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2,434,734

COMPRESSOR VALVE

Filed April 6, 1945

2 Sheets-Sheet 1

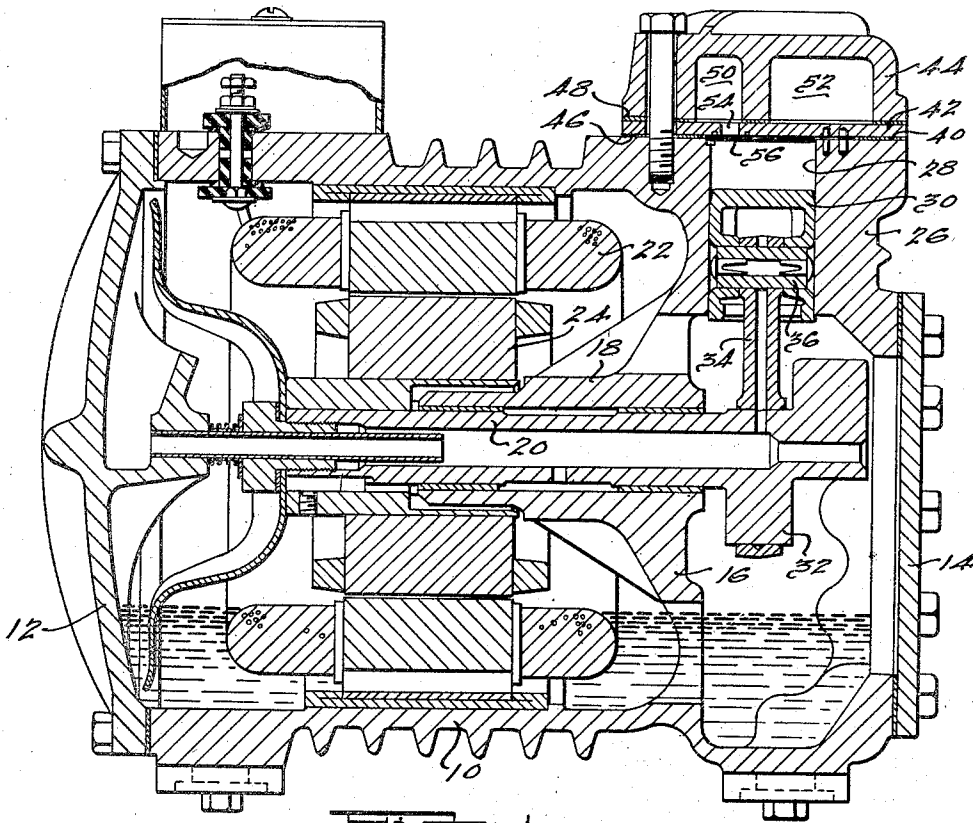


FIG. 1.

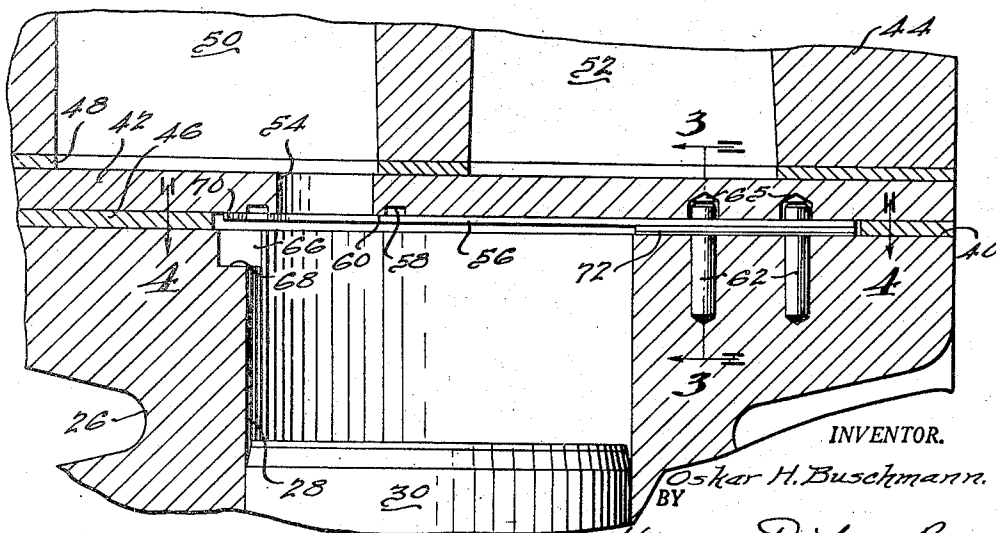


FIG. 2.

