This invention relates to remote control circuits, and more particularly to the remote control of motors or appliances in which alternating current is used for operating purposes. The invention is of great value in connection with toy trains but has various other applications and uses.

In toy trains as previously supplied in the market, there have been motor and other controls, for example, whistle controls, where unidirectional current was employed for control purposes, supplied by a small rectifier and acting upon a so-called D.C. relay controlling the operation of an electromagnetic control device. In such cases there has been a good deal of trouble with the relay for various reasons, one of which is that such a relay has to be very sensitive, and the required sensitivity is difficult to obtain and also to maintain. The operation of the relay has also been adversely affected by the occurrence of various external conditions.

Another objection to prior control circuits of the kind mentioned has been that in many instances there has been undue heating of the rectifier, and in cases where three-position reversing and stopping switches have been employed for the control of propelling motors and like A.C. motors, there has been sticking or other faulty operation of such switches.

One of the objects of my invention is to simplify and improve remote control circuits and apparatus of the type mentioned above.

Another purpose which I have in view is the elimination of the previously mentioned difficulties and drawbacks.

More particularly it is an object of my invention to provide a simple remote control apparatus for an A.C.-operated motor or appliance in which there is a unidirectional control current, but wherein, nevertheless, the relay or relays previously used in connection with such current are dispensed with.

Yet another object is to furnish a simple and inexpensive control for toy trains in which the reversing switch or like controlling device has its control and operation limited and protected in such a manner that the operation of the motor or other appliance will not be adversely affected by external conditions which have heretofore been prejudicial. If the motor being controlled is a propelling motor having associated therewith the usual three-position switch, the operation of the device will be considerably improved as a result of the fact that the switch will not be inadvertently operated as a result of the interruption of the current supplied to the motor.

To these and other ends the invention consists in the novel features and combinations of parts and new procedure to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a diagram of a toy train circuit embodying my improvements;

Fig. 2 shows a somewhat modified and simpler circuit embodying my invention; and

Fig. 3 shows a further modified form.

In the form of my invention shown in Fig. 1, the improvements are applied to the control from a remote point of the starting and stopping of a toy locomotive running on rails supplied with alternating current, and in this particular instance the propelling motor is controlled by a three-position switch of well-known type employing a ratchet device and adapted in one position to cause rotation of the motor in one direction, in the next position to stop the motor, and in the next position to cause rotation of the motor in the opposite direction.

In Fig. 1 the track rails are indicated at A and B, respectively, the transformer supplying alternating current at C, the locomotive at D, and the remote control device for the propelling motor at E, this last device in this particular case comprising a push button switch mounted in a separate casing and adapted to be positioned at any desired point along the track. The locomotive not only carries the propelling motor, indicated generally at F, but also a three-position switch, indicated generally at G, operating in the manner above mentioned. This switch G may be of any appropriate kind for the purposes in view, but I prefer to use a switch of the kind shown in McLoughlin Patent No. 2,196,319 of April 9, 1940. This switch comprises an electromagnet 10 adapted to act on a pivoted arm 11, the free end portion of which engages a ratchet wheel 12 connected to a commutator drum 13.

The field winding 14 of the motor is connected by circuit leg 15, having a suitable collecting shoe, to rail A. From the opposite end of winding 14 a circuit leg 16 is connected to a collecting shoe bearing against the commutator drum. A circuit leg 17 connects the commutator drum to rail B. The armature of the motor is connected at opposite sides to circuit legs or branches 18 and 19, respectively, supplied with collecting shoes bearing against the commutator. The coil or winding of electromagnet 10 is connected with rail B by leg or branch 20, and the oppo-
site end of the coil or winding is connected with rail A through leg or branch 21, but in this leg or branch a half-wave rectifier R, preferably of the multiple plate or disk type, is interposed, which, under certain conditions, as hereinafter described, passes unidirectional current for operating the three-position switch. In Fig. 1 I have shown the three-position switch in a position to operate the motor. Upon the next actuation of ratchet 12 by the switch armature 11 the supply of current to the motor will be arrested and upon the following actuation the motor will be connected for rotation in the reverse direction.

The transformer C can be of the usual type, having a primary winding C' and a secondary C", the latter being controlled by an adjustable knob 22 to supply voltage within certain limits, say from 7 to 14 volts, this, however, being only by way of example. One end of the secondary C" is connected to rail A by leg 23. Knob 22 is connected by leg 24 to a push button switch S forming a part of the remote control device. Leg 24 is connected to a contact leaf 25 normally held in the position shown in Fig. 1, in which it makes contact with a contact member 26 in the box or casing of the switch. A push button member 27 may be used to separate leaf 25 from contact member 26 and put it into engagement with another contact member 28. Associated with the push button switch and preferably in the casing or box of the control device is a half-wave rectifier R', preferably of the multiple plate or disk type, connected at one side to contact member 26 by leg 29, and connected at the other side by leg 30 with rail B. Contact member 28 is connected to circuit leg 30 at point 31, which is located between rectifier R' and rail B, so that upon depression of push button 27 rectifier R' can be by-passed or short-circuited.

