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ELECTRIC SWITCH

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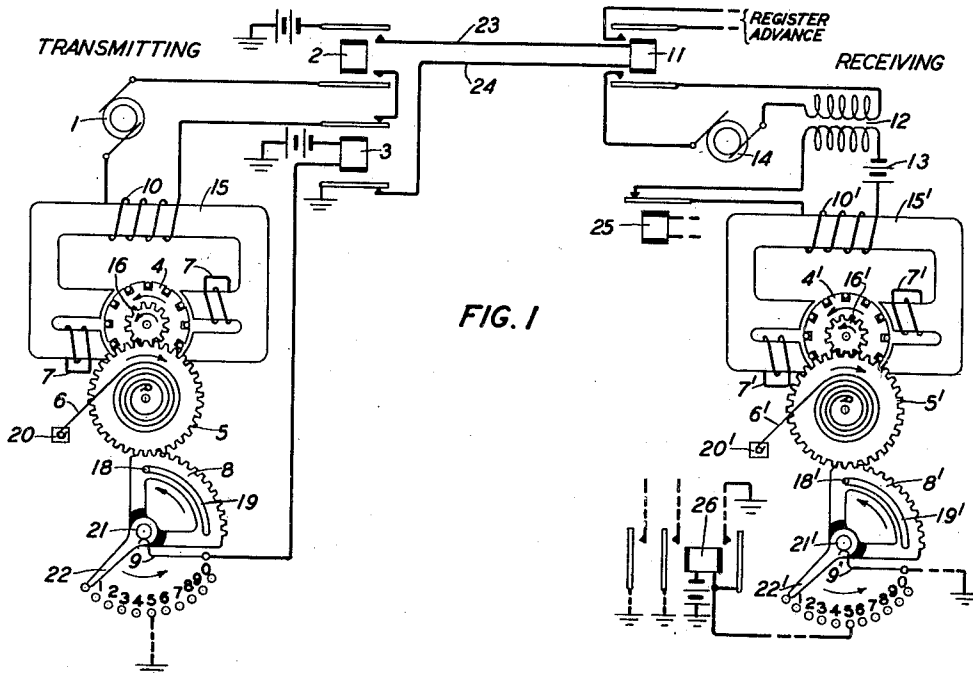