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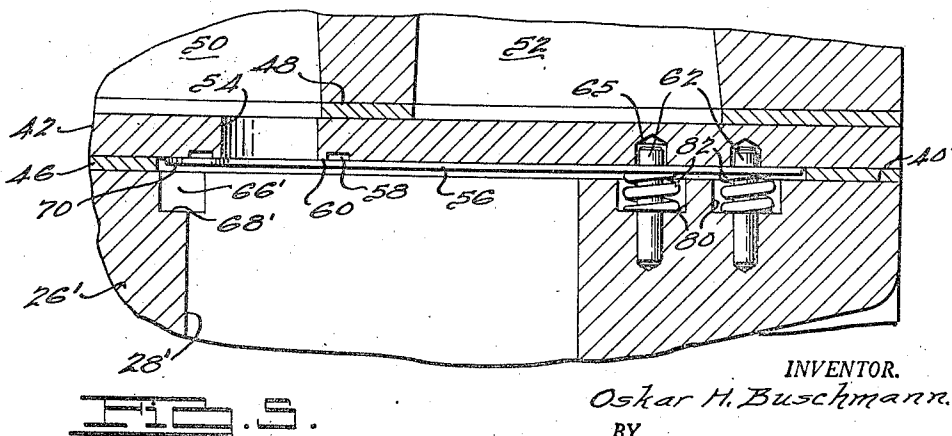
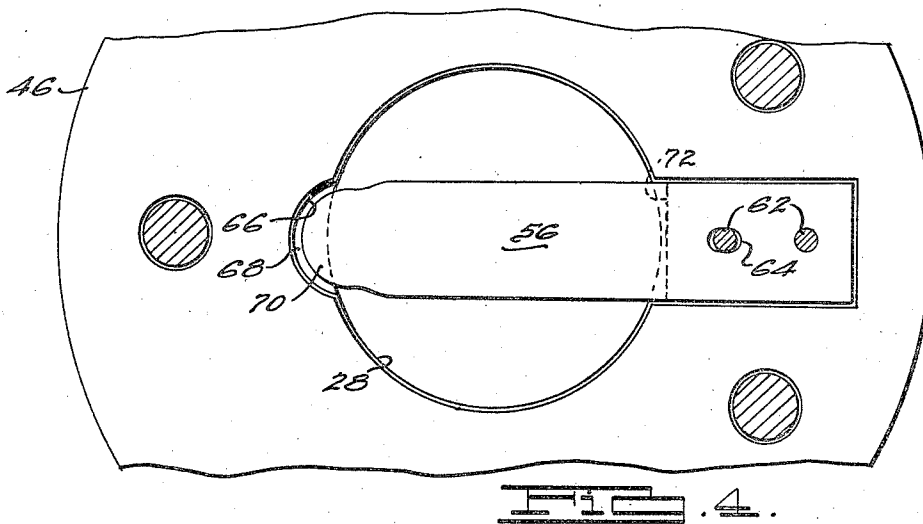
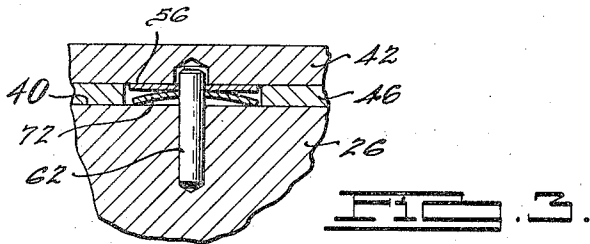
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UNITED STATES PATENT OFFICE

2,434,734

COMPRESSOR VALVE

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5 Claims. (Cl. 251-119)

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This invention relates to refrigeration compressors and particularly to a new and improved valve mechanism therefor, the principal object being the provision of a valve structure capable of efficiently operating at high speed.

Objects of the invention include the provision, in a refrigerant compressor, of a reed valve of the freely suspended type together with means associated therewith materially enhancing the speed of operation thereof; the provision of a valve mechanism for a refrigerant compressor comprising a reed valve supported at one end by the compressor and having a free end cooperating in overlying relationship with respect to a valve seat, together with means cooperating with the anchored end of the valve enabling the natural resilience of the valve itself to be utilized in urging the valve toward contact with its cooperating seat; the provision of a construction as above described including spring means cooperating between a fixed part of the refrigerant compressor and the reed valve at the point of anchorage thereof constantly urging the reed valve toward its seated position; the provision of a construction as above described in which spring means comprises a leaf spring; and the provision of a construction as above described in which the spring means comprises one or more coil springs.

