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(54) **CONSTRUCTIVE ARRANGEMENT FOR A RESONANT COMPRESSOR**

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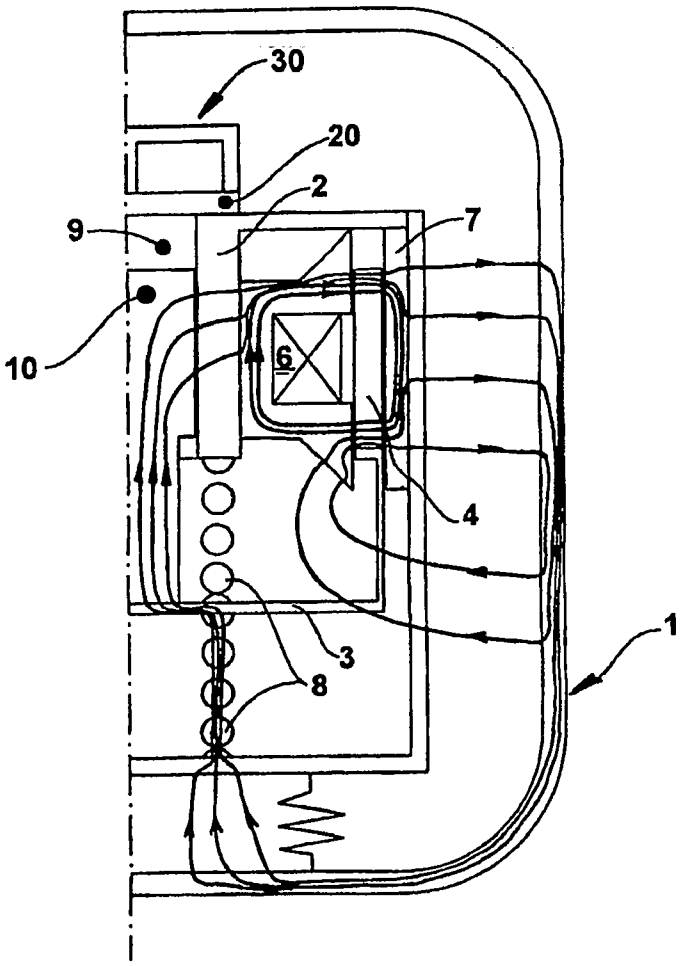
(57) **ABSTRACT**

A constructive arrangement for a resonant compressor comprising a shell (**1**), within which are mounted: a non-resonant assembly formed by a motor and a cylinder (**2**), said motor having a coil (**6**) generating a magnetic flow that travels through the shell (**1**); a resonant assembly formed by a piston (**10**) reciprocating inside the cylinder (**2**) and by an actuating means (**3**) operatively coupling the piston (**10**) to the motor, said arrangement comprising a magnetic insulating means, which is affixed to one of the parts defined by the shell (**1**), by the resonant assembly, and by the non-resonant assembly, and which is arranged so as to interrupt the magnetic flow path between the shell (**1**) and at least one of the parts defined by the piston (**10**) and the cylinder (**2**) in a direction substantially parallel to the displacement direction of the piston (**10**).