FIG. 1

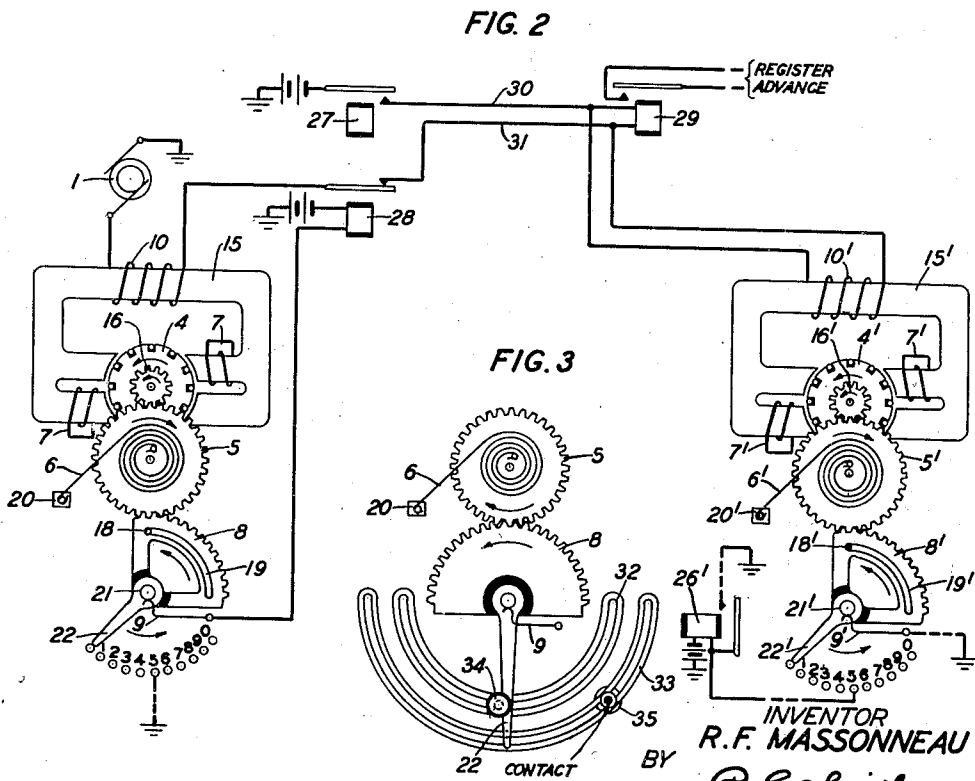


FIG. 2

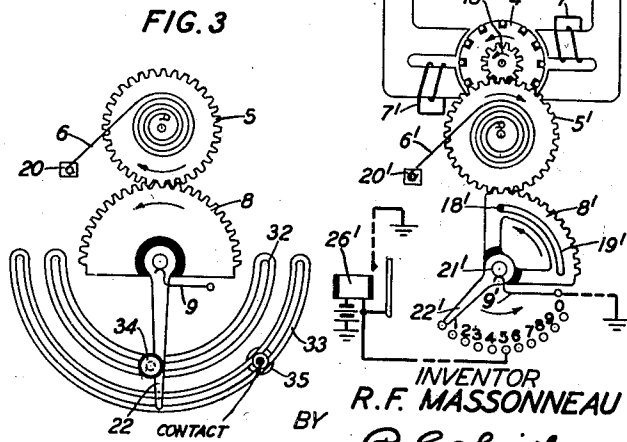


FIG. 3

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ELECTRIC SWITCH

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1 Claim. (Cl. 200—153)

This invention relates to signaling systems and more particularly to the use of an inductor motor relay in a signaling circuit for counting off an interval of time equal to a number of pulses to be transmitted over such a circuit and to the use of a similar relay at the receiving end of the circuit for synchronously operating with the transmitting relay for measuring off the same interval of time and therefore count off the same number of pulses.

The relay contemplated for use in this invention is of the inductor motor type and comprises field coils energized by alternating current of a definite frequency for a pulse interval and followed by a direct current pulse between alternating current pulse intervals. The movable element, or armature of this relay is of the so-called squirrel cage type and is geared to a moving contact which can be advanced by the turning movement of the armature when the alternating current traverses the field coils. No turning movement, however, is produced by the direct current traversing the field coils but, due to the fact that the lines of force produced by the direct current traverse the armature of the relay, said armature is held in a stationary condition at whatever position it may have been advanced by the alternating current. The moving contact is held in a normal position by a restraining member such as a retractile spring, for instance, so that when the direct current is removed and no further alternating current is applied, the armature, together with the moving contact, are pulled back to the normal position by the spring. In this way, a timing relay is produced which can be advanced one step at a time by alternating current impulses and whose period of rest in any particular position to which it is advanced is made directly dependent upon the length of the direct current impulse which follows.

Such a relay may also be used in a signaling system for the transmission and reception of impulses. Ordinarily, most impulse signaling systems are based upon the actual transmission of pulse codes characterizing the information transmitted. This necessarily makes the efficiency of the system and the accuracy of transmission dependent upon the close and not too stable mechanical adjustments of the impulse producing device and the electrical character of the transmission line which, either singly or combined, often produce distortion of pulses that falsely affect the actuation of the impulse receiving device.

In accordance with the invention, the above-mentioned limitations are avoided by the use of relays of the character mentioned for controlling the transmission of impulses and for responding to transmitted impulses. In one modification of the invention, similar relays are provided at both

the transmitting and receiving stations of the system, each having its rotor geared to a shaft upon which a rotatable contact is mounted. The moving contact of each of said relays is arranged to successively engage the stationary terminals of a terminal bank. At the transmitting station, a relay is connected to the rotatable contact and is operable when the contact engages a stationary terminal which has been marked by the application of potential thereto by any suitable means, such as the key, for example, of an associated key-set. When the signaling circuit extending between the transmitting and receiving stations is closed, the field coils of the motor relays at both stations are connected in series with a source of alternating current and a source of direct current. The rotors of both relays operate in synchronism to advance their respective rotatable contacts over their associated terminal banks until the contact of the relay at the transmitting station engages the terminal of its bank to which potential has been applied, whereupon the relay operates to open the signaling circuit and thus arrest the advancing movement of both relays. The contact of the relay at the receiving station, in the meanwhile, will have been advanced the same number of terminals as the relay at the transmitting station. Upon the opening of the circuit, both relays return to their normal positions through the influence of their restoring springs.

