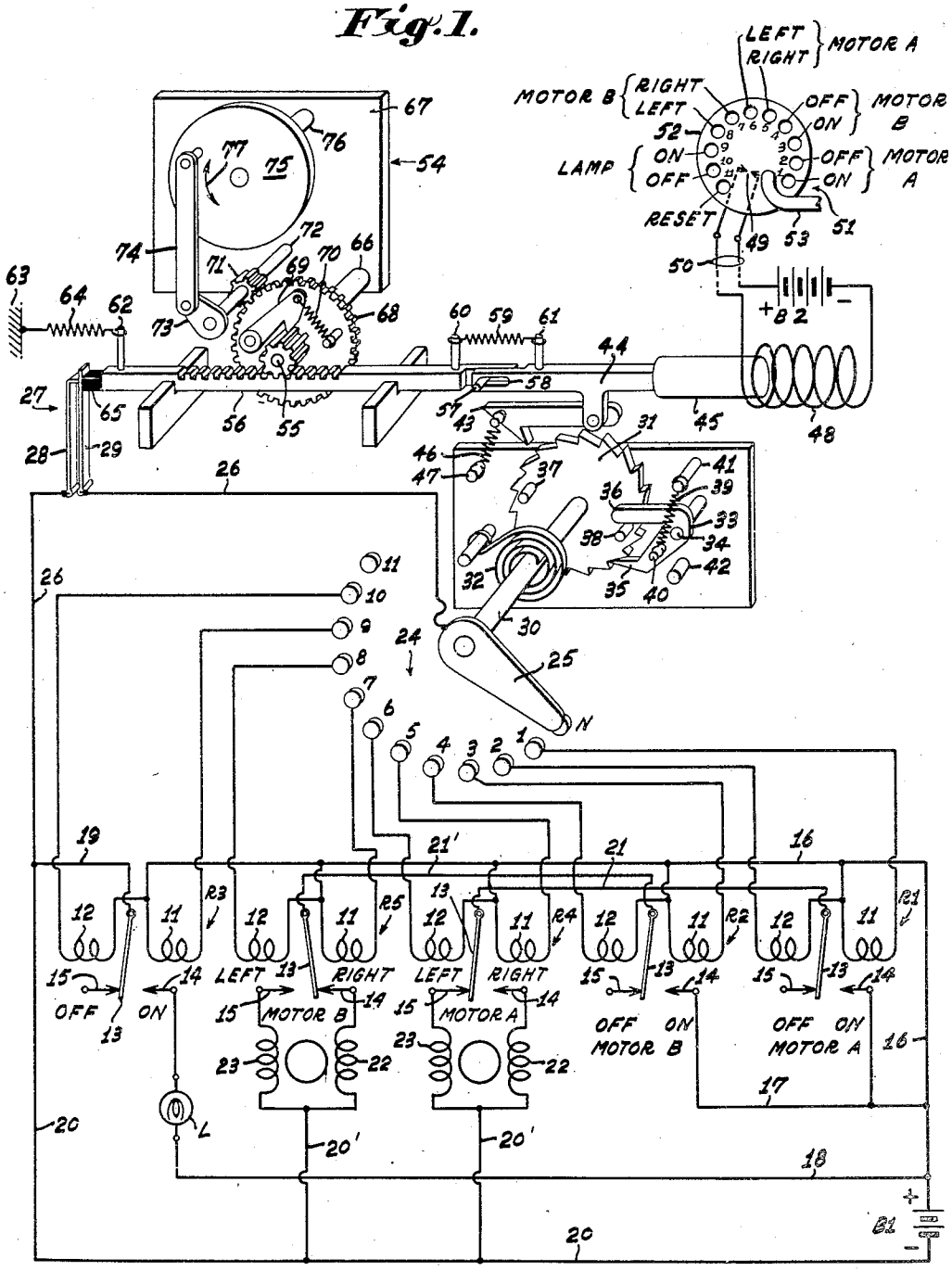
March 11, 1947. W. E. NEWMAN 2,417,376

PULSE TRANSLATING MECHANISM

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Fig. 1.



