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CONTROL APPARATUS

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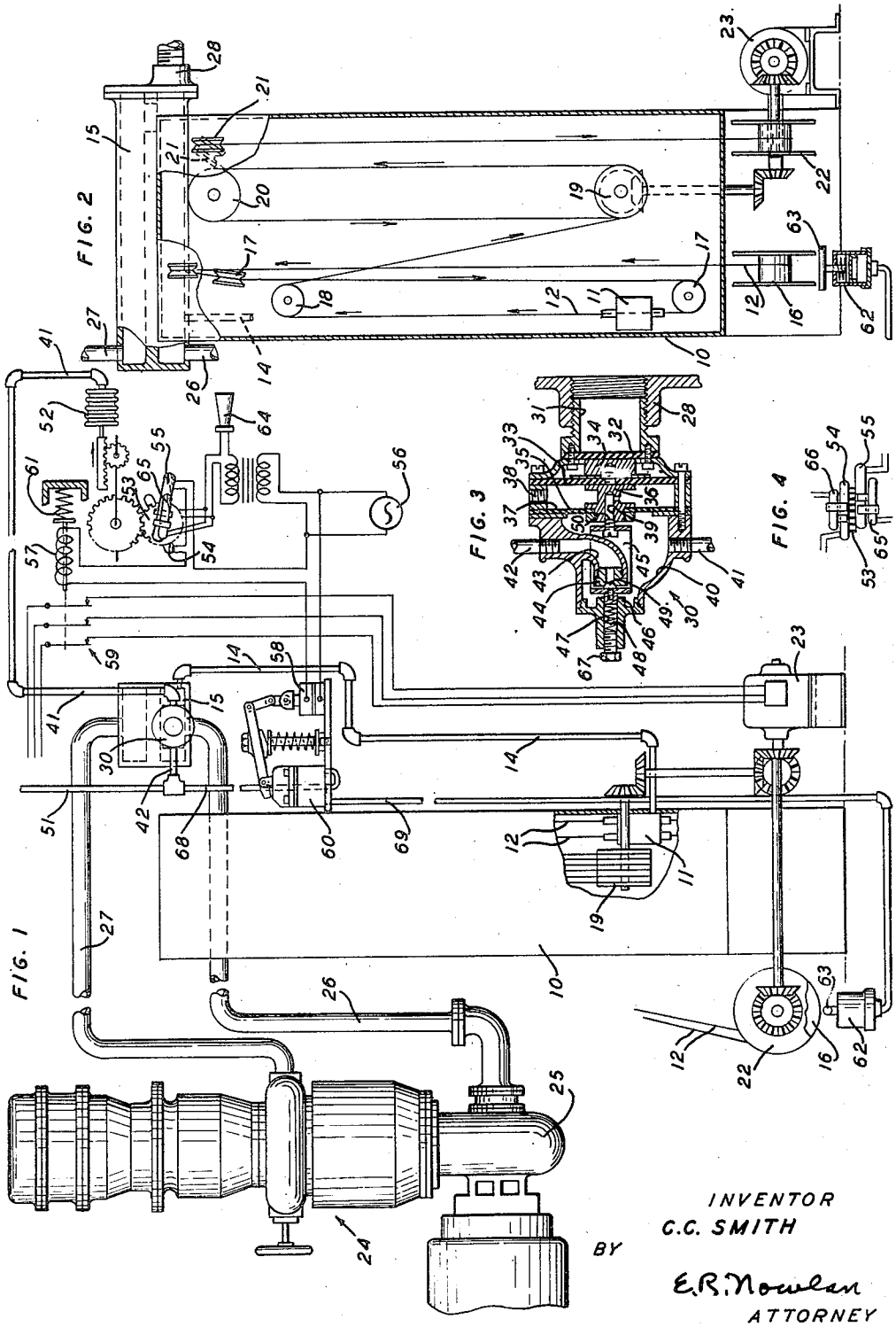


FIG. 1

FIG. 2

FIG. 3

FIG. 4

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CONTROL APPARATUS

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5 Claims. (Cl. 91—18)

This invention relates to control apparatus, and more particularly to apparatus responsive to variation of fluid pressure to actuate mechanism controlling means.

