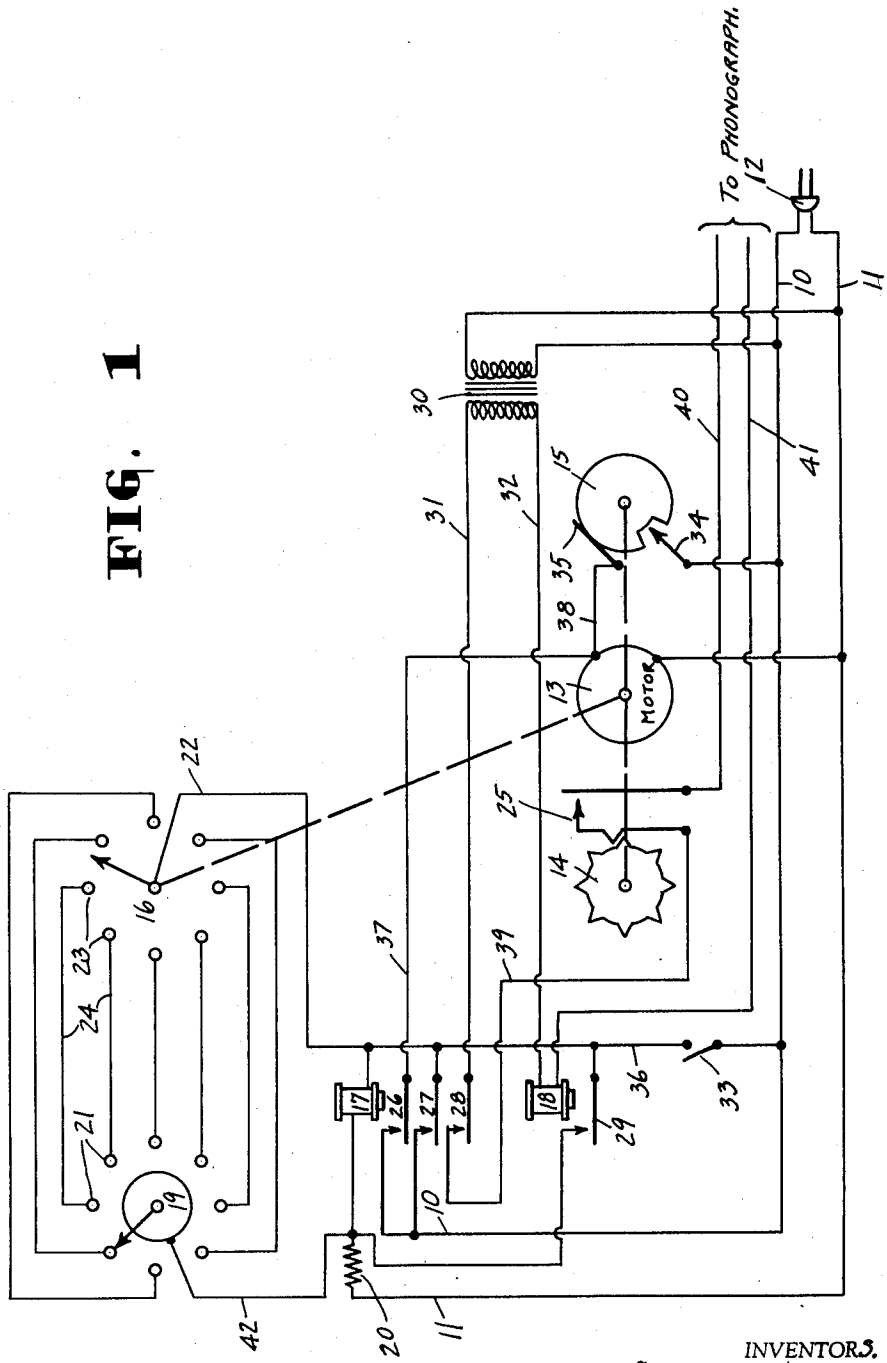
Aug. 24, 1943. C. J. HULL ET AL 2,327,429