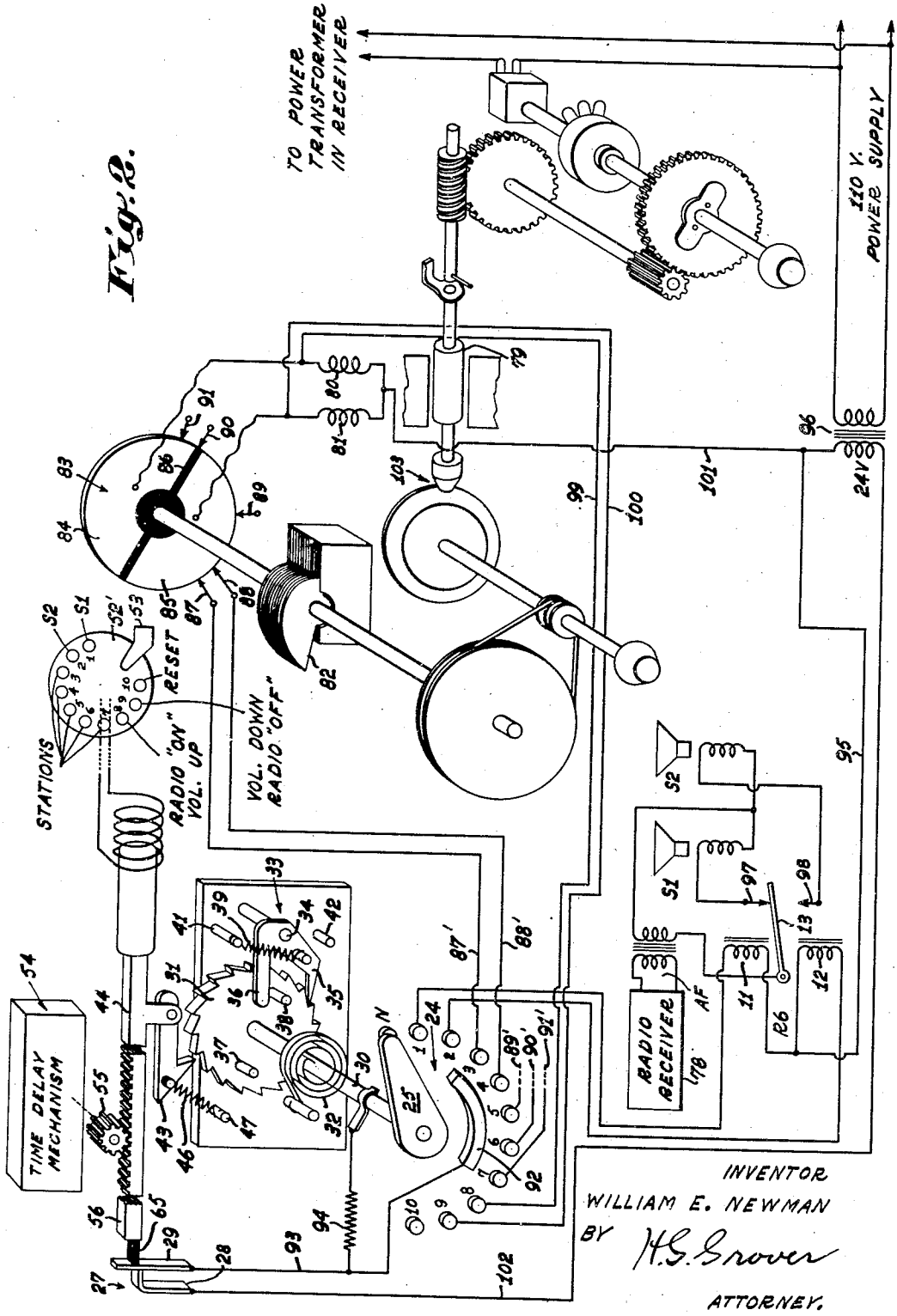
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PULSE TRANSLATING MECHANISM

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Fig. 2.

