CONTINUOUSLY OPERATED COMPRESSOR

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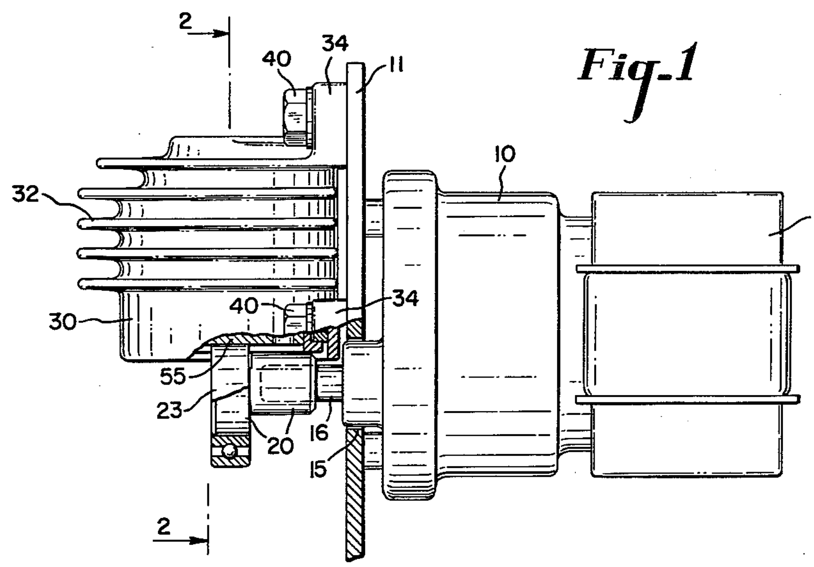

Fig-1

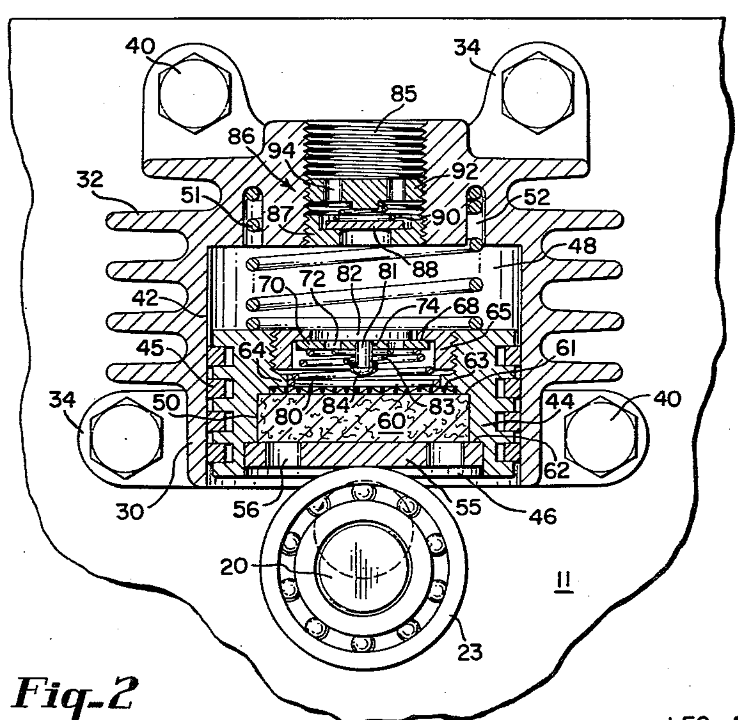

Fig-2

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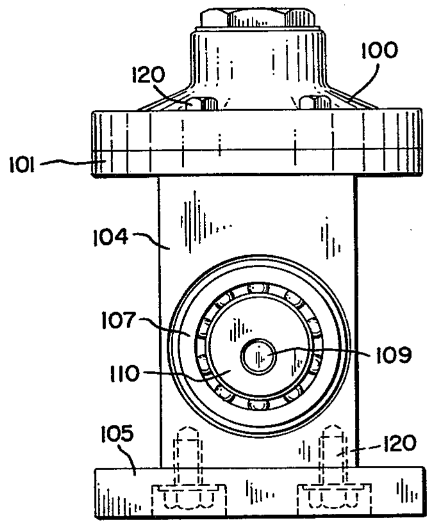

