March 2, 1965 E. GAUSS 3,171,585

ENCLOSED OSCILLATORY COMPRESSOR, MORE PARTICULARLY REFRIGERATING COMPRESSOR

Filed March 8, 1963 2 Sheets-Sheet 1

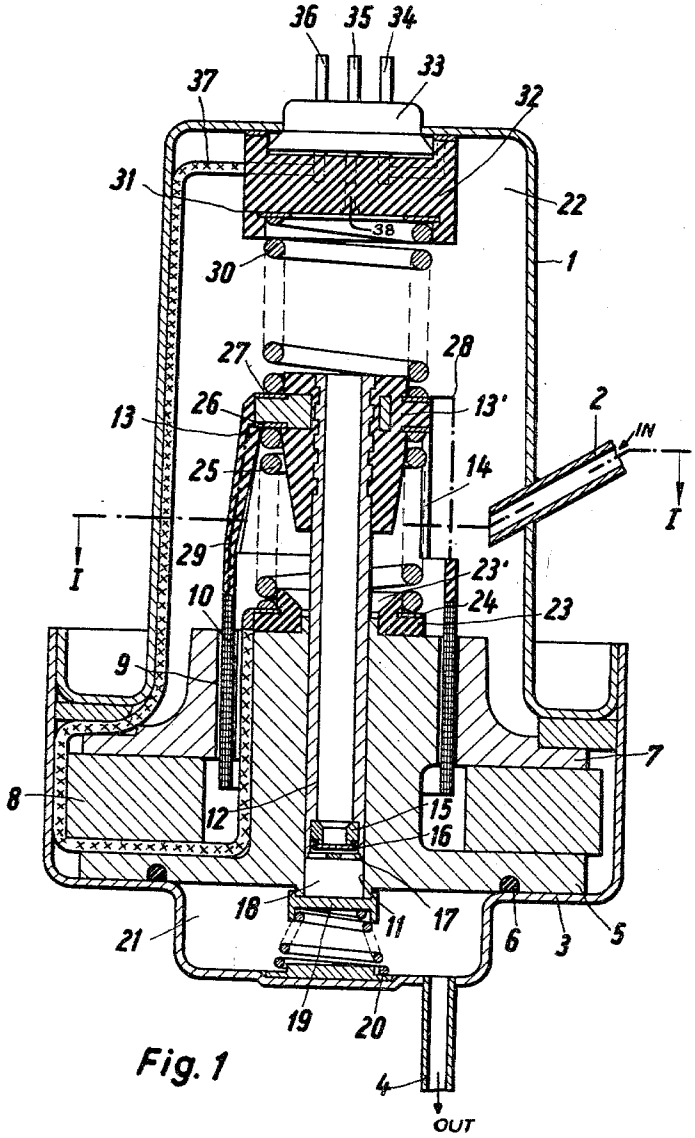


Fig. 1

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ENCLOSED OSCILLATORY COMPRESSOR, MORE PARTICULARLY REFRIGERATING COMPRESSOR

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Fig. 2

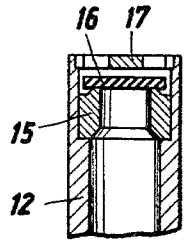


Fig. 3

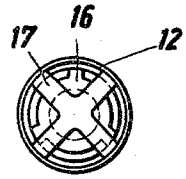
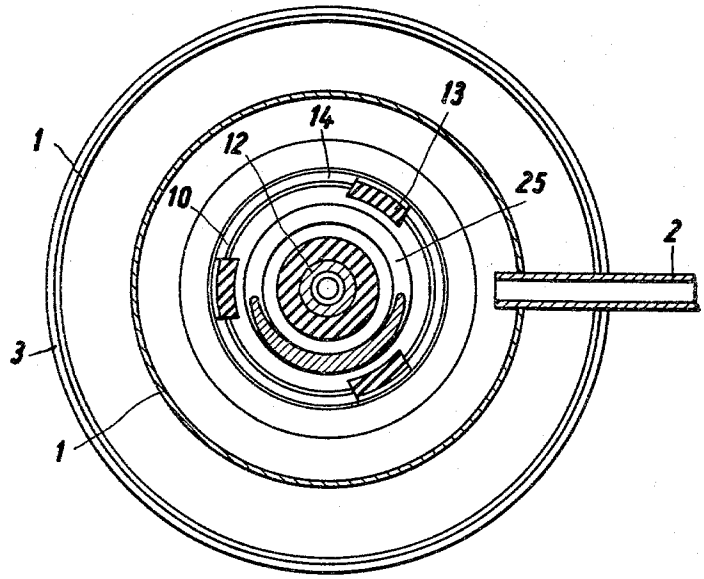


