United States Patent

[11] 3,586,456

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[33] **Italy**
[31] **52068-A/68**

[54] **COMPRESSORS FOR FLUIDS**
9 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **417/312,** 417/363, 417/372
[51] **Int. Cl.** **F04b 39/00,** F04b 39/02
[50] **Field of Search** 230/58, 232, 235, 206; 417/312, 372, 363

[56] **References Cited**
UNITED STATES PATENTS

2,587,246	2/1952	Touborg	230/58
2,977,043	3/1961	Scheldorf	230/235
3,101,891	8/1963	Frank	230/232
3,288,357	11/1966	Comstock et al.	230/232 X

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Attorney—Sughrue, Rothwell, Mion, Zinn & MacPeak

ABSTRACT: A compressor for fluids, particularly the working fluid in a refrigerator, has a motor-compressor unit resiliently suspended within a sealed casing, for example by means of a wire frame suspension. The motor of said unit reciprocates a compressor piston which is formed with at least one interior chamber through which fluid is drawn from the interior of the casing on each induction stroke of the piston, thereby silencing the suction or induction side of the piston.

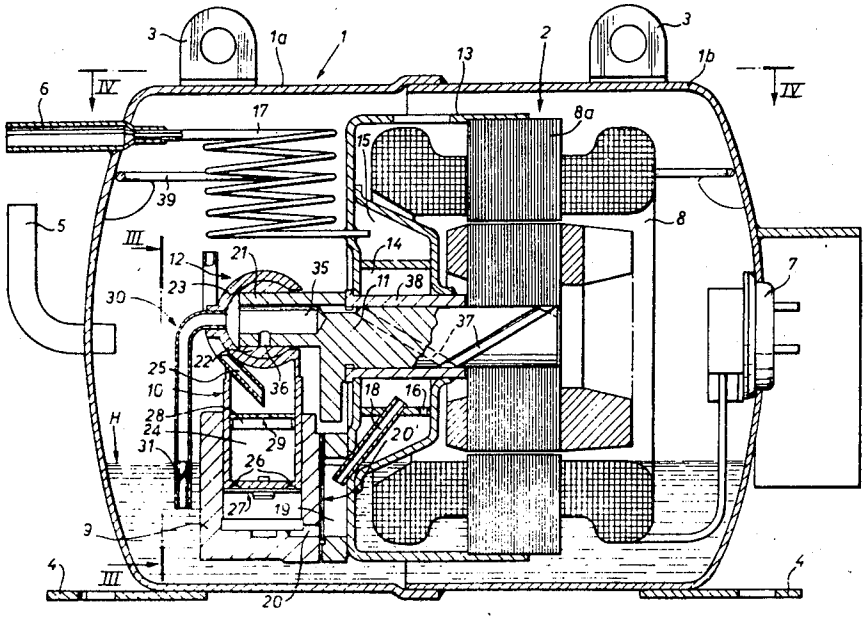
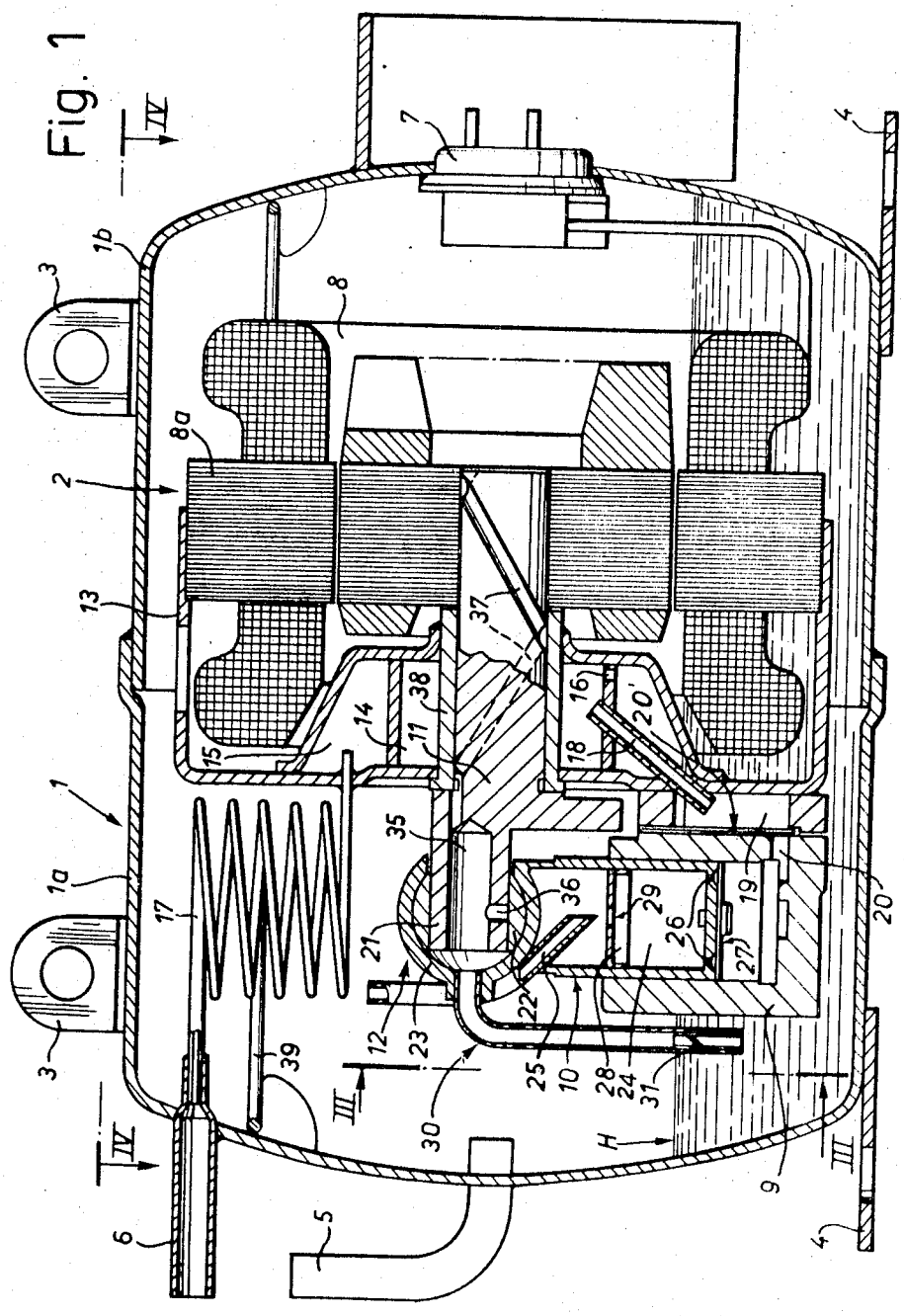


