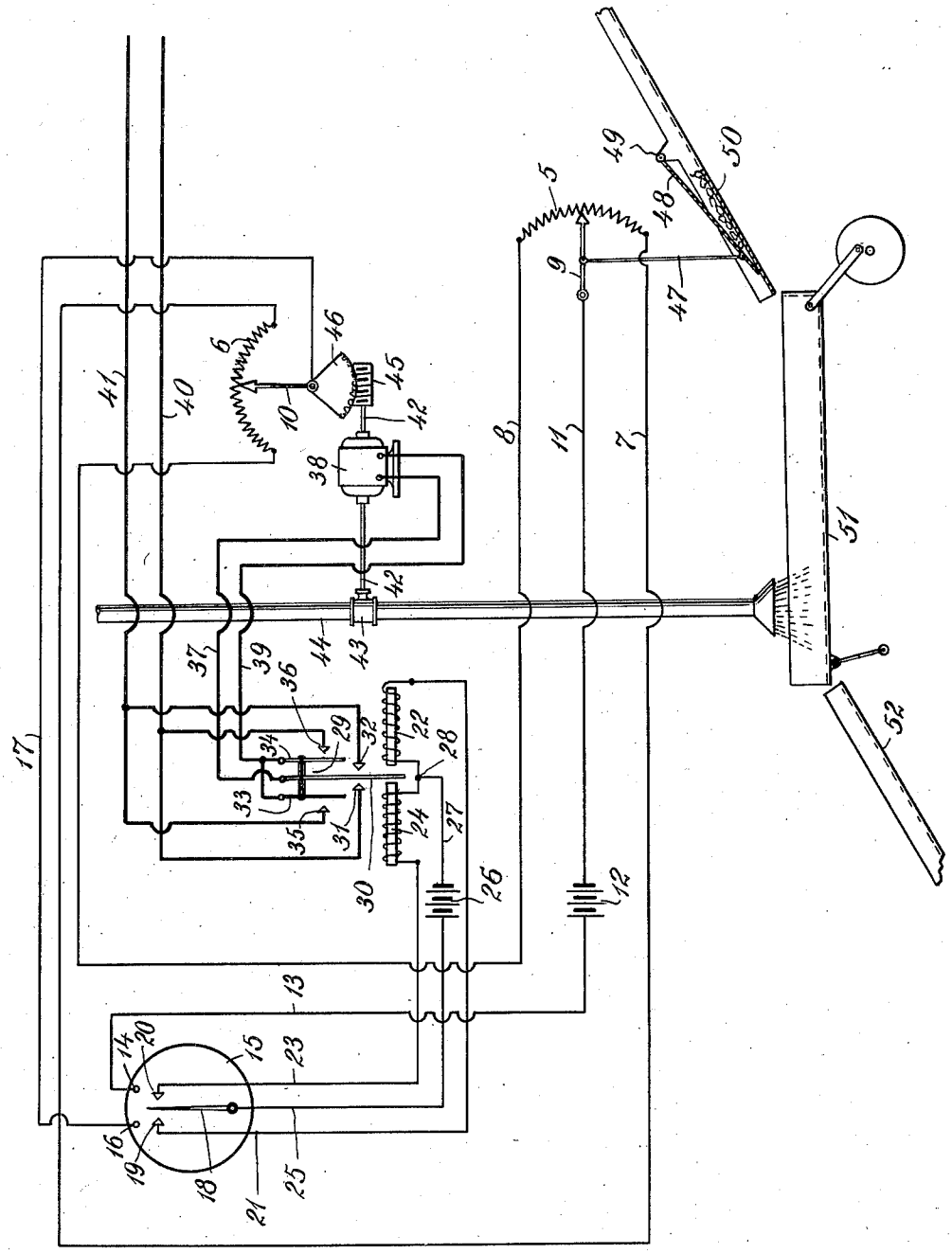
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METHOD OF AND APPARATUS FOR CONTROLLING THE FLOW OF FLUIDS

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METHOD OF AND APPARATUS FOR CONTROLLING THE FLOW OF FLUIDS

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3 Claims. (Cl. 137—164)

This invention relates to flow regulation for fluids and particularly to a method and apparatus adapted to vary the amount of fluid supplied in proportion to the amount required for the treatment of a varying bulk or mass of traveling material.