Fig. 4



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3,171,585
ENCLOSED OSCILLATORY COMPRESSOR, MORE PARTICULARLY REFRIGERATING COMPRESSOR

Ernst Gauss, Enzklosterle, Wurttemberg, Germany
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7 Claims. (Cl. 230—55)

The invention relates to enclosed oscillatory compressors, such as are used primarily for refrigerating compressors. Such oscillatory compressors are equipped with an electrical oscillatory drive operating on the plunger piston principle, employing a moving coil which is supplied with alternating current and is carried by a substantially metal-free, cup-shaped member, is connected to the compressor piston and is arranged in the annular air gap of a permanent magnet exciting a magnetic circuit. The entire oscillatory system of the compressor is adjusted by means of springs to the frequency or approximately to the frequency of the alternating current supplying the moving coil.

The basic object of the invention is to develop enclosed oscillatory compressors of the kind specified hereinbefore further in the sense that they are simpler and cheaper to manufacture, operate with a good degree of electrical efficiency and have a low resistance to oscillation.

The solution of this problem according to the invention is characterised by the combination of the following features:

(*a*) Between the suction side and the delivery side of the compressor there are interposed a piston tube, which is closed at the delivery side by a non-return valve, and a concentric guide bore for the said tube in a pole piece of the permanent magnet, said bore being closed at the delivery side by a valve which is subjected to spring pressure and together with the aforesaid non-return valve forms a pressure antechamber in the bore,

(*b*) The open, suction-side end of the piston tube is held in the head portion of the supporting member of the moving coil, said member being made of insulating material, and

(*c*) Two opposing-action compression springs which are adjusted to one another and compensate the inertia forces which occur are arranged so that they bear one against the outer side and one against the inner side of the head portion of the supporting member for the moving coil.

The opposing-action compression springs, bearing one against each side of the head portion of the supporting member for the moving coil, are so arranged that the axis of the supporting member coincides exactly with the axis of the compressor piston even during operation of the compressor. The moving coil which has synthetic plastic material moulded about it is connected through the agency of the two compression springs to a source of alternating current.

One of the two connecting cables to the source of alternating current, introduced into the compressor housing through a socket, is connected with that end of the compression spring retained on the pole piece through the agency of an insulating ring and a contact ring which faces towards the delivery side of the compressor, and the other connecting cable is connected through the agency of a contact ring with that end of the second compression spring which is remote from the head portion of the aforesaid supporting member. The contact ring arranged at the inner side of the head portion of the cup-shaped supporting member of the moving coil is in contact connection with one end and the contact ring fixed

to the outer side of this head portion is in contact connection with the other end of the moving coil.

The permanent magnet system, the moving coil, its supporting springs, the compressor piston and the valves are arranged in a completely enclosed housing made of a non-ferromagnetic material, the cover of the housing being constructed as a pressure chamber. The housing cover arranged as a pressure chamber is sealed relatively to the upper pole piece of the permanent magnet by a sealing ring. The side walls of the supporting member of the moving coil are provided with apertures which serve for pressure equalisation.

One example of embodiment of the invention is illustrated in FIGURES 1 to 4 of the accompanying drawings, in which:

FIGURE 1 is a longitudinal sectional view through the enclosed oscillatory compressor constructed according to the invention;

FIGURE 2 is a longitudinal sectional view on a larger scale through the upper part of the piston tube;

FIGURE 3 is a plan view on to this piston tube head, in the direction of the piston tube axis, and

FIGURE 4 is a cross-section along the line I—I of FIGURE 1.

The oscillatory compressor constructed according to the invention is arranged—as FIGURE 1 shows—in a housing which is enclosed on all sides and is made of non-ferromagnetic material. This housing is equipped with ribs 1'. The medium to be compressed is introduced into the housing 1 through the pipe 2.

