

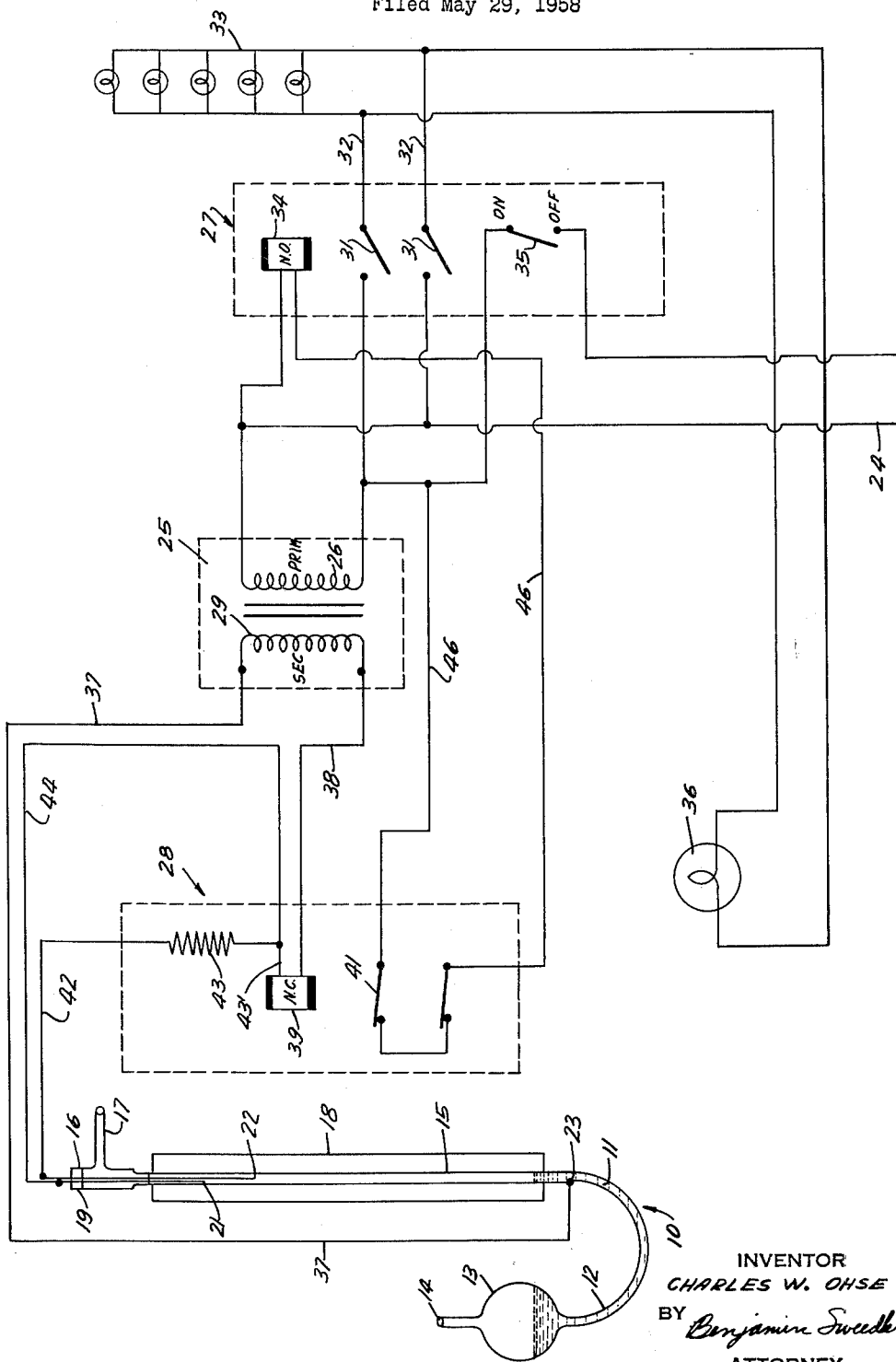
March 13, 1962

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3,025,504

WARNING DEVICE FOR VACUUM SYSTEMS

Filed May 29, 1958



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3,025,504

WARNING DEVICE FOR VACUUM SYSTEMS

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Filed May 29, 1958, Ser. No. 738,696

3 Claims. (Cl. 340-240)

This invention relates to a warning device for vacuum systems, particularly vacuum metal and plastic die casting systems.