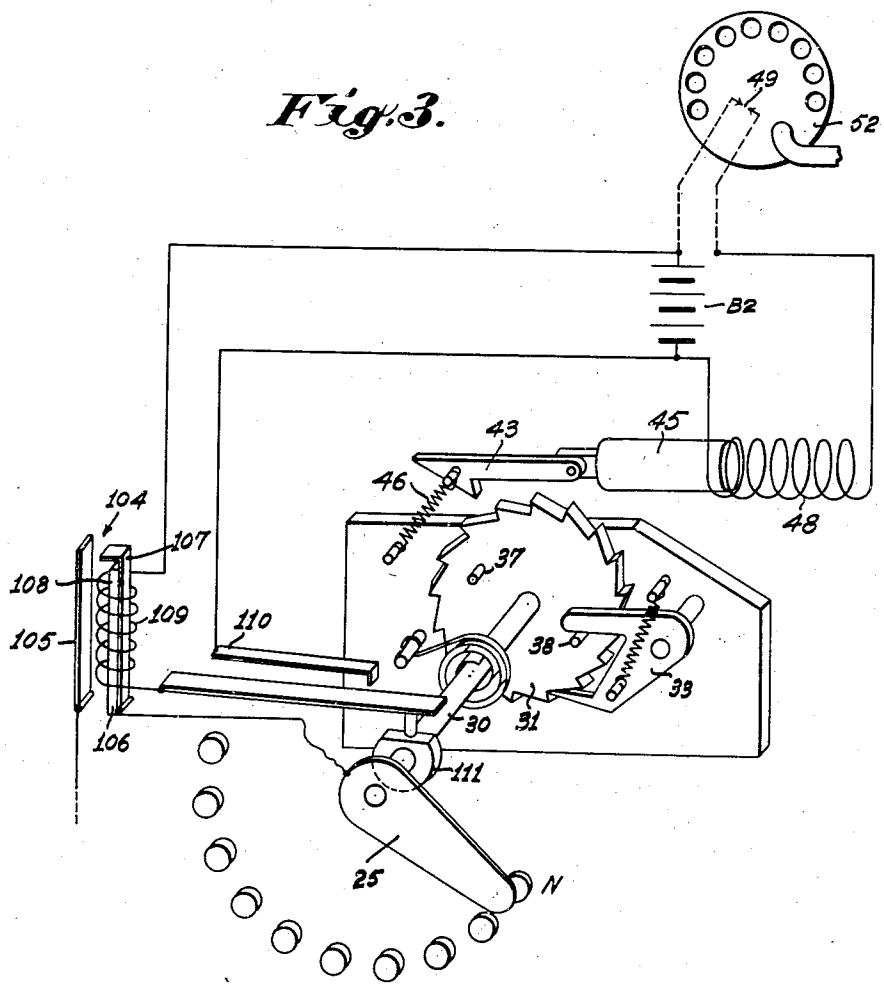


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Fig. 3.



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PULSE TRANSLATING MECHANISM

William E. Newman, Moorestown, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application March 2, 1944, Serial No. 524,727

2 Claims. (Cl. 177—353)

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My present invention relates to pulse translating mechanism for effecting independent control of a plurality of electrical devices, such as, motors, lamps, radio apparatus, etc., from a remote point.

One of the objects of the invention is to provide means whereby the operation and control of electrical apparatus at a remote point is effected by the transmission of electric pulses over conductors or by radio.

Another object resides in the use of pulse dial mechanism analogous to that used in automatic telephony adapted to transmit pulses to operate a selector switch for effecting the operation and control of radio apparatus or other electrical devices.

Another object resides in the provision of a solenoid-actuated ratchet wheel which does not require the customary second solenoid for returning the ratchet wheel to its normal, inoperative position.

A further object is the provision of a time delay device, which may be mechanical or electrical, for effecting closure of a controlling circuit subsequent to the movement of the selector switch to a desired position thereby preventing the operation of devices other than the one presently desired to be operated and controlled.

A still further object is the provision of mechanism for performing a plurality of control functions, said mechanism comprising dial means at a control point for transmitting a plurality of pulses to a remote point, the number of transmitted pulses depending upon the particular control function desired to be performed, function-selecting means at the remote point, means operable by said transmitted pulses for actuating the selecting means to select the desired control function, and a time delay device operative to prevent the selected control function from being performed until after actuation of the selecting means has been completed.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims; the invention itself, however, both as to its organization and mode of operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Fig. 1 discloses schematically a pulse translating mechanism according to the invention for effecting the remote control of certain electrical devices;

Fig. 2 discloses the application of the invention to radio receiving apparatus for the remote control thereof; and

Fig. 3 discloses the use of a thermostatic time

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delay switch which may replace the mechanical time delay mechanism of Figs. 1 and 2.

Referring to Fig. 1, the devices to be controlled are shown, by way of example, to comprise a lamp L, a motor A and a second motor B. These devices are capable of selective control independently of each other, and any number of such devices may be so controlled. In the instant case, the lamp, and the motors which are of the reversible type, may be turned on or off in any desired sequence, and it is possible also to reverse at will the direction of rotation of each motor.

The several devices to be controlled, namely, motors A, B and lamp L, each have associated with it an on-off relay R1, R2 and R3, respectively, and in addition a motor-reversing relay R4, R5 is associated with the motors A and B, respectively. The several relays are of similar construction, each comprising a pair of windings 11, 12 and an armature 13 adapted to rest against one or the other of two contacts 14, 15, depending upon which one of the relay windings was previously energized. In the drawing, the contacts 14 of relays R1, R2 and R3 have been designated as "on" contacts and the contacts 15 of the same relays as "off" contacts. With respect to the contacts 14 and 15 of relays R4 and R5, they have been designated respectively as "right" and "left." The common terminal of windings 11, 12 of each of the relays R1, R2, R4 and R5 is connected to a conductor 16 leading to one side of a suitable source of power B1, which is represented here in the conventional manner by a battery, although it is to be understood that an A. C. source may be employed, if desired.