Fig. 1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4
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37
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29
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27
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Fig. 2

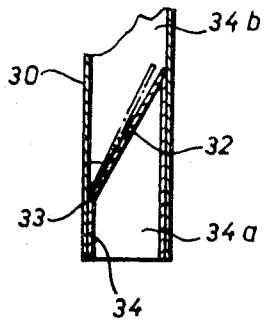


Fig. 3

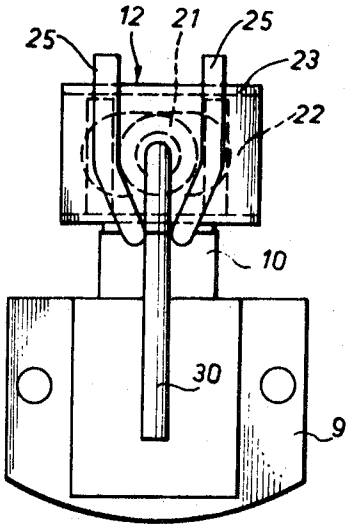


Fig. 6

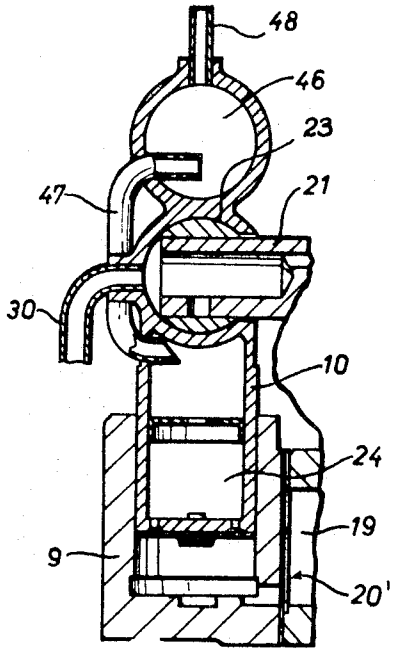


Fig. 7

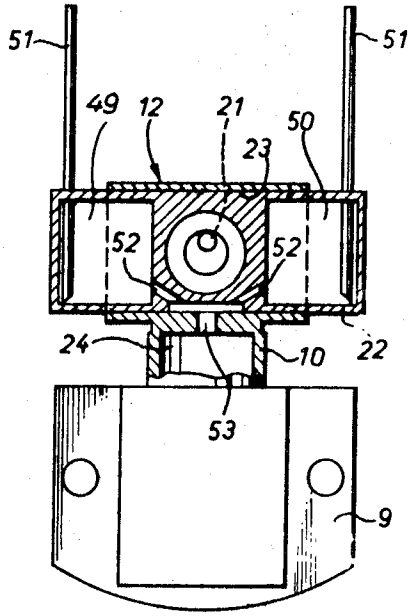
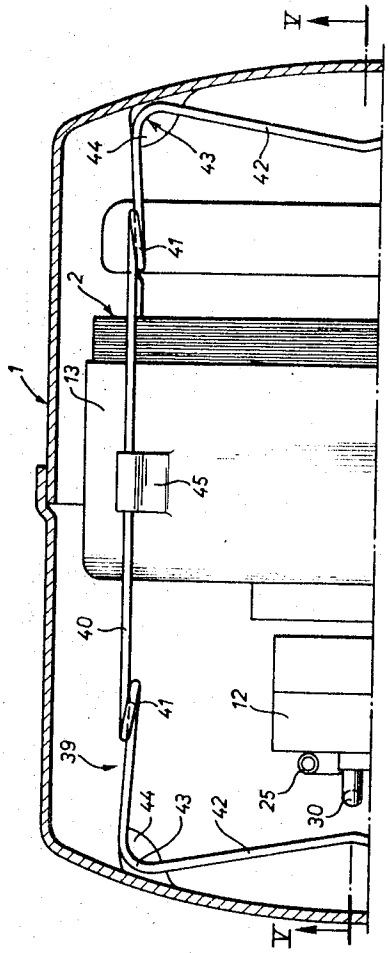


Fig. 4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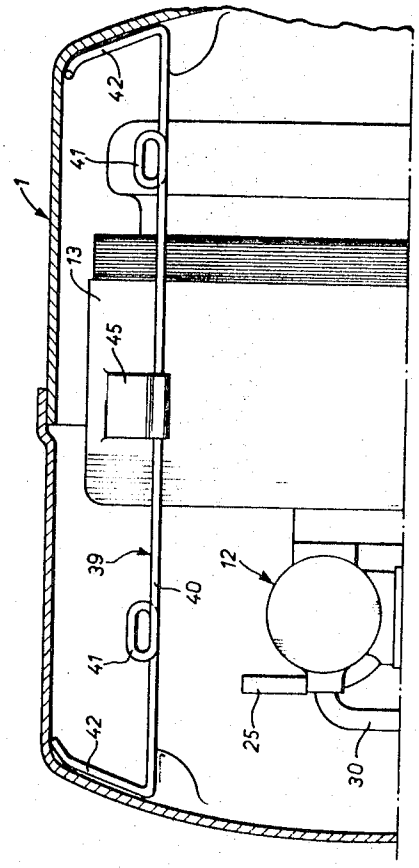
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Fig. 5

COMPRESSORS FOR FLUIDS

This invention relates to compressors for fluids, more particularly compressors for refrigerator working fluids.

