projection 46. When a pair of cylinder blocks are disposed inside of one of the apertures, such as 35, these open ends are adjacent and are accommodated in a common recess formed by the aperture. This open end, as will be described hereinafter, forms an outlet discharge passageway for the compressed gas. The inlet to the cylinder is provided by an annular external groove 47 which is in communication with the inside of the cylinder as by a series of radial apertures 48.

The description of the cylinder block applies to all eight of them as they may be all of identical construction. The manner in which the inlet and outlet passageways are formed and controlled will be described hereinafter.

Each of the cylinder blocks accommodates a reciprocating piston. In Fig. 1 the cylinder blocks in aperture 35 are shown as having the opposed pistons 55 and 49. Similar pistons 50 and 51 are provided in the other two cylinder blocks 52 and 53 which are disposed immediately below the upper cylinder blocks. If desired each of the pistons can be provided with appropriate piston rings, such as indicated at 54 (Fig. 1). The manner in which the pistons are reciprocated will now be described. The operating mechanism can best be understood by the aid of Figs. 1 and 2.

In these figures, it is apparent that each of these pistons such as 55 can be provided with an integral transverse pin, such as 56. The pin extends through the slot 57 provided in one side of the cylinder block. Although the contacting surfaces of the piston and the cylinder may provide an adequate guide for its motion, it is preferred to relieve wear between the piston and

the cylinder wall by providing a supplemental guide for the movement of the piston. This is accomplished by the aid of a block 58 of rectangular configuration disposed over the pin 56 and sliding in the slot 57. A connecting member 59 joins pins 56 and 60 of those pistons 55 and 50 whose axes are in the same vertical plane and on the same side of the vertical centerline of Fig. 1. This connecting member 59 is joined to the respective pins in a manner shown most clearly in the lower left hand corner of Fig. 2. Thus each of the pins can have a reduced portion 61, over which the member 59 is accommodated. The assembly can be held firmly together by the aid of a nut 62 threaded on the portion 61. Furthermore, a compression spring 63 can be provided between the member 59 and the sliding block 58 for holding this block against the cylindrical surface of the corresponding piston.

It is apparent that, by reciprocating the connecting member in a direction parallel to the axes of pistons 55 and 50, these pistons will be correspondingly reciprocated in unison. To accomplish this result use is made of a crank and crank pin connection between the member 59 and the shaft 7. Thus the enlarged portion 19 of shaft 7 can be machined to provide eccentric crank portions such as 64. Connecting the eccentric portion 64 with the member 59 is a connecting rod 65. This connecting rod has a big end 66 forming a bearing block with a cap 67. In the position shown in Fig. 1, pistons 55 and 50 are in their extreme outward positions, since the eccentric portion 64 is in its extreme radial position in a direction parallel to the axes of these pistons. The operating member 59, as eccentric 64 rotates around the axis of shaft 7, is constrained to move in the direction of the axes of the cylinders by virtue of the guiding surfaces between the pistons and the cylinders, as well as between the blocks 58 and the slots 57.

The pivotal connection between the connecting rod 65 and operating member 59 is shown to best advantage in the lower right hand corner of Fig. 2. It is there seen that the connecting rod has a bifurcated portion 68 which embraces the center portion of the member 59. An appropriately headed pivot pin 69 passes through the bifurcations as well as through the center of the member 59.

The other two pistons 49 and 51 whose axes are respectively coincident with the axes of the pistons 55 and 50 are similarly actuated. Thus a connecting rod 70 connects the eccentric portion 64 with the appropriate operating member 59. Since both connecting rods 65 and 70 are accommodated on the same eccentric member 64 it is apparent that as pistons 55 and 50 move inwardly in their respective cylinders the pistons 49 and 51 will simultaneously move outwardly. In this way the phases of intake, compression and discharge are displaced 180 degrees with respect to those pistons which cooperate in coaxial cylinder blocks.

In order to balance the mechanism, the operation of the four pistons closer to the cover 3 is provided by an integral eccentric portion 71 which is displaced by 180 degrees from the eccentric portion 65. Of these four pistons, the two top ones only are illustrated in Fig. 2 by reference characters 72 and 73. These pistons have as before, integral pins 74 which extend in the opposite direction from the pins 56 in the first set of four pistons discussed. The two connecting rods for operating these pairs of upper and lower pistons are indicated in dotted lines by reference characters 75 and 76, which are placed in the same relative symmetrical position as the rods 66, 70, adjacent the other side of the supporting body 17.

Since the cycle of operations is the same in each piston and the cylinder unit, this cycle will be described only in connection with piston 35 and cylinder unit 38 shown in Fig. 1.