A conductor 17 is connected between the same side of the source and the "on" contact 14 of relay R1, R2, and a conductor 18 is connected between the source and a terminal of lamp L, the other terminal of which is connected to the "on" contact 14 of relay R3. The armature 13 of the latter relay is connected by way of conductor 19 to a conductor 20 leading to the other side of power source B1. A conductor 21 connects together the armatures of the relays R1 and R4, and a conductor 21 connects together the armatures of the relays R2 and R5.

The field windings 22, 23 of motor A are connected at one terminal to respectively the "right" and "left" contacts 14, 15 of relay R4 and the similarly-numbered field windings of motor B are connected at one terminal to respectively the similarly-numbered contacts on relay R5, the other terminals of each pair of motor field windings being connected together and to the other side of the power source B1 by way of a conductor 20' and the conductor 20.

At 24 there is shown a selector switch having a pivoted contact arm 25 which is adapted to be actuated always from a normal position, when at

rest on a contact N, in a step-by-step manner to contacting relation with any one of a series of contacts numbered 1 to 11. Contacts 1 and 2 are connected respectively to the individual terminals of windings 11, 12 of the relay R1, similar connections being made between contacts 3, 4 and the windings of relay R2, between contacts 5, 6 and the windings of relay R4, between contacts 7, 8 and the windings of relay R5, and between contacts 9, 10 and the windings of relay R3. The end contact 11 is unconnected, defining the position to which the switch arm 25 is adapted to be stepped when it is desired that the switch arm be reset to its normal position, as will be explained more fully hereinafter.

A conductor 26 conductively connects the selector switch arm 25 to conductor 20, and interposed in the conductor 26 is a power-restoring switch 27, the function of which will be described later. This switch is provided with a fixed contact 28 and a movable contact 29 which, in the absence of a force tending to move it to switch-closing position, is biased away from the fixed contact 28 by its inherent resilience.

The mechanism for stepping the selector switch arm 25 one step at a time in response to successive pulses will now be described. The switch arm 25 is carried on a shaft 30 which also carries a ratchet wheel 31. Suitable means such as a helical spring 32 is adapted, when permitted to do so, to urge or return the switch arm to its normal or inoperative position shown in Fig. 1, in contact with the unconnected contact N.

Associated with the ratchet wheel 31 is a U-shaped trip pawl 33 pivoted at 34 and provided with an arm 35 adapted to engage the teeth of the ratchet wheel and with a further arm 36 which is disposed in front of the ratchet wheel and in the path of a pair of suitably-spaced pins 37 and 38 carried on the face of said wheel. The trip pawl 33 is maintained in its operative position, as shown, by an over-center spring 39 having one end connected to a pin 40 carried by the pawl and disposed below its pivotal point 34 and its other end connected to pin 41 affixed to a suitable support. The function of the pin 37 is to release or disengage the part 35 of the pawl 33 from the ratchet wheel after the contact arm has been stepped to contact 11. In that position of the arm the pin 37 will have been moved to abutting relation with the pawl part 36 and will exert sufficient force thereon to swing the pawl about its pivot 34 in a counter-clockwise direction to move part 35 away from the ratchet wheel, the over-center spring tending to complete said movement of the pawl which is limited by a stop pin 42. The ratchet wheel 31 is now free to move and will do so in a counter-clockwise direction due to the action of spring 32. The switch contact arm also will be moved in the same direction and, just before it is returned to its normal or initial position on contact N, the pin 38 will co-act with the under-side of arm 36 to swing the pawl in a clockwise direction to reset the same to its operative, or ratchet wheel-engaging position, the over-center spring 39 now serving to retain the pawl in that position.

The pawl for actuating the ratchet wheel is shown at 43 pivoted at one end to an extension member 44 affixed to a solenoid plunger 45. A spring 46 is connected between the other end of the pawl and a fixed support 47 and is adapted in its retracted condition to hold the pawl upwardly out of engagement with the ratchet wheel. A stepping solenoid 48 is adapted, when energized

to pull its plunger 45 to the right as viewed in the figure, to similarly move the pawl 43 which is first obliged to move downwardly into engagement with the ratchet wheel by action of the spring 46. Such movement of the pawl in response to each stroke of the solenoid plunger is adapted to move the ratchet wheel through a distance equal to that between adjacent teeth which corresponds also to the distance between adjacent ones of the fixed contacts N through 11.