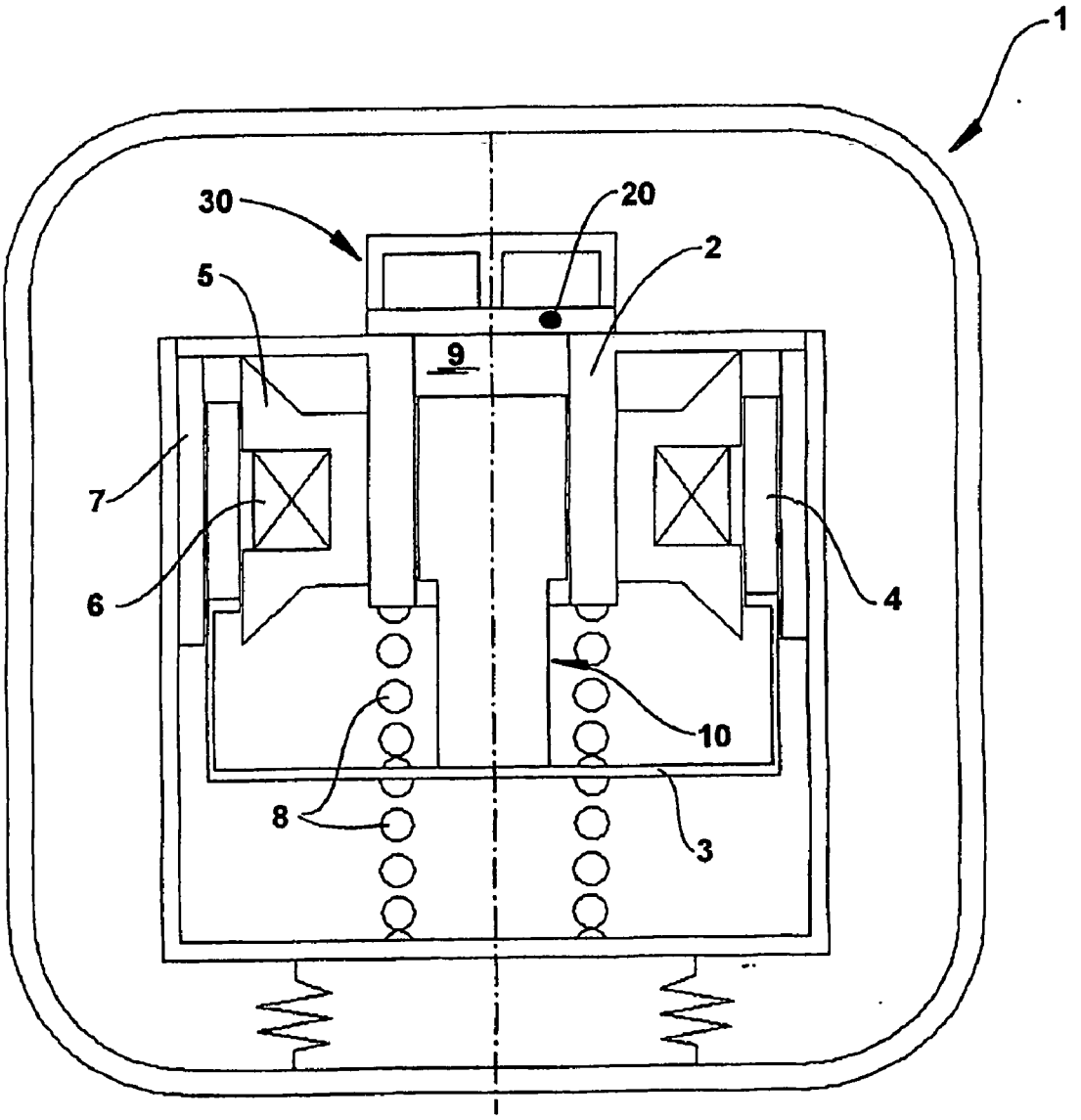


FIG.1

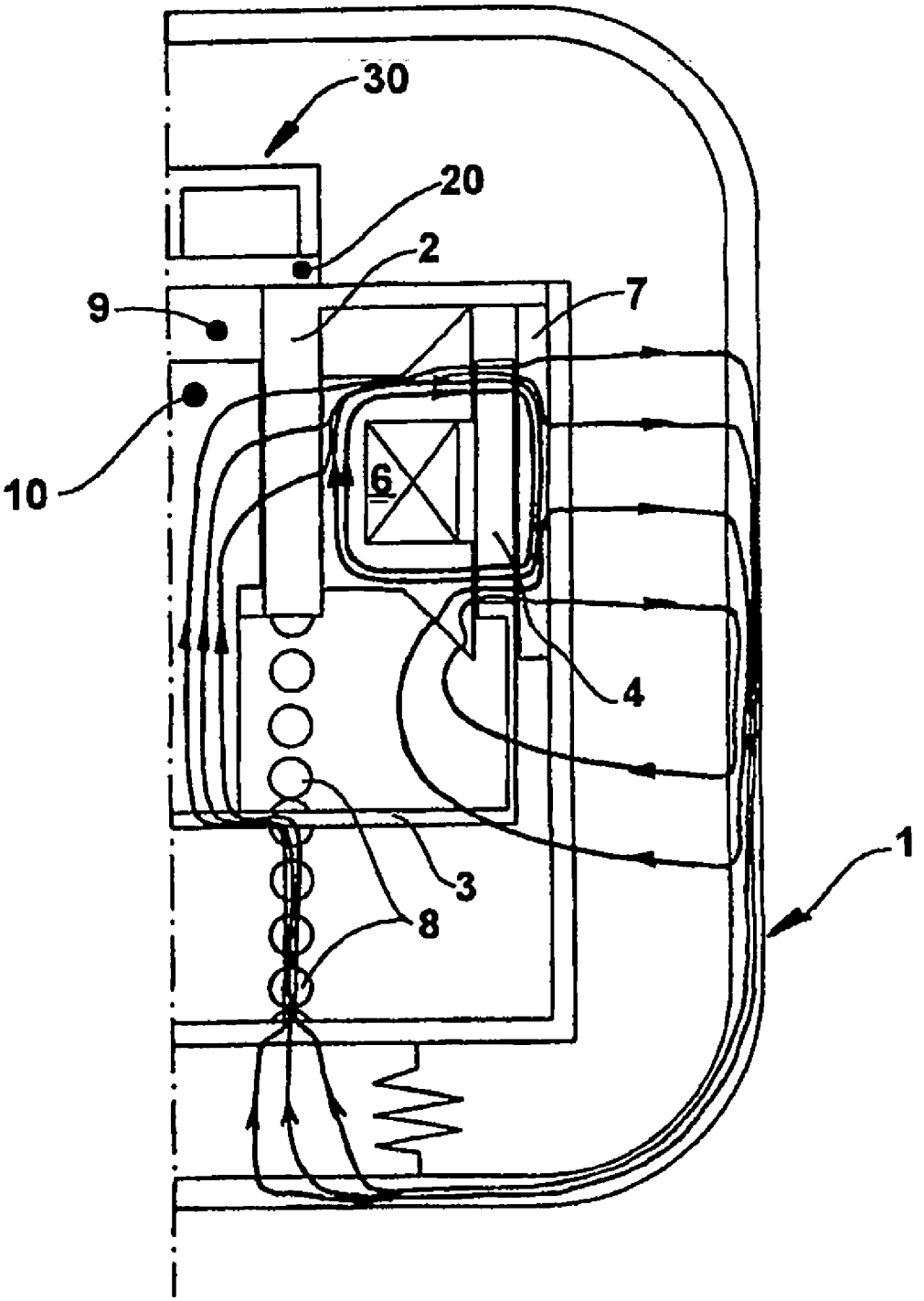


FIG.2

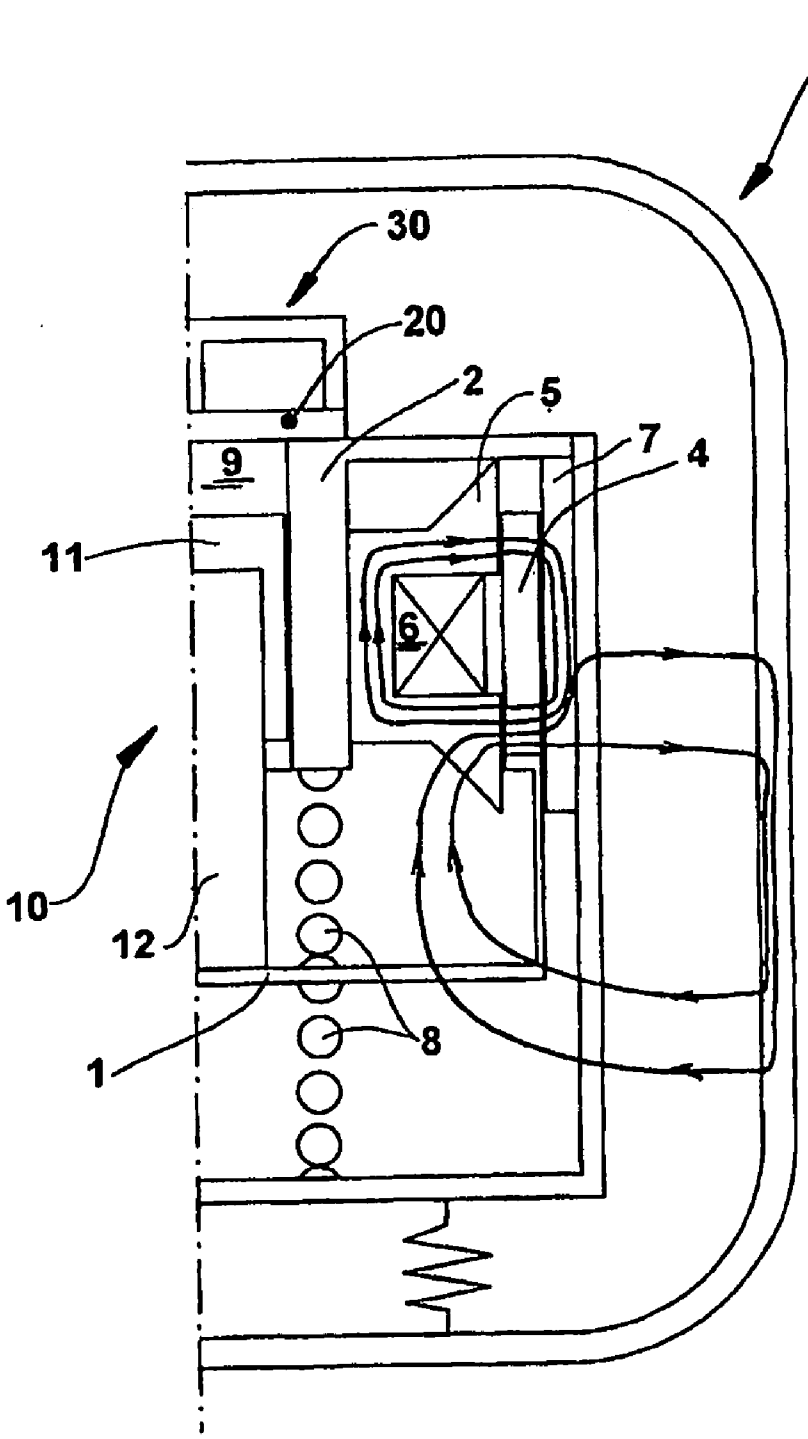


FIG.3

CONSTRUCTIVE ARRANGEMENT FOR A RESONANT COMPRESSOR

FIELD OF THE INVENTION

[0001] The present invention refers, generally, to a constructive arrangement for a resonant compressor of the type driven by a linear motor, to be applied to refrigeration systems and presenting a piston reciprocating inside a cylinder.

BACKGROUND OF THE INVENTION

[0002] In a reciprocating compressor driven by a linear motor, the gas suction and gas compression operations are performed by the reciprocating axial movements of each piston inside a cylinder, which is closed by a cylinder head and mounted within a hermetic shell, in the cylinder head being positioned the suction and discharge valves that control the admission and discharge of the gas in relation to the cylinder. The piston is driven by an actuating means that supports magnetic components operatively associated with a linear motor affixed to the shell of the compressor. In some known constructions, each piston-actuating means assembly is connected to a resonant spring affixed to the hermetic shell of the compressor, in order to operate as a guide for the axial displacement of the piston and make the whole assembly to act resonantly in a predetermined frequency, allowing the linear motor to be adequately dimensioned to continuously supply energy to the compressor upon operation.