Fig-3

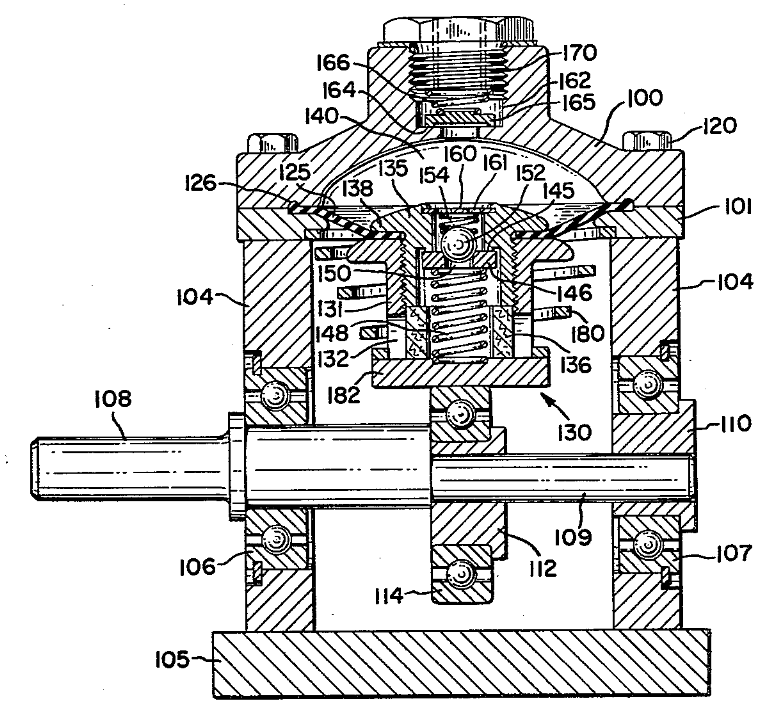

Fig-4

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CONTINUOUSLY OPERATED COMPRESSOR

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My invention relates to compressors and more particularly to an improved low cost continuously operating compressor suitable for supplying a pneumatic control source to operate the controllers in individual heat exchangers such as unit ventilators or in residential control systems.

Air compressors which are used in compressing air as a source of power for tools and also as supplying a pneumatic source of power to be controlled in the operation of tools a pneumatic apparatus is generally old. In general this equipment is of large capacity and requires in addition to special driving or motivating equipment complex valving, filtering and, in some instances, dehumidification equipment. In addition, the problem of maintenance, and lubrication are critical factors in operation of such equipment all adding to the complexity and cost of the apparatus.

The present invention is directed basically to a low cost and low pressure compressor design for continuous operation which is suitable for powering controls on a single or small number of heat exchangers such as unit ventilators, fan control systems, or the like. The apparatus is suitable for separate drive or integrated drive with the heat exchanger to which it is associated. In addition the apparatus while being simple in design eliminates substantially all maintenance problems by requiring no lubrication, incorporating filtering apparatus therewith and providing special relief valving to purge the filters periodically to clean the same. Therefore it is an object of this invention to provide a low cost continuously operated compressor. Another object of the invention is to provide an improved compressor which is suitable for low capacity and low pressure operation which is quiet, has extreme long life and is inexpensive to manufacture and maintain. A further object of this invention is to provide a compressor in which positive connection between the driving link and the moving element of the compressor is eliminated and the apparatus is caused to operate by the thrust imparted from the driving means in one direction and a return spring in the opposite direction which simplifies the structure and automatically takes up wear. A still further object of this invention is to provide a compressor having a combined intake and relief valve built into the movable element with the compressor along with a filter for maintaining cleaning of the filter. These and other objects of this invention will become apparent from a reading of the attached description together with the drawing wherein:

FIGURE 1 is a side elevation view of the compressor including a driving motor,

FIGURE 2 is a sectional view of the compressor of FIGURE 1 taken along the lines 2—2 of FIGURE 1 to show the details of the valving and the movable element of the compressor,

FIGURE 3 is a side elevation view of a second embodiment of the compressor, and

FIGURE 4 is a sectional view of the compressor of FIGURE 3 disclosing the movable element and valve therein.