The circuit for the stepping solenoid 48 contains a power source B2 and a pair of normally-open contacts 49 located at a remote point, the contacts being connected to the solenoid winding and the source B2 by means of a two-wire cable 50. In order that the requisite number of pulses may be transmitted to the stepping solenoid, there is provided a dial mechanism indicated generally at 51 which is similar to that used in connection with automatic telephony. Constituting a part of this mechanism is a rotatable dial plate 52 of usual construction having eleven numbered apertures into any one of which the finger may be placed to rotate the dial in a clockwise direction until the finger is stopped by member 53. The dial plate is then released and the same will return to its normal position by spring means (not shown) in a counter-clockwise direction. During the return movement of the dial plate the contacts 49 will be closed to energize the solenoid a number of times in accordance with the number of the hole into which the finger had been placed to rotate the dial.

For the convenience of the operator, suitable legends may be applied to the disc plate. In the instant case, the holes numbered 1 and 2 will be designated, "Motor A"—"On" and "Off," respectively; holes 3 and 4 as "Motor B"—"On" and "Off," respectively; holes 5 and 6 as "Right" and "Left," respectively, for Motor A; holes 7 and 8 as "Right" and "Left," respectively, for Motor B; holes 9 and 10 as "On" and "Off," respectively, for the lamp L; and the hole numbered 11 will be designated by the legend "Reset."

In order to prevent indiscriminate energization of the windings 11, 12 of the several relays R1 to R5 in either direction of movement of the switch arm 25, there is provided a mechanical escapement or time delay mechanism 54, operatively associated with the plunger extension 44 for preventing the power-restoring switch 27 from closing between pulses, but permitting the switch to close after the final pulse had been transmitted to thereby restore power to the circuit of the device sought to be controlled.

Although any suitable time delay mechanism may be utilized, the particular one that I have used and which I have chosen to disclose in Fig. 1 consists of a pinion 55 in meshing relation with a slidable rack bar 56 which is provided at one end with a pin 57 arranged for sliding movement within a slot 58 formed at the free end of the plunger extension 44. This slidable coupling between the rack and the solenoid plunger removes the load of the time delay mechanism from the solenoid plunger on the return stroke, so that the plunger can travel back and forth freely to impart rotation to the ratchet wheel 31 through the pawl 43. A spring 59 supported between pins 60 and 61 carried respectively by the adjacent ends of the rack 56 and member 44 returns the solenoid plunger 45 to the left between pulses of current through the solenoid. At the other end of the rack, connected between a pin 62 and a fixed support 63, is a spring 64 for driving the

time delay mechanism and for returning the rack and plunger assembly to the neutral position at the extreme left after all the pulses have become effective. The rack is also provided at this end with a part 65 which serves to move the movable contact 29 of switch 27 to switch-closing position.

The pinion 55 is mounted on a shaft 66 suitably journalled in a support 67. A gear 68 is free to rotate on the shaft 66 in a clockwise direction relatively to pinion 55, but is constrained to move together with the pinion in the reverse or counter-clockwise direction by action of a spring-pressed pawl 69 carried by gear 68 and urged by spring 70 to engage the teeth of pinion 55. Meshing with gear 68 and adapted to be driven thereby is a pinion 71 mounted on a shaft 72 also journalled in support 67. Rotating with said shaft is a crank arm 73 to which there is pivotally connected one end of a link 74, the other end of which is pivotally connected to a fly-wheel 75 supported on a shaft 76 also journalled in support 67.

The operation of the mechanical time delay device 54, which it will be remembered, is to prevent premature closing of switch 27, is as follows: movement of the plunger and its extension to the right in response to the first of a series of current pulses through the solenoid will cause similar movement of the rack bar 56 to allow thereby the opening of switch 27. Except for the opposition of spring 64, the rack bar will not be hindered in its movement to the right since in that case only the pinion 55 is moved, its counter-clockwise rotation causing the pawl to ride up and down about its pivotal point. On the return movement of the rack bar, however, upon the solenoid becoming de-energized, the rack bar will be pulled to the left by spring 64 and will cause clockwise rotation of pinion 55 in which case the gear 68 will be coupled to the pinion 55 by the locking action of pawl 69. The motion of gear 68 will then be transmitted through pinion 71, crank arm 73, and link 74 to the fly-wheel 75 which will oscillate back and forth through a distance represented by the arc 77. There is therefore imposed on the rack bar, during its return movement to switch-closing position, a load which tends to retard the closing of switch 27. In practice, the time delay mechanism is adjusted to hold the switch 27 open for an interval at least as long as it takes the switch contact arm 25 to advance to contact 11.