The invention has numerous applications in the practical control of manufacturing operations. For the purpose of clarity, it will be described particularly with respect to only one such operation, as an example of its utility and advantages.

To preserve the identity of coal derived from a particular source, the surface of the coal is colored, for example by the application of a suitable dyestuff. The familiar "blue coal" of commerce is thus colored with a solution of ultramarine. A convenient method of application is to supply the solution to the coal as it is delivered from the storage pocket to the car or other means of transportation. The coal as delivered from the pocket varies in quantity as it travels toward the car. It is, therefore, difficult to regulate the supply of liquid so as to properly color the coal and yet avoid wastage. Attempted manual operation of the valve controlling the flow of liquid results usually in a considerable loss of relatively expensive material. The invention as hereinafter described affords a simple solution of the problem of regulating the supply of liquid in accordance with the bulk of the coal which is treated.

It is the object of the invention to provide a method of and apparatus for positively and accurately controlling the flow of a fluid in accordance with the bulk or mass of traveling material to which the fluid is to be applied.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and the accompanying drawing, which illustrates diagrammatically an apparatus adapted for the practice of the invention, it being understood that in so far as the diagram refers to the treatment of coal it is illustrative merely of an application to which the invention is adapted, and that obvious modifications can be made to permit utilization of the invention for other and analogous purposes.

In carrying out the invention, I utilize a closed electrical circuit including in series two resistance elements of known value. The resistance elements are indicated on the drawing at 5 and 6 and are connected by conductors 7 and 8. Movable contacts, preferably in the form of pivoted arms 9 and 10 are adapted to engage the resistance elements 5 and 6. The devices embodying the resistance elements and the movable contacts are generally referred to as potentiometers. The movable contact 9 is connected by a conductor 11, through a source of low voltage current, preferably a battery 12, and a conductor 13, to one terminal 14 of a galvanometer 15. The other terminal 16 of the galvanometer is connected by a conductor 17 to the movable contact 10. When the resistances are properly balanced, the needle 18 of the galvanometer remains in neutral position.

Two contacts 19 and 20 are provided in the galvanometer and are adapted to be engaged by the needle 18 when the resistances are unbalanced. The particular contact which is engaged at such time depends upon the condition of the circuit.

The contact 19 is connected by a conductor 21 to one terminal of a relay 22. The contact 20 of the galvanometer is connected by a conductor 23 with a terminal of a relay 24. The needle 18 of the galvanometer is connected by a conductor 25 through a source of current of low voltage, preferably a battery 26 and a conductor 27 to a common terminal 28 of the relays 22 and 24.

The relays 22 and 24 are adapted to actuate a three-pole switch 29, one arm 30 of which is adapted to engage either of the contacts 31 or 32. Arms 33 and 34 of the switch are adapted to engage contacts 35 and 36. The arm 29 is connected by a conductor 37 to a motor 38 of the reversible type, and the arms 33 and 34 are connected to the motor by a conductor 39. The direction of rotation of the motor depends upon the position of the arms 29, 33 and 34, that is to say, when the contacts 31 and 35 are engaged, the motor turns in one direction, and when the contacts 32 and 36 are engaged, it turns in the opposite direction. Power is supplied from any suitable source through conductors 40 and 41 which are connected to the contacts 31 and 35, and 32 and 36 respectively, thus affording the necessary current to actuate the motor 38 as hereinbefore described.

The shaft 42 of the motor is connected to a valve 43 in a pipe 44 through which the fluid is supplied. Consequently when the motor turns in either direction, the valve 43 is adjusted accordingly. The opposite end of the motor shaft 42 is provided with a worm 45 which engages a worm segment 46 which is secured to the pivoted arm 10, so that the resistance in the circuit is

modified as the motor operates to adjust the position of the valve 43.