The above being among the objects of the present invention, the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates suitable embodiments of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a sectional view taken diametrically through a sealed motor compressor unit of a type to which the present invention may be satisfactorily applied and illustrating the positioning of the suction valve for the compressor;

Fig. 2 is a greatly enlarged, fragmentary view taken in the same plane as Fig. 1 illustrating the suction valve and the application of the present invention thereto;

Fig. 3 is a fragmentary, transverse sectional view taken on the line 3-3 of Fig. 2;

Fig. 4 is a fragmentary plan view taken on the line 4-4 of Fig. 2; and,

Fig. 5 is a view similar to Fig. 2 but illustrating a modified form of construction.

In modern high speed refrigerant compressors of the reciprocating piston type, if efficient operation of the compressor is to be obtained it is necessary to employ suction and discharge valves which will open and close quickly in response to changes in pressure thereon. A favorite form of suction valve is a reed valve formed of relatively thin

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spring metal and usually of the so-called "freely suspended" type supported at one end only and with its free end arranged for operative relationship with respect to the correlated valve seat surrounding the suction port. I have found, however, that where such freely suspended reed valve is more or less loosely anchored in position in accordance with conventional practice there is a tendency for it to lag in operation at higher compressor speeds with resulting loss in efficiency of the associated compressor. I have discovered that this objection to this type of valve may be overcome by the employment of spring means at the anchored end of the reed valve arranged to hold it firmly against its cooperating valve plate and in a position in which its natural resiliency is utilized to urge it toward seated position.

Such reed valves are conventionally more or less loosely confined at their anchored end between the valve plate and the opposed face of the compressor cylinder and are held against their cooperating valve seat solely by gas pressure. In accordance with the present invention the spring means is interposed between the anchored end of the valve and the opposed face of the compressor cylinder so as to firmly hold the confined end of the valve against the valve plate. Obviously, various forms and arrangements of the spring devices or elements may be employed for the purposes of the present invention and two different types of the same are shown in the drawings by way of illustration.

It will be understood, of course, that the valve structure of the present invention is applicable to any suitable or conventional reciprocating piston type of refrigerant compressor. However, inasmuch as it is particularly valuable in connection with high speed types of such compressors, that is such compressors that may rotate, for instance, at a speed of 1750 R. P. M., in the accompanying drawing by way of illustration it is illustrated in connection with a sealed motor compressor unit of the general type illustrated in United States Patent No. 2,035,276, issued March 24, 1936, to John R. Replogle on Refrigerant compressing unit and owned by the assignee of the present invention.

Referring to the accompanying drawing and particularly to Fig. 1 it will be noted that the motor compressor unit there shown comprises a hollow housing or casing 10 the opposite open ends of which are closed and sealed by means of end plates or covers 12 and 14, respectively. The housing 10 is provided with an integral apertured cross-wall 16 centrally provided with an elongated hub 18 which serves to rotatably support the hollow shaft 20. Within the lefthand end of the housing 10 as viewed in Fig. 1 a stator assembly 22 of an electric motor is received in press fit relation with respect thereto and pressed upon the

shaft 20 within the stator 12 is the armature 24 of such motor. The righthand end of the housing 10 is provided with an integral cylinder extension 26 having a bore 28 therein in which a piston 30 is reciprocally received. Below the cylinder 28 the shaft 20 has an eccentric 32 formed integrally therewith which receives the big end of the connecting rod 34 connected to the piston 30 by means of a conventional piston pin 36.

The cylinder 26 is provided with a flat upper face 40 lying in a plane perpendicular to the axis of the cylinder 28 and receives thereon a valve plate 42 which in turn receives the cylinder head 44 thereon. A suitable gasket 46 serves to seal the plate 42 to the cylinder 26 and a suitable gasket 48 serves to seal the cylinder head 44 to the valve plate 42. The cylinder head 44 is formed to provide a suction chamber 50 and a discharge chamber 52. Valve plate 42 is provided with an opening or port 54 therein opening onto the upper end of the cylinder 28 and this port is closed by a reed valve 56 during the compression stroke of the piston 30. The valve plate 42 is likewise provided with one or more openings or ports (not shown) communicating the pressure chamber 52 with the upper end of the cylinder 28 and normally closed by a valve (not shown) during the suction stroke of the piston 30. For a more detailed description and explanation of the operation of the motor compressor unit shown reference may be had to the above identified Replogle patent.