The operation of the system above described and disclosed in Fig. 1 is as follows: Let it be assumed first that the armatures 13 of the several relays are in the positions shown, in which case motors A and B are in the inoperative state and the light L is turned off. Let it be assumed further that it is desired to have the motor A set into operation and to rotate in the "right" direction. As a preliminary step the dial plate 52 at the control point will be manipulated by placing the finger in hole 1 to dial "Motor A—On." Contacts 49 will, therefore, be closed just once to pulse the stepping solenoid 48 to thereby advance the switch arm 25 to contact 1. Simultaneously, the switch 27 will have been opened by movement of the rack bar 56 to the right, and after some delay as explained above, will again assume its closed position. Upon closure of said power-restoring switch 27, the circuit of winding 11 of relay R1 will be completed as follows: one side of source B1, conductor 16, winding 11 of relay R1, contact 1, arm 25, conductor 26, closed switch 27, conductor 26, conductor 20, and back to the other side of source B1. As a result, winding 11 of the relay R1 will be energized to throw its armature 13 against the "On" contact 14. This will cause operation of motor A but in the "left" direction, the motor circuit being closed from the plus side of B1, conductor 15, "on" contact 14 of relay R1, its armature 13, conductor 21, armature of relay R4, "left" contact 15, field winding 23 of motor A, conductor 20', conductor 20, and back to the minus side of B1.

In order that the direction of motor operation may be reversed so that it will rotate in the "right" direction, as assumed in the example given above, it is necessary first to have switch arm 25 brought back to its neutral or initial position on contact N from its previously set position on contact 1. This is effected by dialing plate 52 of the dial mechanism to "Reset." As a result stepping solenoid 48 is pulsed 11 times. The first 10 reset pulses are effective to actuate ratchet wheel 31 in a clockwise direction and to cause switch arm 25 to be stepped along from contact 1 to contact 11. At the corresponding position of the ratchet wheel the pawl release pin 37 coacts with arm 36 to throw the trip pawl 33 out of engagement with the ratchet wheel, but the latter is not yet free to return to its initial position because the eleventh pulse, which is received immediately after the trip pawl is thrown at the tenth pulse, actuates the stepping pawl 43 to engage the ratchet wheel which is thereby for that instant arrested in its return movement. After receipt of the eleventh pulse the stepping pawl is retracted to its inactive position and the ratchet wheel is then permitted to return under the influence of spring 32 to its initial position, whereat switch contact arm 25 rests on contact N and ratchet wheel 31 is again engaged by the pawl part 35 having been moved to engaging position by coaction of reset pin 38 against arm 36.

Regardless of the position of switch arm 25 on any of the contacts 1 to 10 to which it had previously been stepped to effect a desired function, subsequent operation of the dialing mechanism to "Reset" results in the switch arm being stepped along to contact 11 by the number of pulses necessary to do so, after which the ratchet wheel is arrested in its return movement, as explained above, for the duration of the remaining reset pulses. After the eleventh or final pulse the return spring 32 is effective to rotate the switch arm back to contact N. The mechanism is then set for a new cycle of operation.

To complete the operation, that is, to reverse motor A, the dial plate 52 is then dialed "Motor A—right" (hole 5), with the result that the switch arm will be stepped along to contact 5, it being remembered that the switch 27 was first opened by movement of the rack 56 to the right during the stepping action of the switch arm and later closed after the lapse of an appreciable interval. With the switch arm on contact 5 and the switch 27 closed, a circuit is completed through the winding 11 of relay R4 as follows: one side of source B1, conductor 16, winding 11 of relay R4, contact 5, arm 25, conductor 26, closed switch 27, conductor 26, conductor 20, and back to source B1. The energized relay winding 11 of R4 will, therefore, throw its armature 13 to the right against "right" contact 14 to thereby switch into circuit the other field winding 22. The motor A will now rotate in the "right" direction, as desired.

Should it next be desired to perform some other

control operation, such as to turn motor A off, to turn motor B on, to reverse the direction of operation of either or both motors, or to turn the light "on" or "off," it is only necessary to dial "Reset" and then the next operation, such as "Motor A—Off," by appropriate manipulation of the dial mechanism at the control point. In other words, in order to effect a particular sequence of control functions, each must be preceded by dialing "Reset," as for example: "Reset," "Motor A—On," "Reset," "Motor B—On," "Reset," "Motor B—Off," "Reset," "Motor A—Off," "Reset," etc.

Although I have shown and described the dial mechanism at the control point to be connected to the controlled mechanism located at a remote point by means of a cable of suitable length, it will be understood, of course, that the system will function equally as well by providing a shorter connecting cable in those instances where it is desired that the mechanisms at opposite ends thereof be in closer proximity to one another, as for example, in the same room, or in the same cabinet.

