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(54) PISTON COMPRESSOR FOR MEDICAL USE

(57) A volumetric compressor with one or more cylinders, comprising:
at least one cylinder (2), provided with a suction opening (21) and a discharge opening (22) controlled by respective valves;
a suction duct (3), connected to the suction opening (21);
a discharge duct (4), connected to the discharge opening;
a motor (5), provided with the possibility of varying its rotation speed;
an adjustment valve (6), arranged along the suction duct (3), which is predisposed to vary the flow rate of the air directed to the suction opening.

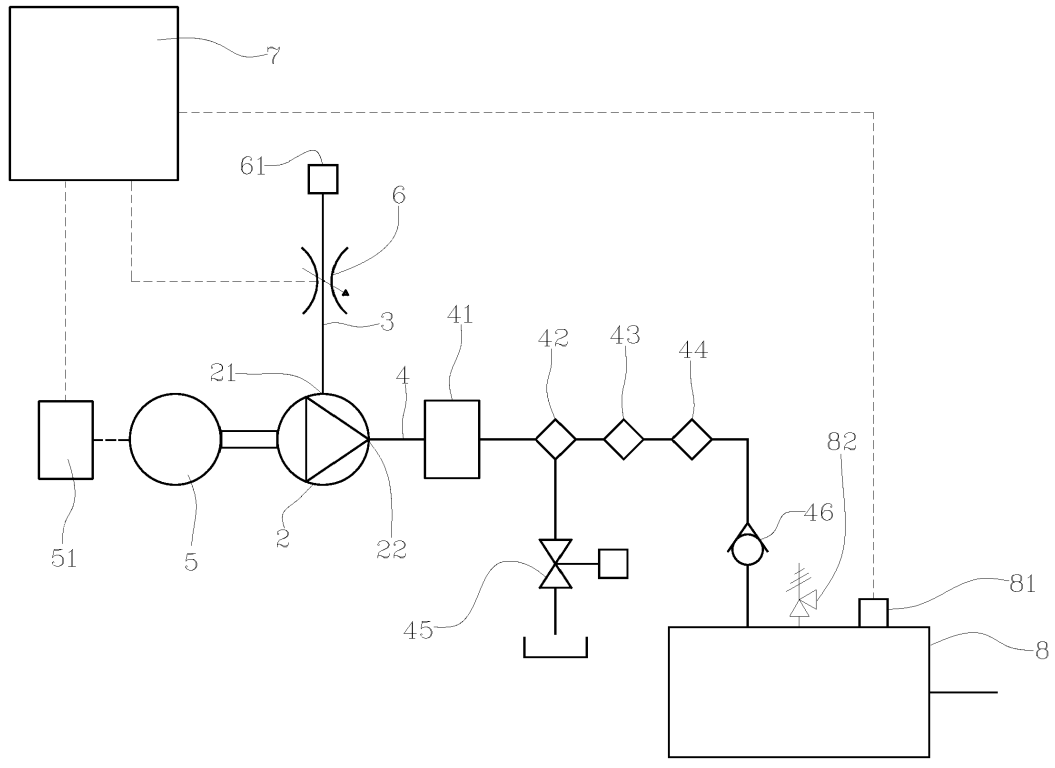

Fig.1

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Description

[0001] The present invention relates to a piston compressor. The compressor according to the present invention is particularly, but not exclusively, advantageous for medical use, for example for operating dental tools and equipment.

[0002] Various types of compressors for dental equipment or medical devices in general are currently available on the market.

[0003] Among the available compressors, volumetric compressors of the piston type with one or more cylinders are very widespread.

[0004] In general, the current compressors are equipped with a tank, connected to the delivery of the cylinders. The pressure inside the tank is detected by means of a pressure gauge, in turn connected to the control module of the motor driving the compressor. The control module controls the ignition of the motor in relation to the pressure detected inside the tank. In particular, when the pressure drops below a predefined minimum value, the motor is placed in operation. The actuation of the motor leads to an increase in the pressure inside the tank. When the pressure reaches a predefined maximum value detected by the pressure gauge, the control module controls the stop of the motor.

