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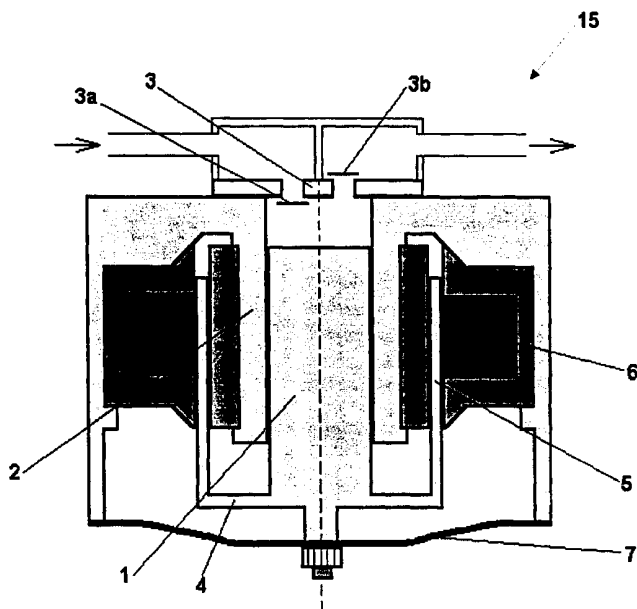
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(54) Title: POSITION SENSOR AND COMPRESSOR



(57) Abstract: A position sensor (10) is described, particularly a sensor (10) applicable to a linear compressor (15), for detecting the position of the piston (1) and preventing the latter from knocking against the head (3) located at the end of its stroke. One of the objectives of the present invention is to provide a sensor (10) capable of detecting the position of the piston (1), which can solve the problem of collision of the latter with the head (3) altogether and that is easy to build and to install, thus reducing the production and manufacture costs of the compressor (15). This objective is achieved by means of a sensor (10), particularly one that is employable in detecting the position of a piston (1) of a compressor (15), the piston (1) being axially displaceable inside a hollowed body (2), the compressor (15) comprising a valve blade (9), the blade (9) being positioned between the head (3) and the hollowed body (2), the sensor (10) comprising a probe (20) electrically connected

to a control circuit (12), the probe (20) being capable of detecting the passage of the piston (1) by a point of the hollowed body (2) and signalling this to the control circuit (12). Another objective of the present invention is to provide a compressor (15) having a sensor (10) that is capable of detecting the passage of its piston (1) at a point (8) and signalling this to a circuit (12) for the purpose of preventing it from knocking against the head (3). This objective is achieved by means of a compressor (15), particularly a linear compressor, comprising a piston (1) axially displaceable inside a hollowed body (2), the compressor (15) comprising a valve blade (9), the blade (9) being positioned between a head (3) and the hollowed body (2), the compressor (15) comprising a probe (20) electrically connectable to a control circuit (12), the probe (20) being capable of detecting the passage of the piston (1) at a point of the hollowed body (2) and signalling this to the control circuit (12).

Specification of the Patent of Invention for: **"POSITION SENSOR AND COMPRESSOR"**

The present invention refers to a position sensor, particularly a sensor applicable to a linear compressor, for detecting the position of the piston, as well as to a compressor provided with a position sensor of its piston.

Description of the State of the Art

A linear compressor basically comprises a piston that can be axially displaced in a hollowed body, such piston compressing the gas used in the refrigeration cycle. suction and discharge valves close to the end of the stroke of the piston regulate gas inlet and outlet in the cylinder or hollowed body. The piston is driven by an actuator that supports a magnetic component, which is driven by a linear motor. The piston is connected to a resonant spring and, together with the magnetic component and the spring, forms the resonant assembly of the compressor.

The resonant assembly, driven by the linear motor, has the function of developing a linear alternative movement, causing the movement of the piston inside the cylinder to perform an action of compressing the gas admitted by the suction valve as far as the point at which it can be discharged to the high-pressure side through the discharge valve.

Variations in the conditions of operation of the compressor, or variations in the feed voltage may cause the resonant assembly to displace beyond an acceptable limit, leading the top of the piston to knock against the head, thus causing noise and even damages to the compressor.

There are various solutions for controlling the movement of the piston so as to avoid collision of the piston with the head. One of them is to control the voltage level applied to the motor, so as to prevent the piston from advancing beyond the predetermined point and colliding with the head.