Considering the compressor of FIGURES 1 and 2 it will be noted that this embodiment includes a driving motor indicated generally at 10 mounted on a base plate 11, the motor having associated therewith a suitable electrical apparatus indicated schematically at 12 to provide for electrical connections to the motor for a polyphase supply of current to the motor. The motor 10 is secured to the base plate through suitable means such as screws (not shown) and the base plate includes an aperture therein indicated at 15 through which the drive shaft 16 of the motor extends. Although not shown, it will be understood that the motor 10 includes gearing to provide the desired operating speed range for the compressor. Mounted on the shaft 16 is a hub including an eccentric indicated at 20 having a ball bearing 23 positioned on the same such that the inner race is connected to the eccentric and the outer race will, as to be later noted, engage or abut against the movable element of the compressor.

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The compressor includes a casing or cylinder member indicated at 30 having a plurality of flanges 32 for cooling purposes positioned on the outer periphery of the same and suitable mounting flanges as at 34 by means of which the cylinder or casing is attached to the base member 11 through suitable securing means such as nuts and bolts indicated at 40. Referring specifically to FIGURE 2, it will be seen that the cylinder or casing includes a recess 42 or a cylindrical bore in which is positioned a floating piston 44 having a plurality of compression rings 45 on the outer periphery of the same to provide a seal between the piston and the walls of the recess or bore of the cylinder 30. It will be noted that the extremity of the cylinder is open as at 46 and a compression chamber indicated generally at 48 is formed between the piston and the closed extremity of casing 30. A spring 51 is positioned in chamber 48 resting against the top of the piston and in a groove process 52 in the closed extremity of the cylinder. Thus the spring 51 will urge the piston down against the outer race of the ball bearing 23 mounted on the eccentric 20 to follow the movement of the same and upon rotation the ball bearing will thrust against the bottom of the piston urging the same upward to decrease the volume of the compression chamber 48 in a conventional manner. No lubricant is applied to the piston sides and the compression rings permit a loose fit of the piston to provide a simple arrangement of parts. The piston 44 includes a generally cylindrical passage therethrough indicated generally at 50 with the lower extremity of the same having a plate 55 positioned therein the plate including a plurality of apertures 56 through which inlet air passes from the open extremity of the cylinder 44. Positioned above the plate 55 is a filter indicated at 60, the filter and plate resting against shoulder portions 61, 62 in the passage 50 of the piston for positioning the same. The plate 55 is secured therein through suitable means (not shown). Positioned above the filter 60 is a screen 63 which rests against an annular flange 64 in the passage 50 to maintain the filter in position. Screen 63 provides a surface as will be later noted for a biasing spring. At the top surface of the piston in the passage 50 is positioned a valve ring 65 which is threaded on the outer periphery and positioned into a cooperating threaded surface in the passage 50 of the piston to complete the assembly. The ring forms a valve seat on its inner peripheral surface, as at 68, for a first check valve which includes a cooperating movable member 70. Member 70 is annular in form and has a plurality of air passages 72 positioned therein and a central aperture 74. Plate 70 is held in position against the valve seat surface 68 of ring 65 by means of a spring 80 which rests against the screen 63 at one extremity and against the plate 70 at the opposite extremity biasing the same against the seat 68 of ring 65 to close a valve passage between these members around the outer periphery of the plate 70. Positioned in the aperture 74 in plate 70 is a stem 81 of a second valve closure member 82 which cooperates with the apertures 72 in the plate 70 to form the directional check valve controlling inlet of air to the compression chamber. A second spring member 83 positioned between a hub 84 on the stem 81 and the surface of the plate 70 biases the stem and hence the valve closure member 82 against the plate 70 to close the passage through the apertures 72 and around the peripheral edge of the plate 70 to complete this valve. Thus as will be later seen the check valve formed between the apertures 72 and the plate 82 provide a first valve controlling the flow of air into the compression chamber while the plate 70 and the valve seat surface 68 of the valve ring 65 provide a second valve concentric with the first which acts as a relief valve and controls the flow of air in accordance with the rate of the spring 80 and the pressure within the compression chamber, which relief valve will provide a flow of air from the compression chamber through the screen 63 and filter 60 back through the passages 56 to purge the filter upon the presence of a predetermined pressure in the compression chamber.