[0005] Some compressors are additionally provided with an inverter for controlling the motor. In the presence of an inverter, the actuation of the motor is adjusted on the basis of the variation of the pressure inside the tank over time, varying the rotation speed.

[0006] In particular, in low air demand conditions, and therefore with a modest pressure drop inside the tank, the motor is progressively slowed, and only in the case of a substantially null demand for air is the motor stopped. Therefore, the motor operates at a rather low rotation speed for rather prolonged intervals of time.

[0007] As is known, both motors and mono- or bi-cylindrical compressors with low rotation speeds produce very low frequency vibrations, i.e. they produce oscillations of comparatively high amplitude that can be mechanically problematic to contain and absorb. Furthermore, at low rotation speeds the efficiency of the compressor declines considerably.

[0008] The object of the present invention is to offer a pneumatic piston compressor which allows the drawbacks summarised above to be overcome.

[0009] One advantage of the compressor according to the present invention is that it allows drastically reducing the oscillations at low rotation speeds. Another advantage of the compressor according to the present invention is that it has a better yield, in particular at low rotation speeds.

[0010] Further characteristics and advantages of the present invention will become more apparent in the following detailed description of an embodiment of the present invention, illustrated by way of non-limiting example in the attached figure 1.

[0011] Figure 1 schematically shows, for the sake of simplicity, a solution in which the compressor is provided with a single cylinder. The description that follows refers to the solution shown, but it is also valid and consistent in the presence of a greater number of cylinders.

[0012] In a known manner, the cylinder (2) encloses a cylindrical volume inside which a piston is sealedly movable, according to a reciprocating motion. The cylinder (2) is provided with a suction opening (21) and a discharge opening (22), controlled by respective valves operated by a distribution system of a known type, not shown in detail.

[0013] The compressor further comprises a motor (5). In a known manner, the motor (5) comprises a drive shaft connected to the piston (2) via a rod-crank linkage.

[0014] The motor (5) is provided with the possibility of varying its rotation speed. To this end, in a preferred but not exclusive embodiment, the motor (5) is an electric motor provided with an inverter (51). This solution, by virtue of the noiselessness of the electric motor, is particularly adapted for use inside the compressor, for example in medical or dental offices. The motor (5) can be of another type for other uses, for example it could be an internal combustion engine. In this case, the adjustment of the rotation speed of the motor can be performed by adjusting the fuel supply.

[0015] The compressor is also provided with a suction duct (3), connected to the suction opening (21), and a discharge duct (4), connected to the discharge opening (22).

[0016] Advantageously, the compressor comprises an adjustment valve (6), arranged along the suction duct (3), which is predisposed to vary the flow rate of the air directed to the suction opening (21).

[0017] The presence of the adjustment valve (6) along the suction duct (3) produces significant technical effects. In fact, thanks to the adjustment valve (6) it is possible to vary the flow rate of the air sucked by the compressor as a function of the rotation speed of the motor (5). In particular, it is possible to reduce the flow rate of the sucked air with the lowering of the rotation speed of the motor (5). This allows significantly reducing the oscillations of the compressor at low rotation speeds. In fact, reducing the flow rate of sucked air, it is possible to reduce the length of the stroke of the piston during which the maximum pressure develops, i.e. the delivery pressure of the compressor. In the limit condition wherein the adjustment valve (6) is closed, the piston completes its stroke cycle without in fact producing the delivery pressure of the compressor. In addition to allowing a reduction of the oscillations, the condition described above also allows increasing the efficiency of the compressor, since the reduction of the flow rate of sucked air, at equal rotation speeds, allows reducing the power absorbed by the motor (5).