There are countless instances in the manufacturing arts where materials flowable under pressure, ranging from a gas under pressure to a thickly viscous liquid, are supplied to or used in a machine having power driven devices to utilize the fluid in question. There may be critical pressures which the fluid pressure may not safely exceed or fall below. Hence many devices and arrangements have been proposed and satisfactorily carried out, to control the operation of a machine in response to variations of fluid pressure approaching or departing from critical values. If the fluid in question is inflammable, or, particularly, if it gives off inflammable or explosive vapors, it may be importantly desirable to avoid so far as possible the use of electrical devices in those parts of the control apparatus necessarily closely associated with the fluid conveying means as well as with the machine utilizing the fluid, to avoid possible sources of heat or sparks.

An object of the present invention is to provide simple and reliable pressure responsive means to control the actuation of mechanism in an apparatus in response to variations in pressure of a fluid being supplied to the apparatus, with avoidance of electrical devices in the vicinity of the apparatus and its fluid supply.

With the above and other objects in view the invention, in connection with a machine having a hollow member supplying a fluid thereto under pressure and having power means to accelerate and drive the machine and brake means for deceleration, may be embodied in pressure responsive means mounted on the hollow member and operative through fluid pressure communication to actuate signal means and to control the driving means and brake means.

Other objects and features of the invention will appear from the following detailed description when taken in conjunction with the accompanying drawing and in which

Fig. 1 is a diagrammatic view in side elevation of an embodiment of the invention applied in a machine for coating wire;

Fig. 2 is a view of the coating machine proper in front elevation with most of the casing broken away;

Fig. 3 is a central longitudinal section on an enlarged scale of a pressure responsive valve; and

Fig. 4 is a detached detail plan view of the control actuated switches.

The invention is herein illustrated as embodied in safety control means applied to apparatus for coating electrical conductor wires with a thickly viscous paste whose principal ingredients are cellulose acetate softened with acetone. Because of the acetone, whose vapors may form explosive mixtures with air, it is desirable to avoid the presence in the immediate vicinity of the apparatus, of any electrical switch or other electrical circuit making or breaking device which might make sparks or arcs.

As shown, a vertical, parallelopipedal casing 10 encloses a drying chamber. A duplex wire coating head 11 is mounted in this chamber and its function is to apply to wires 12 passing through it a coating of the cellulose acetate paste supplied to the coating head 11 through a pipe 14 from a horizontal header 15 near the top of the casing. The wire to be coated is drawn from a supply reel 16, enters the drying chamber through an appropriate aperture in its wall, passes over guide sheaves 17, through the coating head 11, over guide sheaves 18, around a driven capstan 19, over guide sheaves 20 and guide sheaves 21, to a take-up reel 22 driven by a motor 23 which also drives the capstan 19. The motor 23 is induction type and so sparkless.

In another room from that where the apparatus described is located, is the cellulose paste mixing apparatus generally indicated at 24. From this the paste is pumped at about one hundred and fifty pounds per square inch pressure by a pump 25 through a pipe 26 to the header 15. The paste circulates through the header and returns to the mixer via a pipe 27.

The above is a brief description of as much of the apparatus to which the invention is to be applied, as is believed to be necessary for a clear understanding of the function and use of the invention itself.

At any convenient location on the header is located a union 28 to support and afford communication with the interior of the header to a pressure responsive valve 30 shown in position in Fig. 1, omitted in Fig. 2, and shown in enlarged detached section in Fig. 3. At its rear, the valve 30 has a paste chamber 31 open at the rear to the interior of the header 15 through the union 28 and so filled with paste under pressure. The front of the chamber 31 is closed hermetically by a flexible wall or diaphragm 32. Forward of the wall 32 is a parallel flexible wall or diaphragm 33 having a spacing block or push

block 34 secured thereto and normally in contact with the front face of the diaphragm 32. Forward of the wall 33 is a third wall or diaphragm 35, also flexible. A central spacing member 36 is secured between and to both the walls 33 and 35. These walls, the member 36 and the outer wall of the valve delimit an annular chamber 37. The chamber 37 communicates with the outer air by way of an exhaust port or aperture 38. A passage 39 communicates from the chamber 37 through the member 36 with the front chamber 40 of the valve. A delivery pipe 41 communicates from the chamber 40 at one side; and a supply pipe 42 communicates at the other side with a curved intake passage 43 leading into the chamber 40. The forwardly facing open end of the passage 43 is partially closed by a centrally perforated plug 44.

A yoke 45 is positioned around the intake 43 and is supported and guided by a short cylindrical boss 46 slidably held in a suitably bored cylinder 47 formed in the outer housing of the valve and containing also a compression spring 48 tending to urge the yoke 45 to the right (Fig. 3). A hemispherical seal 49 on the yoke is yieldingly held by the spring 48 to close the perforated plug 44 and a like seal 50 also on the yoke is similarly held to close the passage 39.