It will be seen that the plate 55, filter 60, and screen 63, are positioned in passage 50 by means of the hubs or flanges 61, 62 and 64 and are secured in the piston assembly by virtue of the securing of the plate 55 in the piston through means not shown. Further the valve parts are held in assembled relationship by means of the valve ring 65 which is threaded into the upper end of the passage 50 in the piston holding the plate 70 in position through the spring 80 and including the mounting of the valve closure member 82 cooperating therewith.

The closed extremity of the cylinder 30 includes an outlet passage 85 which is threaded to provide the mounting for a suitable external connection (not shown) and for mounting of an outlet check valve indicated generally at 86. Check valve 86 includes an annular valve ring 87 whose inner periphery provides a valve seat which has cooperating therewith a disc-like closure member 88. The closure member 88 and valve ring 87 provide the valving surfaces to control the flow of air from the compression chamber through the passage 85. Plate 88 is held against the surface of the ring 87 by means of a spring 90 which bears against the surface of the plate 88 and is held in position at its opposite extremity by a retaining ring 92 also threaded into the aperture 85 and having passages 94 therein through which the air passes.

The operation of the apparatus from the standpoint of compression of air is for the most part conventional. However the design of the apparatus through the simplified arrangement of parts is extremely economical to manufacture and maintain. It will be noted that the apparatus includes no lubrication and a seal is provided between the relatively loose fitting piston and the bore 50 of the casing cylinder 30 by compression rings 45 which take up wear of the apparatus. Further no positive drive connection is provided simplifying the alignment of parts. Rotation of the motor will cause the eccentric attached thereto to rotate causing the ball bearing to lift the piston 44 in the bore 42 of the casing 30 to compress air in the chamber 48. On the downward portion of the stroke, the bias or return spring 51 will cause the piston to return maintaining contact with the bearing 23 to increase the volume of the compression chamber and permit the opening of the inlet check valve 70, 72, and 82 allowing air to enter therein. This simplified apparatus includes the filter mounted directly in the piston assembly with the inlet check valve such that the air taken from the atmosphere at the open end of the cylinder 44 will be filtered before it is compressed. The outlet check valve is conventional, allowing discharge of the compressed air through the outlet passage 85 upon the presence of a predetermined pressure in the compression chamber overcoming the force of the spring 90 of the check valve. By adjusting the relative sizes of the springs and the surfaces of the closure member, the inlet and exhaust from the compressor can be regulated in a conventional manner.

Also incorporated in the design is a relief valve formed by the valve ring 65 and plate 70 together with the biasing spring 80 which holds this relief closed until a predetermined pressure is obtained in the compression chamber. While this arrangement reduces the efficiency of the compressor, the apparatus is designed to be of a low capacity, low pressure type supplying compressed air as a source of power to a limited number of pneumatic controllers. The relief valve is so adjusted that upon the presence of a maximum pressure above the outlet pressure at the check valve 86. the relief valve will open allowing a certain portion of the air in the compression chamber to bypass the inlet check valve and purge the filter by directing the air back through the filter moving the contaminance therein. This reduces the maintenance in connection with the compressor.