[0018] Advantageously, in a preferred but not exclusive embodiment of the compressor, the control of the adjustment valve (6) can be carried out in an automatic

manner, as a function of the rotation speed of the motor (5). To this end, the compressor is provided with a control module (7), connected to the motor (5) and to the adjustment valve (6), which is predisposed to operate the adjustment valve (6) as a function of the rotation speed of the motor (5). The control module (7) receives in input a significant datum of the rotation speed of the motor (5) and, on the basis of the datum received, adjusts the opening of the adjustment valve (6) so as to obtain a predetermined suction flow rate, according to a control algorithm predisposed in the control module (7). The control module (7), in a known manner, comprises a PLC and/or an electronic processor suitable to operate according to a predetermined control algorithm. Thanks to the control module (7) configured as described above, the motor (5) always operates in conditions of maximum efficiency and with much lower oscillations and vibrations compared to what would occur at low frequencies, without a valve.

[0019] In a preferred embodiment of the compressor, the rotation speed of the motor (5) is considered to substantially coincide with the speed controlled by the inverter (51), i.e. not using the actual motor speed, but the speed that the inverter (51) imposes on the motor. In this way the need to use a sensor for detecting the rotation speed of the motor (5) is avoided. Alternatively, it would be possible to predispose a suitable sensor for detecting the rotation speed of the motor.

[0020] The compressor according to the present invention further comprises a tank (8), connected to the discharge opening (4). The tank (8) is provided with a pressure gauge (81) that is connected to the control module (7). The control module (7) is predisposed to adjust the rotation speed of the motor (5) as a function of the pressure detected by the pressure gauge (81) inside the tank (8). If the pressure inside the tank rises above a predetermined maximum value, the control module controls the stop of the motor (5), possibly with a predefined delay. If the pressure falls below the predetermined maximum value, the control module controls the ignition of the engine (5), adjusting its rotation speed as a function of the pressure and the pressure variation over time. Simultaneously with the rotation speed of the motor (5), as already pointed out, the control module (7) controls the adjustment valve (6), varying the flow rate of sucked air as a function of the rotation speed of the motor (5).

[0021] The compressor according to the present invention can also be equipped with further accessory devices, of known type, illustrated by way of example in figure 1. For example, along the discharge duct (4) and upstream of the tank (8), a cooler (41) can be provided, predisposed to reduce the temperature of the air sent to the tank (8). Downstream of the cooler (41) and upstream of the tank (8) a condensate trap (42) can also be arranged, whose draining can be adjusted by a solenoid valve (45), or by an automatic valve of another type, a dryer (43), to eliminate the moisture in the air sent to the tank (8), and a filter (44). The tank (8) is provided with a maximum pressure safety valve (82). A suction filter (61) is also arranged upstream of the adjustment valve (6), along the suction duct (3).