The air supply pipe 42 is connected to any suitable source of compressed air (not shown) by way of an air supply main 51. The delivery or outlet pipe 41 is connected to a suitable pressure responsive means 52, such as corrugated metal bellows, which in turn is connected through suitable mechanical members to turn a rotatable support member 53 about a horizontal axis, clockwise (Fig. 1) when the pressure in the device 52 increases and counterclockwise when this pressure diminishes. A pair of mercury switches 54 and 55 is mounted on the member 53, tilted in opposite directions, and each closed in the normal position of the support member 53. The switches 54 and 55 are connected in series in an electrical control circuit supplied by any suitable source 56. This circuit energizes two solenoids 57 and 58 when both switches 54 and 55 are closed. The solenoid 57 holds the power supply switch 59 closed against a spring 61 when energized, so that if either switch 54 or 55 opens the solenoid 57 is deenergized and the spring 61 opens the switch 59 and thus cuts off the power supply to the motor 23. The solenoid 58 when energized holds a compressed air valve 60 closed. The valve 60 is supplied with air under pressure from the main compressed air line 51 and is connected at the other side of the valve 60 to an air ram 62 to actuate a brake 63 to retard and stop the supply reel 16, so that when the solenoid 58 is deenergized, the valve 60 is opened to actuate the brake.

An alarm device 64, here shown as a horn but which might be a light or other suitable device, is also fed by the source 56. Two mercury switches, 65 and 66 respectively, are connected in parallel in the circuit of the device 64, so that if both switches are open the device 64 is not actuated, but closing of either switch 65 or 66 completes a circuit to cause the device 64 to operate. The switches 65 and 66 are so mounted as to both be normally open but the switch 65 will close appreciably before the switch 55 opens when the member 53 is turned clockwise by increased pressure in the device 52, while the switch 66 will close appreciably before the switch 54 opens when the member 53 is caused to turn counterclockwise by diminished pressure in the device 52.

Thus, when the pressure in the device 52 increases toward a critical predetermined value, the support member 53 is rotated clockwise and when the pressure value is reached the switch 65 closes and the horn sounds. If this warning signal is unheeded for any reason, the member 53 continues to turn until a second predetermined pressure in the device 52 supervenes, when the switch 55 opens, causing the switch 59 and the valve 60 to open, thus deenergizing the motor 23 and stopping the take-up reel 22 and capstan 19 while also setting the brake 63 to stop the supply reel 16. In the same way, if the pressure in the device 52 diminishes, at one predetermined value the horn is sounded and a second succeeding predetermined value the machine is stopped.

The primary control means is the pressure responsive valve 30. In this the flexible wall, septum or diaphragm 32 is at all times subject to the direct pressure on its outer face of the paste coating material in the header 15 coming into the chamber 31 through the union 28. When this pressure is normal, the state of affairs in this device 30 is that shown in Fig. 3. The passage 39 is closed by the seal 50 and, the chamber 37 being open to the outer air the pressure in the chamber 37 is atmospheric. The compressed air supply to the chamber 40 is shut off by the seal 49, and the chamber 40, the pipe 41 and the device 52 are filled with air under a normal predetermined pressure which holds the member 53 in the neutral position shown with switches 54 and 55 closed and switches 65 and 66 open. If now the pressure of the paste on the wall 32 grows less, the static air pressure in the chamber 40 will move the walls 32 and 35, which act as a unit because of the spacing member 36, to the right, moving the mouth of the passage 39 away from the seal 50. Air passes from the chamber 40, via the passage 39, the chamber 37 and the vent 38, into the open. The pressure in the pipe 41 and the device 52 then falls correspondingly and the device 52 acts to open the switch 55 and close the switch 65. Should the pressure on the wall 32 increase above normal, the walls 32 and 35 move to the left, forcing the seal 49 to open and allow air from the supply 42 to enter the chamber 40 and pass to the device 52 to open the switch 54 and close the switch 66. If other conditions are normal, but there is excess air pressure in the chamber 40, the walls 35 and 32 move to the right and the excess air is vented through passages 39 and 38; or, if there is under pressure in the chamber 40, air will be admitted past the seal 49 until the chamber pressure is normal. Establishment and maintenance of normal pressure in the chamber 40 depend upon the pressure exerted by the spring 48 on the yoke 45. This pressure may be adjusted by suitable means such as a threaded abutment 67 for the outer end of the spring 48.

