

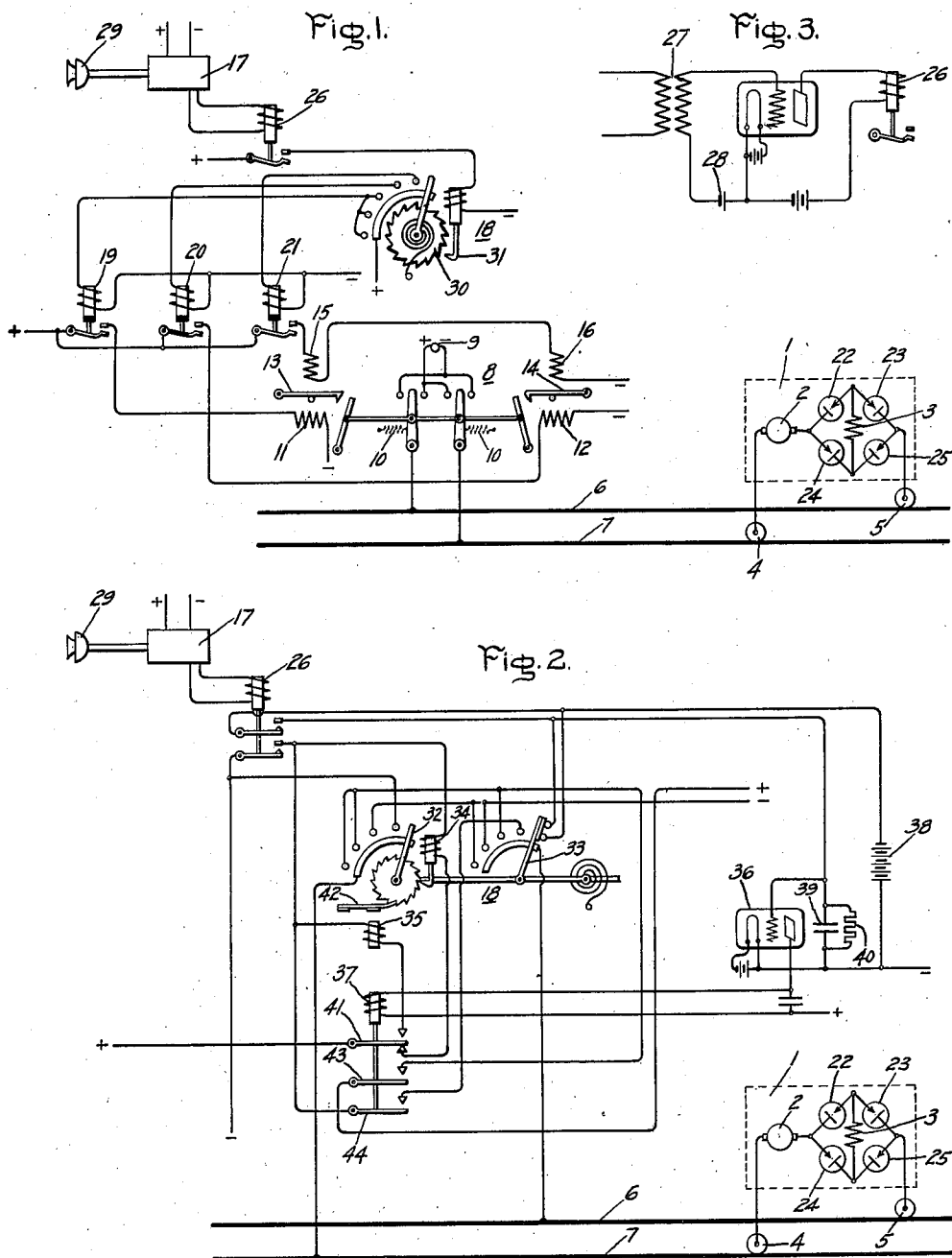
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ELECTRIC CONTROL SYSTEM

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ELECTRIC CONTROL SYSTEM

Application filed June 25, 1928. Serial No. 288,012.