In the position shown in this figure, the cylinder space 77 is connected with the intake passageways, and gas at incoming pressure passes into the cylinder space 77 by way of the annular passageway 78 and radial apertures 79. Shortly upon movement of piston 55 toward the left the apertures 79 are closed by the advancing edge of the piston and the gas is compressed in the cylinder. The cylinder space is closed during this period by a closure member 79' shown in greater detail in Figs. 4 and 5. This closure member contacts with the inner edge of the cylinder wall, and is coextensive in area with the cross section area of the cylinder. It is formed as a flat disk slidable in the recess formed by aperture 35 and urged resiliently into contact with the end of the cylinder. This is accomplished by the aid of a plurality of compression springs 80 urging both closure members 79' and 81 apart. The closure member 81 is similar to closure member 79' but cooperates with the opposite coaxial cylinder 40. In order to provide definite guides for the compression springs 80, a series of circular recesses 82 are provided in the rear of the closure disks 79'—81. These springs are properly designed of such strength that they hold the closure members tightly against the cylinder to provide a closed compression space, until a sufficient pressure is produced by virtue of the reduction in volume of the cylinder space. When this occurs, compression springs 80 are compressed, the closure member moving away under gas pressure and uncovering the end of the corresponding cylinder. Such an uncovering is illustrated in connection with the closure member 81 of Fig. 1. The compressed gas then flows into the aperture 35. This is possible because an annular groove 83 is provided in each closure member 79'—81, and a series of transverse grooves 84 intersect this annular groove adjacent the edge of the closure. The compressed gas can therefore freely pass around the edges of the closure members once they are unseated by gas pressure from the ends of the corresponding cylinders.

The full compression position of the piston is shown in Fig. 1 by the position of piston 49. As soon as the piston begins to move away from the inner end of the cylinder, the closure 79 is permitted to seat, and as soon as the piston uncovers the inlet apertures 79, a fresh charge of low pressure gas is permitted to flow into the cylinder. From then on the cycle is repeated.

It is apparent also that by virtue of the juxtaposition of the pistons such as 55 and 49, the closure members 79' and 81 are alternatively unseated so that the discharge gases flow from the corresponding cylinders at opposite positions of the corresponding operating eccentric.

The manner in which the intake and exhaust connections are provided to all of the eight cylinders can best be explained in connection with Figs. 1, 2, 6 and 7. Thus a conduit 85 (Figs. 2 and 7) leading from an expansion coil, conducts intake pressure to the two branches 86 and 87.

These two branches are provided with elbows 88 and 89 connected into the corresponding bosses 90 and 91 on the outside of the cover 3. There are through apertures in these bosses, and on the inside of the cover, conduits 92 and 93 are respectively provided, and extend, as indicated in Fig. 6, into the opposite sides of the body portion 17 and at a point intermediate the sets of cylinders. These conduits 92 and 93 respectively connect with vertical apertures 94 and 95 bored completely through the body member 17 but plugged at the ends as by plugs 96. These bores 94 and 95 as illustrated most clearly in Fig. 2, intersect the enlarged ends of the cylinder space apertures, such as apertures 29 and 34, at a point where the annular grooves 47 of the cylinder blocks are positioned. Thus for example, the passageway 94 connects with two cylinder spaces at the top and two cylinder spaces at the bottom. Similarly the passageway 95 communicates with the other four cylinder spaces.

The outlet conduit 97 (Figs. 1 and 7) is arranged in an upright position on the exterior of the cover member 3. It also has two branches such as 98 and 99, connected by way of elbows 100 and 101 to bosses 102 and 103 on the outside of cover member 3. These bosses have through apertures, into which are connected respectively the upper and lower convoluted conduits 104 and 105. Each of these conduits 104 and 105 connects respectively with an elbow 106, 107. The construction of these elbows is shown most clearly in Fig. 6. As they are similar, but one of them will be described. Thus for example elbow 106, which is disposed on the top of body member 17, has a circular projection 108 extending into a bore 109 and is held in place by the aid of bolts 110 passing through flange 111 of the elbow.

Extending inwardly from the bore 109 are two apertures 112 and 113 which connect respectively to the horizontal passageways 114 and 115. Each of these horizontal passageways connects with a pair of recesses formed between a pair of opposed cylinder blocks, respectively at opposite ends of the passageways. This is indicated most clearly in Fig. 2.

The four lower cylinder blocks are similarly connected to elbow 107, by way of a pair of horizontal passageways 116 and 117 shown in Fig. 6.

In order to form the bores 114, 115, 116 and 117, it is necessary to bore completely through the body 17. The ends of the bores, however, can be plugged as shown by the plugs 118 in Fig. 2.