In the diagrammatic arrangement of Fig. 1, the components of the apparatus have been so arranged as to show most clearly and simply the relations and coactions of the several devices comprised in the invention with each other and with the machine to which the invention is applied. In actual practise and to effectuate one of the principal advantages of the invention, the mixer 24 and pump 25 will be in one room; the casing 10, header 15, motor 23, reels 16 and 22, valve 30, and brake 63 and brake actuating cyl-

inder 62 will be in a second room separated from the first by a wall impervious except for the pipes 26 and 27 leading to and from the header 15 from the pump 25 and to the mixer 24; while the devices 52, 53, 56, 57, 59, 58 and 60, with their immediately associated elements, will be in a third, control, room separated from either of the other rooms by walls unbroken except for the passage of the three electrical conductors from the switch 59 in the control room to the motor 23, and for the compressed air pipes 68 and 69 to and from the valve 60, and the pipe 41 from the valve 30 to the device 52.

The motor 23, as already pointed out, is preferably an induction motor having no commutator or built in switches or other elements capable of arcing or sparking. Hence this may safely be left in the coating room beside the casing 10. The brake 63 will have a suitable friction surface to prevent mechanically produced sparks. Hence this also may be alongside the casing 10.

While the solenoids 57 and 58 are normally sparkless, they are also both normally energized by the control circuit from the source 56, solenoid 57 to hold the switch 59 closed and solenoid 58 to hold the valve 60 closed. In case of accidental overload in the circuit they might overheat, and hence are isolated in the control room from the coating room, together with the entire control circuit from the source 56.

While the mercury switches 54, 55, 65 and 66 are effectively sparkless and arcless in operation, their dangerous elements are housed within relatively fragile glass tubes which might be accidentally ruptured with consequent danger in a possibly explosive atmosphere. In fact, where these switches are in an isolated control room they may be ordinary make and break contacts instead of mercury switches.

The invention has been disclosed and illustrated as embodied in apparatus for controlling the operation of a machine for coating insulated wire, but it is obviously not so limited. Its usefulness will be apparent wherever any fluid which is itself explosive or combustible or which may evolve explosive or combustible vapors is being held in or moved through a hollow container under an optimum pressure, which pressure for any reason should not be allowed to exceed or fall short of predetermined maximum or minimum values without corresponding mechanical actions being called into play. Hence the particular disclosure above may be modified and departed from variously without departing from the spirit and scope of the invention which are particularly described and pointed out in the appended claims.

What is claimed is:

1. In an apparatus having a hollow member to contain a fluid under pressure and having power operated mechanism and a signal means, means to govern the operation of the mechanism in response to variation of the pressure of the fluid in the member, the said means comprising means to convert the pressure of the said fluid into correspondingly varying pressure of a second fluid, means to control the actuation of the said mechanism, and means responsive to variation of the pressure of the second fluid to actuate the signal means first and the control means thereafter.

2. In an apparatus having a hollow member to contain a fluid under pressure and having power operated mechanism and a brake means, means to govern the operation of the mechanism in response to variation of the pressure of the fluid in the member, the said means comprising means to convert the pressure of the said fluid into correspondingly varying pressure of a second fluid, means to control the actuation of the said mechanism, and means responsive to variation of the pressure of the second fluid to actuate both the control means and the brake means simultaneously.

3. In an apparatus having a hollow member to contain a fluid under pressure and having power operated mechanism and a brake means and a signal means, means to govern the operation of the mechanism in response to variation of the pressure of the fluid in the member, the said means comprising means to convert the pressure of the said fluid into correspondingly varying pressure of a second fluid, means to control the actuation of the said mechanism, and means responsive to variation of the pressure of the second fluid to actuate the signal means first and both the control means and the brake means simultaneously thereafter.

4. In an apparatus having a hollow member to contain a fluid under pressure and having power operated mechanism and a signal means, means to govern the operation of the mechanism in response to variation of the pressure of the fluid in the member, the said means comprising a reducing valve controlled by the pressure of the said fluid to correspondingly vary the pressure of a second fluid, power switching means to control the actuation of the said mechanism, and a member movable in response to variations of pressure of the second fluid to first actuate the signal means and to thereafter actuate the power swtiching means.

5. In an apparatus having a hollow member to contain a fluid under pressure and having power operated mechanism and a brake means and a signal means, means to govern the operation of the mechanism in response to variation of the pressure of the fluid in the member, the said means comprising a reducing valve controlled by the pressure of the said fluid to correspondingly vary the pressure of a second fluid, power switching means to control the actuation of the said mechanism, and a member movable in response to variations of pressure of the second fluid to first actuate the signal and to thereafter actuate both the power switching means and the brake means simultaneously.

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