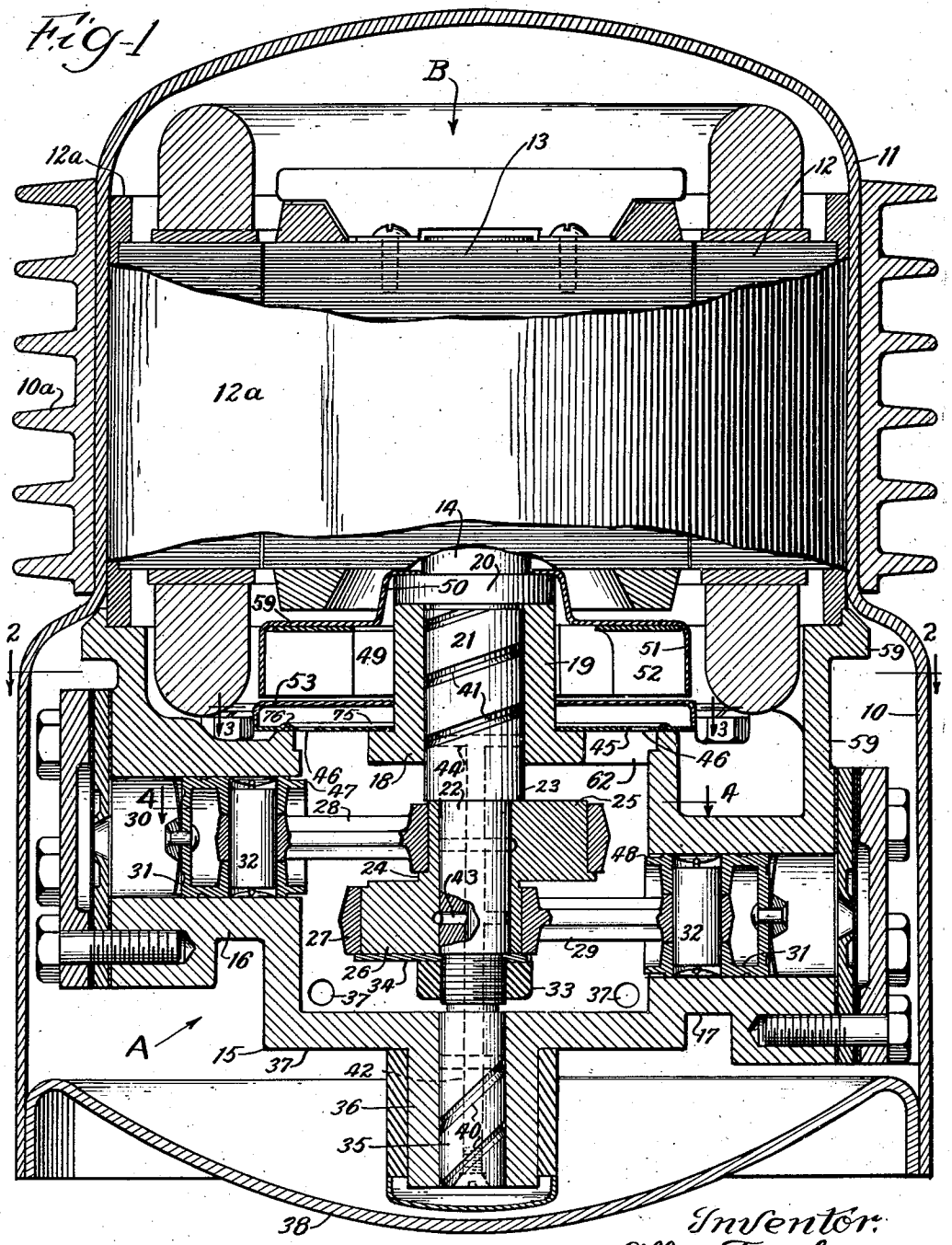
June 24, 1941. A. TRASK 2,246,868

COMPRESSOR

Filed April 11, 1938 3 Sheets-Sheet 1

Fig-1



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