My invention relates to electric control systems and more particularly to systems for controlling the operation of electrical circuits and apparatus in response to current impulses such as may be produced in response to the syllables, or distinct sound, of speech.

More particularly my invention relates, although it is not limited thereto, to systems for controlling dynamo-electric machines such as may be used in connection with toy trains and the like in response to speech, and it has for one of its purposes to provide means whereby a dynamo-electric machine may be started, stopped and reversed in direction of rotation, or otherwise controlled, in response to the verbal commands of the operator.

A further purpose of my invention is to provide improved means, which are entirely electrical, whereby the direction of rotation of an electric motor may be reversed by the expedient of reversing the polarity at the terminals of the machine including those of both the armature and field winding. Still a further purpose of my invention is to provide efficient means of a simple and relatively inexpensive nature for reversing the polarity, and otherwise altering the electrical condition of a circuit in selective response to current impulses such as those which may be produced by speech.

The novel features which I believe to be characteristic of my invention will be set forth with particularity, in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which Figs. 1 and 2 represent different embodiments of my invention and Fig. 3 represents a part thereof.

While I shall describe my invention in connection with a dynamo-electric machine for operation of a moving device, such as a toy train, for example, it will of course be understood that it may be used in other applications of utility as well.

Referring to Fig. 1, 1 represents an electric locomotive such for example as those commonly used for operating toy trains and the like and which is adapted to be driven by a dynamo-electric machine comprising an armature 2 and a field winding 3. The armature 2 and field winding 3 are electrically connected to the wheels 4 and 5 of the locomotive. The track 6, 7 upon which the locomotive 1 is adapted to operate may be supplied with potential of either polarity through the contact members of a switch 8 from any suitable source of potential 9.

The switch 8 comprises a position relay which is suitably biased as by means of springs 10 to an intermediate position in which the track conductors 6 and 7 are disconnected from the source of potential. The switch is provided with a pair of actuating electro-magnets 11 and 12. If the magnet 12 is energized the switch is actuated to the right and potential of a certain polarity is applied to the track conductors. If the coil 11 is energized the switch is actuated to the left and potential of the opposite polarity is applied to the track conductors. The switch is adapted to be retained in either of these positions by means of latching members 13 and 14, these members being controlled by electromagnets 15 and 16. Assuming that the switch is retained in either of the latter two positions mentioned, and the corresponding coil 15, 16 becomes energized the latching member which is actuated thereby will release the switch and permit it to return to its normal position which is that shown in the drawing.

In order to energize the different electro-magnets of the switch 8 in response to the verbal commands of the operator means 17 are provided for producing direct current impulses in response to each of the syllables of the operator's speech together with a selector switch 18, which is actuated in response to the impulses produced by the device 17 to control the energization of additional relays 19, 20 and 21. These latter relays in turn control the energization of the electromagnets 11, 12, 15 and 16 of the switch 8. If the selector switch 18 is actuated to its first po-

sition, as in response to a single impulse from the device 17, the relay 21 will be actuated thereby to cause energization of electromagnets 15 and 16 of the switch 8. If the switch 18 is actuated to its second position the relay 20 is actuated to energize the electromagnet 12, thereby to actuate the switch 8 to the right and supply current of a certain polarity to the track conductors. If the switch 18 is actuated to the third, or any subsequent position, the relay 19 will be actuated to energize the electromagnet 11, thereby to actuate the switch 8 to the left to supply current of a different polarity to the track.

This selective system is described and claimed in my copending application, Serial No. 475,268, filed Aug. 14, 1930 and entitled "Electric control systems."

To cause the dynamo-electric machine 2 to reverse its direction of rotation and hence to cause the locomotive 1 to reverse its direction of travel on the track, means are provided upon the locomotive whereby current flowing in either the armature winding or the field winding, but preferably the latter, is maintained of a constant polarity independently of reversal of polarity in the potential which is supplied to the track conductors, or to the other winding of the dynamo-electric machine. This means comprises a plurality of asymmetrically conducting devices so connected that the field winding 3 of the dynamo-electric machine is included in the circuit in bridge relation to the applied electromotive force. Each terminal of the field winding 3 is connected to both sides of the track circuit 6, 7 through oppositely connected asymmetrically conducting devices 22, 23 and 24, 25, the asymmetrically conducting devices which connect opposite terminals of the field winding to the same side of the track circuit being also oppositely connected.

