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Section 29

AUSTRALIA

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PATENT REQUEST : STANDARD PATENT

I/We, being the person/s identified below as the Applicant, request the grant of a patent to the person/s indicated below as the Nominated Person/s, for an invention described in the accompanying standard complete specification.

Full application details follow.

[71] [70] Applicant/s and Nominated Person/s:
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[54] Invention Title:
**Regulating device with starting and stopping device for screw-type
compressors, and starting and stopping device used thereby**

[72] Name/s of actual inventor/s: (optional)

[74] Address for service in Australia:
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BASIC CONVENTION APPLICATION/S DETAILS:

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Basic Applicant/s: Atlas Copco Airpower

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Section 29(1)
Regulation 3.2(2)

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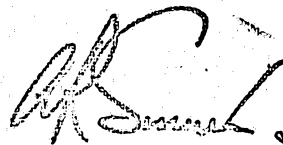
NOTICE OF ENTITLEMENT

Atlas Copco Airpower being the applicant/Nominated Person in respect of the Application No. 60503/94 state the following :

The Nominated Person is entitled to the grant of the patent because the Nominated Person derives title to the invention from the inventors, CHRISTIAAN VAN DYCK, by assignment.

The Nominated Person is entitled to claim priority from the basic application listed on the patent request because the Nominated Person is the applicant in respect of the basic application and because the basic application was the first application made in a Convention country in respect of the invention.

DATED this 6th day of FEBRUARY, 1996



.....
a member of the firm of
DAVIES COLLISON CAVE
for and on behalf of
the applicant(s).



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(12) PATENT ABRIDGMENT (11) Document No. AU-B-60503/94
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- (54) Title
**REGULATING DEVICE WITH STARTING AND STOPPING DEVICE FOR SCREW-TYPE
COMPRESSORS, AND STARTING AND STOPPING DEVICE USED THEREBY**
- International Patent Classification(s)
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- (71) Applicant(s)
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- (56) Prior Art Documents
EP 401485
- (57) Claim

1. Regulating apparatus for a screw-type compressor, the compressor including a compressor element having an inlet and an outlet, an electric motor for driving the compressor element, a minimum pressure valve at or downstream of the outlet and a vessel between the compressor element and the minimum pressure valve, the regulating apparatus including control means for controlling operation of the motor at a frequency-regulated rotational speed and at a substantial constant pressure within the vessel and a starting and stopping device which includes a non-return valve which is disposed at or upstream of the inlet to the compressor element.

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Regulation 3:2

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ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

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Invention Title: Regulating device with starting and stopping device
for screw-type compressors, and starting and
stopping device used thereby

The following statement is a full description of this invention, including the
best method of performing it known to me:-

5 Regulating device with starting and stopping device for
screw-type compressors, and starting and stopping device
used hereby.

10 The invention concerns a regulating device with starting
and stopping device for screw-type compressors which
contain a compressor element, a minimum pressure valve
which is mounted on the outlet of the compressor element
and a vessel which is mounted between the compressor
element and the minimum pressure valve, which regulating
device contains means to control the motor.

15 The oil-injected screw-type compressors have been
equipped until now with a regulating device provided with
a starting and stopping device which contains means to
release the volume, after the compressor has come to a
standstill and thus at zero rotational speed, which is
situated between the outlet of the compressor element and
the minimum pressure valve, in the atmosphere and which
contains a relief valve which makes sure that the
compressor element can further run idly, i.e. at a
20 minimum pressure of about 0.5 to 1 bar which is
sufficient to guarantee the oil injection, but whereby a
minimum amount of air is drawn in.

25 With such a starting and stopping device, the succession
of loaded and idle periods of the compressor provides a
possible compressor regulation, and the means to control
the motor are means which make said motor turn at an
almost constant rotational speed, whereas the pressure in
the vessel varies. Every loaded period, with maximum
30

vessel pressure, is hereby followed by either an idle period with minimum pressure in the vessel sufficient to guarantee the oil injection in the compressor, or by a stop period with full blasting off of the vessel.

5

The blasting off of the volume between the outlet of the compressor element and the minimum pressure valve, until the pressure there becomes equal to the ambient pressure, is necessary with these known regulating devices to avoid very high current peaks when restarting. Indeed, given the output, the motor of the compressor is started with a starting current restriction, normally a star/D switch, to avoid current peaks. As a result, however, also the supplied motor torque drops, which becomes insufficient to start the compressor without blasting off the pressure at the outlet.

15

Said blasting off results in a loss of energy, however, since compressed air is lost without being efficiently used. The blasting off produces a noise which must be possibly muffled, whereas the blast-off air must be blown off. Moreover, the means to blow off said air through the opening and closing of valves and air valves have quite a complicated construction.

