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MEANS AND METHODS FOR CONTROLLING MOTIVE FORCES

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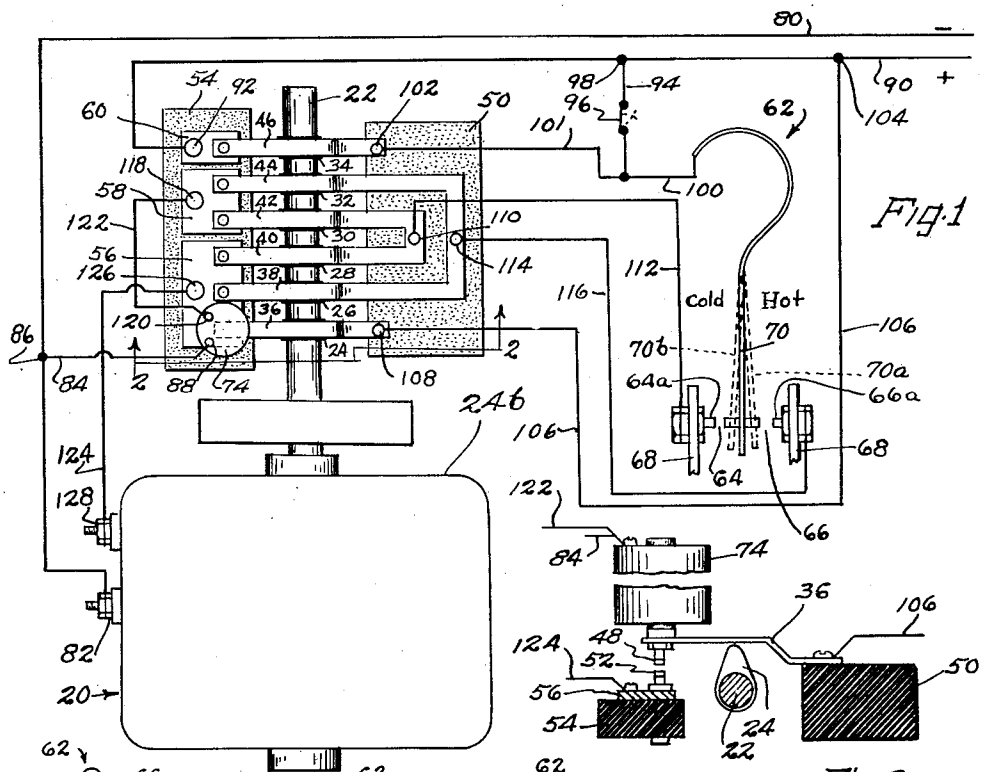