REMOTE CONTROL SYSTEM

Filed Sept. 3, 1940 2 Sheets-Sheet 1

FIG. 1



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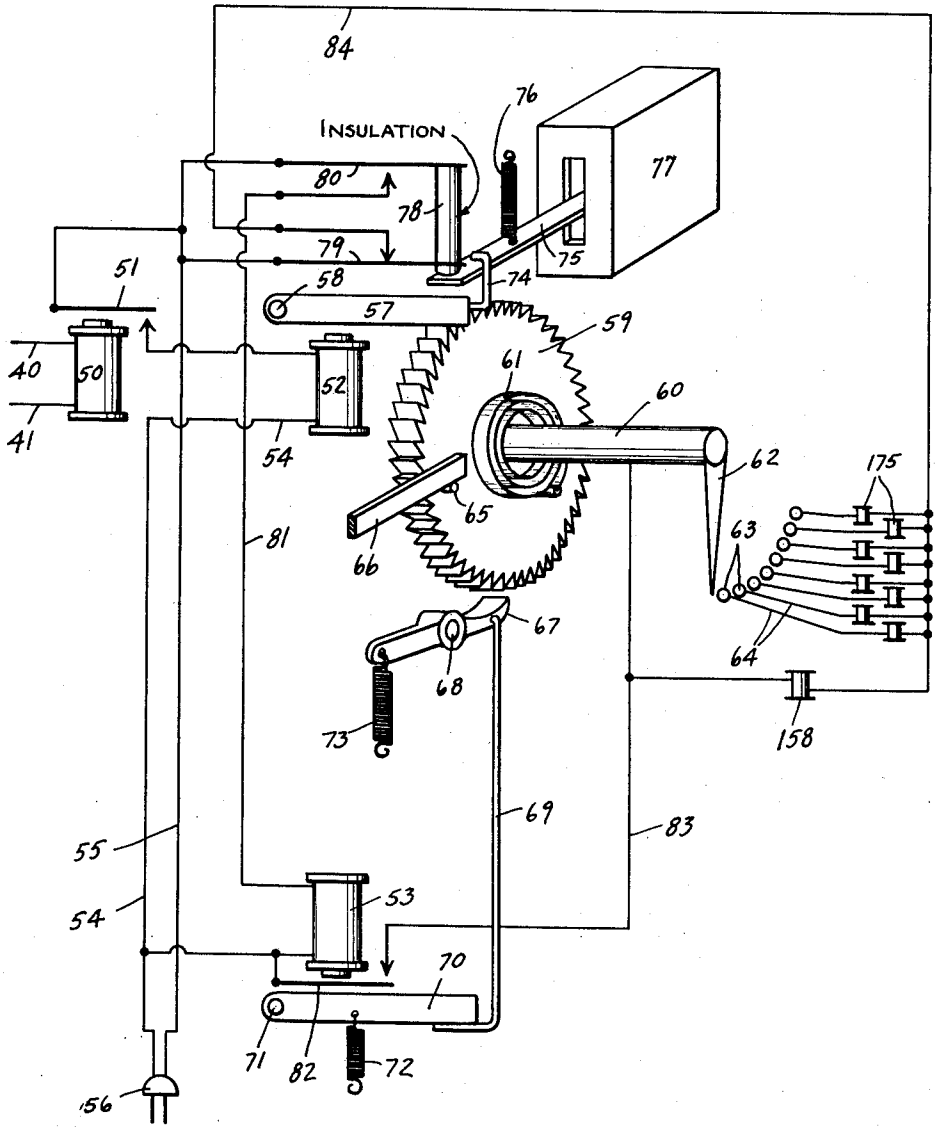


FIG. 2

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2,327,429

REMOTE CONTROL SYSTEM

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Application September 3, 1940, Serial No. 355,204

3 Claims. (Cl. 177—380)

This invention relates to a remote control appratus which is particularly adapted to the selective control of automatic record changing phonograph but may be used for other purposes as well.

