VACUUM CUT-OFF SWITCH

Filed June 18, 1962

FIG. 1

FIG. 2
This invention relates to a protective device for vacuum systems and is more particularly concerned with providing a cut-off switch for detecting relatively large leaks in a vacuum system and responding by cutting off the flow of current to the vacuum pump motor in order to prevent serious damage to the pump.

Various vacuum gauges have long been in existence as a means of detecting small leaks in vacuum systems. These gauges ordinarily operate in the limited range of approximately 5 to 500 microns of mercury and are useful for detecting small leaks and to allow partial vacuum to be maintained by the pump until the leak can be discovered. Although this arrangement is useful in the detection and repair of small leaks, other more serious problems come about when a large leak occurs in the vacuum system. If the pump is operating and a large leak suddenly occurs, the vacuum cannot be maintained at a safe, effective level and usually serious damage results to the system, particularly to the vacuum pump element.

Accordingly, it is an object of the present invention to provide a vacuum cut-off switch that will operate in a range upward of approximately 5 cm. of mercury which is far beyond that of presently known small leak detecting gauges.

Another object of the invention is to provide a protective device for a vacuum system which would only be responsive to large leaks in the system and to operate to break the flow of current to the forepump and thereby protect the system from damage.

A further object of the invention is to provide a pressure sensitive detecting means associated with a switching means for controlling the operation of a vacuum system.

A still further object of the invention is to provide a vacuum cut-off switch that is adjustable to respond to a predetermined drop in vacuum pressure. Biasing means are provided to prevent operation of the switch as a result of the normal variations in atmospheric pressure.

These and other objects, features, and advantages will become more apparent after considering the following detailed description taken in conjunction with the annexed drawings and appended claims.

In the drawings, wherein like reference characters refer to like parts in both views:

FIGURE 1 is a view in cross-section of the vacuum cut-off switch designed and constructed according to the invention; and

FIGURE 2 is a schematic view of the cut-off switch in position in a typical vacuum system.

Referring now to FIGURE 1, there is shown the vacuum cut-off switch 13 having a pressure responsive member in the form of an expansible corrugated metallic bellows 15 suitably mounted on a plate 17. The other end of the bellows 15 is fixedly attached to the lower face of the cut-off switch cover plate 19. A hollow stem portion 21 is attached to the upper face of the cover plate 19 and communicates with the interior of the bellows 15 through an aligned opening in the cover plate 19.

A threaded sleeve 23 is attached to the cover plate 19 and extends downwardly around the outside of the bellows 15. A pressure selector ring 25 engages the threads on sleeve 23 and moves downwardly or upwardly to exert more or less force on the mounting plate 17 through a biasing spring 27. The lock ring 29 serves to maintain the pressure selector ring 25 in position on the sleeve 23 after the adjustments have been made. Openings 31 are provided in the side of the body portion 33 of the cut-off switch 13 in order to allow for pressure differential adjustments. Stop members 35 are attached to the body portion 33 and serve to engage the lower surface of the mounting plate 17 to limit the downward movement of the bellows assembly. A boss 37 is provided on the lower surface of the mounting plate 17 and extends downwardly therefrom.

A normally closed microswitch 39 is mounted in the base portion 41 and extends upwardly into the body portion 33. The button element 43 of the microswitch 39 is located in close proximity to the boss 37 so that downward movement of the bellows assembly and mounting plate 17 engages the button 43 and causes the electrical circuit to be opened, thereby cutting off the flow of current to the vacuum pump motor circuit. Thumb screws 45 are provided for adjusting the vertical position of the microswitch 39 in relation to the bellows assembly in order to control the cut-off action of the switch 13.

In FIGURE 2, there is shown a diagrammatic view of the vacuum cut-off switch 13 in conjunction with a vacuum system to be controlled thereby. The conduit 47 leads from the evacuation chamber 49 to the vacuum pump 51 driven by the motor 53. A power source 55 feeds the windings of the motor 53 and passes through the normally closed microswitch 39 shown more clearly in FIGURE 1.