[0003] In a known construction for a linear compressor, the linear motor is mounted around the cylinder and the piston and comprises a stack of internal laminations with a coil inserted therein, and a stack of external laminations, the magnetic actuator being linearly displaced through the space formed by these two stacks of laminations.

[0004] The magnetic flow generated by the passage of an alternating current through the coil travels through the structure of the linear motor, supplying the necessary power for the axial displacement of the magnet, which is rigidly connected to the linear motor.

[0005] However, part of the magnetic flow generated by the coil also travels through other components of the linear compressor, such as the piston and the cylinder, which are both generally made of cast iron, closing a magnetic circuit with the shell of the compressor. This magnetic circuit causes the generation of Foucault currents in these components, generating electric losses in the compressor.

[0006] According to the known prior art, in order to avoid such losses, at least part of the components through which is established the Foucault current should be manufactured in non-magnetic materials, such as aluminum, in order to interrupt a significant amount of the peripheral flow that is generated. However, producing components with such materials, which are very expensive, sometimes makes economically impractical the manufacture of the compressor.

OBJECT OF THE INVENTION

[0007] Thus, it is an object of the present invention to provide a constructive arrangement for a resonant compressor, which without causing energetic losses during the movement of the piston, minimizes the presence of Foucault currents in a closed circuit with the components of the compressor.

[0008] A further object is to provide an arrangement such as mentioned above, which minimizes the presence of Foucault currents, without increasing the cost of the compressor and making impractical its manufacture.

SUMMARY OF THE INVENTION

[0009] These and other objects are attained through a constructive arrangement for a resonant compressor comprising a shell, within which are mounted: a non-resonant assembly formed by a motor and a cylinder, said motor having a coil generating a magnetic flow that travels through the shell; a resonant assembly formed by a piston reciprocating inside the cylinder, and by an actuating means operatively coupling the piston to the motor, said arrangement comprising a magnetic insulating means, which is affixed to one of the parts defined by the shell, the resonant assembly, and the non-resonant assembly, and which is arranged to interrupt the magnetic flow path between the shell and at least one of the parts defined by the piston and by the cylinder in a direction substantially parallel to the displacement direction of the piston.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention will be described below, with reference to the enclosed drawings, in which:

[0011] **FIG. 1** is a schematic longitudinal diametrical sectional view of a hermetic compressor of the type driven by a linear motor constructed according to the prior art;

[0012] **FIG. 2** is a schematic partial longitudinal diametrical sectional view of the hermetic compressor illustrated in **FIG. 1**, presenting some magnetic flow lines traveling through the shell of the compressor and part of the components thereof, such as the piston and the cylinder; and

[0013] **FIG. 3** is a schematic view, such as that of **FIG. 2**, presenting some magnetic flow lines traveling through the shell and through part of the components of the compressor, according to the arrangement of the present invention.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

[0014] The present invention will be described in relation to a reciprocating compressor driven by a linear motor of the type utilized in refrigeration systems and comprising a hermetic shell **1**, within which is mounted a motor-compressor assembly including a non-resonant assembly affixed to the inside of said shell **1** and formed by a linear motor and a cylinder **2**, and a resonant assembly formed by a piston **10** reciprocating inside the cylinder **2** and by an actuating means **3** external to the cylinder **2** and which carries a magnet **4** to be axially impelled upon energization of the linear motor, said actuating means **3** operatively coupling the piston **10** to the linear motor.

[0015] As illustrated in the enclosed drawings, the linear motor is mounted around the cylinder **2** and the piston **10** and comprises a stack of internal laminations **5** with a coil **6** inserted therein, and a stack of external laminations **7**. The energization of the coil **6** by the alternating current passing therethrough generates a magnetic flow that travels through the structure of the motor, allowing the movement of both the magnet **4** and the piston **10**.