The embodiments shown in FIGURES 3 and 4 are basically of the same type of apparatus and differ therefrom in that a separate driving source is not required and in place of a piston a diaphragm type movable member is incorporated in the compressor. Thus as will be seen in FIGURE 3 the casing for the compressor is a multi-part structure including a bonnet 100, a spacer and clamping member 101 connected to a pair of side plates indicated at 104 which are mounted on a base structure 105. As will be seen best in FIGURE 4, the side plates include bearings or journals 106, 107 mounting a shaft 108 to which a driving source of power is adapted to be connected. Shaft 108 is, for example, adapted to be connected to a fan drive portion of the unit ventilator power source. As will be seen in FIGURE 4, the shaft 108 has an eccentric extension or portion 109 which is mounted in eccentric member 110 journalled in the bearing 107. The eccentric portion 109 also includes a centrally located eccentric member 112 having a bearing 114 mounted thereon. The eccentric portion of the shaft 109 has the eccentric member 110 mounted thereon basically for dynamic balance of the shaft 108 to offset the effect of the eccentric 112 mounted thereon and center the shaft. It will be noted from FIGURE 4 that the parts 104, 105, 101 and 100 are held in assembled relationship by suitable means such as nuts and bolts indicated generally at 120.

The movable member for this embodiment of the compressor is basically a diaphragm indicated at 125 having an outer peripheral lip 126 thereon which is held in position between the retaining plate 101 and the top of the casing 100 being clamped between these parts through suitable means such as the nuts and bolts 120. The diaphragm includes in addition a thrust valve member indicated generally at 130. Member 130 is a two part device one part 131 of which is basically a cup-shaped member having apertures 132 in the side surface thereof providing passages for the inlet air. This member has basically a cylindrical bore communicating with the side passages and the cylindrical filter 136 is positioned therein across the openings 132. Positioned above the filter and threaded into the part 131 is the second part of the thrust member 135 having a flange portion 138 which cooperates with the upper surface of the part 131 to clamp the inner periphery of the annular diaphragm 125 sealing the structure at this point and defining with the diaphragm in the end portion 100 of the casing a compression chamber indicated generally at 140. The inner periphery of the thrust valve plate member 135, as at 145 provides a valve seat which has cooperating therewith a circular valve closure member 146 held in position against the seat 145 by means of a spring 148 positioned in the member 131 and resting against the plate 146. The plate 146 also includes a central bore 150 which defines a second valve seat for a ball type closure member 152 to provide the directional or inlet check valve for the compressor. The ball 152 is held in position against the seat 150 by means of a spring 154 which is positioned against the ball and held in the extremity of the part 135 by means of a retaining washer 160 having apertures 161 therein. Thus it will be seen that these parts are held in assembled relationship by virtue of the threaded connection between the parts 135, 131 which clamps the inner portion of the diaphragm to seal the same and the positions of the filter in addition to the relief check valve and inlet check valve as in the first or beforementioned embodiment. Part **100** or top of the casing includes an outlet passage **162** which has a shoulder portion **164** therein defining an outlet valve seat for a cooperating closure member **165** which is biased against the valve seat by means of a spring **166** held in the inlet passage by an aperture spring retaining member **170**, the retaining member **170** being threaded into the outlet passage **162**.

In operation this embodiment is the same as that of the beforementioned embodiment in that rotation of the shaft will cause the eccentric member to impart a thrust to the diaphragm through the thrust member **130** decreasing the volume of the compression chamber **140**. On the return stroke the diaphragm and thrust member are urged downward against the bearing **114** on the eccentric member **112** by virtue of a spring **180** which rests at one extremity against the retainer or spacer member **101** and a flange section **182** on the thrust member **131**. Thus a return spring is utilized in this embodiment to increase the volume of the compression chamber. Inlet air is taken from the open sides of the casing through the inlets **132** in the thrust member **131** and through the filter **136**, the ball type check member or valve **152**, **146** to the interior of the compression chamber **140**. It will be noted that the direction of opening for the relief valve member formed between the plate **146** and the seat **145** is in the opposite direction being held enclosed by the spring **148**. Similarly the outlet passage **162** includes a directional check valve member allowing air under pressure to be evacuated from the compression chamber **140** upon the presence of a predetermined pressure in the compression chamber as regulated by the spring **166** in the valve of the outlet. The relief valve formed by the closure member **146** and seat **145** will be regulated by the spring **148** to open upon the presence of a still higher pressure in the compression chamber **140** allowing a certain portion of the compressed air to purge the filter **136** maintaining the same clean.