In accordance with another modification of the invention, the field coils of the relays at the transmitting and receiving stations may be energized by sources of alternating current local to the respective stations, the closure of the signaling circuit at the transmitting station causing the connection of the local source of alternating current to the field coils of the transmitting relay and the operation of a relay at the receiving station causing the field coils of the receiving relay to be connected with the source of alternating current local thereto. The advance of the rotatable contact of the transmitting relay to a marked terminal causes the opening of the operating circuit of the transmitting relay and the opening of the signaling circuit whereupon the advancing movement of both relays is arrested.

The invention may be more readily understood by reference to the following detailed description in connection with the accompanying drawing in which:

Fig. 1 shows two inductor motor relays, conventionally drawn, used as elements of an impulse transmitting and receiving circuit which uses one source of power at the transmitting end to operate one of the motor relays and another source of power at the receiving end to operate the other motor relay.

Fig. 2 shows the same circuit as Fig. 1 except 60

that a single source of power is used to actuate both motor relays.

Fig. 3 shows a modification of some of the mechanical elements of the motor relay contemplated by the present invention.

Referring now to a detailed description of the drawing in which similar parts are similarly designated, there is shown in each of the figures a pair of inductor type synchronous motor relays, each of which comprises a rotatable inductor 4 made of the usual circular magnetic laminations with conductors imbedded in the periphery thereof, and a stator or armature structure 15 on which is mounted field winding 10, and shading coils 7. The shaft of the rotor 4 carries a gear 16 whose teeth mesh with that of another gear 5 supported on an axis below that which carries both the rotor 4 and gear 16. The relation between gear 16 and gear 5 may be of any suitable ratio depending upon the speed of rotation desired for gear 5 for the value of any current and frequency used to excite stator coil 10. The rotation of gear 5 is restrained by spring 6, one end of which is connected to one face of the gear and the other end is connected to a stationary post 20. When motion is imparted to gear 5 by gear 16, which latter turns coaxially with rotor 4, spring 6 is placed under tension so that when the rotor is stopped from further rotation, said rotor is free to turn on its own axis and the wound-up spring will pull gear 5 in the opposite direction to its original starting position and will also, of course, affect the opposite rotation of gear 16 and rotor 4. The spring is of such strength as to move the whole gear combination.

Meshing with gear 5 and on the opposite side of gear 16 is contact member 8 which is pivoted at 21 in alignment with the axis of gear 5 and rotor 4. This member has an arcuate member 3 provided with gear teeth to mesh with those of gear 5. Paralleling the gear teeth of said arcuate member is a groove 19 for the accommodation of pin 18 which is fixed to limit the rotation of member 8 to that permitted by the length of the groove. The utmost limits of the groove mark the two extremes between which contact member 8 can rotate. Hence, when power is disconnected from the motor, the contact member 8 will be driven back to its normal position as fixed by pin 18 and the left terminus of groove 19.

Contact member 8, on its opposite end, carries a contacting brush 22 which, as the rotor turns in the counterclockwise direction, is influenced to move in the same direction and make contact with each one of the various terminals 1-0 and on any of which it may stop, as explained hereinafter, to complete an electrical connection through the brush 9 which is in electrical contact with brush 22. Brush 22 is insulated from the rest of the member 8 and also from the axis 21 by any suitable insulating means so that electrical connection is only made with brush 9 and whatever element is connected thereto.