Such compressors as hitherto known comprise a motor-compressor unit resiliently suspended within a fluidtight casing through which a fluid to be compressed flows in a closed circuit.

A primary object of the invention is to provide an improved compressor as above of simplified structure which is suitable for use in a variety of installations.

According to the invention there is provided a compressor for fluids, particularly the working fluid in a refrigerator, comprising a motor-compressor unit resiliently suspended within a sealed casing and including a motor arranged to reciprocate a compressor piston in a cylinder, said piston including at least one interior chamber arranged so that, in operation of the compressor, fluid to be compressed is drawn from the interior of the casing into the cylinder through the or each piston chamber, whereby silencing of the suction or induction side of the piston is effected.

A further object of the invention is to provide a compressor having improved lubricating means for the motor-compressor unit, to afford satisfactory operation of the unit over prolonged periods.

Accordingly, therefore, in a preferred embodiment the piston is arranged for vertical reciprocation and carries a lubricating pump comprising a downwardly extending conduit provided at its lower end with a valve which is disposed below the level of lubricant in the casing interior over at least part of the piston stroke so as to open, admitting lubricant into said conduit, on each descending piston stroke while closing to trap lubricant in the conduit on each ascending piston stroke.

A further object of the invention is to provide in such a compressor an improved resilient suspension for the motor-compressor unit to take up effectively the vibrations arising in operation of the unit. In a preferred embodiment the motor-compressor unit is suspended within the casing by a resilient suspension comprising a continuous frame of resilient wire secured to the casing at opposite ends.

The invention will be more clearly understood from the following detailed description, given by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is an axial sectional view of a compressor according to one embodiment of the invention;

FIG. 2 is a detail on an enlarged scale of part of FIG. 1, showing the lubricating pump associated with the compressor piston;

FIG. 3 is an end elevational view of part of the compressor, viewed in the direction of the arrows III–III of FIG. 1;

FIG. 4 is a part sectional view on line IV–IV of FIG. 1, showing one-half only of the compressor and resilient suspension frame therefor;

FIG. 5 is a part sectional view on line V–V of FIG. 4, again showing one-half only of the compressor;

FIG. 6 is an axial sectional view of the compressor piston in a modified embodiment of the invention; and

FIG. 7 is an end elevational view similar to that of FIG. 3, partly in section, and showing a further modification of the compressor piston according to another embodiment of the invention.

Throughout the drawings the same reference numerals are used to indicate the same or corresponding parts.

Referring to FIGS. 1 to 5, a sealed cylindrical casing 1 has resiliently suspended therein a motor-compressor unit generally denoted by 2. A fluid (gas or liquid) to be subjected to compression cycles, for example the working fluid of a refrigeration system, flows in a closed circuit which includes the interior of the casing 1.

The casing 1 is substantially cylindrical and comprises two sheet metal shells 1*a*, 1*b* welded together in a central transverse plane. The casing 1 is provided with external lugs 3, 4 for attachment of the casing to a fixed support. Inlet and outlet conduits 5, 6 respectively for the fluid to be compressed communicate with the interior of the casing 1. A sealed insulator

plug 7 in one end wall of the casing 1 has electrical connectors sealed therein for supplying electric current to a driving motor 8 of the motor-compressor unit 2.

The motor 8 is arranged with its rotational axis coaxial with the axis of the cylindrical casing 1 and the compressor driven thereby comprises a radially extending cylinder 9 with a compressor piston 10 fluidtightly slidable therein and coupled to the shaft 11 of the motor 8 by a mechanical connection in the form of a crosshead generally denoted by 12.

The motor 8 has a stator 8*a* which is carried by a bell-shaped support 13 of pressed sheet metal having a cylindrical wall secured to the stator by pressing. The support 13 is formed centrally with a compressor delivery silencer comprising a pair of concentric inner and outer annular chambers 14, 15 respectively interconnected by ports 16 (one only of which is shown). The outer chamber 15 communicates with the outlet conduit 6 through a resiliently flexible spiral pipe 17 which permits free displacement of the unit 2 with respect to the casing 1.