In vacuum systems, including vacuum die casting systems, fluctuations or "hunting" of the vacuum in the system invariably takes place. Small drops in vacuum are not seriously objectionable. For example, in metal vacuum die casting systems, a vacuum of from 28 inches to 30 inches of mercury may be employed for the production of sound and dense die castings. A periodic deviation from the lower value of 28 inches of mercury, say within the range of 24 inches to 28 inches of mercury, is not particularly harmful to the quality of the castings. On the other hand, should the operator interrupt the operation each time the vacuum drops below 28 inches of mercury and take corrective measures, this would be seriously objectionable because it would necessitate frequent interruptions of the die casting equipment with consequent reduction in the output of the equipment. Moreover, it would involve excessive waste of the operator's time.

A drop in the vacuum below say 24 inches usually detrimentally affects the quality of the castings. Such large drop in the vacuum may be due, for example, to pump failure or poor seating of the valves controlling the vacuum in the system and hence requires corrective measures.

Warning devices are known in which a signal is actuated whenever the vacuum drops below a fixed value. Such devices necessarily result in frequent unnecessary interruptions of operation with the disadvantages noted above.

To the best of my knowledge and belief, no warning device has been developed which (a) when the vacuum drops from the preferred operating range (e.g., 28 inches to 30 inches of mercury), permits the vacuum to fluctuate within a predetermined range (e.g., 24 inches to 28 inches of mercury) below the minimum value (e.g., 28 inches of mercury) of this operating range without actuating a signal, (b) which actuates a signal whenever the vacuum falls below the lower value (e.g., 24 inches of mercury) of this predetermined range, continues to actuate the signal as long as the vacuum is below the aforesaid limit (e.g., 24 inches of mercury) and also continues to actuate the signal when the vacuum increases and while it is still within the predetermined range (e.g., 24 inches to 28 inches of mercury) until the vacuum reaches the lower limit (e.g., 28 inches of mercury) of the desired operating range, and (c) which renders the signal inoperative when the vacuum reaches a value (e.g., 28 inches of mercury) constituting the lower limit of the desired operating range (e.g., 28 inches to 30 inches of mercury) and continues to render the signal inoperative as long as the vacuum remains within this operating range.

It is among the objects of the present invention to provide such warning device for vacuum systems including vacuum metal die casting systems. These and other objects and advantages of the present invention will be apparent from the following detailed description thereof taken in connection with the accompanying drawing, the single figure of which shows for purposes of exemplification a warning system involving a preferred embodiment of the present invention. This figure includes a wiring diagram of the electrical components of the warning system.

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Referring to the drawing, 10 indicates a manometer in the form of a U-shaped tube containing an electrically conducting liquid 11, preferably mercury. For purposes of brevity of description, liquid 11 will hereinafter be referred to as mercury, but it will be understood that any desired electrically conducting liquid may be employed. Leg 12 of the manometer 10 is formed with an enlarged portion 13 providing a reservoir for the liquid 11. This reservoir communicates with the atmosphere through the restricted port 14. The other leg 15 has at its upper end 16, a branch 17 communicating with the vacuum system of the die casting machine or other equipment on which the warning device is installed. The leg 15 may be mounted on a support 18 suitably calibrated to show the different degrees of vacuum in the system. Such calibration, if desired, may be placed directly on the tubular walls of the manometer.

A stopper 19 closes the upper end 16 of leg 15. Through this stopper passes in spaced relation the electrodes or conductors terminating in contacts 21 and 22. These contacts, it will be noted from FIGURE 1, are positioned at different levels within the tube 15. Electrode or contact 21 is positioned nearer the top of this tube than is electrode 22. A third electrode 23 is disposed in tube 15 at a level such that it is always in contact with the mercury in this tube. The electrodes 21, 22, 23 may be of platinum or other metal inert to the mercury in the manometer, i.e. will not form amalgams therewith.

The electrodes 21, 22 and 23 are disposed in a circuit comprising a current supply line 24, transformer 25, the primary winding 26 of which is in circuit with line 24, and two branch circuits 27 and 28. Circuit 27 contains primary winding 26 of the transformer 25 and circuit 28 has therein the secondary winding 29 of the transformer 25. Current supply line 24 may be a conventional 110 volt line.

Branch circuit 27 comprises a normally open switch 31 in line 32, leading to a signal 33 which in the drawing is a bank of blinker lights. It will be understood that this signal may be an electrically actuated audible signal instead of a bank of blinker lights. Both an audible and visual signal may be used, if desired. A coil or solenoid 34 is provided in this circuit which, when energized effects closing of the switch 31 permitting current to flow to the signal 33. An on and off switch 35 is positioned in the power line 24 which is manually closed to place the warning device in use, when desired, and opened whenever it is desired not to employ the warning device. A pilot light 36, desirably suitably positioned on the control panel or switchboard of the installation, is connected in parallel with the signal 33 so that the signal is visible at the control panel as well as where the signal 33 is positioned. The latter is positioned where it is readily seen and/or heard by the operator charged with the responsibility of maintaining the vacuum system in operation.