In accordance with my invention the motor or other appliance to be controlled is provided with a control device employing unidirectional current of small voltage, but this control device under normal conditions has its circuit blocked so as not to pass the unidirectional current. However, when it is desired to operate the motor or other appliance the blocking against the unidirectional current is removed so that such current passes in one direction to operate the control device, which in turn causes the desired operation of the motor.

In the form described above, in which the rectifiers R and R' are employed, one of these rectifiers, namely, R, is in the circuit of the control device G, while the other, R', is in the main motor circuit under normal conditions, that is to say, when push button 27 is in the normal position. These rectifiers are placed in such relation to each other as to block the flow of unidirectional current into the control device. One rectifier prevents the flow of this current into the control device from one side, and the other rectifier prevents current from passing in from the other side, thus bringing about a blocked or balanced condition of the control device. However, when it is desired to operate the control device, all that is necessary is the depression of the push button 27, which will short-circuit the rectifier R' and cause an instantaneous flow of operating current to the control device G through the rectifier R. In this particular case the current passing through rectifier R will pass from rail A and will go from the rectifier through the winding 10 to rail B. The desired actuation of the control device having been accomplished, push button 27 is released and moves back by spring action to the position shown in Fig. 1 so as to restore rectifier R' to the circuit in blocking relation to the other rectifier.

In operating the control device the half-wave rectifier which is active, namely, rectifier R, will obviously pass a reduced voltage, alternator, or control device from the rails, and therefore if at a given time the operating voltage is, say, 15 volts, the control operating voltage will be approximately 7½ volts.

For the purpose of preventing the magnet 10 from being affected by stray alternating currents or surges, shading disks 31, or similar devices, may be employed.

Owing to the fact that in half-wave rectifiers of the multiple plate or disk type there is appreciable leakage, some A.C. current will flow from the transformer to the motor by way of rectifier R', and the motor will be operated by a pulsating current which is a combination of A.C. and unidirectional. The sine wave has distinct jagged portions below the line indicating some flow of A.C.

In the form shown in Fig. 2, a simplified arrangement is shown in which a motor H is supplied with operating current from a source I by circuit legs indicated at 32 and 33. Circuit leg 32 is connected directly to the motor, and has interpolated therein a rectifier R'. Circuit leg 33 has interpolated therein a rectifier R", and circuit leg 33 is connected to an electromagnetic switch device G'. The rectifiers R' and R" pass current in opposite directions, as in the case first described, the arrangement being such that under normal conditions no control operating unidirectional current flows in the control portion of the circuit. However, when it is desired to actuate the control device, a short-circuiting connection 34 having a manual switch 35 can be used for short-circuiting rectifier R', and causing unidirectional controlling current to pass through rectifier R".

In Fig. 3 I have shown a control circuit for use with key trains which is generally similar to that illustrated in Fig. 1, although differing in detail. In this case two oppositely acting half-wave rectifiers are employed, but they are both placed directly in the circuit of the controlling device, and they bring about a blocked or balanced condition in the control circuit which is overcome by the passage of a current having a sufficiently high voltage to pass through one of the rectifiers and establish a current flow.

In this form, track rails A' and B' are employed, and the locomotive D' is provided with a propelling motor F', the field winding of which on one side is connected to rail A', while connection of the motor to rail B' is through circuit leg 36, which cooperates with the commutator drum 37 of an electromagnetic starting, stopping and reversing switch G. This switch G' has an electromagnet 38 connected to rails A' and B' through circuit legs 39 and 40, respectively. In circuit leg 39 is interpolated a rectifier R', and in leg 40 is interpolated a rectifier R" in blocking or neutralizing relation to rectifier R'. Alternating current is supplied to the rails by a transformer T having a primary 41, a secondary 42, and an adjustable knob 43 controlling the secondary. In a suitable box or casing is a control device E' having a push button switch mechanism S'. Within the casing of control device E' is an auto transformer U, which upon actuation of switch mechanism S' is adapted to
impress additional voltage upon the rails. The auto transformer comprises a main winding 44, and a subsidiary winding 45 in which current can be induced from the main winding, and winding 44 is connected to terminal 46 of transformer T by leg 47. Terminal or post 48 of transformer T is connected by leg 49 to the junction 50 of windings 44 and 45. The opposite end of winding 45 is connected to contact leaf 51, underlying a push button 53. Spring leaf 52 is adapted to press against a leaf 54 in order to make contact therewith, and then press leaf 54 out of contact with a fixed contact member 55 which is connected by leg 56 to the middle or knob terminal 57 of transformer T. Leaf 54 is connected with rail A' by leg or lead 54.