Other solutions detect the excess advance of the piston at the time of its collision with the head, thus not preventing damages to the compressor.

In order to avoid the above-cited problems, some solutions propose the use of position sensors, usually inductive transducers designed to detect the passage of the piston from a point close to the end of its stroke and to prevent it from knocking against the head. The problem of using these
5 sensors lies in the fact that such devices are expensive and difficult to install, which raises the production costs of the compressor.

Objectives and Brief Description of the Invention

The objective of the present invention is to provide a sensor capable of detecting the position of the piston, which prevent collision of the
10 latter with the head altogether, is easy to construct and to install, thus reducing the production and manufacture costs of the compressor.

This objective is achieved by means of a sensor, particularly one that can be employed for detecting the position of a piston, the piston being axially displaceable in a hollowed body, the compressor comprising a valve
15 blade, this blade being positioned between a head and the hollowed body, the sensor comprising a probe electrically connected to a control circuit, the probe being capable of detecting the passage of the piston at a point of the hollowed body and signaling this to the control circuit.

Another objective of the present invention is to provide a compressor having a sensor that is capable of detecting the passage of its piston
20 at a point and signaling this to a circuit, with a view to prevent it from knocking against the head.

This objective is achieved by means of a compressor, particularly a linear one comprising a piston that is axially displaceable inside a hollowed
25 body, the compressor comprising a valve blade, this blade being positioned between a head and the hollowed body, the compressor comprising a probe electrically connectable to a control circuit, the probe being capable of detecting the passage of the piston at a point of the hollowed body and signaling this to the control circuit.

Brief Description of the Drawings

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The present invention will now be described in greater detail with reference to an embodiment represented in the drawings. The figures show:

- Figure 1 – a cross-section view of a linear compressor where the sensor of the present invention is installed;
- Figure 2 – a time diagram view of the actuation of the sensor of the present invention;
- 5 - Figure 3 – a partial cross-section view of a compressor provided with the sensor of the present invention; and
- Figure 4 – a partial view illustrating in detail the sensor of the present invention mounted in a linear compressor.

Detailed Description of the Invention

10 As can be seen from figures 1, 3, and 4, the compressor 15 comprises a piston 1 axially displaceable inside a generally cylindrical hollowed body 2. A head 3 located close to the end of the stroke of the piston 1 comprises the suction 3a and discharge 3b valves. An actuator 4 comprising a magnetic component 3 is actuated by the linear motor 6 and connected to
15 the resonant spring 7, to form a resonant assembly of the compressor 15.

 As can be seen in detail from figures 3 and 4, a sensor 10 is arranged close to the head 3, which is capable of signaling the passage of the piston 1 at a maximum recommendable point 8, so as to prevent it from knocking against said head 3.

20 One of the possible solutions for embodying the sensor 10 is an electric circuit 45, which signals the passage of the piston 1 at the point 8, by means of a probe 20 that physically contacts said piston 1.

 As shown in figure 4, the probe 20, manufactured from an electrically conductive material, is an integral part of the control circuit 12, which
25 in turn comprises an electric circuit 45 that includes a source of electric voltage 42 (preferably in direct current) and a resistor 40, both of them connected in series to said probe 20 and to the body 2, or even to the piston 1, so as to signal the passage of the latter by the maximum point 8. In order to make this solution possible, the probe 20 must be electrically insulated from the body 2,
30 so that the circuit 45 will be open, while the piston 1 remains on this side of the point 8. For this purpose, one can insulate electrically only the portion where said probe 20 contacts the body 2 or else insulate completely the head

3 by means of the electric insulators 11a and 11b, which may be the sealing joint themselves that exist for insulating the compressor 15 and preventing gas from escaping, which significantly reduces the manufacture costs of the latter.

5 The signaling of the passage of the piston by the point 8 causes the a voltage level measured at the terminals 47 (positioned close to the resistor 40) passes from the logical level "0" to the logical level "1". This variation can be easily read by the control circuit 12, which may still include an electronic circuit (not described, because it is not the object of the present
10 invention) capable of interpreting the passage of the piston 1 at the point 8 and correcting its path, thus preventing its collision with the head 3. Figure 2 shows a time diagram of the outlet of the circuit 45 at the terminals 47, where one can see that, when the piston 1 advances beyond the point 8 by a period of time dT , the logic level passes from "0" to "1", returning to "0" as soon as
15 the piston 1 returns to this side of the point 8, this situation repeating after the passage of a T_c cycle.

