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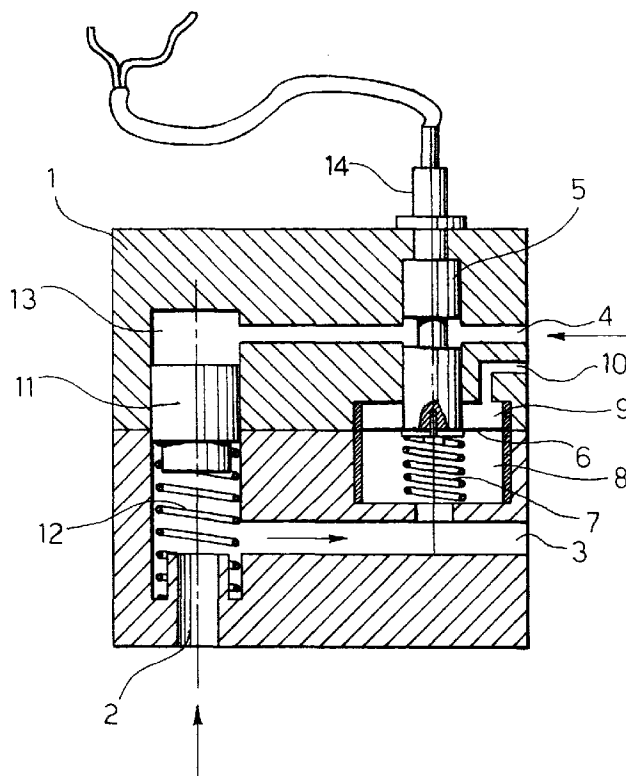
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(54) Vacuum control and cutoff apparatus for a pneumatic duct

(57) The invention is directed to a vacuum control and cutoff apparatus for a pneumatic duct (2) connecting a vacuum generator and a vacuum user device to each other. The apparatus is constituted by a closure member (11) of the duct (2), controlled by a fluid under pressure whose flow is in turn controlled by an intercep-

tion member (5) which is operated by the vacuum amount within the duct (2). The interception member (5) switches over the state of a signalling device (14) which may transmit to other apparatuses the information related to the vacuum condition of the devices connected to the duct (2).



EP 0 872 647 A2

Description

The present invention is directed to a vacuum control and cutoff apparatus designed to be employed along a connection between a vacuum generator and a vacuum user device.

As it is well known vacuum generators are used in several applications, including handling of articles, for instance plane sheets, by means of various grasp devices, generally made as cup-like suckers.

These suckers are designed and sized as a function of the loads to be handled and of the vacuum degree applied therethrough.

Mainly as far as safety is concerned, it is of paramount importance that the amount of vacuum, or underpressure, gauged according to different measurement units (mercury mm., millibar, kg/cm², atmosphere), be checked at the time the article is grasped and over the entire working cycle, since any variation thereof shall involve a variation of the amount of the grasp force provided by the sucker, or similar device.

In the case, which occurs frequently, one vacuum generator supplies several user devices (suckers), if one of these user devices is not able to grasp under vacuum the article to be handled, owing to a number of reasons among which for instance the non perfect adherence of the device itself over the article, the same device keeps the connection between the atmosphere and the vacuum generator open, thus preventing the latter to reach the maximum underpressure degree with the remaining grasp devices.

Moreover the above disclosed situation may occur even after the grasping step, for instance owing to an accidental displacement of the grasped article or to breakage thereof.

In this case, if the vacuum drop produced by the grasp devices placed in communication with the atmosphere is higher than a certain amount, also the other grasp devices connected in parallel to one another shall release grasp thus involving failure of the entire system and dropping of the grasped article.

The object of the present invention is to overcome the above mentioned drawbacks, by means of a control and cutoff apparatus capable to detect the degree of vacuum along a duct and, based upon the detected vacuum degree, to close or leave open the duct itself.

A further object of the invention is to provide a control and cutoff apparatus designed to perform the two above mentioned functions both upon activation thereof and subsequently during further operation thereof.

Still another object of the invention is to provide a control and cutoff apparatus capable to provide an outer signal corresponding to the closed and/or open condition of the duct.

These and other objects are achieved, according to the invention, by a control and cutoff apparatus whose main features are set forth in claim 1. Additional secondary features are recited in the dependent claims.

The proposed invention enables, with particular reference to application thereof to handling systems comprising multiple grasp devices connected in parallel to a single vacuum generator, to make these devices independent from one another so as to enable cutoff of a portion thereof without any loss of underpressure to be employed by the remaining portion thereof, thus providing to this active portion the entire vacuum degree produced by the vacuum generator.

These and other advantages and features of the invention will become more apparent from the following detailed description, purely provided by way of non limiting example, with particular reference to the annexed drawing showing a diagrammatic sectioned view of the apparatus.