The pivoted arm 9 is connected by a link 47 to a plate 48 pivoted at 49 and adapted to rest upon the material, for example coal, flowing through a chute 50. As the coal passes beneath the plate 48, the position of the pivoted arm 9 is adjusted with respect to the resistance element 5, thus modifying the conditions in the circuit. Movement of the needle 18 of the galvanometer to engage one or the other of the contacts 19 or 20 will cause either of the relays 22 or 24 to close the corresponding circuit to the motor 38, thus causing the valve 43 to be adjusted to supply more or less fluid. As the motor rotates, the pivoted arm 10 is moved until balance is restored in the circuit, whereupon the power circuit is broken by the return of the galvanometer needle 18 to its neutral position. The flow of fluid will then continue at the adjusted rate until the circuit is again disturbed.

The coal in the particular application of the invention described flows from the chute 50 onto a shaker 51, and the fluid from the pipe 44 is discharged thereon, the dye solution for example. The liquid flowing over the coal colors it, and the coal is discharged through a chute 52.

In the particular example described, the fluid in the pipe 44 is a liquid dye solution, but obviously other liquids and gases may be employed in various applications of the invention, and the flow thereof may be controlled in the manner hereinbefore described.

Various changes may be made in the form, construction and arrangement of the parts of the apparatus without departing from the invention or sacrificing the advantages thereof.

I claim:

1. In an apparatus for automatically controlling the flow of fluid in proportion to the quantity of material to be treated therewith, a conduit for the fluid, a valve therein, a reversible electric motor to actuate the valve in two directions, circuits adapted to supply current to the motor, a relay controlling the motor circuits and means for actuating the relay comprising resistance elements in series in a closed circuit, a galvanometer, movable arms engaging the resistance elements and connected to the galvanometer and a source of electric current, contacts in the galvanometer and connections between the contacts and the relay including a source of electric current, means adapted to be actuated by variations in quantity of the material to be treated and connected to one of the movable arms, and a connection between the electric motor and the other movable arm, one of said contacts in the galvanometer being movable in response to variations in the position of the movable arm connected to the means actuated by variations in quantity of the material to be treated to close a circuit through said relay to operate the motor to actuate said valve and to move the arm connected thereto to vary the resistance with which it engages to create a balanced condition in the circuit including said resistances.

2. In an apparatus for automatically controlling the flow of fluid in proportion to the quantity of material to be treated therewith, a conduit for the fluid, a valve therein, electrically actuated means for adjusting the valve and means for selectively controlling the electrically actuated means including a galvanometer having means for closing a circuit including said electrically-actuated means, a circuit including variable resistances connected to the galvanometer, means for varying one of the resistances in proportion to variations in the quantity of material and means for varying the other resistance in proportion to the adjustment of the valve, said circuit-closing means of the galvanometer being responsive to movement of the means for varying said one of the resistances.

3. In an apparatus for automatically controlling the flow of fluid in proportion to the quantity of material to be treated therewith, a conduit for the fluid, a valve therein, a reversible electric motor to actuate the valve in two directions, circuits adapted to supply current to the motor, a relay controlling the motor circuits and means for actuating the relay comprising resistance elements in series in a closed circuit, a switch including a pair of stationary contacts and a contact movable into engaging position with either of said stationary contacts, movable arms engaging the resistance elements, connections between said stationary contacts of the switch and the relay, means adapted to be actuated by variations in quantity of the material to be treated and connected to one of said movable arms, a connection between the motor and the other movable arm, the movable contact of said switch being actuated in response to variations in the position of the movable arm connected to the means actuated by variations in quantity of the material to be treated to engage one of said stationary contacts to close a circuit through said relay, to operate the motor to actuate said valve, and to move the arm connected thereto to vary the resistance with which it engages to create a balanced condition in the circuit including said resistance.

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