In Fig. 2 I have shown the present invention applied to a radio receiving system for the automatic control of the tuning and volume thereof from a remote point. For simplicity, the time delay mechanism of Fig. 1 is not shown in detail but is represented by the block 54.

The radio receiver to be controlled from a remote point is represented by the block 78 and may be any conventional type utilizing motor-operated tuning mechanism. For the purpose of illustration, the receiver control mechanism is shown to be the same as that in my application, Serial No. 517,585, filed January 8, 1944, now U. S. Letters Patent 2,383,338, granted August 21, 1945, wherein the motor is of the reversible type and its armature is axially displaced in one direction to effect automatic tuning and in the opposite direction to effect volume control adjustment.

In Fig. 2 the motor armature is indicated at 79 and the motor field windings at 80 and 81. The adjustable tuning device of the receiver is represented as a variable condenser 82 with which there is associated a commutator or selector disc 83 provided with conductive segments 84, 85 and an interposed insulating strip 86. 87 to 91 are the pre-set brush contacts for determining the various positions of adjustment of the tuning device. As shown, the brush contacts 87 to 91 are conductively connected, respectively, by way of conductors 87' to 91', to the contacts 3 to 7, with which the movable contact arm 25 of the selector switch 24 is adapted to co-act. Also adapted to co-act with the switch contact arm 25, when the latter is stepped to any one of the contacts 3 to 7, is an elongated, arcuate contact 92 which for that reason extends only for a distance equal to that between contacts 3 and 7. The arcuate contact 92 is conductively connected to the movable member 29 of switch 27 by way of a conductor 93. For a purpose which will appear later, a voltage dropping resistance 94 is connected between the latter conductor 93 and the conducting shaft 30 having the switch arm 25 affixed thereto.

The contacts numbered 1 and 2 of the selector switch are connected respectively to the windings 11 and 12 of a relay R6, the common terminals of the windings being connected by way of conductor 95 to one side of a source of operating current constituted by the transformer 96. The

relay R6 is provided with an armature 13 which is adapted to co-act with one or the other of two fixed contacts 97, 98 connected, respectively, to the voice coils of a pair of loud speakers S1 and S2 which are adapted to be energized from the audio output AF of the radio receiver 78.

The contacts 8 and 9 of the selector switch are connected, respectively, to the motor field windings 80 and 81 by way of conductors 99 and 100. The transformer 96 which constitutes the source of operating current for the motor and relay R6 has one side of its secondary connected to the common terminal of the field windings through a conductor 101 and the other side connected to the fixed contact 28 of the power-restoring switch 27 through a conductor 102.

The manner of operation is as follows: In order to turn the receiver "on," the dial plate 52 is manipulated by dialing number 8. As will be understood from the operation previously explained in connection with Fig. 1, the pulse transmitting mechanism will advance the switch arm 25 to contact 8. As a consequence the motor circuit through field winding 80 will be closed as follows: one side of source 96, conductor 102, switch 27 which will close after an appropriate time delay, resistance 94, shaft 30, switch arm 25 resting on contact 8, conductor 99, field winding 80, conductor 101 and back to the other side of source 96. The operating voltage for the motor having been reduced due to the inclusion of resistance 94 in the above circuit, the motor armature 79 remains in its axially displaced position to the right and will operate in the proper direction to turn the power switch on and to effect volume increase, as more fully described in my above-mentioned application. The volume of the receiver having been adjusted to the desired extent, the dial mechanism is next manipulated to dial "Reset" in order that the motor may be deenergized and the switch arm 25 returned to its normal position.

In order to effect a desired tuning adjustment of the receiver, the dial plate 52 will next be suitably manipulated to step along the switch arm 25 to an appropriate contact, such as for example, contact 5. This will complete the following circuit: one side of the source 96, conductor 102, closed switch 27, conductor 93, arcuate contact 92, contact arm 25, contact 5, conductor 89', brush contact 89, commutator segment 85, field winding 81, conductor 101 and back to the other side of the source. The full operating voltage now being effective to energize the motor (resistance 94 having been short-circuited), the motor armature 79 will be displaced to the left to establish the friction drive at 103. As a consequence, the motor will rotate the commutator or station selector disc 83, and incidentally the tuning device 82, until the insulating strip 86 arrives in contacting relation with the brush contact 89, at which point the motor circuit will be broken, leaving the tuning device in the desired adjusted position.

Should it now be desired to vary the volume up or down, the switch arm 25 will first be returned to its normal or neutral position by manipulating the dial plate 52 to "Reset," if this had not been done previously, and then to number 8 or 9, depending upon the function desired to be carried out, in which case the switch arm 25 will be stepped along accordingly, so that the motor circuit will be completed through one or the other of the motor-reversing field windings 80, 81.