20

The relief valve is necessary to restrict the number of starting and stop frequencies. With a star/D start, the number of starts and stops is limited to some fifteen per hour, as the motor would otherwise heat up too much.

25

Also this relief valve causes a loss of energy, since, also when the compressor, instead of stopping, turns on idly and does not produce any output, the motor still absorbs up to one fourth of its nominal output.

30

According to the present invention there is provided a regulating apparatus for a screw-type compressor, the compressor including a compressor element having an inlet and an outlet, an electric motor for driving the compressor element, a minimum pressure valve at or downstream of the outlet and a vessel between the compressor element and the minimum pressure valve, the regulating apparatus including control means for controlling operation of the motor at a frequency-regulated rotational speed and at a substantial constant pressure within the vessel and a starting and stopping device which includes a non-return valve which is disposed at or upstream of the inlet to the compressor element.

10 Preferably the non-return valve includes a housing, a valve rod and a valve member on the valve rod, a valve seat within the housing which cooperates with the valve member and valve rod mounting within the housing for receiving said valve rod. The valve rod is preferably movable relative to the mounting so that the valve member can move relative to the valve seat between an open position and a closed position and
15 spring means arranged to urge said valve member into the closed position.

Preferably the non-return valve further includes a guide pin within the housing and a cooperating guide element on the valve rod, the guide pin being disposed generally parallel to the valve rod and the guide element being movable along the pin when the valve moves between its open and closed positions.

20 Thanks to the drive with a frequency-regulated rotational speed, it is possible to make the compressor start without any current peaks or peak torques, even against the pressure. As a result, the blasting off of the vessel is not necessary. After the initial filling under pressure of the vessel, its pressure remains almost constant, with no regard to whether the compressor element is turning or not.

25 In order to better explain the characteristics of the invention, the following preferred embodiment of a regulating device with starting and stopping device for screw-type compressors, and of a starting and stopping device used hereby, according to the invention, is described as an example only without being limitative in



any way, with reference to the accompanying drawings,
where:

5 figure 1 is a schematic representation of a
compressor provided with a regulating device
according to the invention;

figure 2 shows a cross-section of a non-return valve
indicated by F2 in figure 1;

10 figure 3 shows a diagram of the rotational speed of
the motor and the pressure in the vessel as a
function of time.

15 The screw-type compressor represented in figure 1 mainly
contains a compressor element 1, an electric induction
motor 2 with frequency-regulated revolutionary speed,
which drives the compressor element 1 by means of a
coupling 3, a minimum pressure valve 4 mounted on the
20 outlet 5 of the compressor element 1 and a vessel 6 which
is mounted in said outlet 5, between the compressor
element 1 and the minimum pressure valve 4.

On the outlet 5 is connected a pipe 7 downstream of the
25 vessel 6 in which is mounted a safety valve 8.

The revolutionary speed of the motor 2 is regulated by
means of frequency control via a control 9. This control
9 contains a microprocessor-controlled frequency
30 transformer with a fully controlled bridge rectifier, a
direct current voltage interstage circuit with capacitor
bank, and a pulse width modulation transformer with
transistors. The materials used for the motor 2 and its
actual construction are selected such that the iron and

copper losses are restricted to a minimum. Very important hereby are the losses caused by eddy currents, since these losses are in proportion to the squared frequency.

5

The compressor element 1 draws in air via an inlet 10 in which is mounted an air filter 11, and between said air filter 11 and the compressor element 1 is mounted a non-return valve 12.

10

As represented in detail in figure 2, said non-return valve 12 contains a housing 13, which forms a passage with a narrow part 14 which joins the air filter 11, and a wider part 15 which joins the compressor element 1. At the height of the transition from the wider part 15 to the narrow part 14, the housing 13 forms a seating 16 for a valve 17 which is mounted on a valve rod 18 which extends centrally in the narrow part 14. Said valve rod 18 can be shifted through bush 19 which is mounted in an edge 20 of the housing 13 protruding inwardly in the part 14.

25

At the free end of the valve rod 18 is fixed a hook 21 by means of a bolt 22. Said hook 21 can be shifted with its end over a guiding pin 23 which is directed parallel to the valve rod 18 and is fixed in the edge 20 next to the bush 19. The guiding pin 23 makes sure that the valve rod 18 and the valve 17 cannot rotate when opened. Between said bush 19 and the hook 21, the valve rod 18 is surrounded by a spiral spring 24 which pushes the valve 17 in its closed position via the valve rod 18.