The housing is closed at its underside by the cover 3 which is provided with an outlet pipe 4 for the compressed medium. This cover encloses the pressure chamber 21 which adjoins the underside of the pole piece 5 and is sealed relatively thereto by means of a sealing ring 6. The permanent magnet 8 is held between the lower pole piece 5 and the upper pole piece 7. The two pole pieces are arranged concentrically with respect to one another. They form with one another an annular gap 9 in which the moving coil 10 is arranged. The pole piece 5 is provided with a central bore 11 in which the piston tube 12 is mounted in axially displaceable manner. The moving coil 10 which has synthetic plastic material cast about it forms the lower end of a downwardly open moving coil supporting member 13 made of insulating material. The suction-side, open end of the piston tube 12 is held in the head portion 13' of the said member. Situated above the moving coil 10 in the supporting member 13 are apertures 14 which are intended for ensuring pressure equalisation.

The piston tube 12 comprises at its side adjacent the pressure chamber 21 a head piece 15 which is closed by a non-return valve 16.

FIGURE 2 shows that a retaining spider 17 is fixed over the valve disc 16 at the end of the piston tube 12. This is merely intended to prevent the valve disc 16 from becoming too far removed from the head piece 15, which serves as a valve seat.

The lower portion of the bore 11 of the pole piece 5 serves as a pressure antechamber 18. This chamber is closed at its lower end by the pressure relief valve 19 which is held in its position shown in FIGURE 1 by the compression spring 20 which bears on the inner side of the cover 3. The valve 19 separates the antechamber 18 from the pressure chamber 21.

The medium which is to be compressed and is sucked in through the pipe 2 passes first of all into the suction chamber 22 of the housing 1. Through the bore in the hollow piston tube 12 the said medium enters the pressure antechamber 18 when the valve 16 is lifted away from the valve seat 15. When as a result of the periodic

axial movement of the piston tube **12** the pressure in this antechamber is sufficiently great, the valve **19** is lifted from its seat in opposition to the pressure of the spring **20**. The compressed medium then passes from the antechamber into the actual pressure chamber **21** and can be discharged thence by means of the delivery pipe **4**.

An insulating ring **23** is mounted, co-axially with the bore **11**, on the upper end of the pole piece **5** facing towards the suction chamber **22**, and the said ring comprises at its side facing towards the head portion **13'** of the supporting member **13** a central, trough-shaped recess **23'** in which the oil required for lubricating the piston tube **12** can settle, the said oil entering the suction chamber **22** through the inclined pipe **2** along with the medium to be compressed. The pipe **2** is arranged at such an inclination that its axis intersects the axis of the piston tube **12** approximately at the level of the bottom of the trough-shaped recess **23'**. The insulating ring **23** carries at its upper side a contact ring **24** on which the lower compression and contact spring **25** bears which is arranged within the moving coil supporting member **13**.

Fixed on the head portion **13'** of the supporting member is a further contact ring **26** on which the other end of the aforesaid spring **25** bears. The last-mentioned contact ring is connected to the plunger piston **10** by means of the wire **29** arranged in the wall of the supporting member **13**. The other end of this moving coil is connected by means of the wire **28** represented by a dot-dash line in FIGURE 1 to the contact ring **27** which is fixed on the upper side of the head portion **13'** of the supporting member **13**. The lower face of the upper compression and contact spring **30** bears on the contact ring **27**. The upper end of this spring bears on the contact ring **31** which is fixed on an insulating member **32** which is in connection with the plug **33** whose pins **34**, **35** and **36** project from the housing **1** of the oscillatory compressor. The plug pin **34** grounds the housing **1**. The pins **35** and **36** are connected to an alternating current mains. The pin **35** is connected by the cable **38** to the contact ring **31** on which the spring **30** bears. The pin **36** is connected to the cable **37** which, as FIGURE 1 shows, is guided along the inner wall of the housing **1** and is connected below the permanent magnet **8** to the lower contact ring **24** which serves as a lower support for the spring **25**.

The springs **25** and **30** have not only the task of compensating for inertia forces which occur when the oscillatory compressor is in operation and of ensuring that the axis of the supporting member **13** is always exactly coincident with the axis of the compressor piston **12**, but they also have the task of connecting the moving coil **10** to the alternating current connections **35** and **36**.