Referring to the drawing, the apparatus depicted by way of non limiting example comprises a body 1, formed with a connecting port 2 to be connected to a vacuum user device, for instance to a grasp cup-like sucker of conventional type, a connecting port 3 for connection to a vacuum generator not shown in the drawing, and a connecting port 4 to be connected to a source of air under pressure, also not shown in the drawings. The connecting ports 2 and 3 are normally communicating with each other.

Reference numeral 5 designates a cutoff member controlling opening and closing of the connecting port 4, and secured to a resilient membrane 6 which is sealingly separating a chamber 8, communicating with the connecting port 2, from a chamber 9 communicating with the atmosphere through a passage 10. The cutoff member 5, which in the non limiting shown example consists of a spool valve, is secured to the membrane 6 in any possible different way, such as for instance by means of screw fixing, vulcanisation or the like, and is biased by a spring 9 housed within the chamber 8.

As it will become apparent in the following, the cutoff member 5 is capable to perform two distinct functions, respectively consisting of closing the passage towards the connecting port 4, and actuating a signalling device 14 whose output is switched over as a function of the position of the cutoff member 5. This signalling device 14 may comprise by way of non limiting example a simple electrical switch, or a proximity inductive sensor as in the case depicted in the drawings, or an electro-mechanical limit switch or any other electrical, potentiometric, electronic, mechanical or simply visual device, designed to change over its condition and thus the either electrical or mechanical or visual signal provided thereby, as a function of the displacement of the cutoff member 5.

The apparatus further comprises an additional cutoff member 11, consisting for instance of an obturator designed to interact with the inner end of the connecting port 2.

The cutoff member 11 is biased at one side by a spring 12 normally urging it towards a spaced-apart position with respect to the connecting port 2, which cor-

responds to an open condition thereof, and at the other side is subjected to the pressure within a chamber 13 connected to the connecting port 4. When the cutoff member 5 is set in the open position of the connecting port 4, the chamber 13 is thus placed under overpressure.

Operation of the apparatus according to the above disclosed embodiment of the invention is as follows, assuming that the connecting port 3 is connected to a grasp device for instance of the cup-like sucker type.

It is to be pointed out that the configuration of the apparatus as shown in the drawing corresponds to the absence of vacuum at the connecting port 3, and to the absence of overpressure at the connecting port 4.

Upon activation of the vacuum generator connected to the connecting port 3, if the grasp device connected to the connecting port 2 is adhering to the article to be handled, a certain amount of vacuum is produced between the connection ports 2 and 3, and thus also within the chamber 8 connected thereto, whereby the membrane 6 is deformed downwardly with reference to the drawing, owing to the pressure difference between the chamber 8 and the chamber 9 which has pointed out its under atmospheric pressure, through the passage 10.

Shifting of the membrane 6 operates displacement of the cutoff member 5 downwardly, against the action of spring 7, which thus move away from the signalling device 14 simultaneously interrupting communication between the connection port 4, leading to the overpressure source, and the chamber 13. As a consequence the cutoff member 11 is held, under the action of the related spring 12, in the open position shown in the drawing.

If instead upon activation of the vacuum generator the grasp device connected to the connecting port 2 is unable to ensure pneumatic tightness between itself and the article to be handled, vacuum is not produced within the chamber 8 and there is no displacement of the membrane 6 nor consequently of the cutoff member 5, which thus remains in the open position shown in the drawing. Therefore even communication between the connecting port 4 and the chamber 13 remains open.

In other words, after bringing the grasp device into contact with the article to be handled, when compressed air is supplied to the connecting port 4 two different results may be achieved depending upon the vacuum at the connecting port 2, and consequently at the grasp device connected thereto, be or be not sufficient to determine displacement of the cutoff member 5, and thus closure of the passage for the compressed air. If vacuum is sufficient, the supplied compressed air produces no effect, since its passage is obstructed by the cutoff member 5. If instead vacuum is inadequate, the freely flowing compressed air produces downward displacement of the cutoff member 11, consisting in the non limiting shown example of an obturator valve, which overcomes the action of spring 12 by virtue of the pressure within the chamber 13 and closes upon the inner end of

the connecting port 2, thus excluding the grasp device connected thereto thereby suppressing the leakage effects generated by this grasp device and enabling the remaining part of the circuit to reach the maximum underpressure which the vacuum generator is capable to provide.

Moreover the apparatus disclosed according to the present invention can intervene even after the grasp device has properly carried out grasping of the article, but subsequently releases it accidentally, owing to several possible reasons such as breakage of the article, vibrations, etc. In fact while the compressed air is maintained at the connecting port 4, if the vacuum degree within the chamber 8 decreases and thus the cutoff member 5 moves upwardly with reference to the drawing, flowing of the compressed air is allowed in order to operate the cutoff member 11, which thus closes the connecting port 2.

