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ELECTRICAL SIGNALING SYSTEM WITH REMOTE CONTROL

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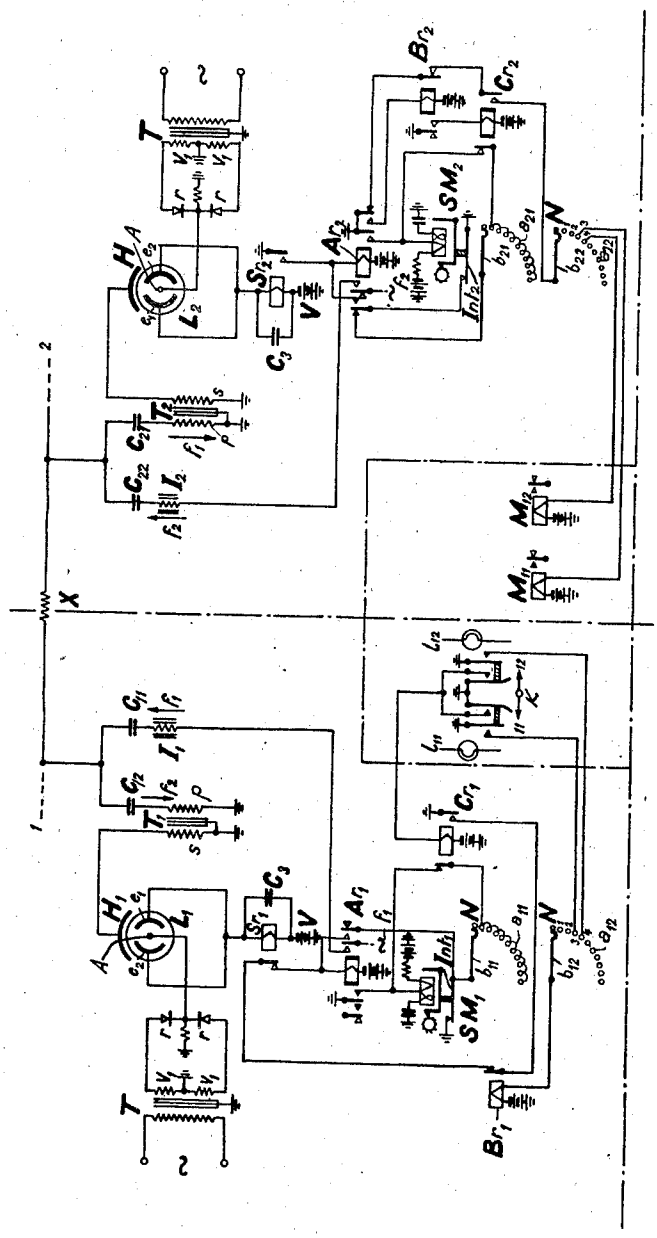


FIG. 1

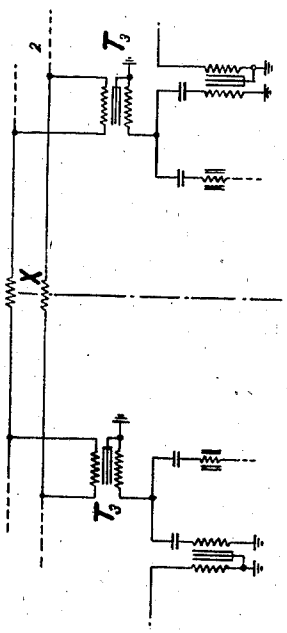


FIG. 2

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ELECTRICAL SIGNALING SYSTEM WITH REMOTE CONTROL

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2 Claims. (Cl. 177—353)

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The invention relates to electrical signalling systems, which serve the particular purpose of controlling from one central point the positions of a plurality of mechanisms at one or several distant points by means of electrical signals, transmitted from a central point to each of the distant points or vice versa.

A variety of such systems already exists, some of which using two or more separate signalling wires, whereas other systems use existing wires, employed for other signalling purposes, by the superposition of some type of modulated carrier wave.

Most of the existing remote control systems are based on the code sending principle. A separate code, comprising a predetermined number of current pulses, is assigned to each individual mechanism at the distant point, and these code signals are transmitted from the central point by a simple manipulation. For the purpose of controlling the correctness of the operations of the apparatus, most existing systems comprise special means for checking eventual discrepancies between the number of transmitted and received pulses.

The purpose of the present invention is to apply improvements to existing remote control systems.

The signalling system according to the invention uses only one wire and ground between the central and distant points. This wire may be used concurrently for other signalling purposes using direct or alternating current.