Fig. 1

Fig. 2

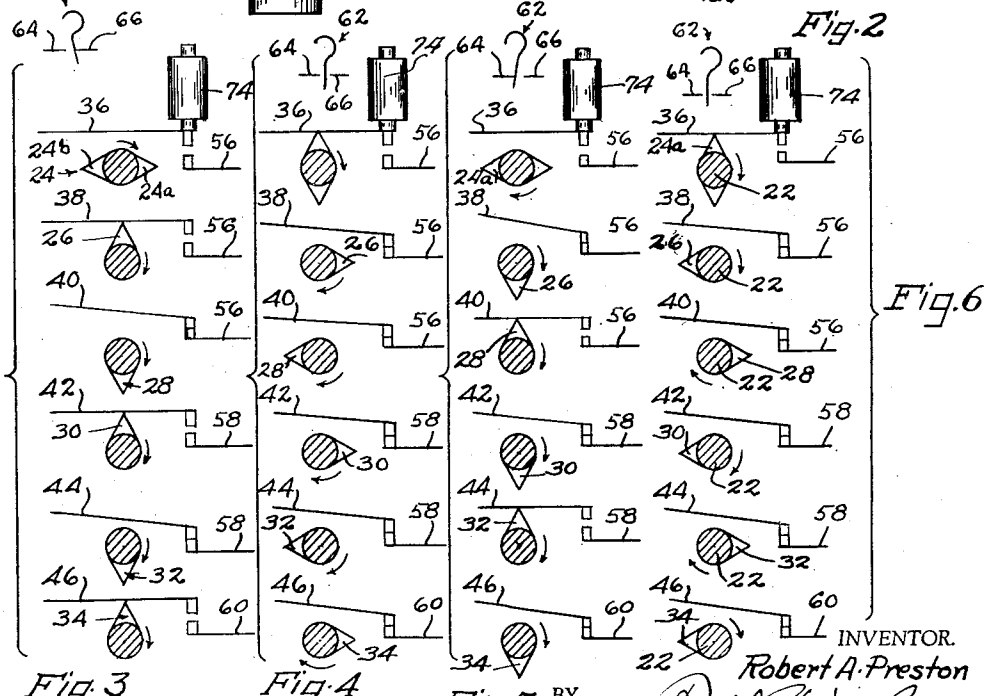


Fig. 3

Fig. 4

Fig. 5

Fig. 6

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MEANS AND METHOD FOR CONTROLLING MOTIVE FORCES

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6 Claims. (Cl. 172—239)

An object of the invention is to provide power means automatically brought into being to control movement of a power shaft in rotary or lineal movement whereby a distributor such as a valve or a timing device may be moved to and from an assumed standard or starting point.

Another object of the invention is to provide means to control a driven actuator recurrently through cycles of operation wherein each cycle of operation is divisible into segments having either equal or unequal magnitude depending only upon service requirements.

Another object of the invention is to provide means to control a driven actuator recurrently through cycles of operation wherein each cycle of operation is divisible into segments having unequal magnitude, that is, where a first segment of an operating cycle is of minimum value, where a diametrically opposite segment of operation is of maximum value, where an intermediate segment of operation is of less than maximum value, and where a second intermediate segment of operation is of more value than said minimum value, although of less value than said other intermediate segment of operation.

Another object of the invention to to provide means to control a driven actuator recurrently through cycles of operation wherein each cycle of operation is divisible into segments thereof having unequal values, and which actuator when moved clock-wise will have a first operable position of minimum value, a diametrically opposite or third operable position of maximum value, a second segmental position or a position intermediate of the stated first and third segmental positions in moving clock-wise which is of less than maximum value, and a fourth segmental position of operation or a position following the third and prior to the first mentioned position which is of greater value than said first mentioned segmental position or minimum value position, although of less value than said second mentioned segmental position.

A further object of the invention is to provide electrical circuits which may be energized upon conclusion or attainment of a maximum and/or minimum and/or intermediate condition of temperature, pressure, humidity, luminosity, etc., to operate an impulse unit whereby the then prevalent maximum and/or minimum and/or intermediate condition will be reversed and/or advanced from or through the ten existing partial cycle of prevailing condition.

Other objects, features, and advantages of the invention may appear from the accompanying drawing and specification which are only illustrative of the instant form thereof, and from the appended claims.

In the drawing, of which there is one sheet:

Figure 1 is a schematic view showing essential construction to effect control of a driven shaft within the purview of this invention.

Figure 2 is a detail taken substantially on line 2—2, in Figure 1, showing the magnet in conjunction with one of the cams adapted to effect circuit interruption as contemplated to partially control the driven element (shaft).

Figures 3, 4, 5, and 6 show in schematic arrangement the impulse unit driven element (shaft) in each of four successive positions and the positions assumed by the cams thereon, each of the positions being or representing a different point to effect control of the circuit shown in Figure 1.

The use to which the apparatus of this invention is put, may, it is believed, be stated as being a matter of choice and depends upon the task at hand, however, as a matter of back-ground and to give substantiation of usefulness, one application may be stated to be a means to remotely control a regulator or valve in a steam-heating system for an auditorium where the primary heat admitting valve is actuated by a power impulse based upon electrical energy.

In regard to the above reference to a control valve, it may be mentioned, that within the spirit of this specific reference may be mentioned dampers and other types of regulators, and that such regulator regardless of its nature and function may be formed to entirely cut-off passage therethrough when moved to any extreme open or closed position, and likewise, as probably would be the case in a majority of installations, it may be formed to provide for variable degrees of passage or bleeding therethrough when in any closed or intermediate position. This theory of operation being within the scope of the art covering valves and regulators in general will be fully appreciated by those conversant therewith.

The present illustration of this invention, as in many other types of control is shown as utilizing a thermostat which is set for an accepted standard condition of temperature, and such standard regardless of its degree is reflected in the position in which the driven cam shaft of the impulse unit (motor) is placed, each being complementary to the other, even though a lag may occur in the one while following the other, and in this respect it is to be noted that pressure gages, hygrostats,

etc., may be used with equal facility depending only upon the service requirements.