The inner chamber 14 communicates through one or a plurality of conduits 18 inclined to the vertical with a delivery antechamber 19 formed in the wall of the cylinder 9 and in turn communicating with the interior of the cylinder 9 through a port 20. A nonreturn delivery flap valve 20′ in the form of a resilient steelplate is interposed between the port 20 and the antechamber 19.

Reciprocating movement is transmitted to the piston 10 by an eccentric pin 21 mounted on the motor shaft 11 through the intermediary of the crosshead 12. The crosshead 12 includes a cylindrical slide 22 movable in a corresponding cylindrical bore 23 in one end of a connecting rod portion integrally formed with the piston 10.

According to the invention the piston 10 has an induction or suction silencer associated therewith.

In the embodiment shown the induction silencer comprises a hollow chamber 24 in the body of the piston 10. The chamber 24 communicates with the interior of the casing 1 through induction pipes 25 and also communicates with the interior of the cylinder 9 through ports 26 by way of a non-return valve 27, likewise in the form of a resilient steelplate.

In order to improve the silencing action of the chamber 24 the latter is subdivided internally by a diaphragm 28 provided with a central restrictor orifice 29.

The piston 10 as described has associated therewith a lubricant pump activated by the piston reciprocation.

The pump includes a delivery conduit 30 communicating at an upper end with the bore 23 and provided at its lower, free, end with a valve 31. The valve 31 comprises (FIG. 2) a resiliently deformable metal plate 32 secured at one end 33 to the lowermost part of an inclined upper end face of a tube section 34 fitted within the conduit 30. In effect the valve plate 32 subdivides the lower end of the conduit 30 into a bottom and a top chamber 34*a*, 34*b*, respectively.

The lower, free, end of the delivery conduit 30 dips into lubricating oil, which fills the lower part of the casing 1 to a level H which is higher than the lowermost point reached by the valve 31 during vertical reciprocation of the piston 10, so that the valve 31 is below the level H over at least part of the piston stroke.

Whenever the delivery conduit 30 descends and its lower end dips into the lubricating oil, the oil in the bottom chamber 34*a* lifts the valve plate 32 by inertia and is transferred to the top chamber 34*b*. The opposite, ascending, movement of the conduit 30 results in closure of the valve plate 32, trapping lubricant in the conduit 30. In the course of several reciprocations of the conduit 30 oil will be delivered through the conduit 30 into the bore 23.

The lubricating oil thus pumped into the cylindrical bore 23 flows into an axial drilling 35 in the end of the eccentric pin 21 and is then forced by centrifugal action through radial ports 36 (one only of which is shown) communicating with the drilling 35 to effect forced lubrication of the mating faces of the slide 22, the bore 23 and the pin 21. Excess oil oozes

through a clearance between the pin **21** and the connecting rod portion of the piston **10** and descends under gravity over the outer surface of the piston **10**, lubricating the latter.

A helical groove **37** in the surface of the shaft **11** communicates with the drilling **35** and supplies oil to a sleeve bearing **38** for the shaft **11**. The helical groove **37** transmits an axial thrust to the oil, forcing it to issue through the end of the shaft **11** opposite the pin **21**. The rotor of the electric motor **8** is supported at this end of the shaft **11**, and the oil issuing through this end is thrown against the stator windings of the motor **8**.

The motor-compressor unit **2** is resiliently suspended within the casing **1** by a continuous resilient metal frame generally denoted by **39**. The frame **39** is made of a continuous steel wire bent to form two longitudinal members **40** (FIGS. **4** and **5**) formed with loops **41** to enhance their flexibility. The opposite longitudinal ends of the frame **39** are formed with upraised end portions **42** which engage the internal end surfaces of the casing **1**.

The frame **39** is fastened to the casing **1** by means of four lugs **44** which engage four acute-angled corners **43** formed where the longitudinal members **40** meet the end portions **42**. The longitudinal members **40** engage beneath respective outwardly projecting ears **45** formed on opposite sides of the support **13** to support the entire unit **2** within the casing **1**.