Since the latter circuits include the voltage dropping resistance 94, the motor armature will remain displaced to the right to effect the control of the volume either up or down, in the manner more fully described in my above application.

As an additional control, one or the other of the loud speakers S1 and S2 may be operative, their selective control being brought about, as will now be clear from the above description, by suitably dialing to position 1 or 2 at the remote point. When so dialed, switch arm 25 will be stepped to either contact 1 or 2 closing thereby the following circuit which will energize one or the other of relay windings 11, 12: one side of source 95, conductor 95, winding 11 or 12, contact 1 or 2, switch contact arm 25, shaft 30, resistance 94, conductor 93, closed switch 27, conductor 102 and back to the other side of the source. Depending upon which one of the relay windings is energized the armature 13 will be actuated to contacting relation with contact 97 or 98 to complete thereby the voice coil circuit for speaker S1 or S2.

In place of the mechanical time delay mechanism 54 utilized in Figs. 1 and 2 there may be substituted a thermostatic time delay device which I have shown in Fig. 3. The thermostatic time delay is shown generally at 104 and comprises a fixed contact 105 and a movable contact blade 106 made of two dissimilar materials 107, 108 having different coefficients of expansion. A heater element 109 is wound over the two pieces of the movable blade and as the heater coil heats these two pieces simultaneously, one of them will lengthen at a different rate than the other thereby causing them to bend to make contact with fixed contact 105. The heater coil is connected across the source B2 through a switch 110 which is actuated to circuit-closing position by a cam 111 affixed to the selector switch shaft 30. In the normal position of the switch arm 25, the cam is positioned to permit switch 110 to remain open. In all other positions of the switch arm the cam will effect closure of the switch to complete the heating circuit for coil 109.

The thermostatic time delay disclosed herein should preferably be so designed that the contacts 105, 106 will not close until after the ratchet-driven switch arm 25 has had time to advance step-by-step to the last contact button. This will prevent premature closing of any of the relay circuits. When "Reset" is dialed the switch arm will make momentary contact with each button as the arm sweeps over them on the return path but the relays may be so designed that the momentary pulses will not disturb the positions of the several relay armatures.

While I have shown in each case the telephone dial at the control point for transmitting pulses connected to the pulsing solenoid at the remote controlled point by wire or cable it will be understood by those skilled in the art that this wired link could be a radio channel. In this case the telephone dial pulses would be transmitted by radio and picked up by a receiver for actuating the pulse translating mechanism.

The pulse translating mechanism herein described may be utilized, for example, in a remote controlled submergible torpedo carrier, in which only the antenna rod would be above the surface for picking up the radio signals for actuating the pulsing solenoid. In this case one of the motors of Fig. 1 could be used for operating the rudder,

and the other motor for submerging and surfacing. Additional relays may be used for firing the torpedos or for controlling other devices.

While I have indicated and described certain preferred embodiments for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:

1. Control mechanism comprising a rotary switch including a movable arm and a plurality of contacts, a plurality of devices to be controlled, each respectively connected to one of said contacts, means including a ratchet wheel for causing the switch arm to be selectively stepped along step by step from a neutral position to any one of said contacts, a pawl for retaining the ratchet wheel and switch arm in their stepped positions, a time delay device effective as soon as the switch arm begins to step until it reaches the selected contact for preventing actuation of those devices connected to the intermediate contacts, means carried by the ratchet wheel operative at a limiting position of the switch arm to trip the pawl out of engagement with said ratchet wheel, spring means for returning the wheel and arm to neutral position, and additional means carried by the ratchet wheel effective upon its return to neutral position to return the pawl to engaging position.

2. A control system comprising, in combination, dial mechanism for selectively transmitting predetermined numbers of pulses, a stepping solenoid adapted to be energized a number of times corresponding to the number of pulses dialed, a rotary switch including a movable arm and a plurality of contacts, there being a series of a contact and additional contacts, each of the latter corresponding to a different predetermined number of dialed pulses, means actuated upon energization of the solenoid for moving the switch arm step-by-step in a forward direction from the first contact to a contact corresponding to the number of dialed pulses, a device to be controlled connected to each of the switch contacts except the first and last, means under control of the switch actuating means for delaying operation of the device selected to be controlled by the dial mechanism until after the switch arm has been stepped to the corresponding contact, and spring means effective, in the absence of transmitted pulses and after the switch arm has first been stepped to its last contact, to actuate the switch arm in the reverse direction to its first contact.

WILLIAM E. NEWMAN.

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