The course of the gas through the compressor can now be traced. The intake conduit 85 as before stated, leads the expanded gas or vapor from a refrigerating space, such as an expansion coil. The expanded gases then flow through branches 86 and 87 to the branches 92 and 93. Thence the gases flow through the passageways 94 and 95 in communication with the annular groove 47 in each of the cylinder blocks. When the corresponding piston is withdrawn far enough to uncover the radial apertures 48, these gases enter the cylinder space. When the gases are compressed to a definite pressure in the cylinders, the corresponding closure member 79', 88 is urged away from the end of the cylinder and the compressed gases flow into the recess formed by the transverse bores such as 29, 34, 35. From this recess, the compressed gases are allowed to flow into the apertures 114, 115, 116 and 117. These apertures are respectively in communication with the vertical apertures 112, 113, 118' and 119 leading to the elbows 106 and 107. From these elbows the branches 104 and 105 lead the compressed gases through the cover member 3 to the elbows 100, 101 to the outlet conduit 97.

It is furthermore apparent that in case lubricant or other incompressible material be trapped in any of the cylinder spaces, the correspondingly high abnormal pressures will cause a maximum motion of the corresponding closure members 79' and 81. In this way a large outlet passageway is formed which permits quick passage of the obstructing body of liquid or plug, into the outlet passageways without danger of disrupting the mechanism. The closure members such as 79', 81 are freely slidable in the corresponding recesses and are unrestrained except by the pressure of the compression springs 80.

Preferably the housing 1 carries a body of oil, as by filling the housing 1 to a level indicated at 120 in Fig. 1. This level is at about the lower edge of the lower cylinders. Furthermore, in order to distribute the oil to the bearing parts, oil discs 121 and 122 (Fig. 2) may be provided adjacent each end of the body member 17 and rotatable with the shaft 7. These discs dip into the body of oil and serve to throw lubricant to the moving parts.

In the form just described use is made of a plurality of connecting rods for operating all eight of the pistons. In lieu of such connecting rods, use may be made of a yoke mechanism, shown diagrammatically in Fig. 8. In this figure, one yoke is shown operating a set of four pistons 123, 124, 125 and 126. It is apparent that a duplicate yoke could be utilized, axially spaced along the shaft, for operating a total of eight pistons, the cylinders for which may be arranged as in the form just described. In this form, the yoke mechanism comprises two brackets 127 and 128 appropriately braced as by vanes 130 and fastened together to form a vertical slide 131. Slidable in the slide is a rectangular member 132 formed of two halves and engaged by an eccentric portion of the shaft. As the eccentric rotates, it is apparent that the yoke 127, 128, being constrained to move in a horizontal direction by the cylinder walls and by the slide 58, allows the member 132 to slide vertically through an overall distance corresponding to twice the eccentricity of the eccentric portion.

The pins 56, joined to the pistons, are firmly attached into the ends of the arms of the yoke.

Since otherwise the mode of the operation of this form of the invention is similar to that disclosed in connection with the other figures, further description thereof is considered unnecessary.

When the compressor is to be driven at high speed, it is sometimes advisable to provide a valved inlet which is operated to open during the suction stroke of the piston. This is preferable to the "flash" inlet described in connection with Figs. 1 and 2 and occurring when the edge of the piston uncovers the apertures 48.

Such a suction valve construction is shown in Figs. 9 and 10. In this figure the cylinder block 45 and apertures 48 are arranged as heretofore. However, the apertures 48 are in communication at all times with the annular space 133 formed around a reduced portion of a piston 134. This annular space in turn connects with the radial apertures 135 and the axial apertures 136. These axial apertures 136 lead to the cylinder space 49, but are overlaid by a light disc closure 137. This

disc closure is guided by the shoulder 138 of a screw 139 and is shown in Fig. 9 as in unseated position.

Thus when the piston 134 is moving toward the left, a suction is produced in the space 49 which causes the disc 137 to lift slightly as shown, allowing the intake gases to pass around the edges of the disc into the cylinder space. It is thus apparent that the introduction of the intake gases by suction continues during the entire suction stroke of the piston. This makes it possible to obtain a full charge in shorter time than if the intake of the gases is accomplished only when the apertures 48 are uncovered.

The closure disc 137 seats over the apertures 136 when the piston 134 begins the compression stroke. However, even when so seated, the conical edge of the disc is spaced from the corresponding conical wall in the end of the piston 134.

I claim:

1. In a compressor mechanism, a pair of cylinder blocks having spaced parallel axes, a piston in each block, a yoke extending between the pistons, a pin connection at each end of the yoke for the corresponding piston, each of said blocks having a slot through which said pin extends, a pair of members respectively disposed over the pins and contacting opposite sides of the slot to slide therein, and means for reciprocating said yoke.