One object of the invention is to simplify the apparatus necessary for remote control of a machine having a number of different operations to be selectively actuated.

Another object of the invention is to reduce the number of electrical conductors required between the remote control point and the controlled machine. Heretofore a relatively large cable containing at least one conductor for each operation has generally been used for this purpose except when extremely complicated signal transmitting and receiving apparatus has been employed. In the present invention, in its preferred form, a single electric circuit which may consist of two metallic conductors or a single conductor and a ground connection is employed. The circuit may be operated on relatively low voltage so that the cable may be relatively small in diameter since the insulation may be designed for mechanical strength rather than for electrical resistance. The cable is inexpensive, inconspicuous and easy to install since no great skill is required for the installation of a two-wire cable. The result is an apparatus which possesses ease of installation, low first cost, freedom from cross wire leakage and a high degree of dependability.

Another object of the invention is generally to improve transmitting and receiving apparatus for remote controls of the type described.

Other objects and features of the invention will be understood from the accompanying drawings and the following description and claims:

Fig. 1 is a diagram of a preferred form of transmitting apparatus located at a remote control station. Fig. 2 is a diagram of the receiving apparatus located at a local station adjacent the machine to be controlled, mechanical parts being shown in perspective and electrical connections diagrammatically shown. For the sake of clearness the stationary structure of the receiver is omitted.

Referring now to Fig. 1, power for operating the transmitter is supplied to a pair of conductors 10 and 11 from any suitable source. Preferably said conductors are connected to a plug 12 which may be inserted in the usual wall receptacle of a lighting system from which alternating current at 110 volts, 60 cycle is obtained. The transmission apparatus includes a motor 13 adapted to turn a starwheel 14, a limit switch 15 and a multi-point switch 16 through suitable shafts and gearing not shown. The elements 14, 15 and 16 are so connected that each makes one revolution during the same period of time. There are also included a main relay 17, a safety relay 18, a manually operable selector switch 19 and a resistor 20.

The manual selector switch 19 may be operated to establish electrical connection selectively between a conductor 42 and any one of a series of switch points 21, herein shown as eight in number. As many such points may be provided as there are operations to be selectively performed by the controlled machine. The switch 16, when turned by the motor 13, successively establishes electrical contact between a conductor 22 and each of a series of switch points 23, each of which corresponds with one of the points 21 and is electrically connected thereto by one of a series of conductors 24 providing a plurality of parallel current paths. The starwheel 14, when turned by the motor 13, periodically closes an impulse switch 25 and each such closure takes place in timed relation with the movement of switch 16 from one of the points 23 to the next. The relay 17, when energized, closes a set of normally open switches 26, 27 and 28. The relay 18, when energized, closes a normally open switch 29. A transformer 30 having its primary winding connected to the power lines 10 and 11 supplies alternating current to a pair of conductors 31 and 32 at a suitable low voltage for the control circuit to the receiver. An initiating switch 33 is preferably coin controlled and is momentarily closed upon receipt of a coin by any well known mechanism now used for the purpose. The limit switch 15 is provided with a pair of brushes 34 and 35 between which an electrical contact is established in all positions of the switch except the initial position shown in the drawings.