In operation, the normal position of the cut-off switch 13 is indicated in the view shown in FIGURE 1. As shown, the normally closed microswitch 39 is out of contact with the boss 37. In this position, the current is flowing to the pump motor 53 and the pump 51 is operating to generate and maintain a vacuum in the chamber 49.

The bellows 15 is drawn and held upward because of the negative pressure therein and, as a result, the biasing spring 27, is held in a compressed state. If a large leak should develop in the chamber 49, the resulting pressure rise would be communicated to the bellows 15 through the conduit 47. This would cause the bellows 15 to move downward because the pressure differential therein would be reduced and the biasing action of the spring 27 would be the dominant force acting on the mounting plate 17. As the above sequence of events occurs, the boss 37 contacts and depresses the button 43 which instantaneously cuts off the flow of current to the motor 53, thereby stopping the rotation of the pump 51. Thus, any damage which may result to the fore-pump 51 or the material in the evacuated chamber 49 because of the continued operation of the pump after a large leak develops, would be prevented by the action of the cut-off switch 13.

After the leak in the vacuum system has been located and repaired, the system can be restarted by manually shunting the energizing current directly to the pump motor causing the system to become evacuated and the cut-off switch 13 will automatically be in condition to operate again to protect the system from possible damage. In other words, no resetting or replacing of parts in the vacuum cut-off switch is necessary in order to restore the switch to operating condition.

As shown and described, the switch is directed toward a protective device to prevent damage to a vacuum pump. However, it can be seen that the device is useful in many other applications in vacuum systems. For example, the switch could be used to cut off the flow of current to a unit in the evacuation chamber, if this were desirable or necessary when the vacuum reading reached a particular range.
Although the invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that various changes and modifications can be made therein without departing from the invention. Therefore, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted in the illustrative sense, and it is aimed in the appended claims to cover all such changes and modifications without departing from the true spirit and scope of the invention.

What is claimed is:

1. A protective device for controlling the operation of a motor driven vacuum system, said device comprising an evacuated chamber, a pressure responsive bellows means having a single opening therein in communication with said evacuated chamber, said bellows means being held in contracted position by the pressure differential therein, adjustable spring biasing means surrounding said bellows means for urging said bellows means into expanded position, and switch means operatively associated with said bellows means to be actuated thereby, the expansion of said bellows means on the urging of said biasing means causing the actuation of said switching means thereby resulting in the opening of an electrical circuit to cause cessation of the flow of current to the drive motor.

2. The control device defined in claim 1 wherein balancing means are provided for varying the applied expansion force on said bellows means through said biasing means, the applied load being dependent upon the prevailing atmospheric pressure.

3. The control device defined in claim 1 wherein means are provided for varying the position of said switching means in relation to said bellows means thereby correspondingly varying sensitivity level of said device.

4. A protective device responsive to a rapid change of pressure in a motor driven vacuum system, said device comprising an expandable corrugated pressure responsive bellows means having its interior in direct communication with an evacuated chamber, one end of said bellows means being fixedly attached to a cover plate and the other end being fixedly attached to a movable plate defining a sealed chamber of variable volume having a single opening therein, switching means disposed in close proximity to the movable plate end of said bellows means, and adjustable spring biasing means surrounding said bellows means for urging said bellows means into contact with said switching means in response to a rapid change of pressure in the evacuated chamber, said switching means operating to disconnect the motor from the power supply of the vacuum system.

References Cited in the file of this patent

UNITED STATES PATENTS
334,890 O'Donel ........................ Jan. 26, 1886
1,231,561 Briggs ........................ July 3, 1917
2,601,757 Horton ......................... July 1, 1952
2,695,764 Burlingham ..................... Dec. 21, 1954
2,765,743 Hollinshead .................... Oct. 9, 1956
2,768,646 Plank ........................ Oct. 30, 1956

FOREIGN PATENTS
1,135,558 France ........................ Apr. 30, 1957