COMPRESSOR

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Fig-3

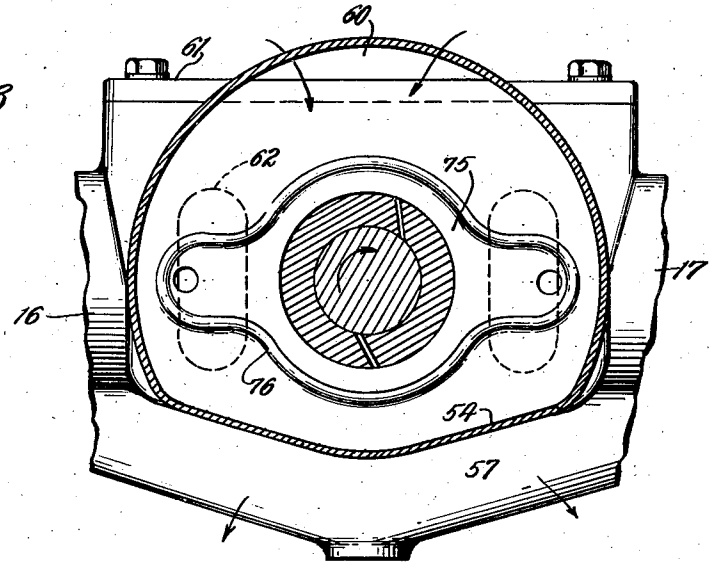
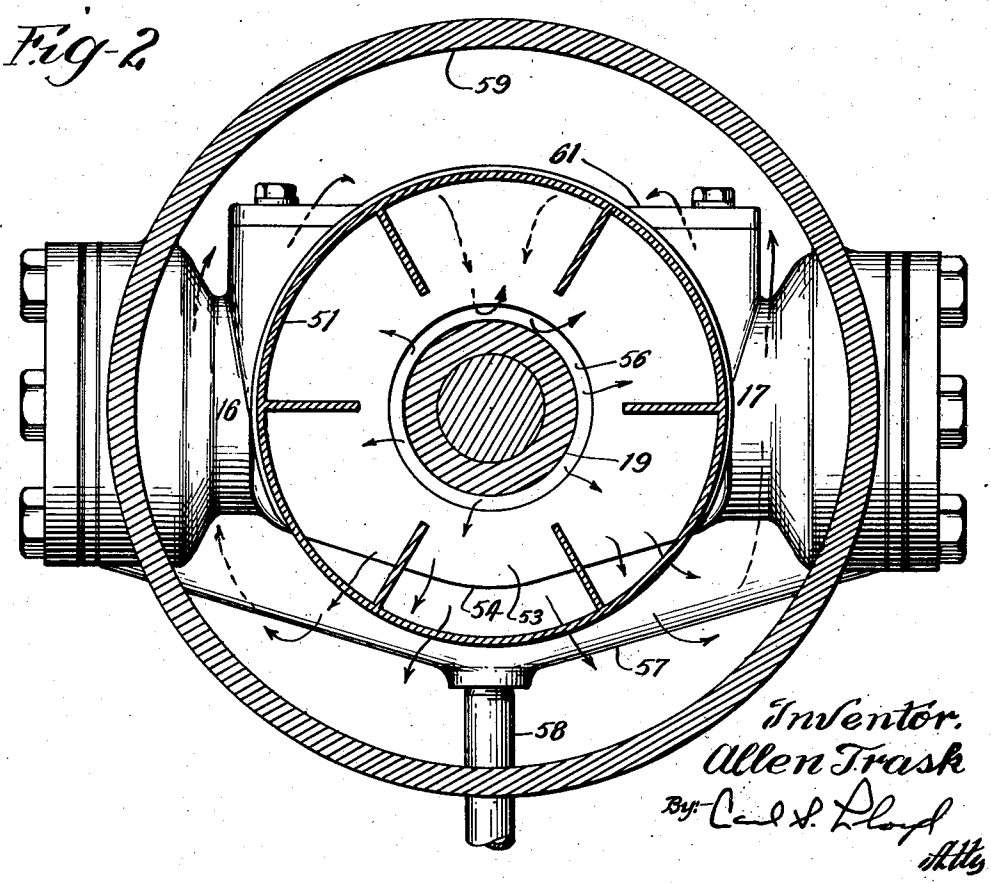