In the normal idle position of the transmitter the parts are as shown in Fig. 1 in which the switch 16 is in an initial position with its contact fingers between two of the points 23 and the limit switch 15 is in open circuit position. The switch 25 and the switches controlled by relays 17 and 18 are open. Assuming that the invention is in use for the control of an automatic record changing phonograph, each of the contact points 21 will be numbered to correspond with the number of a record to be played as shown by a suitable index. In the operation of the transmitter the operator first places the manual selector switch 19 in position to make contact with the point 21 corresponding to a desired record. He then inserts a coin, momentarily closing the initiating switch 33. The operation of said switch

completes a circuit for the relay 17 from power line 10 through switch 33, a conductor 36, relay 17 and resistor 20 to power line 11. The switch 27 is connected in parallel with the switch 33 and thus when the relay 17 is operated said switch 27 completes a retaining circuit to hold the relay after switch 33 is opened. Switch 26 is closed by the relay 17 and starts the motor by completing a circuit from power line 10 through a conductor 37 to one terminal of the motor, the opposite terminal of which is connected to the power line 11. The first movement of the motor turns the limit switch 15 to close the connection between brushes 34 and 35 and to complete a retaining circuit for said motor from the power line 11 through said switch and a conductor 37. The motor thus continues to operate even after relay 17 is deenergized until a complete revolution of the starwheel 14, switch 16 and switch 15 has been made.

The operation of switch 28 when relay 17 is energized conditions a connection from the secondary winding of transformer 30 through the conductor 31, switch 28, a conductor 39 and switch 25 to a conductor 40. This connection is intermittently completed by operation of the switch 25. The conductor 32 leading from the second terminal of the transformer is connected through the winding of relay 18 to a conductor 41. The conductors 40 and 41 lead to the receiver shown in Fig. 2 and constitute the external conductors of the control circuit between the transmitter and receiver. At the receiver said conductors are connected to a relay 50.

With the motor 13 in operation and the relay 17 energized, the opening and closing of switch 25 by the rotation of the starwheel 14 impresses on the external control circuit a series of electrical impulses or signals spaced at regular intervals and adapted to energize the relay 50. At the same time, the switch 16 is turned by the motor 13 so that each of said signals occurs just prior to the completion of contact through one of the points of said switch. When switch 16 reaches the point 23 corresponding to the selected point 21, a connection is made between opposite terminals of the relay 17 through the conductor 42, switch 19, one of the conductors 24, switch 16 and the conductor 22. This connection short circuits the coil of relay 17 and deenergizes the same. The provision of the resistor 20 prevents the short circuit from imposing an overload on the power lines 10 and 11. When relay 17 is deenergized, switch 28 is opened and no further impulses can be impressed on the external circuit, even though switch 25 continues to operate. Thereafter the motor continues to run until limit switch 15 and switch 16 have returned to their initial positions, whereupon contact is broken at switch 15 and the motor is stopped.

It will be apparent that during the time that relay 17 is energized a series of electrical impulses is transmitted and the number of such impulses in the series depends upon the selective setting of the switch 19. It will also be seen that current passes through the winding of relay 18 at each such impulse. The characteristics of said winding are so chosen that the relay does not respond to the normal current flow but only to an overload which may be imposed if there is a short circuit between the conductors 40 and 41 at any point between the transmitter and the receiver. In case of such an overload, the relay 18 closes switch 29. Said switch is connected in parallel with the winding of relay 17 and short circuits the same to stop further transmission of signals. Relay 18 thus serves as overload protection for the external circuit and as protection against tampering with said circuit.

Referring now to Fig. 2 in which there is diagrammatically illustrated the receiving apparatus located at a station adjacent the controlled machine, there are shown therein the two conductors 40 and 41 leading from the transmitter in the remote control station and connected to the relay 50. Said relay is adapted to close a switch 51 in response to each impulse or signal received from the transmitter. There is also shown an electromagnet 52, an electromagnet 53, a series of magnets 175 and a magnet 158. Power for operating said magnets is supplied from a pair of power lines 54 and 55 connected to a plug 56 which may be inserted in a suitable receptacle, preferably carrying the common 110 volt, 60 cycle alternating current. The series of magnets 175 corresponds to a series of magnets of the same number shown in Wilcox Patent No. 2,002,236 when the invention is to be used to control a machine of the type shown in said Wilcox patent. In that patent each of the magnets 175 controls the selection for playing of an individual phonograph record. In other types of machines, said magnets may control different operations of the machine which are to be selectively actuated. The magnet 158 may correspond to the magnet of the same number shown in said Wilcox patent which serves to start the operation of the Wilcox machine to play the selected record.