Claims

1. A volumetric compressor with one or more cylinders, comprising:

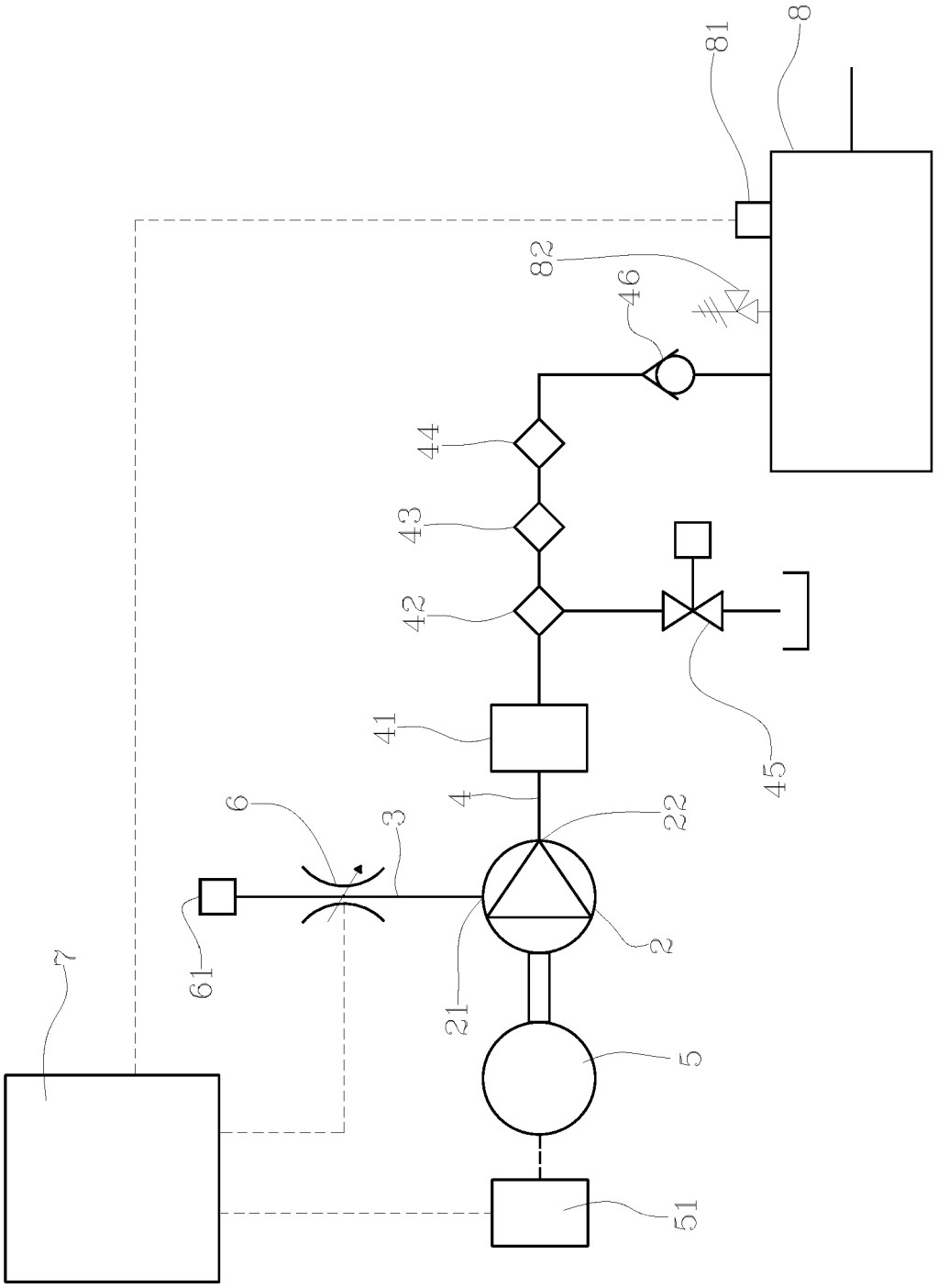
   at least one cylinder (2), provided with a suction opening (21) and a discharge opening (22) controlled by respective valves;
   a suction duct (3), connected to the suction opening (21);
   a discharge duct (4), connected to the discharge opening;
   a motor (5), provided with the possibility of varying its rotation speed;
   characterised in that it comprises at least one adjustment valve (6), arranged along the suction duct (3), which is predisposed to vary the flow rate of the air directed to the suction opening.

2. The compressor according to claim 1, comprising a control module (7), connected to the motor (5) and to the adjustment valve (6), which is predisposed to operate the adjustment valve (6) as a function of the rotation speed of the motor (5).

3. The compressor according to claim 2, comprising a tank (8) connected to the suction opening (4) and provided with a pressure gauge (81) that is connected to the control module (7), wherein the control module (7) is predisposed to adjust the rotation speed of the motor (5) as a function of the pressure detected by the pressure gauge (81) inside the tank (8).

4. The compressor according to claim 2 or 3, wherein the motor (5) is an electric motor provided with an inverter (51) connected to the control module (7).

Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 4030

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B60T
F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 September 2019	Paulson, Bo

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