[0016] According to the illustration in **FIG. 2**, in the prior art construction, the magnetic flow generated by the coil **6** travels through the structure of the linear motor, as well as through the shell **1** and other components of the compressor, closing circuits of magnetic flow lines which allow Foucault currents to be generated in these components, generating electric losses to the compressor.

[0017] In this construction, the piston **10** and the cylinder **2** are manufactured in a magnetic material, for example cast iron.

[0018] In the illustrated construction, the compressor also includes spring means **8**, for example in the form of helical springs, mounted under constant compression to the resonant assembly and to the non-resonant assembly and which are resiliently and axially deformable in the displacement direction of the piston **10**.

[0019] In the embodiment illustrated in **FIG. 1**, the cylinder **2** has an end closed by a valve plate **20** provided with a suction valve and a discharge valve, which are not illustrated, allowing the selective fluid communication between a compression chamber **9** that is defined between a top portion **11** of the piston **10** and the valve plate **20**, and respective internal portions of a cylinder head **30** that are respectively maintained in fluid communication with the low and high pressure sides of the refrigeration system to which the compressor is coupled. In this construction, the valve plate **20** is generally made of a ferrous material, such as cast or sintered iron, and the cylinder head **30** is generally made of a non-magnetic material, such as aluminum, forming a barrier to the path of the magnetic flow lines through said component.

[0020] The present invention provides a constructive arrangement for the resonant compressor of the type described above and comprising a magnetic insulating means, which is affixed to one of the parts defined by the shell **1**, by the resonant assembly, and by the non-resonant assembly, and which is arranged to interrupt the magnetic flow path between the shell **1** and at least one of the parts defined by the piston **10** and by the cylinder **2**, in a direction substantially parallel to the displacement direction of the piston **10**.

[0021] Although only one specific construction for the present invention, to be described below, has been illustrated, it should be understood that the invention also comprises other constructive options, such as that in which the magnetic insulating means interrupts the magnetic flow path between the non-resonant assembly and at least one of said parts defined by the piston **10** and the cylinder **2**, for example, particularly interrupting the magnetic flow path between the spring means **8** disposed between the non-resonant assembly and the actuating means **3** and the latter, and more particularly between said non-resonant assembly and at least the piston **10**.

[0022] The present solution also foresees a constructive option, in which a magnetic insulating means is disposed to interrupt the magnetic flow between the actuating means **3** and at least said piston **10**. Since the Foucault currents generate more losses when the magnetic flow lines are crossing bodies of higher mass, the present invention, when applied between the actuating means **3** and the piston **10** and the cylinder **2**, provides a magnetic insulating means preferably between said actuating means and the piston **10**, as described hereafter, and it can additionally provide the magnetic insulating means between the actuating means **3** and the cylinder **2**.

[0023] In this constructive option, the magnetic insulating means is defined by at least part of the piston **10**, and it can also be defined by at least part of the cylinder **2**.

[0024] While the solution in which the whole piston **10** is constructed in a magnetic insulating material interrupts the magnetic flow traversing these components of the compressor, such solution, besides being expensive is not the ideal one because the piston **10** does not form an adequate tribologic pair with the cylinder **2**. On the other hand, the construction of the cylinder **2** in a magnetic insulating material that is tribologically compatible with the piston **10**, not only makes the construction of the compressor impractical, as a function of the high cost thereof, but also results in an insatisfactory tribologic pair, which is not the more adequate one when cast iron is used.

[0025] In a constructive option of the present solution, the magnetic insulating means comprises, for example at least one element made of a non-magnetic material disposed between the piston **10** and the actuating means **3**, and each element in a non-magnetic material can be defined by a coupling portion **12** of the piston **10** connecting the actuating means **3** to the top portion **11** of the piston **10**. In this construction, said top portion **11** is made of a magnetic material tribologically compatible with that of the cylinder **2**, such as cast iron. In a variation of said constructive option, in which, for example, the piston **10** is massive, each element of a non-magnetic material is in the form of a pastille, not illustrated, defined adjacent to the actuating means **3** and attachable to a respective part defined by the piston **10**, and which can also be attached to the cylinder **2**.