The apparatus as here set forth includes an impulse unit 20 provided with a directly actuated shaft 22, although a clutch could be interposed between the shaft and the impulse unit. Cams or interrupters 24, 26, 28, 30, 32, and 34 are positioned upon, although electrically insulated from the shaft 22 and are pre-formed with such conventional shape as to provide for lift in time and interval in raising and permitting gravitational lowering of the several fingers 36, 38, 40, 42, 44, and 46 as may of necessity be required.

A breaker point 48 is carried on each of the fingers aforementioned and they in turn are operatively mounted upon a block of insulating material 50. Points 52 are complementary to each of the points 48 and as shown in Figure 1, are grouped in separate electrical zones. The contact points 52 of fingers 36, 38, and 40 are secured in a single metallic base 56, while the points 52 of fingers 42 and 44 are secured upon a second separate metallic base 58, while the point 52 of fingers 46 is secured upon a third metallic base 60. All of these bases being mounted upon an insulating block 54.

A thermostat or other automatically operated device 62 remotely situated from the aforementioned apparatus is so formed and adapted to close and open certain electrical circuits to energize and de-energize certain of the above mentioned fingers, as will be subsequently set forth in detail, suffice to here state that the contacts 64 and 66 secured in supports 68 are adapted to alternately and/or as may be required by changing conditions, complete an electrical circuit when the movable element or bar 70 of the automatically operated device 62 is moved to close either of the contacts 64 and 66, or is moved to an intermediate point without contacting either one of the contacts.

A magnet 74 is adapted to periodically hold the finger 36 in elevated position when energized for the purpose of breaking a parallel circuit to the impulse unit when the contacts 64 and 66 are not closed, as and for the subsequently set forth purpose.

The foregoing structure while simple in nature, comprises the physical structure of the apparatus of this invention when taken together with the essential inter-connected circuit wiring, a description of which will now follow, reference being had to the drawing.

As shown in Figure 1, a lead 80 connected with a source of power (not shown) is directly connected with the impulse unit 20 at terminal post 82 while a lead 84 joined to lead 80 at point 86 is connected to one of the terminal posts 88 of the magnet 74. Lead 90 which is complementary to lead 80, is joined to the terminal 92 upon the metallic base 60, while lead 94 having a switch 96 is joined to lead 90 at point 98, and is connected with the thermostat 62 by an intermediate lead 100, and with the finger 46 at point 102 by means of a second intermediate lead 101. A gear speed reducer 20b is adapted to obtain a reduction in rotation of shaft 22 as compared with the motor 20.

The lead 90 is also tapped at point 104 and this connection or lead 106 is directly connected to finger 36 at point 108. The contact point 64 is connected with fingers 40 and 42 at point 110 by lead 112, while contact point 66 is connected with fingers 38 and 44 at point 114 by means of the lead 116. Terminal post 118 upon the metallic base 58 is joined to the terminal 120 of magnet 74 by lead 122, while a lead 124 joins the terminal post 126 of base 56 and the terminal post 128 of the impulse unit 20.

Assuming that the shaft 22 of the impulse unit 20 is operatively connected with a four-way valve or other analogous control device in a heating system and that the thermostat 62 is suitably located in an auditorium to which the above mentioned valve directs steam or other heating medium, dependent only upon open, or partially open, or closed position thereof, and that the thermostat is electrically connected with the impulse unit operated assembly previously outlined, and that the valve (not shown) is set to continue admission of heat when the thermostat is initially in the position indicated by the reference character 70a, in other words, when the bar 70 is moving from the position 70b to 70a, and is of course closed when initially in the position 70b, that is, when the bar 70 is moving from the position 70a to the position 70b, then in that case operation of the system is as follows.

Figures 3, 4, 5, and 6 are each representative of successive positions of the shaft 22 and the cams thereon, and in illustration of a cycle of operation, Figure 3 may be considered indicative of the shaft position necessary to close a heat admitting valve, and with the contact point 66 closed. For as previously stated, this position is contemporary with the hot side of the thermostat and the circuit energized by the closure of the contact 66 has already resulted in movement of the impulse unit so as to at least partially close the valve against further full heat rate admission. Also, fingers 36, 38, and 40 are parallel feeders to energize the impulse unit 20, while fingers 42 and 44 are parallel feeders to energize the magnet 74 which co-acts with cam 24 to periodically lift finger 36 to interrupt a flow of power through the finger 36 to the impulse unit.