The magnet 52 is connected across the power lines 54 and 55 by switch 51 at each actuation of the relay 50. Said magnet is arranged to attract an armature 57 which is pivotally mounted at 58 on a fixed support. Said armature is adapted to engage the teeth of a ratchet wheel 59 mounted on a shaft 60 and normally urged in the clockwise direction by a torsion spring 61. The shaft 60 carries an electrical contact finger 62 adapted to engage a series of contact points 63 each of which is connected to one of the magnets 175 by one of a series of conductors 64. A stop pin 65 carried by the ratchet wheel 59 is adapted to engage a stationary stop member 66 and is normally held against said stop member by the spring 61 when the parts are in their normal idle position. In this position the finger 62 is out of engagement with the switch points 63. Successive actuations of the armature 57 move the ratchet wheel 59 to bring said finger successively into engagement with said switch points. A pawl 67 pivotally mounted at 68 on a fixed support is normally held in the position shown in the drawings out of engagement with the ratch wheel by a rod 69 having its lower end horizontally bent to engage the under surface of an armature 70. Said armature is pivotally mounted at 71 upon a fixed support and is drawn upwardly against the action of a tension spring 72 by the magnet 53 when energized. A tension spring 73 normally urges the pawl 67 toward engagement with the ratchet 59. The relative characteristics of the springs 72 and 73 are such that the spring 72 holds the pawl free of the ratchet unless magnet 53 is energized. When said magnet is energized the spring 73 is free to draw the pawl 67 into engagement with the ratchet 59 to prevent clockwise rotation thereof.

The armature 57 is provided with an upwardly extending hook 74 engaging a lever arm 75 which is urged upwardly by a tension spring 76. Said lever arm is pivotally mounted within the hous-

ing of a time delay mechanism 77. Said mechanism is of a well known form adapted to permit unrestricted downward movement of the lever 75 but to delay upward movement thereof. The mechanism has the same action as a dashpot and a dashpot may be substituted therefor if desired. The lever arm 75 in its uppermost position engages an insulation block 78 connected to the leaves of a normally closed switch 79 and a normally open switch 80 and retains said switches in their normal position. Downward movement of the lever arm 75 permits the position of said switches to be reversed.

In the operation of the receiving apparatus a series of electrical impulses from the transmitter actuates the magnet 50 and repeatedly closes the switch 51. Each closure of switch 51 actuates magnet 52 which thus serves as a high voltage repeater for magnet 50. Each actuation of magnet 52 moves the ratchet wheel 51 one step in the counterclockwise direction and engages the finger 62 with one of the points 63. The first actuation of magnet 52 draws the lever arm 75 downwardly, opens switch 79 and closes switch 80. The closing of switch 80 completes a circuit from the power line 55 through a conductor 81 to the magnet 53, thus energizing said magnet and permitting the pawl 67 to engage the ratchet 59 to prevent reverse rotation thereof. The characteristics of the time delay device 77 are such that the lever 75 can not be raised far enough to open switch 80 for a predetermined time interval after said lever has been drawn to its lower position. This time interval is longer than the normal interval between impulses and since each impulse results in movement of the lever 75 to its lower position, the switch 80 remains closed as long as a series of impulses is in progress. The magnet 53 thus remains energized throughout a series of impulses and the pawl 67 remains in engagement with the ratchet wheel 59 and permits said wheel to be moved one step for each impulse in the series. When the last impulse of a series is received the finger 62 rests upon a point 63 determined by the number of impulses in the series and corresponding to the selected magnet 175.