In considering this invention it should be remembered that the present disclosures are illustrative only and the scope of the invention should be determined by the appended claims:

What is claimed is:

1. In a compressor: a casing having an aperture therein, a movable member positioned in said aperture and forming an air tight seal therein to provide a compression chamber between said casing and said movable member, an inlet passage in said movable member, a filter positioned in said inlet passage, first check valve means positioned in said inlet passage between said filter and said compression chamber and adapted to pass air only into said compression chamber, second check valve means positioned in said inlet passage and operative upon the presence of a predetermined pressure in said compression chamber to bypass said first check valve means to permit the flow of air from said compression chamber back through said filter and said inlet passage to purge said filter, an outlet passage in said casing, a third check valve means positioned in said outlet passage and adapted to pass air from said chamber, and means for reciprocating said member in said casing to vary the volume of said compression chamber to compress air therein.

2. In a compressor: a casing having an aperture therein, a movable member positioned in said aperture and forming an air tight seal therein to provide a compression chamber between said casing and said movable member, an inlet passage in said movable member, a filter positioned in said inlet passage, first check valve means positioned in said inlet passage and adapted to pass air only into said compression chamber, second check valve means included as a part of said first check valve means in said inlet passage and adapted upon the presence of a predetermined pressure in said compression chamber to bypass said first check valve being operative to permit the flow of the air from said compression chamber back through said filter in said inlet passage to purge said filter, an outlet passage in said casing, a third check valve means positioned in said outlet passage and adapted to pass air from said chamber, and means for reciprocating said member in said casing to vary the volume of said compression chamber to compress air therein.

3. In a compressor: a casing having an aperture therein, a movable member positioned in said aperture and forming an air tight seal therein to provide a compression chamber between said casing and said movable member, an inlet passage in said movable member, a filter positioned in said inlet passage, first check valve means positioned in said inlet passage between said filter and said chamber and adapted to pass air only into said compression chamber, relief valve means connecting said compression chamber back to said filter and adapted to pass air from said compression chamber through said filter upon the presence of a predetermined pressure in said compression chamber to purge said filter, an outlet passage in said casing and connected to said compression chamber, additional check valve means positioned in said outlet passage and permitting outflow from said passage upon the presence of a second predetermined pressure in said compression chamber, and means including a compression spring positioned in said chamber between said casing and said movable member for drivingly oscillating said member in said casing to vary the pressure of the air in said compression chamber.

4. In a compressor: a casing having an aperture therein, a movable member positioned in said aperture and forming an air tight seal therein to provide a compression chamber between said casing and said movable member, an inlet passage in said movable member, a filter positioned at the start of said inlet passage, first check valve means positioned in said inlet passage between said filter and said compression chamber and adapted to pass air only into said compression chamber, second check valve means positioned in said inlet passage and operative to bypass said first check valve means to permit the flow of air from said compression chamber back through said filter to purge said filter, an outlet passage in said casing, a third check valve means positioned in said outlet passage and adapted to pass air from said chamber, a shaft journalled in said casing adjacent said movable member remote from said compression chamber, continuous driving means connected to satid shaft, an eccentric member mounted on said shaft and abutting said movable member to impart a driving thrust thereto to decrease the volume of said compression chamber, and spring means positioned in said compression chamber and between said casing and said movable member and urging said movable member against said eccentric member to increase the volume of said compression chamber.