In accordance with the present invention and now referring to Figs. 2, 3, and 4 it will be appreciated that the intake port 54 is cylindrical and positioned adjacent one side of the cylinder bore 28 and that the free end of the reed valve 56 is adapted to lie against the bottom face of the valve plate 42 in overlapping relationship with respect to the margins of the port 54 when in closed position. To enhance the seal between the valve 56 and the margins of the opening 54 the bottom face of the valve plate 42 is provided with an annular groove 58 in concentric and slightly outwardly spaced relation with respect to the walls of the port 54 thereby to provide a valve seat 60 between it and the port for contact with the valve 56.

The reed valve 56 extends diametrically across the cylinder from the port 54 and its opposite end projects between the upper face 40 of the cylinder 26 and the valve plate 42, the gasket 46 being cut away to receive it as shown in Fig. 4. To maintain the valve 56 against longitudinal and lateral displacement a pair of dowel pins 62 are provided in the upper end of the cylinder 26 in spaced relation with respect to each other longitudinally of and in line with the center line of the valve 56. As brought out in Fig. 4 the radially outer pin 62 closely fits a hole provided therefor in the valve 56 and the radially inner pin 62 is received within a hole, or slot 64 formed in the valve 56 and elongated axially of the valve 56. The radially inner pin 62 is, however, relatively closely received between the laterally opposite sides of the slot 64 so that in conjunction with the pin 62 it maintains the valve 56 against lateral movement. The pins 62 project above the valve 56 and the lower face of the valve plate is provided with complementary blind holes 65 to receive these ends.

In order to limit the downward movement of the free end of the valve 56 under the suction produced in the cylinder bore 28 during downward movement of the piston 30 the cylinder wall

28 at its upper end and in line with the free end of the valve 56 is cut away as at 66 to provide an axially upwardly directed shoulder 68 and the end of the valve 56 is slightly reduced in diameter and extended as at 70 to within the cut-away portion 66 but in spaced relation with respect to the side walls thereof. If the valve 56 tends to open beyond a desirable extent its free outer end will strike the shoulder 68 and thereby limit its opening movement.

The construction thus far described is conventional. When it is understood that reed valves such as the valve 56 are made from thin metal which may be on the order of .008"-.010" thick, and that it is commercially impractical to form gaskets such as 46 and 48 from material of the same thinness, or thickness, of such valves and such material must be compressible, it will be understood that the anchored ends of such valves in conventional constructions are more or less loosely confined between the valve plate and cylinder and are held against their cooperating valve seat solely by gas pressure in the cylinder. As a result conventional valve structures of the type described seldom operate efficiently at compressor speeds above 660 R. P. M. This difficulty is overcome in accordance with the present invention by providing spring means between the anchored end of the valve and the cylinder which act to firmly clamp the anchored end of the valve to the valve plate, so that the resiliency of the valve itself, in addition to the gas pressure, is taken advantage of in normally holding the free end portion of the valve against its seat. Such spring means is of a character permitting it to be compressed to various extents without materially affecting its operativeness so that the thickness of the gasket between the cylinder and the valve plate may vary materially and be compressed to different degrees in drawing the cylinder head down on the cylinder, without affecting the function of the spring or the efficiency of the valve.

In the construction illustrated in Figs. 1 to 4, inclusive, this spring means is illustrated at 72 and comprises a thin strip of spring metal interposed between that portion of the valve 56 received between the valve plate 42 and the upper surface 40 of the cylinder 26. When thus formed from thin sheet metal the spring 72 may be of any suitable character sufficient, when compressed between the surface 40 and the valve 56, to constantly urge the valve 56 up against the lower face of the valve plate 42. In other words it may be longitudinally or transversely curved or of a corrugated or meandering type, but in the particular case shown it is, as brought out in Fig. 3, of a transversely curved type. It will be appreciated that in its free state the spring 72 shown is of a greater sectional curvature, that is of a curvature of smaller radius, than that illustrated in Fig. 3, so that when the valve plate 42 is drawn down upon the cylinder the sectional curvature of the spring will be straightened out to a greater or lesser extent depending upon the stiffness of the spring 72, the pressure desired therefrom upon the valve 56, and the thickness of the gasket 46. In the particular case shown it may be considered, by way of illustration, that the valve 56 is .008" thick, the material of the spring is .004" thick, and the gasket 46, when compressed between the valve plate 42 and the cylinder, .016" thick.

The spring 72 has the effect of firmly holding the anchored end portion of the valve 56 against the valve plate 42 so that the natural resiliency

of the valve 56 is available and is employed to urge the valve 56 toward closed position against the valve seat 60. By utilizing the natural resiliency of the valve in this manner it has been found that the valve will function satisfactorily and efficiently up to speeds in excess of 1750 R. P. M.