2. In a compressor mechanism, four cylinder blocks, said blocks being paired so that each pair are coaxial, the axes of the two pairs being parallel, a piston in each block, and means for simultaneously reciprocating the pistons, comprising a connection from one piston of a pair to another piston of another pair, a similar connection for the other two pistons, and a common means for moving both connections in a direction parallel to the axes.

3. In a compressor mechanism, a pair of coaxial cylinder blocks, a piston in each block, and means interposed between and cooperating with the adjacent ends of the blocks to define outlet valve openings for the blocks, comprising a pair of end closures respectively for the adjacent ends of the blocks, means resiliently urging said closures apart for closing the ends of the blocks, and means forming a common outlet conduit from said blocks.

4. In a compressor mechanism, a pair of coaxial cylinder blocks, a piston in each block, and means interposed between and cooperating with the adjacent ends of the blocks to define outlet valve openings for the blocks, comprising a pair of end closures respectively for the adjacent ends of the blocks, means resiliently urging said closures apart for closing the ends of the blocks, said closures having areas coextensive with the areas of the ends of the cylinder spaces, and means forming a common outlet conduit from said blocks.

5. In a cylinder block structure, means defining a cylindrical wall, said wall having on its external surface, an annular groove, as well as apertures connecting the groove with the inside of the block, and a support having a recess for accommodating said external surface, said recess having a passageway cooperating with the annular groove to form a connection to the inside of the block.

6. In a compressor mechanism, four cylinder blocks, said blocks being paired so that each pair are coaxial, the axes of the two pairs being parallel, a piston in each block, and means for simultaneously reciprocating the pistons, comprising a connection from one piston of a pair to another piston of another pair, a similar connection for the other two pistons, and a common means for moving both connections in a direction parallel to the axes, comprising a crank shaft having an axis perpendicular to the axes of the cylinder blocks, and intermediate the axes of the two pairs.

7. In a compressor mechanism, a support, and a cylinder block in said support, said block having a cylindrical wall for defining the cylinder space, the exterior of the wall having an annular groove, as well as apertures connecting the groove with the inside of the block, said support having a passageway in communication with the annular groove.

8. In a compressor mechanism, a cylinder block having an open end, said open end being coextensive with the cross section area of the cylinder, a closure covering said end, and means resiliently urging said closure against said end, and forming with said end an outlet discharge valve, said closure being otherwise free to move a substantial distance away from the open end, whereby a large outlet opening can be automatically formed upon the occurrence of abnormal pressures in the cylinder.

9. In a compressor mechanism, a support, a cylinder block having an open end disposed in a recess in the support, a closure for the open end, said open end being coextensive with the cross section area of the cylinder, said closure being slidable in the recess and defining with the open end, an outlet valve for the cylinder, and means whereby abnormal pressures in the cylinder can cause the closure to separate by a substantial distance from the open end.

10. In a compressor mechanism, a support having a recess, opening on opposite sides of the support, a pair of cylinder blocks respectively inserted into the recess from opposite sides of the support, said blocks having openings at their adjacent ends in the recess, a pair of closure members in the recess cooperating respectively with the cylinder block openings, and means resiliently urging said closures apart and against their respective cylinder openings.

11. In a compressor mechanism, a support having a recess, opening on opposite sides of the support, a pair of cylinder blocks respectively inserted into the recess from opposite sides of the support, said blocks having openings at their adjacent ends in the recess, a pair of closure members in the recess cooperating respectively with the cylinder block openings, and means resiliently urging said closures apart and against their respective cylinder openings, each of said closure members being guided in the recess, and having an annular groove in the outer periphery and slots across said groove.

12. In a compressor mechanism, a support having a recess, opening on opposite sides of the support, a pair of cylinder blocks respectively inserted into the recess from opposite sides of the support, said blocks having openings at their adjacent ends in the recess, a pair of closure members in the recess cooperating respectively with the cylinder block openings, and means resiliently urging said closures apart and against their respective cylinder openings, said support having an outlet passageway communicating with the recess.

13. In a compressor mechanism, means forming a pair of coaxial cylinder chambers, a pair

of pistons, respectively operating in said chambers, a pair of valve members respectively cooperating with the chambers and interposed between the pistons for controlling the outlet to the chambers, and means whereby compression of the piston in one chamber urges the valve member of the other chamber toward closed position.

14. In a compressor mechanism, means forming a pair of coaxial cylinder chambers, a pair of pistons, respectively operating in said chambers, a pair of valve members respectively cooperating with the chambers and interposed between the pistons for controlling the outlet to the chambers, means for simultaneously moving both pistons so that one piston approaches its corresponding valve and the other recedes from its corresponding valve, and means connecting the valves for causing the compression in one chamber to exert a force tending to close the valve for the other chamber.

WILFRED FOURNESS.