Bottom electrode 23 is connected by a conductor 37 with one end of the secondary winding 29 of the transformer 25. The other end of this winding is connected by a conductor 38 with a solenoid or coil 39 which effects actuation of normally closed switch 41 of any conventional type normally maintained closed under spring tension. Intermediate electrode 22 is connected by conductor 42 with a resistor 43 which is connected in circuit with the line 43' leading to the coil 39. Electrode 21 is connected by a conductor 44 with line 43' leading to coil 39. Conductor 44 by-passes the resistor 43.

Conductors 46 place the switch 41 in circuit with the power line 24 through the primary winding 26 and the coil 34, as shown in the drawing.

In operation, assuming the vacuum system is starting up and there is little or no vacuum in the system, current flows from line 24 when the switch 35 is closed, through the primary winding 26, lines 46, coil 34 effecting closing of the switch 31 thus energizing the signal 33 and the pilot light 36. No current can flow through the secondary winding 29 because there is a break in circuit 28 due to the mercury level being below that of electrode 22. As the vacuum increases the mercury begins to rise in leg 15, eventually reaching electrode 22, thus closing circuit 28 comprising transformer winding 29, line 38, coil 39, line 43', resistor 43, line 42, electrode 22, column of mercury in tube 15, electrode 23, line 37 and secondary winding 29. Accordingly coil 39 is energized with a reduced current due to flow of current through resistor 43. With the current thus supplied to coil 39, this coil does not exert sufficient force to overcome the spring tension maintaining switch 41 closed, leaving this switch in the closed position shown on the drawing.

When eventually the mercury reaches the level of electrode 21, it completes an additional circuit through conductor 44, line 43', coil 39, conductor 38, secondary winding 29, conductor 37, electrode 23 and the column of mercury extending from electrode 23 to electrode 21. This circuit, it will be noted, by-passes resistor 43, thus sending a stronger or full current through coil 39, which current is of sufficient strength to open the switch 41. Opening of this switch interrupts the flow of current through coil 34, thus causing the switch 31 to open and interrupting the flow of current to the signal 33 and the pilot light 36. This indicates that a vacuum of the desired preferred minimum value, say at least 28 inches, has been attained.

Should the mercury level drop below the electrode 21, this will break the circuit constituted of electrode 21, column of mercury in tube 15, electrode 23, conductor 37, secondary winding 29, conductor 38, coil 39 and conductor 44. The current will then flow through the conductor 42, resistor 43, coil 39, conductor 38, secondary winding 29, conductor 37 because the level of mercury is such that it is in contact with the electrode 22. However, this current is weaker due to its flow through the resistor 43. Since a weaker current will maintain a relay set once it has been fully energized, the signal 33 will remain de-energized. This condition will prevail while the vacuum fluctuates and the mercury level remains in contact with electrode 22, which level corresponds say to a vacuum of 24 inches of mercury.

Should a drop in vacuum take place such that the mercury level falls below the electrode 22, the circuit above described including resistor 43 will be interrupted due to the break in the circuit caused by the drop in the mercury level below the electrode 22, de-energizing coil 39, closing switch 41 with consequent energization of the signal 33 and the pilot light 36. As above explained the signal 33 will remain energized until the mercury level again reaches electrode 21.

It will be apparent that the switches, coils and other parts of the control equipment are chosen to accomplish their intended function employing the voltage of the particular power source for which the installation is designed. The spring actuated switches, coils, transformer, etc., are standard electrical equipment and hence require no further description.

It will be noted that the present invention provides a warning device which actuates a signal (either visual or audible, or both) as long as the vacuum in the system is below a predetermined minimum value, interrupts the actuation of this signal when the vacuum reaches a predetermined high value, say 28 inches of mercury, maintains the signal out of operation while the vacuum is within the desired operating range, say 28 to 30 inches of mercury, and while the vacuum fluctuates below this operating range, say within a range of 24 to 28 inches of mercury, actuates the signal as soon as the vacuum falls

below the minimum level of the aforesaid range, say from 24 to 28 inches of mercury, and maintains the signal operative while the vacuum rises through this range until it reaches the aforementioned value of the operating range (e.g., 28 inches of mercury).