Fig-2



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COMPRESSOR

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Fig-4

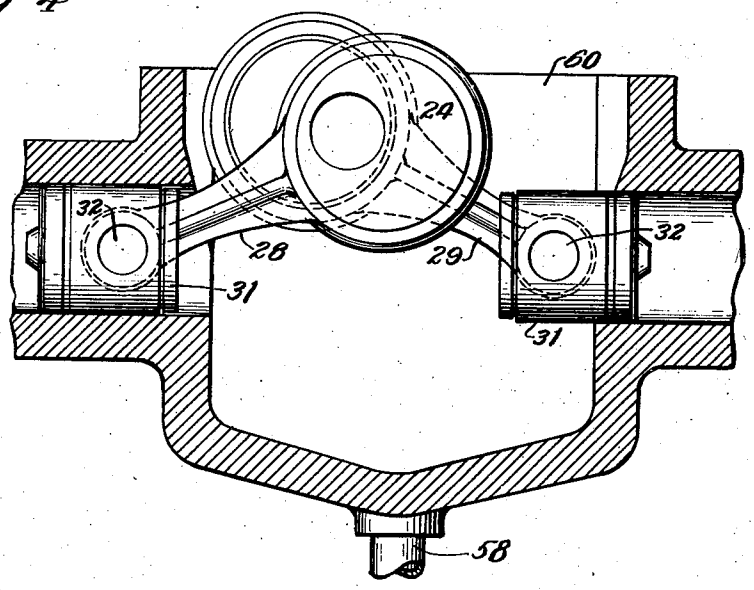


Fig-5

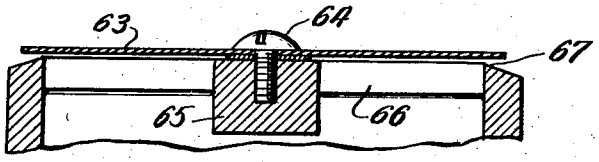


Fig-6

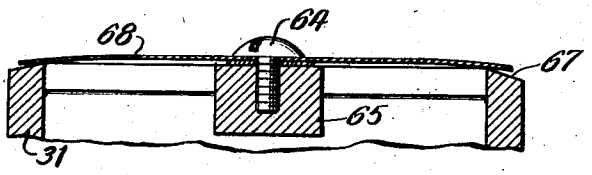
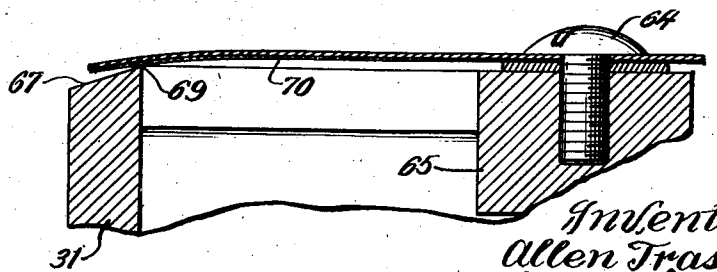


Fig-7



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Patented June 24, 1941 2,246,868

UNITED STATES PATENT OFFICE

2,246,868

COMPRESSOR

Allen Trask, Chicago, Ill., assignor to Mills Novelty Company, Chicago, Ill., a corporation of Illinois

Application April 11, 1938, Serial No. 201,272

16 Claims. (Cl. 230—206)

This invention relates to hermetic compressors of the type disclosed in my Patent No. 2,065,162, issued December 22, 1936, and incorporates certain improvements upon the compressor covered in that patent.

An object of the invention is to provide an improved arrangement for lubricating the pistons and cylinders of a compressor of this type. In former devices of this general nature, reliance has been placed upon the splash system in which some portion, usually a small one, of the oil which is thrown off the crank shaft, etc., is expected to find its way into the cylinders and upon the piston.

The present invention provides a greatly improved arrangement for lubricating the cylinders and pistons by providing for the positive direction of the oil which is pumped up to and escapes from the upper bearing of the crank shaft, downwardly along the rear end of the cylinder in the top central region thereof so as to deposit such oil upon the top central portion of the skirt of the piston which is arranged to project somewhat beyond the rear end of the cylinder at the extremity of its rearward stroke. From this point the oil will flow on both sides of the skirt, and, following the same into the cylinder, will continue its travel down both sides of the wall of the cylinder.

A further object is to provide an arrangement in which the amount of oil delivered to the pistons may be accurately controlled at a predetermined rate of flow, the excess being returned directly to the oil reservoir.

Another object of the invention is to provide, in combination with such arrangement, an arrangement for directing a flow of refrigerant vapor against the upper bearing of the compressor and around the interior of the housing thereof and in contact with the oil flowing from said bearing, so as to cool the bearing, the shaft, the crank case, the cylinder heads, and the oil, and to carry the heat by forced convection from said parts to the housing.