Since switching over of the apparatus is most quick no leakage is produced at the other grasp devices connected to the same vacuum generator and, therefore, if these devices are in a sufficient number release of the handled article, or of an assembly of handled articles, shall be prevented.

The signalling device 14 piloted and switched over by the cutoff member 5 shall provide a signal indicative of the fact that the cutoff member 5 is in one or in the other of the two above disclosed positions. The signal may be transmitted to a control apparatus which shall thus provide an information on whether or not the device connected to the connecting port 2 is properly operating.

It is to be pointed out that a number of apparatuses of the above disclosed type can be provided as a bank, with the related connecting ports 3 connected in parallel to the vacuum generator through a common duct. In this case also the connecting ports 4 shall be connected in parallel through a common duct to the compressed air generator.

Naturally, the details of construction and the embodiments may widely vary with respect to what has been disclosed and illustrated, without thereby departing from the scope of the present invention, such as defined in the appended claims. Thus, for example, the resilient membrane 6 may be replaced by a sealingly slidable plunger, and the load of the spring 7 biasing the cutoff member 5 can be adjusted from the outside, for instance by mean of a screw device or equivalent system. Moreover this spring 7 could be replaced by a piston, even of the membrane type, on which a certain amount of even adjustable pressure is applied, and also the cutoff member 11 can be designed as a spool instead of an obturator, or it may also consist of a pneumatically piloted known valve available on the market. Lastly, the two cutoff members 5 and 11 may be provided separately within two distinct bodies connected to each other.

Claims

1. Control and cutoff apparatus for a pneumatic duct (2) connecting a vacuum generator (3) and a vacuum user device, characterised in that it comprises first valve means (11) displaceable between an open position and a closed position of said duct (2), second valve means (5) displaceable between a closed position and an open position for controlling communication between said first valve means (5) and an overpressure source (4), actuator means (6) responsive to the underpressure within said duct (2) to normally keep said second valve means (5) in the closed position and to enable displacement thereof to the open position when the vacuum in said duct (2) is lower than a set threshold value, so as to perform displacement of said first valve means (11) to the closed position by means of said overpressure. 5
2. Apparatus according to claim 1, characterised in that said actuator means comprise a membrane (6) operatively connected to said second valve means (5) and exposed at one side (8) to the vacuum in said duct (2) and at the other side (10) to atmospheric pressure, and a spring (7) urging said second valve means (5) towards the open position. 10
3. Apparatus according to claim 1, characterised in that said second valve means (5) are operatively associated to a signalling device (14) of the vacuum amount within said duct (2). 15
4. Apparatus according to claim 1, characterised in that said second valve means include an obturator (5) subjected to the action of a spring (12) urging said obturator towards the open position. 20
5. Apparatus according to claim 2, characterised in that said membrane (6) is replaced by a sealingly slidable plunger. 25
6. Apparatus according to claim 2, characterised in that the reaction force of said spring (7) urging said second valve means (5) towards the open position is adjustable from the outside by means of a screw system or the like. 30
7. Apparatus according to claim 2, characterised in that said spring (7) is replaced by a piston, even of the membrane type, upon which an adjustable pressure is applied. 35
8. Apparatus according to claim 1, characterised in that said first and said second valve means (11,5) are housed within a common body (1). 40
9. Apparatus according to claim 1, characterised in that said first and said second valve means (11,5) are separately housed within two distinct bodies connected to each other. 45
10. Apparatus according to claim 4, characterised in that said first valve means (11) include a spool valve instead of an obturator valve. 50
11. Apparatus according to claim 4, characterised in that said first valve means (11) include a pneumatically piloted valve. 55
12. Apparatus according to claim 1, characterised in that it is arranged in a bank with a number of same apparatuses whose respective connection ports (3) to the vacuum generator are connected to a common duct.
13. Apparatus according to claim 12, characterised in that also the connecting ports (4) to the compressed air generator of said apparatuses are connected to a common duct.
14. Apparatus according to claim 3, characterised in that said signalling device (14) consists of a proximity or limit switch detecting the position of said second valve means (5).
15. Apparatus according to claim 3, characterised in that said signalling device (14) consists of an electric contact which opens or closes depending upon the position of said second valve means (5).
16. Apparatus according to claim 3, characterised in that said signalling device (14) consists of a visual indicator provided outside of the apparatus.
17. Apparatus according to claim 3, characterised in that said signalling device (14) consists of a potentiometric or electronic position transducer detecting the position of said second valve means (5) and transmitting a signal proportional to the vacuum amount within said duct (2).