Considering Fig. 1 in detail, let it be assumed that the left side of the circuit represents the transmitting arrangement for a mechanism designed to transmit impulses, and that it is desired to transmit the equivalent of five impulses to the receiving end, on the right side of Fig. 1, which may be assumed to be the registering arrangement of the sender at the terminating office that controls the setting of the selectors. The fact that the equivalent of five impulses is to be transmitted is evidenced by the connection of ground

by any suitable means to the terminal marked 5 on the group of contacts accessible to rotating brush 22.

At the instant that the signaling circuit is to begin operation, relay 2 is operated by any suitable means and a circuit is thereby closed from battery through the top contacts of relay 2, line conductor 23, winding of relay 11 at the distant end, line conductor 24, bottom contacts of relay 3 to ground. Another circuit is also completed from one side of alternating current generator 1, bottom contacts of relay 2, top contacts of relay 3, motor field winding 10 to the other side of alternating current generator 1. Simultaneously with the closure of this circuit at the transmitting end, another circuit is also completed at the receiving end which extends from one side of alternating current generator 14, lower contacts of relay 11, primary winding of transformer 12, to the other side of generator 14. The current traversing this circuit is effective in inducing a similar current through the secondary circuit of the transformer, which circuit extends from the negative pole of the battery 13, secondary winding of transformer 12, contacts of relay 25, field winding 10' to the positive pole of battery 13. Inasmuch as generators 1 and 4 are in phase and each produces a current of the same frequency and intensity as the other, the rotors 4 and 4' of the motor relays, that is, the one at the transmitting end and the one at the receiving end, will start to revolve at the same time and will continue to revolve at the same speed so long as the field circuits remain undisturbed.

During the time that the field circuits are kept closed, rotor 4 of the relay at the transmitting end will cause the rotation of brush 22 over the contacts accessible to it while at the receiving end, rotor 4' revolving at the same speed as the motor 4 of the relay at the transmitting end and having the same gear ratio between gears 16' and 5' as the gears 16 and 5 of the relay at the transmitting end, causes the brush 22' to be advanced over its accessible terminals at the same rate of speed as brush 22 at the transmitting end.

When brush 22 of the motor relay at the transmitting station reaches terminal 5 to which ground has been connected, and, therefore, brush 22' has reached terminal 5, an obvious circuit is completed for relay 3 which operates and opens the circuit of field coil 10 as well as the circuit of relay 11 which relay, on releasing, opens the circuit through the primary of transformer 12. Both rotors now stop with their respective brushes resting on their separate terminals 5. Brush 22 of the motor relay at the transmitting end, however, and as soon as the exciting circuit for field coil 10 is opened, is restored immediately to its normal terminal by virtue of the tension built up in spring 6 during the rotation of the brush. Brush 22', on the other hand, will remain stationary on terminal 5 despite the tension built up in spring 6' because, although no more alternating current is induced in the field windings through the secondary of the transformer 12 as a result of the release of relay 11, yet a direct current now flows through the stator circuit by virtue of battery 13 which is effective to produce a magnetic flux that traverses the iron laminations of the rotor 4' and thereby cause it to remain in the position to which it has been advanced at the time the generator circuit is opened.

Contact 22' of the motor relay at the receiving end now completes a circuit for register relay 26

extending from ground on contact 22' and cooperating terminal No. 5 of the relay contact arc, No. 5 back contacts of relay 36, winding of relay 26 to battery. Relay 26 operates and then locks through its right contacts to: (1) record the reception of the five impulses; (2) close an obvious circuit for operating slow-acting register switching relay 36 of which one may be provided for each group of register relays, such as the group in which relay 26 belongs; and (3) close a circuit for relay 25 over a path extending from ground through its left inner contacts, right back contacts of relay 36, winding of relay 25 to battery, causing the operation of relay 25. Inasmuch as relay 36 is "slow to operate", relay 25 opens its contacts before its own circuit is opened at the back contact of relay 36. Relay 36, on operating, advances the path of the motor relay terminals to a succeeding relay like relay 36, such as relay 36' in the next register group for the registration of a succeeding group of impulses, it being understood that while one set of switching contacts on relay 36 is shown in detail, one such set of switching contacts is provided on each switching relay, like 36', for each terminal in the arc of the motor relay accessible to moving contact 22'.