The circuit of the moving coil **10** runs from the pin **36** through the cable **37**, the contact ring **24**, the spring **25**, the contact ring **26**, the wire **29**, to the beginning of the winding of the moving coil **10**. The end of the winding of this coil is connected through the wire **28**, contact ring **27**, spring **30**, contact ring **31** and cable **38** to the pin **35**. Therefore, the moving coil **10** is excited when the pins **35** and **36** are connected to the alternating current supply.

The moving coil **10** and its supporting member **13** oscillate at the frequency of the mains voltage. Since the supporting member **13** is provided with relatively large apertures **14**, it is not possible for any pressure to build up within the cup-shaped supporting member **13** which would prejudice the working capabilities of the compressor. These apertures are to be so arranged that the axis of the suction pipe **2** disposed at an inclination into the housing **1** passes through one such aperture **14**.

I claim:

1. An enclosed oscillatory compressor having an electrical vibratory drive operating on the plunger piston principle comprising a permanent magnet with two concentric pole pieces forming an annular air gap therebetween and exciting a magnetic circuit, a moving coil to be supplied with electric current arranged in the said air gap, a piston tube extending between the suction and delivery sides of low and high pressure zones, respectively, of the compressor and being connected to said coil, a non-return valve closing the delivery end of said tube, a central guide bore for said tube in the inner pole piece of the permanent magnet, a valve under spring pressure for closing the delivery end of said bore, said valves forming therebetween a pressure antechamber, an insulating member with a head portion supporting the coil in the air gap, the open suction end of the piston tube being held in said supporting member, and two opposing compression springs adjusted to one another and compensating the inertia forces, arranged one above and the other below the said head portion, and an electric circuit connecting said coil to a source of alternating electric current comprising said compression springs, and two cables fed from said source and connected to the opposite outer ends of said compression springs, said coil being electrically connected in series to the opposite inner ends of said compression springs.

2. An oscillatory compressor according to claim 1, wherein the moving coil has synthetic plastic material moulded about it.

3. An oscillatory compressor according to claim 1, wherein said circuit includes a contact ring arranged at the lower side of the head portion of the coil supporting member in contact connection with one end of the coil, and a contact ring fixed to the upper side of said head portion in contact connection with the other end of the coil.

4. An oscillatory compressor according to claim 1, comprising a housing made of non-ferromagnetic material fully enclosing the permanent magnet, the moving coil, the compression springs, the compressor piston and the valves therefor, said housing being closed at its under side by a cover constructed as a pressure chamber, said cover being sealed relatively to the inner pole piece by a sealing ring separating the high pressure zone from the low pressure zone.

5. An oscillatory compressor according to claim 1, wherein the coil supporting member is cup-shaped and is provided in its side walls with apertures which serve for pressure equalization.

6. An oscillatory compressor according to claim 1, comprising a housing, a suction pipe in said housing for the introduction of the medium to be compressed, and an insulating ring formed with a central trough-shaped recess and arranged coaxially with the piston tube and fixed on the upper end of the inner pole piece which serves to guide the piston tube, the support for the moving coil being cup-shaped and provided in its side walls with apertures and the suction pipe being inclined at such an angle that oil introduced with the medium to be compressed is conducted through one of said apertures into said central trough-shaped recess.

7. An enclosed oscillatory compressor having an electrical vibratory drive operating on the plunger piston principle comprising a permanent magnet with two concentric pole pieces forming an annular air gap therebetween and exciting a magnetic circuit, a moving coil to be supplied with electric current arranged in the said air gap, a piston tube between the suction and delivery sides of the compressor connected to said coil, a non-return valve closing the delivery end of said tube, a central guide bore for said tube in the inner pole piece of the permanent magnet, a valve under spring pressure for closing the delivery end of said bore, said valves forming therebetween a pressure antechamber, an insulating member with a head portion supporting the coil in the air gap, the open suction end of the piston tube being held in said supporting member, and two opposing compression springs adjusted to one

another and compensating the inertia forces, arranged one above and the other below the said head portion, a housing, an insulating ring, a first contact ring supported by said insulating ring and supporting the lower spring disposed below said head portion, and a second contact ring supported by the upper spring disposed above said head portion, a plug in said housing, and two connecting cables introduced into said housing through said plug, one of said cables being connected with the lower end of the lower compression spring through said first contact ring, while the other cable is connected through the second

contact ring with the upper end of the upper compression spring.

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