 The probe 20 should preferably be manufactured from the valve blade 9 itself. This valve blade 9 remains positioned between the head 3 and the body 2, further having the insulators 11a and 11b, positioned between
20 such elements, as shown in figure 3, and is used for making the suction valve 3a. The probe 20 is embodied from an additional cut and a fold of the blade 9, so as to achieve a projection advancing inwardly of the body 2, configuring the probe 20, which is suitable for physical contact with the piston 1. The end portion of the projection that configure the probe 20 should be on a plane
25 substantially farther away from the head 3 than the plane of the blade 9.

 Preferably, the probe 20 is positioned at a point close to the end of the stroke of the piston 1, that is to say, substantially close to the head 3 within the body 2, but it may also be positioned at another point of the compressor 15, as for instance close to the end portion of the actuator 4, provided that the position of the piston 1 is adequately detected to the effect of
30 avoiding problems of collision of the latter with the head 3.

 In addition, the probe 20 should be designed in such a way, that

it will always work in elastic regime, so that it can always return to the original position after being displaced/pressed by the piston 1 when the latter passes beyond the point 8.

- 5 A preferred embodiment having been described, one should understand that the scope of the present invention embraces other possible variations, being limited only by the contents of the accompanying claims, which include the possible equivalents.

CLAIMS

1. A sensor (10), particularly one that can be employed for detecting the position of a piston (1) of a compressor (15), the piston (1) being axially displaceable inside a hollowed body (2), the compressor (15) comprising a valve blade (9), this blade (9) being positioned between a head (3) and the hollowed body (2), the sensor (10) being characterized by comprising a probe (20) electrically connected to a control circuit (12), the probe (20) being capable of detecting the passage of the piston (1) at a point of the hollowed body (2) and signaling this to the control circuit (12).

2. A sensor according to claim 1, characterized in that the probe (20) is positioned at a point inside the hollowed body (2), the probe (20) being capable of physically contacting the piston (1) and signaling to the control circuit (12).

3. A sensor according to claim 1 or 2, characterized in that a first end portion of the probe (20) is fixed to the body (2) so as to be electrically insulated from the latter.

4. A sensor according to claim 3, characterized in that the electric insulation is carried out by means of an electrically-insulating material (11a) and (11b), which is respectively positioned between the body (2) and the blade (9), and between the head (3) and the blade (9).

5. A sensor according to claim 4, characterized in that the insulation (11a) and (11b) is the sealing joint of the head (3).

6. A sensor according to claim 1, 2, 3, 4, or 5, characterized in that the physical contact of the piston (1) with the probe (20) is an electric contact.

7. A sensor according to claim 1, 2, 3, 4, 5, or 6, characterized in that the location point the probe (20) within the body (2) is a point (8) substantially close to the head (3).

8. A sensor according to claim 1, 2, 3, 4, 5, 6, or 7, characterized in that the probe (20) is a projection of the valve blade (9).

9. A sensor according to claim 8, characterized in that the projection is a fold of a portion of the blade (9).

10. A sensor according to claim 9, characterized in that the end portion of the fold is on a plane substantially farther away from the head (3) than the plane of the blade (9).

11. A sensor according to claim 1,2,3,4,5,6,7,8,9, or 10, characterized in that the control circuit (12) comprises an electric circuit (45) that includes a source of electric voltage (42) and a resistor (40) connected in series to the probe (20) and to the body (2), the electric circuit (45) closing when the piston (1) makes physical contact with the probe (20).

12. A sensor according to claim 1,2,3,4,5,6,7,8,9, or 10, characterized in that the control circuit (12) comprises an electric circuit (45) that includes a source of electric voltage (42) and a resistor (40) connected in series to the probe (20) and to the piston (1), the electric circuit (45) closing when the piston (1) makes physical contact with the probe (20).

13. A sensor according to claim 1,2,3,4,5,6,7,8,9, or 10, characterized by comprising an electric circuit (45) that includes a source of electric voltage (42) and a resistor (40) connected in series to the probe (20) and to the body (2), the electric circuit (45) closing when the piston (1) makes physical contact with the probe (20).