By virtue of the operation of relay 25 the direct current circuit through the field winding 10' is opened and the secondary of transformer 12 is also opened. The tension stored in spring 6' will now cause gear 5' to rotate in the counter-clockwise direction and drive arcuate member 8' back to its normal position against the pin 18', at which time brush 22' will come to rest on the normal terminal of the terminal arc.

In connection with the circuit arrangements shown in Fig. 1 and by which the terminals of the receiving motor relay are advanced to succeeding groups of registers, it should be understood that this arrangement is merely illustrative of the many other arrangements known to the art that could be used to achieve the same purpose, such as, for instance, the one shown in Patent No. 1,862,549, issued to R. Raymond and W. J. Scully on June 14, 1932. The invention therefore is not to be understood as limited to the specific arrangements shown, but includes, necessarily, any other known arrangement of similar scope which can be adapted by a person skilled in the art to the performance of the function above described.

Fig. 2 is a modification of the circuit shown in Fig. 1 in that one source of exciting current is used for both motor relays and no direct current component is used to hold the relay at the receiving end in the position to which it is advanced.

When relay 27 is operated in any suitable manner, a circuit is completed from ground, through the generator 1, field winding 10, contacts of relay 28, line conductor 31, winding of relay 29, line conductor 30, to battery on the contacts of relay 27. In parallel with the above circuit, another circuit is completed through the field winding 10' of the relay at the receiving end. Both motor relays now operate in the same manner as already described for Fig. 1. When brush 22 reaches the fifth terminal, an obvious circuit is completed for relay 28 at the transmitting end and another obvious circuit is completed for register relay 26' at the receiving end, the latter relay being oper-

ated for the purpose of registering the impulses received. With the operation of relay 29, the field circuit for both motor relays is opened, causing both of said relays to restore to normal in the manner already described, while relay 29 releases to advance the register on its release.

Obviously the relay contemplated as a part of this invention is adapted to a variety of uses. In the signal circuits described, the relay is adapted for use as a selector switch wherein the moving contact element can be stepped in succession over a number of terminals. In Fig. 3 is shown a variation of certain mechanical parts of the motor relay shown in Figs. 1 and 2 and an addition of other mechanical elements by which the motor relay can be adapted for use as a slow-acting relay wherein the time taken for the moving contact to reach the stationary contact may be varied by either altering the normal position of the moving contact or the position of the stationary contact, or both.

Considering Fig. 3, it will be seen that the terminal bank is replaced by two concentric arcs 32 and 33, each provided with a slot containing a movable stop 34 in the inner arc, and a movable contact 35 on the outer arc. Stop 34 is located on the left of contact arm 22, is provided with a thumb nut for tightening said stop anywhere in the slot of the arc 32 and forms a rest for contact arm 22. Contact 35 is likewise slidable along the contact arc 33 and can be locked in any position by a tightening nut which may be concentric with the contact.

It is clear that the distance between stop 34 and contact 35 can be varied by altering their position along their respective arcs 32 and 33. If stop 34 is assumed to be in that position on its arc for which no tension is placed on spring 6, the time taken for contact 22 to reach contact 35 will obviously depend on the distance between the two contacts and may be increased or decreased by altering the position of contact 35 along its arc. However, the time taken for bringing the two contacts together may further be increased by altering the normal position of contact 22. Stop 34 may be moved to the right as a result of which gear 5 is influenced to move in a clockwise direction and tension is built up in spring 6. Additional time will now be required to move contact 22 away from the backstop 34 since the torque in rotor 4 will not only have to overcome the inertia of the gear train but also the tension in spring 6. By providing springs having different tension characteristics, the time of operation may thus be altered within very broad limits.

What is claimed is:

A retarded circuit closer comprising a rotatable contact arm, a gear connected therewith, a driving means, gearing interposed between said gear and said driving means, a spring connected to said gearing, two arcuate slotted guides associated with said contact arm, a back stop adjustably supported in the slot of one of said guides for determining the normal position of said contact arm whereby said spring is tensioned to partially restrain the rotation of said contact arm, and a contact adjustably supported in the slot of said other guide for engagement by said contact arm when said arm is rotated against the tension of said spring.

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