In Fig. 5 a modified form of spring structure is illustrated. Inasmuch as the structure illustrated in Fig. 5 is identical to that shown in the preceding views with the exception of the spring means which is employed to replace the spring 72 shown in the preceding views, only the difference in the spring means and the difference in the formation of the cylinder 26 to receive the same need be described. Accordingly, parts identical to those in the preceding views are illustrated by the same numerals and the described parts of the cylinder are illustrated by the same numerals except that such numerals bear a prime mark.

In the construction illustrated in Fig. 5 the upper face 40' of the cylinder 26' is counterbored as at 80 concentrically with each pin 62 but for a portion of the length of such pins only. Instead of using a flat spring such as 72 a coil spring 82 is positioned in each counterbore 80 in freely surrounding relation with respect to each of the pins 62. The springs 82 are of a free length greater than the depth of the counterbores 80 and gasket 46 so that when the valve plate 42 is drawn down upon the upper end of the cylinder 26' the springs 82 are axially compressed, thereby firmly clamping the anchored end of the valve 56 up against the lower face of the valve plate 42. The springs 82 are of such length as to function in their intended manner even though the gasket 46 varies appreciably in thickness from a desired value. It will be appreciated without further description that the effects of the springs 82 are equivalent to the effects of the springs 72 previously described.

Having thus described my invention, what I claim by Letters Patent is:

1. In a compressor mechanism, a ported valve plate marginally clamped to a cooperating part and sealed thereto by the interposition of a sealing gasket therebetween, a resilient reed valve arranged with its plane of thickness parallel to a face of said valve plate and substantially coplanar with said gasket, said reed valve having a substantially unrestricted free end portion overlying the port in said valve plate and adapted to close said port by contact with said valve plate around the margins of said valve, the opposite end portion of said reed valve being confined between said valve plate and said cooperating part, and spring means reacting between said part and said confined end portion only of said reed valve and holding said confined end of said reed valve in flat contacting relationship with respect to said valve plate.

2. In a compressor, a valve plate having a part therethrough, a chamber-defining member, a gasket interposed between said plate and member, and a resilient reed valve confined at one end between said member and said valve plate and substantially coplanar with said gasket and provided with a substantially unrestricted free edge overlying the margins of said port, spring means interposed between the confined end only of said valve and said member and holding said confined end in flat contacting relationship with respect to said valve plate, said spring means

comprising a strip of sheet metal of curved sectional configuration.

3. In a compressor a chamber-defining member, a valve plate overlying the member, a gasket interposed between said plate and member, the valve plate being provided with a port therethrough, and a resilient reed valve confined at one end between said member and said valve plate and substantially coplanar with said gasket and provided with a substantially unrestricted free end overlying the margins of said port, a pair of pins fixed with respect to said member and projecting through said confined end of said reed valve, and spring means located by said pins and interposed between said member and said reed valve holding said confined end of said reed valve in flat contacting relationship with respect to said valve plate.

4. In a compressor a chamber-defining member, a valve plate overlying the member, a gasket interposed between said plate and member, the valve plate being provided with a port therethrough, and a resilient reed valve confined at one end only between said cylinder and said valve plate and substantially coplanar with said gasket and provided with a substantially unrestricted free edge overlying the margins of said port, a pair of pins fixed with respect to said member and projecting through said confined end of said reed valve, said member having a counterbore therein concentric with each of said pins, and a coil compression spring encircling each of said pins in said counterbore and bearing against said confined end of said reed valve holding said confined end against said valve plate.

5. In a compressor mechanism, a ported valve plate marginally clamped to a cooperating part and sealed thereto but separated therefrom by the interposition of a sealing gasket therebetween, a flat resilient reed valve arranged with its plane of thickness parallel to a face of said valve plate, said reed valve having a substantially unrestricted free end portion overlying the port in said valve plate and adapted to close said port by contact with said valve plate around the margins of said port, the opposite end portion of said reed valve being confined in the space between said valve plate and said cooperating part, and spring means reacting between said part and said confined end portion only of said reed valve and firmly holding said end of said reed valve in flat contacting relationship with respect to said valve plate irrespective of the thickness of said gasket whereby the resilience of said reed valve will constantly act to urge said valve to closed position.

OSKAR H. BUSCHMANN.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,434,734.

January 20, 1948.

OSKAR H. BUSCHMANN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Column 5, line 64, for the word "part" read *port*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of March, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.