14. A sensor according to claim 1,2,3,4,5,6,7,8,9, or 10, characterized by comprising an electric circuit (45) that includes a source of electric voltage (42) and a resistor (40) connected in series to the probe (20) and to the piston (1), the electric circuit (45) closing when the piston (1) makes physical contact with the probe (20).

15. A compressor (15), particularly a linear one, comprising a piston (1) axially displaceable inside a hollowed body (2), the compressor (15) comprising a valve blade (9), the blade (9) being positioned between the head (3) and the hollowed body (2), the compressor (15) being characterized by comprising a probe (20) electrically connectable to a control circuit (12), the probe (20) being capable of detecting the passage of the piston (1) at a point of the hollowed body (2) and signaling this to the control circuit (12).

16. A compressor according to claim 15, characterized in that the probe (20) is positioned at a point inside the hollowed body (2), the probe

(20) being capable of making physical contact with the piston (1) and signaling to the control circuit (12).

17. A compressor according to claim 15 or 16, characterized in that the probe (20) is fixed to the body (2) so as to be electrically insulated
5 from the latter.

18. A compressor according to claim 17, characterized in that the electric insulation is carried out by an electrically-insulating material (11a) and (11b), which is respectively positioned between the body (2) and the blade (9) and between the head (3) and the blade (9).

10 19. A compressor according to claim 18, characterized in that the insulation (11a) and (11b) is the sealing joint of the head (3).

20. A compressor according to claim 15, 16, 17, 18, or 19, characterized in that the location point of the probe (20) within the body (2) is a point (8) substantially close to the head (3).

15 21. A compressor according to claim 15, 16, 17, 18, 19, or 20, characterized in that the probe (20) is a projection of the valve blade (9).

22. A compressor according to claim 21, characterized in that the projection is a fold of a portion of the blade (9).

20 23. A compressor according to claim 22, characterized in that the end portion of the fold is on a plane substantially further away from the head (3) than the plane of the blade (9).