Another object of the invention is to provide in a compressor of this type embodying two cylinders and two pistons, in an integral cylinder block and crank case, an arrangement permitting ready removal of the pistons and connecting rods. To this end, the invention provides an eccentric member which is detachably mounted upon the crank shaft, the latter being spaced so that it may be withdrawn from the eccentric member to allow the latter to be moved to one side of the crank case to a point remote from the cylinder so as to expose the piston pin and allow its removal.

Another object of the invention is to provide an improved inlet valve of the self-unloading type mounted upon the head of a piston. Instead of the normally dished valve disclosed in my prior patent, above identified, I employ a perfectly flat disc which is rigidly attached to the central region of the piston head and arranged to coact with the valve seat formed in the periphery of said head. Means are provided for spacing the valve element a slight distance from the valve seat in its normal unstrained position, whereby the valve is normally unseated. The invention in this respect involves the discovery that flat valve discs of resilient metal of proper thinness and diameter, will, under the influence of inertia during the compression stroke, contract to a dished shape seating against the valve seat. The invention in this respect aims to simplify and cheapen the cost of construction of a valve arrangement of this type by eliminating the necessity of giving the valve a pre-dished shape and making it possible for all parts to be machined perfectly flat.

Other objects of the invention will become apparent from the following detailed description of the invention in connection with the accompanying drawings, in which:

Fig. 1 is a vertical sectional view through a compressor embodying the invention.

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

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 1 and illustrating the removal of a piston pin;

Fig. 5 is an enlarged sectional view illustrating the inlet valve in normal unbowed position;

Fig. 6 is a similar view illustrating the valve in closed position; and

Fig. 7 is a similar view of a modified form of the valve.

A typical compressor embodying the invention comprises an outer housing embodying an enlarged lower portion 10 to receive a compressor A and a reduced upper portion 11 to receive a motor B. The motor B embodies a stator 12, an armature 13, and a shaft 14 secured in the armature and projecting downwardly below the motor. The compressor A includes a crank case 15 and a pair of cylinders 16, 17, integrally formed with and projecting from opposite sides of the crank case 15. The compressor A is supported by means of an annular flange 59, formed integrally with the cylinders and crank case, pro-

jecting upwardly therefrom, and suitably secured to the shell 12a of the motor B. Forming an upward projection of the top wall 18 of the crank case is an upper bearing 19 in which the projecting portion of the shaft 14 is journaled. The shaft is provided with an integral shoulder or flange 20 which bears against the upper end of the bearing 19 to carry the end portion of the shaft under its own weight and the weight of the armature 13.

Below a portion 21 of the shaft 14, which is journaled in the bearing 19, the shaft is reduced as at 22 to form a shoulder 23, against which is received an eccentric member 24. The eccentric member 24 comprises an upper throw 25 and a lower throw 26, the former receiving a bearing ring 27 of an upper connecting rod 28 and the latter receiving the bearing ring 27 of a lower connecting rod 29.

Each cylinder 16, 17 has a cylinder bore 30 in which is received a piston 31. Each piston 31 is connected to its respective rod 28, 29 by means of a piston pin 32.

The eccentric member 24 is securely held on the shaft portion 22 by means of a nut 33 mounted upon the shaft portion 22 and engaging a plate member 34 which projects beyond the periphery of the lower throw 26 to form a shoulder to support the ring 27 of the connecting rod 29.

The lower end of the shaft 14 is further reduced to form an end trunnion 35 which is journaled in a lower bearing 36 formed integrally with and projecting downwardly from the bottom of the crank case 15.

The bottom of the crank case 15 is provided with an opening or openings 37, which serve, during the operation of the device, to allow oil to be returned from the crank case 15 into the oil pan or reservoir 38 forming the bottom of the casing 10.

When it is desired to disassemble the device, access to the nut 33 may be had by extending a proper tool through a door 60 (Fig. 4) in the crank case, normally closed by a closure plate 61 (Figs. 4 and 2), and as the nut 33 is unthreaded, the shaft 14 may be lifted upwardly, until it finally may be lifted entirely out of the crank case. Thereupon, the eccentric member 24 may be moved to one side of the crank case, remote from one of the cylinders 16, 17, moving with it the connecting rods and the pistons, one piston being pushed farther into its cylinder and the other one being pulled out of its cylinder until the piston pin 32 of the latter is exposed sufficiently to be driven out through the opening 37. In order that this may be accomplished, openings 62 are provided in the top wall 18 of the crank case, opposite the openings 37, and a tool may be inserted through an opening 62, to engage the pin 32.