The finger 46 as will be shown, acts in the nature of an automatically operated switch to kill the entire electrical system following the opening of switch 96.

The cam positions shown in Figure 3 are arrived at as the result of the bar 70 moving, because of temperature drop, to the full line or intermediate position shown in Figure 1 and the accompanying opening of contact 64, for upon opening of contact 64, the circuit through finger 42 is dead, hence the magnet is de-energized and the finger 36 falls to close its contact point 52, thus closing the circuit through lead 106 and energizing the impulse unit, whereby it is rotated from the position shown in Figure 6 to that shown in Figure 3, which latter figure forms the beginning of this description of operation.

Reference to Figure 6 will show that the static position of the cam shaft 22 and the impulse unit 20 is the result of cam lobe 24a having raised the finger 36 and thus breaking the circuit to the impulse unit.

As the temperature of the room or auditorium rises, the bar 70 of the thermostat moves from intermediate position to the contact 66, thereby energizing lead 116 and fingers 38 and 44 both of which are in closed position because of the non-functional position of cams 26 and 32 (see Figure 6), hence magnet circuit A comprising lead 116, finger 44, and leads 122 and 84, is energized and holds the finger 36 in open circuit position. Simultaneously through finger 38 the impulse unit is energized through circuit B comprising lead 116, finger 38, and lead 124, thereby

rotating or actuating the same, and during this rotation cam 26 has moved from a non-functional position to a position to lift finger 38 (see Figure 3) which action breaks circuit B to the impulse unit and the system comes to rest, having carried its entrained valve to closed or partially closed position depending only upon the construction of the valve and its passages. It is to be noted that during this cam movement that cam 32 is still in non-functional position, that is, it does not lift the finger 44, hence the magnet 74 is still energized through circuit A and remains energized as long as the contact 66 remains closed, however, upon a sensible increase in temperature the thermostat actuated contact 66 will automatically open and break circuit A to the magnet. The finger 36 will then drop and close its contacts 48—52 and since the lead 106 is always energized, the impulse unit 20 through circuit C comprising lead 106, finger 24 and lead 124 will be again motivated and caused to move through another segment of its cycle of operation, which results insofar as the cams are concerned, in the movement of cam 30 from lifting to non-lifting position (see Figure 4) thus preparing for closure of circuit D comprising lead 112, finger 42, leads 22 and 84, of the magnet 74 upon the next subsequent closure of contact 64.

Likewise cam 28, see Figure 4, is also in non-lifting position, hence the finger 40 is in circuit closing position preparatory to the next subsequent energization resulting from closure of contact 64. Also, the past movement of the cam shaft has carried cam lobe 24b to functional position in that it now supports the finger 36, thereby deenergizing the impulse unit through the parallel circuit C.

From the foregoing it will appear that the impulse unit is not only at rest, but that it has now carried its entrained cam 28 to such position as to enable energization of circuit F, comprising lead 112, finger 40 and lead 124, to the impulse unit upon further drop of temperature in the place being heated or serviced by the system.

Closure of contact 64 will energize the fingers 40 and 42 with the result that the magnet 74 is again energized through circuit D to hold finger 36 in open circuit (circuit C) position, thereby preventing movement of the impulse unit through this circuit which is parallel to circuits E and B, also, it results in energizing the impulse unit through finger 40 (circuit F), which aside from again actuating the associated valve or other mechanism, also, moves the cams preparatory to the next subsequent energization of parallel power circuit C.

Accordingly cam 28 moves finger 40 to break the power circuit E to the impulse unit, and cam 30 is further moved through the non-functioning position of its travel which still leaves the finger 42 in circuit (circuit D) closing position and hence holds the finger 36 in open circuit (circuit C) position as long as the magnet is energized, however, cam lobe 24b has moved to a position where it no longer supports the finger 36 so upon de-energization of the magnet the finger 36 will again fall and close the parallel power circuit C through lead 106 to energize the impulse unit 20.