A feature of the invention is, that each point comprises a source of alternating current, of different frequency for each point, these alternating currents being used for signalling purposes in both directions between the two points; each point further comprising a signal receiving device arranged by means of adequate filters to respond selectively to the frequency received from the opposite point only, a step-by-step selector switch or the like apparatus and a group of controlling relays, the arrangement being such that the two selector switches are made to advance step-by-step in synchronism under the control of the alternating current signals in both directions, a signal of one frequency in one direction corresponding to the energisation of the power magnets of both said selector switches and thus initiating a step, while a signal of the other frequency in one direction corresponds to the de-energisation of said two power magnets, thus completing a step; this process is repeated cyclically until the selector switches reach a predetermined position, marked at the central point.

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Another feature of the invention is that the signal receiving device at each point comprises a gas-filled tube, provided with an exterior electrode, which is connected to the secondary winding of a transformer, the primary winding of which is inserted in the signalling wire in series with a filter, tuned for resonance with the frequency received from the opposite point.

A stepping relay, connected in series with the main gap of the tube, remains energised as long as the signal received from the opposite point is applied to the exterior electrode of the tube.

The invention will be clearly understood from the description of a typical embodiment, shown in the accompanying drawing, which illustrates the equipment for operating circuit breakers or the like mechanisms at a distant point by means of simple maneuvers of a key at a central point.

In Figure 1 the signalling wire between the central point and distant point is designated by 1—2. This wire will have a certain impedance X and may be used for D. C. or A. C. signalling without interference from the remote control system, due to the tuned coupling condensers C_{12}, C_{11}, C_{21}, C_{22} inserted at both ends.

The system according to the invention comprises two electrical filters at each end of the signalling wire. At the central point one filter, comprising condenser C_{12} and the primary winding of transformer T_1, is tuned for the frequency f_2, while the second filter, comprising condenser C_{11} and impedance I_1 is tuned for frequency f_1. At the distant point one filter, comprising condenser C_{21} and the primary winding of transformer T_2, is tuned for frequency f_1, while the second filter, comprising condenser C_{22} and impedance I_2, is tuned for frequency f_2. It is evident that the tuning of the filters has to be carried out with regard to the impedance X of the signalling wire, which may vary within considerable limits.

It is also evident that the filters, which on the drawing have been shown in one of their simplest forms, may consist of any of the well-known combinations of capacities, inductances and resistances, depending on the impedance of the signalling wire and on the absolute and relative values of the two frequencies used.

In Fig. 1, L_1 and L_2 designate gas-filled tubes of well-known types, using cold or hot cathodes. Examples of the former type are the so-called "cold cathode tubes," and of the latter type the so-called "thyratrons." These tubes have certain well defined characteristics, of which two are of particular importance for the satisfactory

functioning of the tube, namely the main gap breakdown voltage and the sustaining voltage. The main gap is defined as the space between the anode A and one or both of the electrodes e_1 and e_2.

The exterior electrode H with which the tubes are provided, has the purpose of creating an electrostatic field, superimposed on the anode-electrode field which results in an increase or decrease in the value of the main gap breakdown voltage, depending on the polarity of the potential applied to the exterior electrode.

The action of this exterior electrode in the particular circuit combination as used in this invention has been described in detail in United States application Serial No. 481,510, filed April 1, 1943.

For completion's sake a recapitulation of the operation of such an apparatus will now follow:

The two electrodes e_1 and e_2 are connected to a negative potential in series with the stepping relay sr_1. The voltage V of the negative potential is smaller than the main gap sustaining voltage VD. By means of transformer T and the two rectifiers r, a pulsating direct current potential V_1 is applied to the anode A, in such a direction that V and V_1 are algebraically added. The value of V_1 max. is such that $V+V_1$ max. is smaller than the main gap breakdown voltage Vc, but greater than the sustaining voltage VD. Under influence of the potentials V and V_1 the tube will not be sufficiently ionised to light.

If now a potential with a certain minimum, instantaneous or constant, positive value is applied to the exterior electrode H, the effect will be to lower the main gap breakdown voltage, while the sustaining voltage is not influenced. By a suitable choice of the potential on electrode H, the tube may, therefore, be lit. When the pulsating potential on the anode A, however, reaches a certain value, such that $V+V_1$ is less than V_D, the tube will be extinguished.

If the potential on H is maintained, the tube will again relight for a certain value of V_1, and the same process as mentioned above will repeat itself cyclically. The stepping relay Sr_1, inserted in the main gap circuit, is prevented from following these rapid lightings and extinctions of the tube; this may be attained by a plurality of known means. On Fig. 1 a condenser C_3 is bridged across the relay for this purpose. Relay Sr_1 remains, therefore, operated, as long as the potential on electrode H is maintained.