The lower bearing 36 extends into the body of oil in the oil reservoir 38, and the lower region of the crank shaft 14 is provided with helical oil pumping grooves 40 and 41 respectively for carrying the oil to the connecting rod bearings 27 and the upper bearing 19 respectively. Oil distributing passages 42, 43, and 44 are provided in the shaft for receiving and distributing the oil thus lifted by the spiral grooves.

Oil distributed to the bearing 19 will flow out between the top of the bearing and the shoulder 20, thence downwardly along the exterior of the bearing 19, to the top 18 of the crank case, where it will be collected. It is collected upon a plate 45, which is positioned upon the top wall 18 of the crank case and normally covers the opening 62. In the plate 45 are a pair of relatively small openings 46, through which the oil collected upon the plate 45 will flow downwardly along the end walls of the cylinders 16, 17, respectively, to the points indicated by numerals 47, 48, respectively, where the respective streams of oil will be delivered upon the piston 31. The oil is collected and guided to the openings 46 by means of a well 75 formed in the plate 45 by an upwardly embossed bead 76, encircling the bearing 19 and extending to the openings 46.

The openings 46 being centered above cylinder 30, the oil streams will be delivered to the top central regions of the piston and will thence divide equally and flow along both sides of the piston, following the piston into the cylinder 30 and then flowing downwardly along the sides of the cylinder.

In this manner any desired amount of the oil escaping from the bearing 19 may be delivered to the pistons. The size of openings 46 determine the volume of oil delivered to the pistons.

A centrifugal ventilating fan 49 embodies a top wall 59 formed with a central portion 50 which receives the shoulder 20 and is caught between said shoulder and the armature 13. The fan has an annular flange 51 which serves to direct the discharged refrigerant vapor downwardly. It has conventional blades 52.

Between the fan and the top wall 18 of the crank case is disposed a ring 53 the periphery of which substantially registers with that of the fan with the exception of one side which is flattened as at 54. The ring 53 has an annular flange 55 extending around its entire periphery and engaged against the plate member 45. Its central opening forms the inlet, or "eye" of the fan.

Referring now to Fig. 3, it will be noted that the flange 55 extends beyond the flattened side of the crank case defined by a cover plate 61, thereby forming an inlet 60 through which vapor may flow into the space between the member 53 and the top of the crank case. From this space, the vapor flows (Fig. 2) through an opening 56, annularly shaped, between the member 53 and the bearing 19, into the center of the fan.

In leaving the fan, the vapor is discharged downwardly and tangentially through the space formed between the flat side 54 of the member 53 and the depending annular flange 51 of the fan.

The flattened side 54 is shaped to conform to the shape of the exhaust manifold 57 through which the compressed fluid is led to the exhaust tube 58. This flow of air over the exhaust manifold helps to cool the same.

It may be noted that the vapor in traveling through the fan proceeds up one side of the crank case, thence to the fan, and thence down the other side of the crank case. It may also be noted that the vapor-flow contacts the flow of oil from the top of the bearing 19 and through the opening 46.

Thus the vapor first absorbs heat from the oil, then, as it travels into the center of the fan through the inlet thereof, it cools the bearing 19. After leaving the fan, it spirals downwardly outwardly past the cylinder heads cooling them, and thence into contact with the inner surface of the housing 10, transferring its absorbed heat thereto. This heat is transferred by conduction

to the heat dissipating vanes 10a and is then radiated into the atmosphere.

The cooling of the bearing 19 is important in view of the heat developed in the rotor 13 by the resistance characteristic of a motor of the type most suitable for the particular use involved.

An improvement residing in the present invention is the arrangement of a crank case within an outer housing, the lower part of which forms an oil reservoir, and the spacing of the delivery openings 37 in the crank case above the level of the oil in the reservoir 38. In my prior patent above identified, the oil is delivered from the bottom of the crank case into the oil reservoir through a pair of tubes which extend down into the body of oil. I find that the present arrangement is an improvement over that construction in that it eliminates a tendency for the oil to be pumped up through the tubes into the crank case upon the compression stroke of the pistons.

The crank case serves not only as a means for collecting all of the oil that is thrown off by the moving parts of the compressor, but also serves to muffle the noise of intake, compression, and exhaust, so as to make the unit very silent in operation. This muffling effect is secured by the combination of the crank case and the outer housing, and the arrangement of the crank case inside of the outer housing as shown. The openings 37, in addition to providing drain openings for the crank case, also provide breather vents for the crank case.