30

In the wall of the part 14 is provided an opening 28 to connect the measuring appliances.

Downstream of the minimum pressure valve 4 is mounted a cooler 25 on the outlet 5 of the compressor to cool off the compressed air. This cooler works in conjunction with a fan 26 which is driven by an electrical motor 27.

5

The minimum pressure valve 4 is mounted on the outlet of the vessel 6 and opens the outlet 5 as soon as the pressure in the vessel exceeds a certain value, for example 4 bar. This valve 4 also functions as a non-
10 return valve which, when the compressor element 1 is stopped and thus when the output is zero, immediately closes off the outlet 5 and prevents air from streaming from the compressed air net situated behind towards the compressor. Such minimum pressure valves are already
15 known and contain for example a sealing washer which is attached on a first plunger which can be moved against the action of a spring in a larger plunger which, when pressure rises, against the action of a second spring, is pushed away by the sealing washer when the above-
20 mentioned minimum pressure is reached.

The regulating device consisting of the control 9 and the non-return valve 12 works as follows.

25 When the compressor is started, an underpressure is created in the part 15 of the non-return valve 12. When a certain value has been reached, the force exerted by this underpressure on the valve 17 exceeds the prestress which the spring 24 has in the opposite sense. As a
30 result, the valve 17 is lifted from the seating 16, and the compressor element 1 can draw in the full flow. The valve 17 opens entirely until the hook 21 is situated against the bush 19.

The minimum pressure valve 4 closes off the outlet 5 until the pressure in the vessel 6 has risen up to a certain minimum value.

- 5 When the compressor element 1 stops, the above-mentioned underpressure in the non-return valve 12 falls out, and the spring 24 will close the valve 17 before air or oil can escape from the compressor element 1. Also the minimum pressure valve 14 immediately closes off the
10 outlet of the vessel 6, as already mentioned.

- Between the starting and stopping, the control 9 provides for a variable rotational speed of the motor 2 with a constant pressure in the vessel 6. The induction motor
15 2 is provided with a variable tension and a variable frequency as a function of the required revolutionary speed, which revolutionary speed is transmitted to the frequency transformer by an electronic control unit which is integrated in the compressor and which does not only
20 control the frequency transformer but also provides for the pressure regulation of the compressor. The control 9 makes sure that the tension and the frequency of the motor 2 are such that the torque on the shaft of the motor 2 is sufficient to drive the load.

- 25 Figure 3 represents the fluctuation of said revolutionary speed as a % of the maximum revolutionary speed as a function of time, in a full line. The chain line represents the pressure in the vessel 6 as a function of
30 this time. When starting up, this pressure very quickly rises to its maximum value, after which said pressure is maintained almost constant.

The above-described control device has a relatively

simple construction. The starting and stopping device used hereby is restricted to a simple non-return valve 12 and thus has a relatively simple construction.

- 5 The present invention is by no means limited to the embodiment described above and represented in the accompanying drawings; on the contrary, such a regulating device and starting and stopping device can be made in all sorts of variants while still remaining within the
- 10 scope of the invention.

The reference numerals in the following claims do not in any way limited the scope of the respective claims.

The claims defining the invention are as follows:

1. Regulating apparatus for a screw-type compressor, the compressor including a compressor element having an inlet and an outlet, an electric motor for driving the compressor element, a minimum pressure valve at or downstream of the outlet and a vessel between the compressor element and the minimum pressure valve, the regulating apparatus including control means for controlling operation of the motor at a frequency-regulated rotational speed and at a substantial constant pressure within the vessel and a starting and stopping device which includes a non-return valve which is disposed at or upstream of the inlet to the compressor element.
2. Regulating apparatus according to claim 1 wherein said non-return valve includes a housing, a valve rod and a valve member on said valve rod, a valve seat within said housing which cooperates with said valve member and valve rod mounting within said housing for receiving said valve rod, said valve rod being movable relative to said mounting so that the valve member can move relative to the valve seat between an open position and a closed position and spring means arranged to urge said valve member into the closed position.
3. Regulating apparatus according to claim 2 wherein said non-return valve further including a guide pin within said housing and a cooperating guide element on said valve rod, said guide pin being disposed generally parallel to said valve rod and said guide element being movable along said pin when said valve moves between its open and closed positions.
4. Regulating apparatus substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 6th day of FEBRUARY 1996

ATLAS COPCO AIRPOWER

By Their Patent Attorneys

DAVIES COLLISON CAVE



Regulating device with starting and stopping device for
5 screw-type compressors, and starting and stopping device
used hereby.