The just described condition will prevail during the period that the contact 64 is closed, for such closure insures continued energization of magnet 74 and non-energization of the impulse unit 20 through the parallel circuit C, however, upon a sensible drop of temperature the bar 70 of the thermostat will move to an intermediate position thereby opening contact 64 which de-energizes the magnet circuit A through lead 116 which permits finger 36 to drop and close circuit C, and actuating the impulse unit through another segment of its cycle. This movement results in the cam release of fingers 44 and 38 preparatory to the next closure of contact 66. It also results in rotation of the cam 24 to a point where cam lobe 24a supports the finger 36 in elevated position thereby breaking the power source to the impulse unit so that it is now brought to rest although the fingers 44 and 38 are in position (see Figure 6) to carry an energizing current to the impulse unit upon the next closure of contact 66.

Upon conclusion of any period of operation, if it should be desired to discontinue operation of the control system, as during the night, it is only necessary to open the switch 96, thereby killing the circuits 112 and 116 through lead 94, however, lead 96 is directly connected to post 92, plate 60, points 48—52 on finger 46, the finger 46, post 102, and lead 101 to the previously mentioned lead 100 to the thermostat 62 from which point the system is fed as previously described, thus forming a feed back, and permitting and effecting energization thereof until such time as the cam 34 is rotated by the shaft 22 to lift the finger 46 and break the circuit through the points 48—52 thereon, thus killing the entire system until such time subsequently thereto as the switch 96 may be again closed. Thus it will appear that this element of the combination is merely an automatically operated switch which would kill the circuit once in each cycle of operation if it were not for the positive connection afforded by the switch 96.

In résumé, it may be stated that the system of this invention essentially comprises a group of power driven cams which are actuated in such sequence as to open and close certain parallel circuits as to enable an electrical energy impulse unit to intermittently function to manipulate a control valve to maintain a relatively constant condition.

In the present embodiment of the invention, a thermostat is shown as a means to periodically close and open circuits for the above outlined purpose, obviously other instruments may be used with equal facility, depending only upon the service to be maintained, for instance, hygrometers, hydrometers, gages, and barometers, etc., may be used with equal facility to open and close prime sources of power for utilization in the system.

It is also to be noted that the thermostat 62 in the embodiment of the invention shown, comprises or forms a three-way switch, for the points 64a and 66a each form a pole or terminal of the directional circuit switch symbolized by the bar 70, the third leg of the referred to three-way switch resides in the negative fact that upon arrival of the bar 70 in a neutral position, the magnet 74 is de-energized in all cases so that the finger 36 closes its contacts 48—52 thus closing the impulse circuit through lead 106, which action carries the system through another segment of its repetitious cycle. Thus, by reason of the absence of a condition, i. e., circuit closure at 64 or 66, an additional and parallel circuit is closed which in its sequence is as vital as any of the circuits completed through contacts 64 and 66.

In conclusion it may be stated as being obvious that various changes and modifications may be made in practicing the invention in departure

from the showing of the drawing and description as given, without however, departing from the true spirit of the invention as defined by the scope of the appended claims.

It is to be understood that the interrupters or cams may be so shaped as to cause one or more of the fingers to make or break their contact sooner or later or remain open or closed for a longer or shorter time, as long as their relation to one another is not disturbed, and this latitude of operation is to be considered as not departing from the spirit of this invention.

I claim:

1. In a system of control adapted to regulate periodic electric power actuation of a shaft for functional use, said system having an electrical impulse unit and an automatic switch with contact points individually closable as one power source whereby movement of said impulse unit may be had, and another circuit to effect movement of said impulse unit, said last mentioned circuit being operative upon opening of either of said contacts whereby a finger is gravitationally movable to close a parallel circuit to said impulse unit, and a cam to open said last mentioned circuit upon subsequent actuation of said impulse unit.

2. In an electric control system adapted to regulate a power impulse with respect to a given standard of departure, a motor having a shaft provided with cams, circuit closing fingers actuated by said cams, a magnet functionally co-operable with one of said cams to move an associated finger from closed circuit position, and a remotely positioned switch closable upon attainment of a given standard, said switch upon closure of one of its contact points being so connected to certain of said fingers as to energize a circuit to said impulse unit and said magnet when certain of said cams are in finger releasing position whereby said impulse unit is actuated through one of its circuits, and a parallel circuit thereto is de-energized whereby said impulse unit is actuated and certain of said cams are moved to lift the then energized fingers and break said impulse unit and magnet circuits, and another circuit closable upon magnetic release of the finger actuated by the magnet whereby said parallel circuit to said impulse unit is again energized.