In the embodiment shown in FIG. **6** the piston **10** is modified to further improve the noiselessness of operation, particularly in units **2** of relatively higher power.

According to this modification the piston **10** is provided with a cylindrical suction antechamber **46** overlying the connecting rod portion in which the bore **23** is formed and integral with said portion.

The antechamber **46** connects with the hollow chamber **24** of the piston **10** through an external conduit **47** and with the interior of the casing **1** through a suction conduit **48**.

FIG. **7** shows a further modification, which is, similarly, more particularly suited for silencing the suction or induction side of larger power motor-driven compressor units according to the invention.

According to this further modification two suction antechambers **49**, **50** are formed in the slide **22** of the crosshead **12**. The slide **22** is in this embodiment elongated with respect to the cylindrical bore **23** of the piston connecting rod portion and is provided with suction conduits **51** which connect the respective antechambers **49**, **50** with the interior of the casing **1**.

The antechambers **49**, **50** further communicate with the hollow chamber **24** in the piston **10** through downwardly inclined ports **52** cooperating with an axial port **53** opening directly into the said chamber **24**.

It will be understood that constructional details of practical embodiments of the invention may be widely varied from the examples described and illustrated without departing from the scope of the invention as defined in the claims.

What I claim is:

1. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, and a diaphragm subdividing said interior chamber of the piston, said diaphragm having a central restrictor orifice through which the fluid flows during induction strokes in operation of the compressor, whereby silencing of the suction or induction side of the piston is effected.

2. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, said compressor piston being provided with a suction antechamber and an external conduit interconnecting said suction antechamber with said interior chamber of the piston, and means communicating the suction antechamber with the interior of the casing, whereby silencing of the suction or induction side of the piston is effected.

3. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, a crosshead carried by the piston, and a slide mounted for reciprocation in the crosshead by means of the motor, said slide being formed with two suction antechambers each communicating with the interior of the casing and cooperating parts in the slide and the crosshead communicating the suction antechambers with said interior chamber of the piston, whereby silencing of the suction or induction side of the piston is effected.

4. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, an inlet nonreturn valve on said piston through which valve fluid is admitted from said interior chamber of the piston into the cylinder upon induction strokes of the piston, whereby silencing of the suction or induction side of the piston is effected.

5. Compressor as claimed in claim **4**, in which the said inlet nonreturn valve comprises a metal flap valve.

6. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, said piston being arranged for vertical reciprocation and including a lubricating pump carried by the piston and comprising a downwardly extending conduit, a one-way valve at the lower end of the conduit disposed below the level of the lubricant in the casing interior over at least part of the piston stroke, said valve opening to admit lubricant into said conduit on each descending piston stroke, and closing to trap lubricant in the conduit on each ascending piston stroke, whereby silencing of the suction or induction side of the piston is effected.

7. Compressor as claimed in claim **6**, in which said one-way valve has a movable element comprising a metal plate and means supporting the metal plate in an inclined plane subdividing the said conduit into upper and lower chambers.

8. Compressor for fluids, particularly the working fluid in a refrigerator, comprising a sealed casing, a motor-compressor unit, and resilient suspension means supporting said motor-compressor unit within said casing, said unit including a motor, a cylinder and a compressor piston reciprocable in the cylinder, said piston including at least one interior chamber through which fluid to be compressed is drawn from the interior of the casing into the cylinder, said resilient suspension means comprise a continuous frame of resilient wire and means securing the wire frame to the casing at opposite ends of the casing, said frame comprising two longitudinal members formed with loops for enhancing their flexibility, and upraised end portions interconnecting opposite ends of the longitudinal members and meeting the respective longitudinal members in respective acute-angled corners, whereby silencing of the suction or induction side of the piston is effected.

9. Compressor as claimed in claim **8**, in which the motor-compressor unit has a support provided with parts which engage the longitudinal members of the frame to support the unit from the frame.