As thus arranged it will be seen that if the track conductor 6 is at positive potential with respect to the potential of track conductor 7 current will flow through the field winding from the track conductor 6 through the wheel 5 of the locomotive, asymmetrically conducting device 23, field winding 3, asymmetrically conducting device 24 and armature 2 to the track conductor 7. If the conductor 7 is at positive potential with respect to the potential of conductor 6 current will flow from the conductor 7 through the armature 2, asymmetrically conducting device 22, field winding 3, asymmetrically conducting device 25 to conductor 6. It will be seen that under both of these conditions the current in the field winding 3 flows in the same direction, whereas that of the armature 2 is reversed. Accordingly the direction of rotation of the armature will reverse in response to reversal of polarity of the potential of track conductors 6, 7. By this means as thus described it will be seen that the direction of rotation of the motor is

reversed in response to reversal of polarity of the potential which is applied to the track, this result being effected by means which are entirely electrical. Thus the necessity for mechanical switching means upon the train and for operations involving moving parts, such as mechanical polarized relays and the like, is obviated.

Although I have shown the field winding 3 connected in series relation with the armature 2 it will of course be understood that it may be connected with reference to the armature in any manner well-known in the art, as for example, in shunt relation, with it. The asymmetrically conducting devices 22, 23, 24, 25 may comprise any suitable type of electron discharge device, such as the ordinary evacuated vessel containing dissimilar electrodes spaced apart and surrounded by an attenuated gaseous medium such as neon or argon. Preferably, however, these devices are of the form comprising a copper plate having cupreous oxide formed thereon and mounted between suitable electrodes as shown and described in United States Patent No. 1,640,335 to Lars O. Grondahl issued August 23, 1927.

The impulse producing device 17 comprises an electron discharge device of the usual three element type having a relay 26, connected in the anode circuit thereof and the secondary winding of a transformer 27 connected between the grid and cathode thereof, this grid being biased to a suitable negative potential by means of a battery 28. In the primary winding of the transformer is connected a suitable microphone 29. When the operator speaks into the microphone 29 alternating current potentials are impressed upon the grid of the discharge device causing an increase in the direct current which flows in the anode circuit and thereby energizing the relay 26. The contacts of this relay are connected in series with the actuating coil of the selector switch 18, such that a current impulse is produced through the actuating winding of the switch 18 in response to each syllable, or distinct sound, of the operator's speech.

As thus described the operation of the system is as follows. Let us assume that the operator speaks into the microphone 29 commanding the locomotive 1 to "go straight ahead". This command comprises essentially three syllables, or three distinct sounds, and accordingly three current impulses will be produced in the actuating winding of the switch 18. The armature of the switch 18 will then be actuated to its third contact by means of the ratchet and pawl arrangement 30, 31. In this position the relay 19 will be energized through a circuit extending from positive battery through the armature of the switch 18 and its third contact and relay 19 to the negative battery. The relay 19 will then close its contact, energizing the electromagnet 11 through an obvious circuit.

Switch 8 will be actuated to the left and will be retained therein by the latching member 13. In this way potential of a certain polarity is applied to the track conductors and the dynamo-electric machine will drive the locomotive 1 in a forward direction. After the third impulse the operator remains silent and the pawl 31 returns to its normal position under its bias. Due to inertia of the ratchet 30 this contact does not return to its normal position between syllables. For the same reason this contact remains upon the contact to which it is last actuated for a longer period than upon contacts which it passes in being actuated from its normal position to a predetermined contact or in returning to its normal position under its bias. The relays 19, 20, and 21 are sufficiently slow acting to prevent closing of their contacts as the armature of the selector switch 18 is actuated rapidly over the contacts or as it returns in its course to the normal position. These relays do, however, respond to the longer engagement of the armature of the switch 18 upon the last contact to which it is actuated.