5. A compressor comprising in combination, a casing member having a recess therein, a piston member positioned in said recess and defining with the closed end of said casing a compression chamber, an inlet passage in said piston member communicating with the open end of said recess and said compression chamber, a filter member positioned over the inlet passage of said piston and adapted to filter air into said compression chamber, a first check valve means positioned in said inlet passage beyond said filter and adapted to control the passage of air into said compression chamber, second check valve means included as part of said first check valve means and adapted to bypass said first check valve to permit the flow of compressed air from said compression chamber upon the presence of a predetermined pressure therein back through said filter to purge the same, an outlet passage positioned in said casing and communicating with said compression chamber, third check valve means positioned in said outlet passage and permitting outflow of air from said compression chamber at a second predetermined pressure level below that of said first predetermined pressure level, a continuous driving means includ-

ing an eccentric member abutting the extremity of said piston remote from said compression chamber for urging said piston within said recess to decrease the volume of said compression chamber, and spring means positioned in said compression chamber and urging said piston against said eccentric member in a direction to increase the volume of said compression chamber.

6. A compressor comprising, a casing having a recess therein, diaphragm means attached at its periphery to said casing and forming with the closed end of said casing a sealed compression chamber, a thrust member included in said diaphragm, an inlet passage included in said thrust member and adapted to pass air from the open end of said recess through said passage to said compression chamber, filter means covering said inlet passage and connected to said thrust member, first check valve means included in the inlet passage of said thrust member between said filter means and said compression chamber and adapted to permit the flow of air into said compression chamber, second check valve means positioned in said inlet passage of said thrust member and included as part of said first named check valve means being adapted to bypass said first check valve means and permit the flow of air from said compression chamber back through said filter upon the presence of a predetermined pressure in said pressure chamber, an outlet passage positioned in the closed extremity of said casing and including a third check valve means permitting the flow of air only from said compression chamber, a shaft journalled in said casing, continuous driving means connected to said shaft, an eccentric member mounted on said shaft and abutting said thrust member of said diaphragm to oscillate said diaphragm in a direction to decrease the volume of said compression chamber, and spring means cooperating with said thrust means and said casing and adapted to move said diaphragm in a direction to increase the volume of said compression chamber.

7. A compressor comprising, a casing having a recess therein, diaphragm means attached at its periphery to said casing and forming with the closed end of said casing a sealed compression chamber, a thrust member included in said diaphragm, an inlet passage included in said thrust member and adapted to pass air from the open end of said recess through said passage to said compression chamber, filter means covering said inlet passage and connected to said thrust member, first check valve means included in the inlet passage of said thrust member between said filter means and said compression chamber and adapted to permit the flow of air into said compression chamber, second check valve means positioned in the inlet passage of said thrust member and included as a part of said first check valve means being concentric therewith adapted to bypass said first check valve means and permit the flow of air from said compression chamber back through said filter upon the presence of a predetermined pressure in said pressure chamber, an outlet passage positioned in the closed extremity of said casing

and including a third check valve means permitting the flow of air only from said compression chamber, a shaft journalled in said casing, continuous driving means connected to said shaft, an eccentric member journalled on said shaft and abutting said thrust member of said diaphragm to oscillate said diaphragm in a direction to decrease the volume of said compression chamber, and spring means cooperating with said thrust means and said casing and adapted to move said diaphragm in a direction to increase the volume of said compression chamber.

8. A compressor comprising in combination, a casing member having a recess therein, a piston member positioned in said recess and defining with the closed end of said casing a compression chamber, an inlet passage in said piston member communicating with the open end of said recess with said compression chamber, a filter member positioned over the inlet passage in said piston and adapted to filter air flow into said compression chamber, a first check valve means positioned in said inlet passage beyond said filter and adapted to control the passage of air into said compression chamber, second check valve means positioned in said inlet passage of said piston and concentric with said first named check valve means being adapted to bypass said first named check valve means and operative to permit the flow of air from said compression chamber back through said filter to purge said filter upon the presence of a predetermined pressure in said compression chamber, an outlet passage positioned in said casing and communicating with said compression chamber, third check valve means positioned in said outlet passage and permitting outflow of air from said compression chamber at a second predetermined pressure level below that of said first predetermined pressure level, a continuous driving means including an eccentric member abutting the extremity of said piston remote from said compression chamber for urging said piston within said recess to decrease the volume of said compression chamber, and spring means positioned in said compression chamber and urging said piston against said eccentric in a direction to increase the volume of said compression chamber.

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