The oil is delivered through the openings 37 by a pumping action caused by the movement of the pistons toward each other simultaneously.

The intake valve construction comprises a valve seat formed on the head of the piston and a flexible metal disc valve, normally flat, secured to the head of the piston and adapted to move against the valve seat. The valve in its normally flat condition is indicated by the reference numeral 63 in Fig. 5 and is secured by means of a screw or other securing element 64 to a boss 65 in the center of the head of the piston. Between the boss 65 and the skirt of the piston are intake openings 66. The valve seat 67 is formed on the periphery of the cylindrical wall of the piston, and is trunco-conical in shape.

I find that in the operation of the device, as the piston moves forwardly on the compression stroke, the valve will assume a dished shape as shown in Fig. 6 at 68, the peripheral region contracting and bearing downwardly. The inclination of the trunco-conical valve seat 67 is adjusted to match the inclination of the peripheral region of the valve element 63 in its bowed condition.

Another method of forming the valve seat 67 is to give it a trunco-conical shape of greater inclination than that of the peripheral region of the valve 63 during curvature, so that the region of contact of the valve with the seat is a circular line or edge as illustrated at 69 in Fig. 7. Improved results may be secured by plating the lower side of the valve element with a coating of soft metal such as lead or copper, as indicated at 70 in Fig. 7.

The valve element 63 is normally spaced away from the valve seat, the high edge of which may be in the same plane with the face of the boss 65, so that the valve 63 in its normal unbowed condition is spaced above the valve seat 67, forming an opening around its entire periphery through which gas may flow from the piston through the openings 66. This spacing may be as small as five-thousandths of an inch on a piston of 1" diameter. In fact, it is necessary that the spacing be small in order that the invention may be successful. In case of even comparatively slight irregularities in tension or compression of the material of the valve element, it will not curve with uniformity around its entire periphery and, if the spacing is too great, it will assume a distorted shape in bowing, and will not seat properly. By employing the arrangement where the spacing is only slight, such as five-thousandths of an inch, however, I find that the valve will seat with sufficient accuracy to produce efficient results.

While it is possible to employ the above described feature in a compressor in which the valve seats by the combined effect of inertia and fluid resistance, in the preferred form of the invention, the thickness, diameter, and elasticity of the valve disc, the region of attachment of the disc to the piston head, the normal clearance between the valve disc and the valve seat, and the speed of reciprocation of the piston 31 are so related to one another that the inertia of the valve will overcome its elastic tendency to being unseated at that point of the compression stroke of said piston at which no fluid tends to flow through said valve. In other words, the arrangement is such that the valve will close solely by inertia without the assistance of the fluid which is being compressed. It is common practice in compressors to employ an inlet valve that is held closed by tension. It is also old to employ an inlet valve that is normally unseated and to arrange the parts so that as the piston commences to compress the gas which has been drawn into the cylinder on the intake stroke, the pressure thus developed will aid in the closing of the valve. However, where this is the case, the pressure thus developed will tend to cause a portion of the gas to escape before the valve closes.

The present invention aims to achieve maximum compressing efficiency by retaining all of the gas which has been drawn into the cylinder, the valve being arranged to close exactly at the point where all movement of the gas has stopped.

Owing to the momentum, particularly in high-speed compressors, of the fluid as it flows into the compression chamber on the intake stroke, it will continue to flow into the compression chamber after the pressure difference between the chamber and the source of intake fluid has become equalized. Thus it is possible to attain momentarily in the compression chamber a fluid pressure greater than that at its source. The present invention takes advantage of this momentum induced fluid pressure by closing the valve structure exactly at the point where the fluid flow is at a standstill.

The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible in view of the prior art.

I claim as my invention:

1. A hermetically sealed compressor comprising, in combination, an outer housing, a motor shaft disposed on a vertical axis, a cylinder disposed on a horizontal axis, a piston in the cylinder including a skirt portion, a bearing projecting above the level of said cylinder, in which the shaft is journaled, means for feeding oil to said bearing, and means for directing the oil that es-

capes from said bearing to a point from which it will flow by gravity across the end of the wall of said cylinder into contact with the rear extremity of the skirt of said piston.