Let us assume that the next command of the operator is "stop". This command comprises a single sound, or syllable. Relay 21 will then be actuated to close its contact, thereby to energize relays 15 and 16, operating the latching members and restoring the switch 8 to its normal position. The locomotive will then stop. If the next command of the operator is one comprising two syllables, as for example, "back up" relay 20 will be actuated, thereby causing energization of the electromagnet 12 and the switch 8 will be actuated to the right. In this position the polarity of the potential applied to the track conductors is opposite to that formerly applied and the dynamo-electric machine is caused to drive the locomotive 1 in the reverse direction.

It will be noted that each of the contacts of the selector switch 18 beyond and including the third contact are connected together. The purpose of this is to permit the locomotive to run in a certain direction in response to any command of the operator comprising three or more syllables. For example, if the operator speaks into the microphone commanding the locomotive to "go along the track and stop in front of the gentleman", the locomotive will perform the same operation which it did in response to "go straight ahead". When it has reached the desired point upon the track the operator may blow slightly into the microphone and the locomotive will stop.

In accordance with the embodiment of my invention shown in Fig. 2 the selector switch 18 is replaced by one of a different type comprising a pair of armatures 32 and 33, actuating winding 34, and a restoring winding 35. Associated in the circuit with the selector switch is a time delay relay 36, 37. While I

have illustrated this relay as of the electron discharge type it will be understood that other types may be used as well. The connections of the different components of the circuit and their operation may be best understood by reference to the operation of the system.

If we assume that the operator speaks into the microphone 29 commanding the locomotive to "go straight ahead", the relay 26 will close its contacts successively three times. By means of the upper contacts of the relay 26 negative potential from the battery 38 is impressed across the condenser and resistance combination 39, 40 at each syllable of the command. This condenser then assumes a strong negative charge which is maintained upon the grid of the electron discharge relay 36 until it has had time to drain off through the resistance 40. By means of the lower contacts of the relay 26 three impulses will have been produced in a circuit extending from negative battery through the lower contacts of the relay 26, actuating winding 34 and lower contact and armature 41 of switch 37. The armatures 32 and 33 of the selector switch 18' will then be actuated to their third position in which position they will be retained by the pawl 42. No potential is, as yet, applied to the track. After a slight time interval the charge on condenser 39 will drain off through the resistance 40 and current will flow through a circuit extending from the negative battery, through the cathode and anode of the electron discharge relay 36 and actuating winding of relay 37 to positive battery. Relay 37 will then be energized closing a circuit extending from positive battery through armature 43 of the switch 37 and its contact, third contact and armature 32 of the switch 18, track conductor 7, dynamo-electric machine 3, 2, track conductor 6, armature 33 and third contact of the switch 18 to negative battery. Potential of a certain polarity is now applied to the track conductors, such that the locomotive is caused to travel in a forward direction along the track. It will be noticed that each of the contacts beyond the third, as in the former case, are connected to the third contact such that any command having three or more syllables, or three or more distinct sounds, will cause the locomotive to produce a similar operation.

The time interval determined by the condenser resistance combination 39, 40 is substantially longer than that which normally occurs between the distinct syllables, or sounds, in speech. Hence the relay 37 is not actuated as the armatures 32 and 33 are actuated over the different contacts during the command.

Assuming that the next command is one of one syllable as, for example, "stop", a current impulse will be produced in the circuit extending from the negative battery

through the lower contacts of the relay 26, winding of the resetting magnet 35, upper contact and armature 41 of relay 37, the winding of which is now energized, to positive battery. Immediately thereafter the relay 37 becomes deenergized due to negative potential from battery 38 being applied to the grid of the discharge device 36. This relay assumes the position shown in the drawing. The magnet 35 upon being energized attracts the pawl 42, thereby releasing the selector switch and permitting the armatures to return to the normal position, which is that shown in the drawings.