[0026] In another constructive option, the coupling portion **12** defines the magnetic insulating means and is mounted to the piston **10** through a respective end mounted to the top portion **11** of the piston **10**, for example affixed to the inside of said top portion **11** when the latter is tubular.

[0027] In the illustrated construction, the coupling portion **12** is an insert made of a non-magnetic material, such as aluminum and, for example 10 mm thick, which is mounted to the inside of the top portion **11** of the piston **10** made of a material tribologically compatible with that of the cylinder **2**. The fixation between the coupling portion **12** and the top portion **11** of the piston **10** can be made by any one of the processes, such as interference, welding, and gluing.

[0028] Although not illustrated, the interruption of the magnetic flow in the present invention can be achieved through a magnetic insulating means in the form of a lining provided in the part to which it is affixed.

1. A constructive arrangement for a resonant compressor comprising a shell **(1)**, within which are mounted: a non-resonant assembly formed by a motor and a cylinder **(2)**, said motor having a coil **(6)** generating a magnetic flow which travels through the shell **(1)**; a resonant assembly formed by a piston **(10)** reciprocating inside the cylinder **(2)** and by an actuating means **(3)** operatively coupling the piston **(10)** to the motor, characterized in that it comprises a magnetic insulating means, which is affixed to one of the parts defined by the shell **(1)**, by the resonant assembly, and

by the non-resonant assembly, and which is arranged to interrupt the magnetic flow path between the shell (**1**) and at least one of the parts defined by the piston (**10**) and by the cylinder (**2**) in a direction substantially parallel to the displacement direction of the piston (**10**).

2. The arrangement according to claim 1, characterized in that the magnetic insulating means interrupts the magnetic flow path between the non-resonant assembly and at least one of said parts defined by the piston (**10**) and the cylinder (**2**).

3. The arrangement according to claim 2, in which the resonant assembly carries at least one spring means (**8**) mounted to the actuating means (**3**) and to the non-resonant assembly and which is resiliently and axially deformable in the displacement direction of the piston (**10**), characterized in that the magnetic insulating means interrupts the magnetic flow path between said spring means (**8**) and at least one of said parts defined by the piston (**10**) and the cylinder (**2**).

4. The arrangement according to claim 2, characterized in that the magnetic insulating means interrupts the magnetic flow path at least between the actuating means (**3**) and the piston (**10**).

5. The arrangement according to claim 4, characterized in that the magnetic insulating means is defined by at least part of the piston (**10**).

6. The arrangement according to claim 5, characterized in that the magnetic insulating means is defined by at least part of the cylinder (**2**).

7. The arrangement according to claim 4, characterized in that the magnetic insulating means comprises at least one element made of a non-magnetic material disposed between the piston (**10**) and the actuating means (**3**).

8. The arrangement according to claim 7, characterized in that each element in a non-magnetic material is defined by a coupling portion (**12**) of the piston (**10**) connecting the actuating means (**3**) to a top portion (**11**) of the piston (**10**).

9. The arrangement according to claim 4, characterized in that each element in a non-magnetic material is a pastille (**40**) defined adjacent to the actuating means (**3**) and attachable to a respective part defined by the piston (**10**) and by the cylinder (**2**).

10. The arrangement according to claim 1, characterized in that the magnetic insulating means is a lining provided in the part to which it is affixed.

11. The arrangement according to claim 5, characterized in that the piston (**10**) is massive.

12. The arrangement according to claim 8, characterized in that the coupling portion (**12**) has an end mounted to the inside of the top portion (**11**) of the piston (**10**).

13. The arrangement according to claim 12, characterized in that the top portion (**11**) is tubular and the coupling portion (**12**) is an insert mounted to the inside of the top portion (**11**).

14. The arrangement according to claim 13, characterized in that the insert is mounted to the top portion (**11**) by any one of the processes, such as interference, welding, or gluing.

15. The arrangement according to claim 7, characterized in that the element in a non-magnetic material presents a thickness of at least about 10 mm.

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