2. A hermetically sealed compressor comprising, in combination, an outer housing, a motor shaft disposed on a vertical axis, a cylinder disposed on a horizontal axis, a piston in the cylinder including a skirt portion, the rear extremity of the skirt of said piston being adapted at the extremity of its rearward stroke to project from said cylinder, a bearing projecting above the level of said cylinder, in which the shaft is journaled, means for feeding oil to said bearing, and means for directing the oil that escapes from said bearing to a point from which it will flow by gravity across the end of the wall of said cylinder, upon the projecting portion of the piston skirt at the top center thereof.

3. A hermetically sealed compressor comprising, in combination, an outer housing, a motor shaft disposed on a vertical axis, a cylinder disposed on a horizontal axis, a piston in the cylinder including a skirt portion, a bearing projecting above the level of said cylinder, in which the shaft is journaled, means for feeding oil to said bearing, and a partition member between a point of discharge of oil from said bearing and the cylinder, surrounding said shaft and adapting to collect the oil escaping from said bearing, said partition member having an opening located directly above the rear extremity of the wall of said cylinder, the oil collected by said partition member being adapted to flow through said opening and across the said rear extremity of the cylinder wall, into contact with the rear extremity of the skirt of said piston.

4. In a hermetically sealed compressor, in combination, an outer housing, a motor in the upper region thereof, said motor having a shaft projecting downwardly, a cylinder block including a cylinder, an upper bearing projecting above the level of said cylinder, and a horizontal member extending between a point of discharge of oil from said bearing said bearing and the cylinder and surrounding the shaft, said member being adapted to collect oil escaping from said bearing, and an opening in said member through which oil thus collected is directed to flow downwardly across the rear extremity of the wall of said cylinder into contact with the rear extremity of said piston.

5. A hermetically sealed compressor comprising, in combination, an outer housing, a motor shaft disposed on a vertical axis, a cylinder disposed on a horizontal axis, a piston in the cylinder including a skirt portion, a bearing projecting above the level of said cylinder, in which the shaft is journaled, means for feeding oil to said bearing, means for directing the oil that escapes from said bearing to a point from which it will flow by gravity across the end of the wall of said cylinder into contact with the rear extremity of the skirt of said piston, and means for creating a flow of vapor in said housing in contact with such oil flow, whereby to cool the same.

6. A hermetically sealed compressor comprising, in combination, an outer housing, a motor shaft disposed on a vertical axis, a cylinder disposed on a horizontal axis, a piston in the cylinder including a skirt portion, a bearing projecting above the level of said cylinder, in which the shaft is journaled, a member extending between said bearing and said cylinder, means for feeding oil to said bearing, said member comprising means for directing the oil that escapes from said bearing to a point from which it will flow across the end of the wall of said cylinder into contact with the rear extremity of the skirt of said piston, and means for creating a flow of vapor in said housing in contact with such oil flow, whereby to cool the same, said means comprising a centrifugal fan carried by said shaft, adapted to receive vapor from one side of said member, to cause such vapor to flow across said member to the eye of the fan, and to thereafter discharge said vapor on the other side of the said member.

7. In a hermetically sealed compressor, in combination, an outer housing, having a lubricant reservoir formed in its lower region, a motor therein, a cylinder therein, a piston in said cylinder, an upper bearing in which said shaft is journaled, means for delivering oil from said reservoir to said upper bearing, and means for directing the oil escaping from said bearing, to the rear extremity of the wall of said cylinder, whereby such oil will flow by gravity downwardly across the rear extremity of the wall of said cylinder, into contact with said piston, said oil thence returning to said lubricant reservoir.

8. In a hermetically sealed compressor, in combination, an outer housing, a motor therein having a downwardly projecting shaft, a cylinder block below said motor, including a crank case and a cylinder projecting from said crank case, and a cup-shaped centrifugal fan mounted on the shaft above the crank case and opening downwardly so as to discharge vapor from its peripheral region in a downwardly and outwardly spiraling path, past said cylinder and into contact with the inner surface of said housing.

9. In a hermetically sealed compressor, in combination, an outer housing, a motor therein having a downwardly projecting shaft, a cylinder block below said motor, including a crank case and a cylinder projecting from said crank case, a passage for compressed refrigerant extending along one side of the crank case, a cup-shaped centrifugal fan mounted on the shaft above the crank case and opening downwardly so as to discharge vapor downwardly and outwardly from its peripheral region past said compressed-refrigerant passage, and into contact with the inner surface of said housing, and a bearing for said shaft projecting upwardly from said crank case into said fan, oil from said bearing being discharged from the upper end thereof and adapted to flow downwardly along the exterior thereof, in contact with the flow of vapor entering said fan so as to be cooled thereby.