In this position, by means of the back contact on the armature 33 negative potential is maintained upon the grid of the device 36 and relay 37 is maintained deenergized.

Let us assume that with the selector 18 in its normal position a command of one syllable is spoken into the microphone. The selector switch will be actuated to its first position. If it were permitted to remain in this position the apparatus would produce an erroneous operation in response to subsequent commands. To obviate this difficult it is provided that after the time interval, determined by the condenser resistance combination 39, 40, has elapsed subsequent to the command of one syllable, a circuit will be completed extending from negative battery through the first contact and armature 32 of the switch 18, track conductors 7 and 6, armature 33 and first contact of the switch 18, contact and armature 44 of the relay 37 resetting magnet 35 and upper contact and armature 41 of the relay 37 to positive battery. Thus the pawl 42 is actuated and the selector switch is restored to its normal position from which position it will properly operate in response to subsequent commands.

Assuming that a command of two syllables is spoken into the microphone, that switch 18 will be actuated to its second position. After the time delay determined by the condenser resistance combination 39, 40 has elapsed, potential is applied to the track through the circuit extending from positive battery through armature 43 of switch 37 and its contact, second contact and armature 33 of the switch 18, track circuit 6, 7, armature 32 of the switch 18 and its second contact to negative battery. Thus in response to a command of two syllables potential is applied to the track having polarity opposite to that which is applied in response to a command of three or more syllables. It will be seen that by the arrangement shown in Fig. 2 the necessity for the delicately adjusted time delay relays 19, 20 and 21 of Fig. 1 are obviated, these relays being replaced by the single time delay relay comprising electron discharge device 36 and relay 37.

While I have shown and described my invention with particular reference to the op-

eration of toy locomotives and the like it will, of course, be understood that it is not limited thereto since it is also applicable in the field of power purposes as well, as, for example, for the control of motors for operation of electric cable cars, hoists, elevators and the like. Further it will be understood that my switching means may be utilized for otherwise affecting the character of the potential applied to the electric circuit comprising the track conductors, as for example, to vary the magnitude; or frequency, if alternating current be employed, in which case two alternating current motors operating in opposite directions might be utilized upon the locomotive.

While I have described particular embodiments of my invention it will be understood that I do not wish to be limited thereto since many modifications, both in the circuit arrangement and in the instrumentalities employed may be made without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a dynamo-electric machine, means for producing current impulses in response to verbal commands of the operator, and means responsive to a certain number of said current impulses for causing said dynamo-electric machine to operate in one direction and responsive to a different number of said current impulses for causing said dynamo-electric machine to operate in the other direction, whereby the direction of operation of said machine may be selectively controlled in response to different verbal commands of the operator.

2. In combination, a car, a track, a dynamo-electric machine for driving said car upon the track, said dynamo-electric machine having an armature winding and a field winding, both said armature and said winding being connected to the track, a source of direct current potential, means for connecting said source to supply current of either polarity to the track and means entirely electrical mounted on the car for reversing the polarity of current in one of said windings in response to reversal of polarity of the potential supplied to the track thereby to reverse the direction of rotation of said dynamo-electric machine.

3. In combination, a vehicle, means for driving said vehicle in either direction, and means responsive to the verbal commands of the operator for selectively controlling said last means thereby to control the direction of operation of said vehicle.

4. In combination, a vehicle, means for driving said vehicle in either direction, and means responsive to the syllables of speech for selectively controlling said last means thereby to control the direction of operation of said vehicle.

5. In combination, a vehicle, means for driving said vehicle, means responsive to a certain verbal command of the operator for selectively controlling said driving means thereby to cause a certain operation of said vehicle, said means being responsive to a different verbal command of the operator to cause a different operation of said vehicle and responsive to a third verbal command to cause said vehicle to stop.

6. In combination, a vehicle, means for operating said vehicle, and means responsive to different predetermined numbers of impulses to selectively control said means thereby to cause corresponding operations of said vehicle.

In witness whereof, I have hereunto set my hand this 22nd day of June, 1928.

ALAN S. FITZ GERALD.