10 Regulating device with starting and stopping device for
screw-type compressors which contain a compressor element
(1), an electrical motor (2) to drive this compressor
element (1), a minimum pressure valve (4) which is
mounted on the outlet (5) of the compressor element (1)
and a vessel (6) which is mounted between the compressor
15 element (1) and the minimum pressure valve (4), which
regulating device contains means (9) to control the motor
(2), characterized in that the means (9) to control the
motor (2) are means to make said motor (2) turn at a
frequency-regulated rotational speed at an almost
constant pressure in the vessel (6), and in that the
20 starting and stopping device contains a non-return valve
(12) which is mounted on the inlet (10) of the compressor
element (1).

25 Figure 1.

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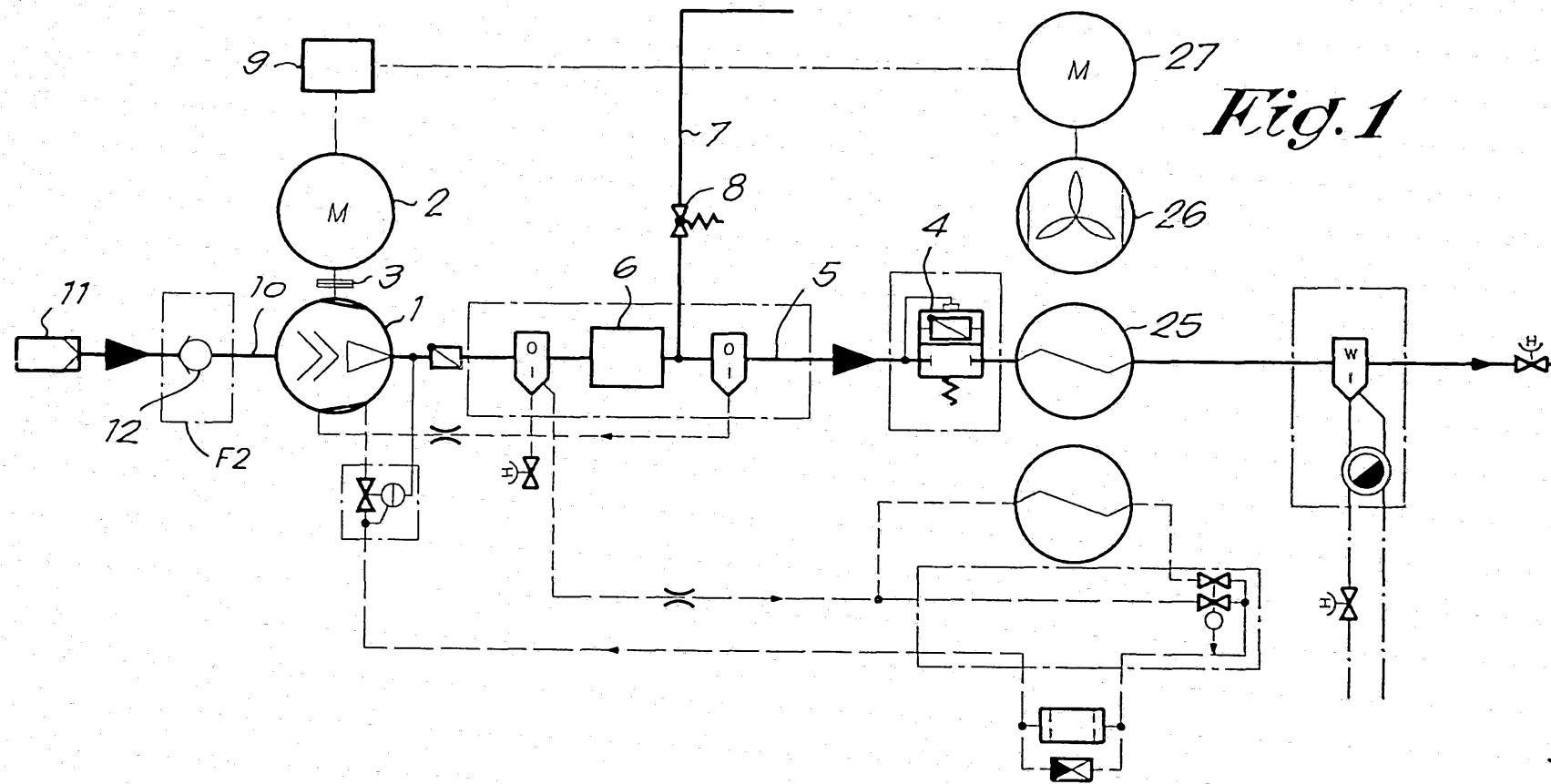


Fig. 1

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