Thus the present invention permits the vacuum to drop and/or fluctuate from any level within the desired operating range, to within a predetermined lower range, without actuating the signal. When the vacuum level falls below this predetermined range, the signal is actuated. After the operator makes the necessary repair or adjustment and the vacuum rises, the signal remains actuated, even while the vacuum level reaches and remains within the aforesaid predetermined range, until it reaches the desired operating range. This insures proper repair or adjustment for optimum operation.

Since different embodiments of the warning device of the present invention could be made without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A warning device for a vacuum system, comprising a manometer having a tubular portion connected to said vacuum system, an electrically conducting liquid in said tubular portion which rises and falls responsive to the vacuum conditions in said tubular portion, three spaced electrical contacts in said tubular portion positioned at different levels therein, the lowermost contact being positioned at a level in said tubular portion where said contact is always in contact with said liquid, the intermediate contact being positioned at a level corresponding to a predetermined minimum value of vacuum it is desired to maintain within said system and the upper contact being positioned at a high level corresponding to a predetermined value representing the lower value of preferred vacuum operating conditions in said system, a circuit comprising an electrically energized signal, said contacts, and a transformer, said contacts being in circuit with one winding of said transformer, and the signal being in circuit with the other winding of said transformer, the portion of said circuit containing said contacts also having therein a resistor in circuit with said intermediate contact, a first switch and a first coil for actuating said first switch, and the portion of said circuit containing said signal having therein a second switch and a second coil for actuating said second switch whereby when said electrically conducting liquid rises in said tubular portion and reaches said intermediate contact, current flows through said resistor and said first coil, which current is not strong enough to open said first switch, when said electrically conducting liquid rises in said tubular portion and reaches said upper contact, the current by-passes said resistor and flows to said first coil which then exerts a force to effect opening of said first switch and thus deactivates said signal, and when the level of the electrically conducting liquid falls below said upper contact and remains above said intermediate contact, current flows through said resistor to said first coil, exerting a force insufficient to close said first switch so that said signal remains deactivated.

2. A warning device comprising, in combination; a U shaped manometer, one leg of said U containing a reservoir for mercury and the other leg having three spaced contacts positioned at different levels therein; a power circuit; a first branch circuit communicably connected with said power circuit and having therein a signal, a normally open switch, a first coil for actuating said switch and one winding of a transformer; and a second branch circuit having therein the other winding of said transformer, a conductor leading from the other winding of said transformer to the lowermost contact, a resistor in circuit with the intermediate contact and with a second coil arranged to actuate a normally closed switch and a

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conductor by-passing said resistor leading from said top contact directly to said second coil, said normally closed switch being in circuit with the said first coil so that when the normally closed switch is opened by the said second coil, the first coil is de-energized to open the switch in the first branch circuit and de-energize said signal, whereby when said mercury rises in said tubular portion and reaches said intermediate contact, current flows through said resistor and said second coil, which current is not strong enough to open said normally closed switch in said second branch circuit, when said mercury rises in said tubular portion and reaches said upper contact, the current by-passes said resistor and flows to said second coil which then exerts a force to effect opening of said normally closed switch in said second branch circuit and thus de-energizes said signal, and when the level of the mercury falls below said upper contact and remains above said intermediate contact, current flows through said resistor to said second coil, exerting a force insufficient to close said normally closed switch in said second branch circuit so that said signal remains de-energized.

3. A warning device for a vacuum system, comprising a manometer having a tubular portion connected to said vacuum system, said tubular portion containing an electrically conducting liquid which rises and falls responsive to the vacuum conditions in said tubular portion, the said liquid being at its highest level within said tubular portion when the vacuum is greatest and falling as the vacuum decreases, a first electrical contact in said tubular portion positioned to be always in contact with the liquid therein, a second electrical contact in said tubular portion positioned at a higher level corresponding to a

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predetermined minimum vacuum condition, a third electrical contact positioned at a still higher level in said tubular portion which level corresponds to the lower level of vacuum under preferred conditions of operation, a signal, means electrically connecting said signal with said electrical contacts including two circuits, one of said circuits containing a normally open switch and the other of said circuits containing a normally closed switch, and means in said circuits for actuating said switches constructed and arranged so that said normally open switch is closed and said signal is energized, said normally open switch remaining closed when said electrically conducting liquid rises in said tubular portion toward and reaches said second electrical contact, when the level of the electrically conducting liquid reaches said third electrical contact, said normally open switch is opened, thus deactivating said signal, when the level of the electrically conducting liquid falls below said third contact and remains above said second contact, said normally open switch remains open so that said signal remains deactivated, and when the level of liquid falls below said second contact, said normally open switch is closed to again energize said signal.

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