The magnet 53 closes a normally open switch 82 connected by a conductor 83 to the magnet 158 and through the shaft 60 to the finger 62. The closure of said switch at the first impulse of a series has no immediate result. When a series of impulses ceases, the spring 76 slowly draws the lever 75 upwardly against the action of the time delay mechanism 77. In the upward movement of said lever, the switch 79 is closed before switch 80 is opened. The closure of switch 79 completes a circuit from the power line 55 through a conductor 84, the selected magnet 175, the corresponding switch point 63, finger 62, shaft 60, conductor 83 and switch 82 to the power line 54. At the same time a parallel circuit is completed through the magnet 158. The completion of these circuits operates the selected magnet 175 and the magnet 158 to initiate the operation of the phonograph to play the record corresponding to said selected magnet. Said upward movement of the lever 75 opens switch 80, deenergizes magnet 53 to break the last mentioned circuits and to withdraw the pawl 67 from the ratchet wheel 59. The spring 61 thereupon returns the ratchet wheel 59 to its initial position and the parts are in readiness for another cycle of operation.

From the foregoing specification it will be apparent that a single electric circuit is used between the transmitter and receiver. The transmitter is adapted to impress on said circuit a series of regularly spaced electrical impulses or signals. The number of such signals in a given series is determined by the manual setting of the selector switch 19. The receiver operates in response to said impulses to select the control circuit for one of the magnets 175, the selection depending upon the number of impulses in a series. In response to the cessation of said impulses, the selected circuit is momentarily closed and then reopened and the parts are permitted to return to initial idle position.

The invention has been described in one of its preferred forms, the details of which may be varied without departing from the scope thereof as defined by the appended claims.

The invention claimed is:

1. In a remote control system having an electric control circuit extending from a remote control station to a local station adjacent a controlled machine, the subcombination of a motor operated impulse switch in said circuit at said remote station, a motor for operating said switch, a second switch in said circuit, initiating means for operating said second switch to render said impulse switch effective in making and breaking said circuit and for simultaneously starting said motor, apparatus automatically operable after a predetermined period of motor operation to reverse said second switch to render said impulse switch ineffective, said apparatus being selectively operable to vary said period below a predetermined maximum, and a limit switch connected to control said motor and to stop the same at the end of a predetermined period of operation at least as long as said maximum period.

2. In a remote control system having an electric control circuit extending from a remote control station to a local station adjacent a controlled machine, the subcombination of an impulse switch in said control circuit at said remote station, a second switch in said circuit adapted to render said impulse switch effective or ineffective in making and breaking said circuit, a relay operating said second switch, a manually operable multi-point selector switch, a second multi-point switch having points corresponding to those of said first multi-point switch, electrical connections between corresponding points of said multi-point switches forming parallel current paths, a motor operating said impulse switch and the second of said multi-point switches, manually operated means for operating said relay to make said impulse switch effective and for simultaneously starting said motor, electrical connections including said multi-point switches for reversing said relay to make said impulse switch ineffective when a circuit is completed through one of said parallel current paths, and means including a limit switch operable thereafter to stop said motor when said motor driven multi-point switch has been returned to an initial position.

3. In a remote control system having an electric control circuit extending from a remote control station to a local station adjacent a controlled machine, the subcombination of a make and break device in said control circuit at said remote station, a switch in said circuit connected in series therewith, a relay operating said switch and adapted to close the same when energized and to open the same when deenergized, a manually operable multi-point selector switch, a second multi-point switch having points corresponding to those of said first multi-point switch, electrical connections between corresponding points

of said multi-point switches forming parallel current paths, a motor operating said make and break device and the second of said multi-point switches, manually operated means for setting said relay in energized condition, circuits controlled by said relay when energized to start said motor, said relay being ineffective to stop said motor when deenergized, electric connections including said multi-point switches for deenergizing said relay when connections are completed through any one of said parallel paths, and means including a limit switch operable thereafter to stop said motor when said motor driven multi-point switch has been returned to an initial position.

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