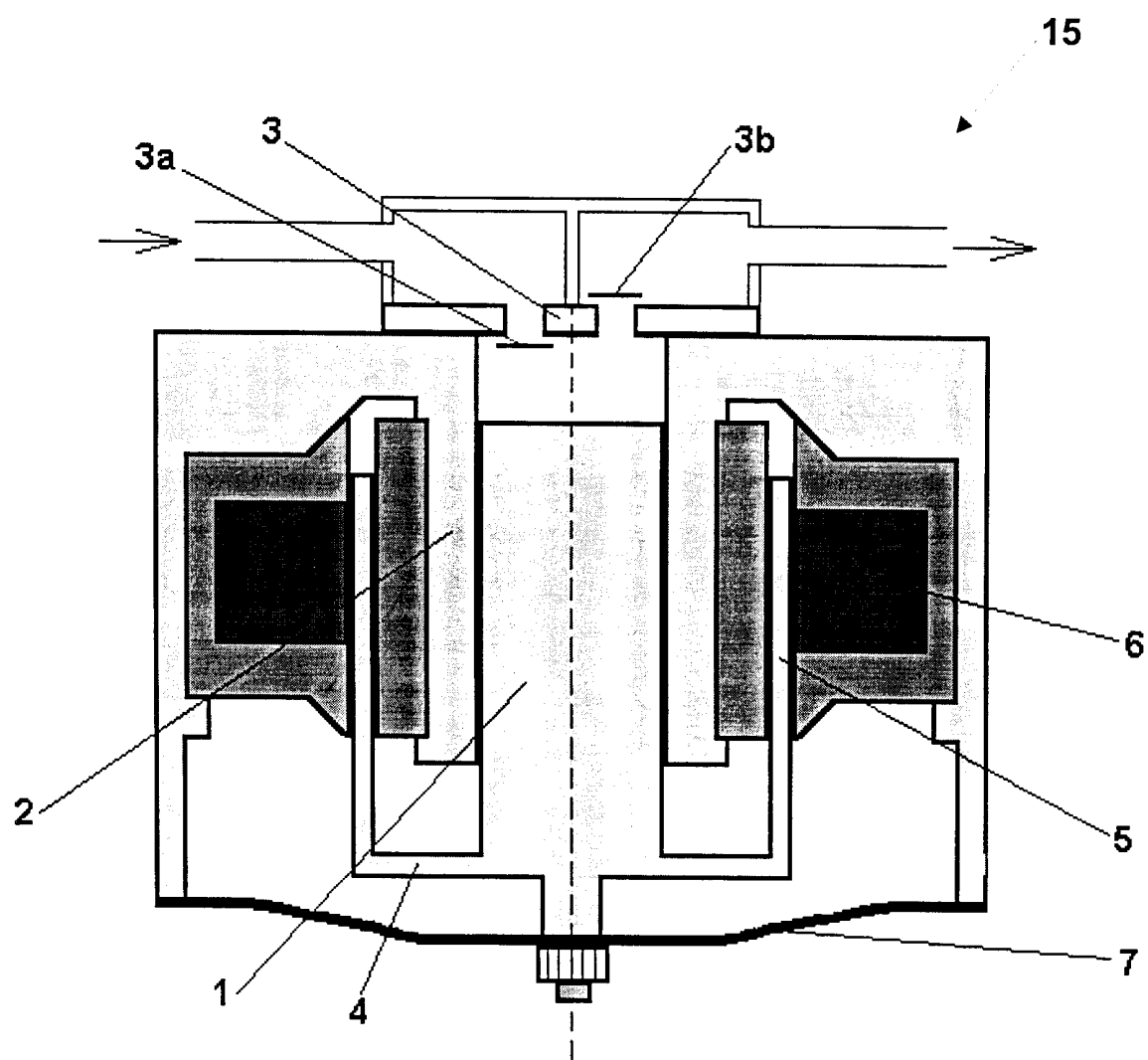


FIG. 1

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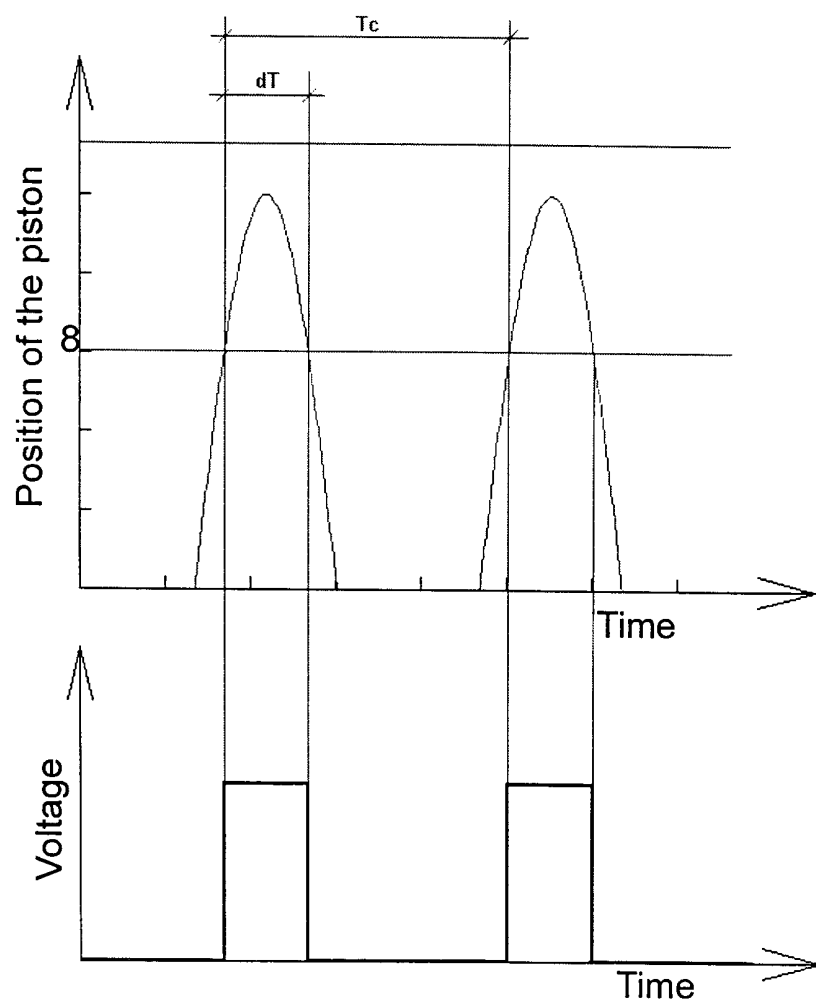