3. In a control system adapted to regulate movement of a driven shaft having cams thereon, electric circuit closing fingers adapted to be moved to open circuit position by said cams, an impulse unit to actuate said shaft and cams, a magnet, a switch having circuit closing contact points and being actuated to closed and open position by a sensible change of temperature, a first group of said fingers being in circuit with said impulse unit, said magnet and one of said switch poles, a second group of said fingers being in circuit with the other of said switch poles, said impulse unit and said magnet, a single finger in series with said impulse unit and a power source, said cams being positioned upon said shaft in such sequence of function with respect to each other that upon closure of a circuit through one of said contacts said magnet will be energized to lift said single finger to open circuit position and will energize the other finger of the group to actuate said impulse unit and shaft pending development of cam rotation to break the circuit through one of the energized fingers, and further circuit energization effected by further change in said temperature actuated switch, said last mentioned circuit energization being effected by opening of the closed switch pole whereby said magnet is de-energized and said single finger is magnetically released to complete its circuit to said impulse unit to actuate the same and said shaft through a segment of a cycle of operation, and means repetitious of said first mentioned switch contact closure to effect further energization of said impulse unit and shaft rotation through a further segment of a cycle of operaiton.

4. In an electrical control system to regulate the useful position of a motor driven mechanism, in combination, a motor having a shaft provided with cams, motor circuit fingers actuated by said cams, a magnet functionally co-operable with one of said fingers, and a remotely positioned plural circuit switch in circuit with said fingers and closable upon attainment of a predetermined standard condition and adapted to be opened upon attainment of a predetermined variant of said standard condition, said system being electrically connected whereby the motor is actuated upon closure of one of the circuits of said switch whereby said mechanism is moved through a partial cycle of operation, and means to further rotate said motor through a parallel circuit following opening of said switch through its closed circuit whereby said mechanism is further actuated in a segmental portion of a cycle of operation, said last mentioned means comprising a circuit parallel to said last mentioned circuit and being operable upon de-energization of said magnet following opening of said remotely positioned switch.

5. In an electrical system including a motor, in combination, means to provide intermittent electrical impulses whereby said motor may be actuated in a constant direction, said means comprising a motor, a shaft extending from said motor, cams on said shaft, and electrical contact making fingers, said fingers being actuatable in one direction by said cams whereby electrical circuits to said motor may be closed, a solenoid to hold said fingers in open circuit position in timed sequence with respect to actuation by said cams, and a thermostat, said thermostat being provided with a plural number of electrical contacts in series with certain of said motor circuit closing fingers, and another circuit, said last mentioned circuit being parallel to said first mentioned circuits and being independent of the contacts on said thermostat, certain of said circuits being separately energized in timed sequence to said motor upon closure of certain of said motor actuated fingers and upon closure of an associated thermostat contact, the other of said circuits to the motor being energized upon closure of a certain one of said motor actuated fingers independently of the contacts on said thermostat.

6. In an electrical system including a motor in combination, means to direct intermittent electrical impulses whereby said motor may be actuated in a constant direction, said means including a condition responsive switch connected with a power source and having two parallel circuits extending therefrom, a cam shaft, said cam shaft being actuated by said motor, a pair of contact fingers connected with each of said parallel circuits, said fingers being moved to open circuit position by certain of the cams on said cam shaft in response to motor operation, one of the fingers of each of said pair of fingers being in circuit with said motor, a solenoid, said solenoid being in circuit with one finger of each of said

pairs of fingers, a single finger, said single finger being connected with a power source and in parallel with said switch to form a third parallel circuit to said motor, all of said fingers being intermittently actuated in sequence by said cams, said solenoid being functionally cooperable with one of said cams to move said single finger out of circuit to said motor, said system being energized upon closure of said condition responsive switch whereby energy flows through one of said parallel circuits to said motor and to said solenoid to lift said single finger and de-energize said third parallel circuit, said cams being so positioned upon the cam shaft that their sequence of rotation breaks the said energized parallel circuit after a predetermined period of motor rotation, said single finger actuating cam being non-functional at the termination of said period of rotation to release said single finger upon de-energization of said solenoid to close said third parallel circuit whereby the motor is again moved through the remainder of its predetermined range of rotation in response to initial closure of said condition responsive switch.

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