10. In a hermetically sealed compressor, in combination, an outer housing, a motor therein having a downwardly projecting shaft, a cylinder block below said motor, including a crank case and a cylinder projecting from said crank case, a passage for compressed refrigerant extending along one side of the crank case, a cup-shaped centrifugal fan mounted on the shaft above the crank case and opening downwardly so as to discharge air downwardly and outwardly from its peripheral region, past said compressed-refrigerant passage, and a member cooperating with the upper wall of said crank case to form an air-inlet passage for said fan, extending from the side of the crank case opposite said lubricant passage, to the central region of the fan, and having an annular central opening leading into said fan, said member extending to the periphery of the fan except in the region above said lubri-

cant passage, where it is cut away to form the discharge opening of the fan.

11. In a hermetically sealed compressor, an outer housing, a one-piece cylinder block therein comprising a central crank case and opposed cylinders projecting therefrom, a motor, a motor shaft projecting through the crank case, a one-piece eccentric demountably attached to the shaft, pistons in the cylinders, connecting rods journaled on the eccentric, piston pins connecting said rods to the pistons, the parts being so proportioned and arranged that upon removing the shaft and moving the eccentric to a point remote from one of the cylinders, the piston in that cylinder will be withdrawn sufficiently to expose its piston pin, allowing removal of the same.

12. In a fluid compressor, in combination, a reciprocable piston having in its head a valve seat of trunco-conical shape, and a normally flat disc valve element of thin, resilient metal, the central region of which is rigidly secured to the head of the piston in a plane spaced above the plane of the highest edge of said valve seat, the dimensions and flexibility of said valve element being so coordinated with respect to its normal spacing from the seat and the speed of reciprocation, that said valve element will assume a dished shape and make closing contact with said seat under the effect of inertia on the compression stroke of the piston and will lag on such closing until a maximum amount of fluid has been drawn into the cylinder.

13. In a fluid compressor, in combination, a reciprocable piston having in its head a valve seat of annular shape, and a normally flat disc valve element of thin, resilient metal, the central region of which is rigidly secured to the head of the piston in a plane spaced above the plane of the highest edge of said valve seat, the dimensions and flexibility of said valve element being so coordinated with respect to its normal spacing from the seat and the speed of reciprocation, that said valve element will assume a dished shape and making closing contact with said seat under the effect of inertia on the compression stroke of the piston and will lag on such closing until a maximum amount of fluid has been drawn into the cylinder.

14. In a fluid compressor, in combination, a reciprocable piston having in its head a valve seat of annular shape, and a normally flat disc valve element of thin, resilient metal, the central region of which is rigidly secured to the head of the piston in a plane spaced above the plane of the highest edge of said valve seat, the dimensions and flexibility of said valve element being so coordinated with respect to its normal spacing from the seat and the speed of reciprocation, that said valve element will assume a dished shape and make closing contact with said seat solely under the effect of inertia on the compression stroke of the piston and will lag on such closing until a maximum amount of fluid has been drawn into the cylinder.

15. In a fluid compressor, in combination, a reciprocable piston having in its head a valve seat of trunco-conical shape, and a normally flat disc valve element of thin, resilient metal, the central region of which is rigidly secured to the head of the piston in a plane spaced above the plane of the highest edge of said valve seat, the dimensions and flexibility of said valve element being so coordinated with respect to its normal spacing from the seat and the speed of reciprocation, that said valve element will assume a dished shape and make closing contact with said seat under the effect of inertia on the compression stroke of the piston and will lag on such closing until a maximum amount of fluid has been drawn into the cylinder, said valve seat being related to the valve element so as to conform to the inclination of the contacting portion of the latter.

16. In a fluid compressor, in combination, a reciprocable piston having in its head a valve seat of annular shape, and a normally flat disc valve element of thin, resilient metal, the central region of which is rigidly secured to the head of the piston in a plane spaced above the plane of the highest edge of said valve seat, the dimensions and flexibility of said valve element being so coordinated with respect to its normal spacing from the seat and the speed of reciprocation, that said valve element will assume a dished shape and make closing contact with said seat under the effect of inertia on the compression stroke of the piston and will lag on such closing until a maximum amount of fluid has been drawn into the cylinder, said valve seat being in the form of a relatively sharp edge with relation to the contacting region of the valve element so as to make a circular line contact therewith.

ALLEN TRASK.