The rectifiers R4 and R5 are theoretically of equal capacity, and under normal conditions prevent flow of unidirectional current through electromagnet 38. However, when it is desired to actuate the control device, push button 53 is depressed, which has the effect of inducing secondary winding 45 into the track circuit, thus increasing the voltage, say to 24 volts, which is a voltage sufficient to break through one of the rectifiers R4, namely, the weaker of the two, and permit current to pass. In this manner unidirectional current will pass through the electromagnet 38, and will cause actuation of the control device. The rectifiers R3, R5 will be of the self-healing type so that after a brief interval in which current is flowing, the continuity of the control circuit will be restored preliminary to a subsequent operation of the control device. In order to actuate the control device the control button need be depressed only momentarily, as the action of the additional voltage will be so rapid that one of the rectifiers will be very rapid, and, in fact, practically instantaneous, bringing about an extremely quick actuation of the control device, even in the event that the control device and the push button are separated by a considerable distance.

In the case now under discussion it will be apparent that in the ordinary running condition of the motor P the operating current will not be required to pass through a rectifier, and this may be considered an advantage in cases where the motor has a small number of poles and might be subject to greater vibration or noiser if a rectifier were in series connection with the motor. Where the motor has a larger number of poles this factor need not be considered. In such a case, that is, where the motor has as many as five or seven poles, the fact that a small direct or unidirectional current is carried along with the alternating current, as in the case of Fig. 1, would be of no particular moment from an operating standpoint. However, should it be desired to operate the motor on alternating current at all times, an arrangement such as shown in Fig. 3 can be used. In the form shown in Fig. 3 it is understood, of course, that both rectifiers R4, R5 are carried by the locomotive. These can be small rectifiers which are quite inexpensive, and the auto transformer or booster employed in connection with the push button device is also an inexpensive feature of the toy train outfit.

One of the most important advantages of my invention is the complete elimination of D. C. relays in connection with the electromagnetic control device, some of the disadvantages of which relays have been previously mentioned. There is no need of superimposing direct or unidirectional current on A. C. for control purposes nor of interrupting the supply of A. C. when the control device is to actuate the forms of my invention herein shown, two rectifiers are required, but these are relatively inexpensive. Upon actuation of the push button or like switch, the operation of the control is very quick, certain and positive, and moreover, the control is not adversely affected by a number of factors which previously enters into consideration. Heretofore much trouble and inconvenience has been occasioned by the fact that in a circuit employing a three-position switch for controlling a propelling motor of a toy train, the interruption of the supply of operating current, from one cause or another, would effect an undesired actuation of the switch. The fact that this condition is entirely overcome is an added advantage of my invention. Cutting off the current at the transformer or shorting the circuit across the rails will not affect the control device. Furthermore, there is much less tendency for the control device to stick as a result of surges of current and the like.

In the cases shown in Figs. 1 and 3 the track rails are intended to pass through holes from one to the other, but I may of course use a so-called third rail acting as one leg of the circuit.

It will be understood that in the broad aspects of the invention I do not limit myself to the control of the operation of motors as distinct from other translating devices, and that while in illustrating the invention I have shown in all cases a three-position control switch of the ratchet type, the character of the control device may be considerably changed.

While I have shown three forms which the invention may take, it can be embodied in various other forms, and various modifications and changes in the organization of parts and in the details can be made without departing from the principles of the invention or the scope of the claims.

What I claim is:
1. The combination of a translating device, a source of alternating current, a circuit having one leg connecting said translating device directly with said source, a second circuit leg having interpolated therein a control means for said translating device operable by unidirectional current and a valve device blocking passage of unidirectional current in one direction, a valve device in the first-mentioned circuit leg in opposed relation to the first mentioned valve device and normally acting while said translating device is in operation to block passage of unidirectional current to said control means, and means for shorting out one of said valve devices.
2. The combination of a translating device, a source of alternating current, a circuit having one leg connecting said translating device directly with said source, a second circuit leg having interpolated therein a control means for said translating device operable by unidirectional current, means blocking the flow of unidirectional current through the control means in either direction under normal conditions, and means including a manually operable member located at a distance from the control means for overcoming the action of said blocking means, said blocking means comprising opposed rectifiers, and said overcoming means including means for short-circuiting one of the rectifiers.
3. In an operating and controlling circuit for
toy trains, the combination of a transformer supplying alternating current, a circuit including rails supplied with alternating current from the transformer and on which the train travels, said train carrying a motor and a control device for said motor operable by unidirectional current, a rectifier adapted to pass current in the circuit in one direction only, a second and opposed rectifier adapted to pass current in the opposite direction only, and means including a manually operable switch located at a fixed point along the rails for overcoming the blocking action of one of said rectifiers so that the other is effective, said second rectifier being associated with said switch, and said last-named means being adapted to short-circuit said second rectifier.

4. In an operating and controlling circuit for toy trains, the combination of a transformer supplying alternating current, a circuit including rails supplied with alternating current from the transformer and on which the train travels, said train carrying a motor and a control device for said motor operable by unidirectional current, a rectifier adapted to pass current in the circuit in one direction only, a second and opposed rectifier adapted to pass current in the opposite direction only, and means including a manually operable switch located at a fixed point along the rails for overcoming the blocking action of one of said rectifiers so that the other is effective, both of said rectifiers being carried by the train, and said last-named means including a booster device adapted to cause a breakthrough of one of said rectifiers.