FIG. 2

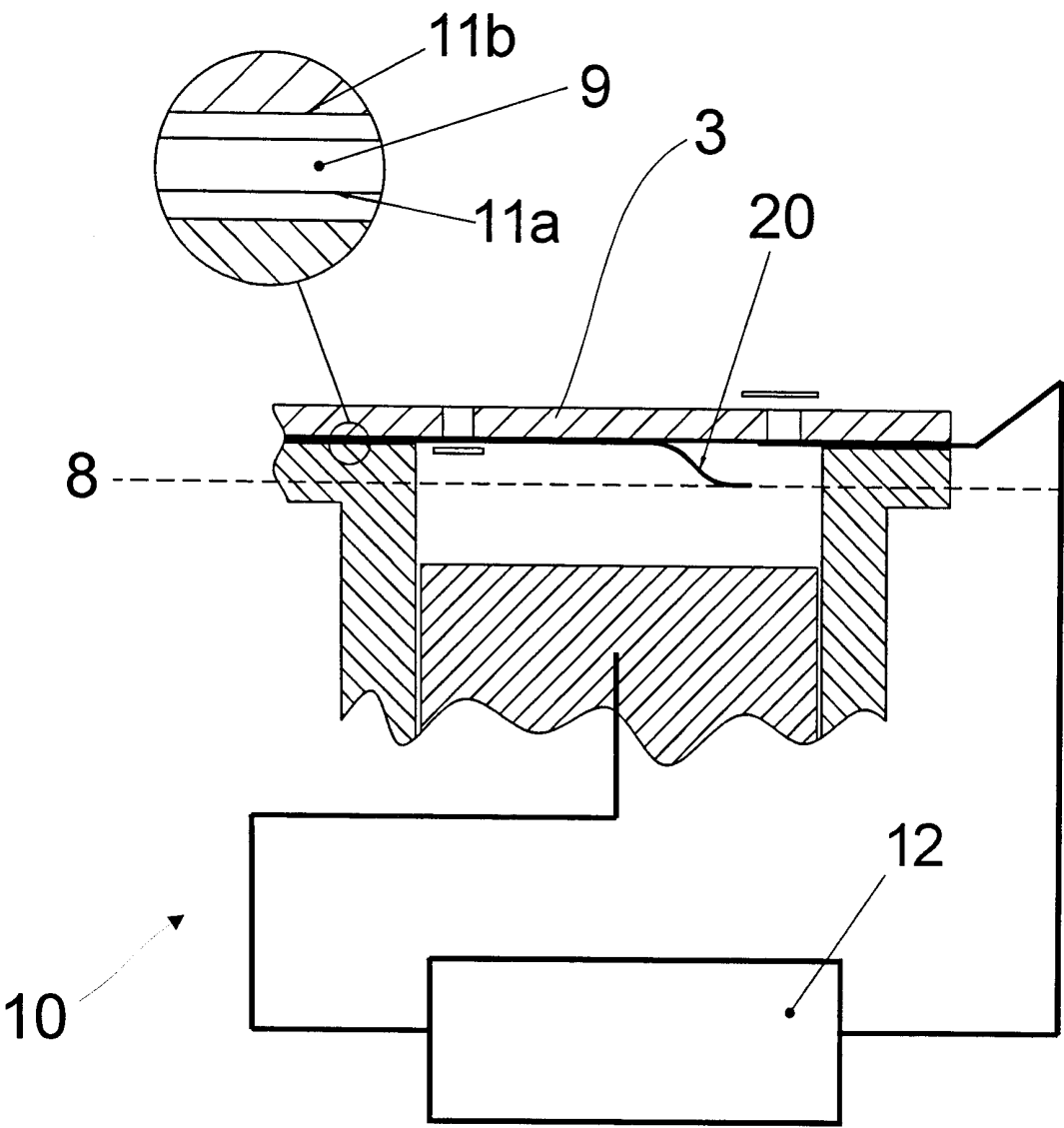


FIG. 3