SM_1 and SM_2 represent the power magnets of two selector switches of the step-by-step type, well-known in telecommunication technique. Each selector has its interrupter, Int_1, and two arcs a with individual terminals and corresponding rotating brush members b. The purpose of the group of controlling relays at each point will be described later.

Each mechanism at the distant point is represented on the drawing by two relays or magnets M_{11} and M_{12}. One of these relays corresponds to one position (f. i. the "open" position) of the mechanism, while the other relay corresponds to the other position (f. i. the "closed" position).

Each relay has an individual terminal in the arc a_{22}.

Each mechanism is at the central point provided with a two-position key K. When this key is thrown to the left, i. e. in position 11, then relay M_{11} becomes finally energised, and when the key is thrown to the right, i. e. position M_{12}, relay M_{12} becomes operated. Each key is associated with two lamps l_{11} and l_{12}, for the purpose of supervising that the mechanism have really executed the change of position, as indicated by the maneuver.

When the system is at rest, all keys are in the normal position, and one of the lamps l_{11} and l_{12} is lit corresponding to the position occupied by the mechanism. When it is desired to change the position of a mechanism, the relevant key is thrown in the direction of the dark lamp and as soon as this lamp is lit, indicating that the new position has actually been occupied, the key is restored to normal.

The manner in which the lamp is lit under remote control from the distant point is not covered by this description, since that action is supposed to be performed by means of a different signalling system, as f. i. that, described in United States application Serial No. 473,276 filed January 22, 1943.

Suppose that a mechanism occupies a position corresponding to the lighting of lamp l_{12} and that it is desired to change to the other position.

To this effect key K is thrown to the left (position 11), thereby causing the operation of relays Cr_1 and Ar_1. The latter relay energises in turn the power magnet SM_1, which attracts its armature and opens its interrupter contact Int_1. Relay Ar_1 locks momentarily over Int_1, in order to ensure that SM_1 is always fully energised. Relay Ar_1 connects over its right inner front contact an alternating current of frequency f_1 to the line. This signal passes through the primary winding of transformer T_2 in the distant point, resulting in the application of an alternating current potential to the exterior electrode H. As explained above, this potential is tantamount to a decrease in the main gap breakdown voltage of the tube, so the tube L_2 will now be lit and cause the operation of the stepping relay Sr_2.

Sr_2 energizes relay AR_2 which in turn energises the power magnet SM_2 of the selector switch and connects a signal of frequency f_2 to the line. Relay Ar_2 locks temporarily to the interrupter Int_2 of SM_2 and operates the slow releasing relays Br_2 and Cr_2.

The signal of frequency f_2 passes through transformer T_1 at the central point and causes, in the same manner as already explained, the lighting of tube L_1 and the operation of stepping relay Sr_1.

The latter relay opens the circuit for Ar_1, which releases, thereby disconnecting the signal of frequency f_1 from the line. At the same time the power magnet SM_1 de-energises, thus causing the switch to complete a step. The removal of the signal of frequency f_1 causes the extinction of tube L_2, when the instantaneous value of V_1+V falls below the sustaining voltage of the tube. Relay Sr_2 and subsequently relay Ar_2 therefore fall off, thereby disconnecting signal f_2 from the line and de-energising the power magnet SM_2. This causes the switch to complete a step.

The removal of signal f_2 causes in due course the extinction of tube L_1 and the release of relay Sr_1. One entire cycle has now been completed.

The two switches will continue to step in synchronism in exactly the same manner as described above. The sending of a signal of different frequency in opposite directions will each time result in the advancement of the switches by one step.

Relays Br_2 and Cr_2 are made slow releasing,

in order to ensure that their armatures will remain on their front contacts during the periodic release of Ar_2.

When switch SM_1 reaches the terminal marked by a ground from the outer spring of key K (terminal 3 of arc a_{12}), relay Br_1 operates and opens the starting wire to relay Ar_1. When, therefore, the cycle is over and relay Sr_1 has released, relay Ar_1 will not operate any more, and the stepping of the switches will be discontinued.

At the distant end, after the final release of relays Sr_2 and Ar_2, relay Br_2 will first fall off, thereby closing a temporary circuit for relay M_{11}, which will operate and, directly or indirectly cause the mechanisms to change position. After a short time relay Cr_2 will also fall off, thereby opening the circuit for relay M_{11}, and closing the resetting circuit for switch SM_2 over its own interrupter and arc a_{21}. The latter circuit is opened when SM_2 reaches its normal position.

The complete circuit at the distant point has now reverted to its original state of rest.

In the meantime the change in the position of the mechanism if successful, has provoked the transmission of a back signal to the central point, resulting in the extinction of lamp l_{12} and the lighting of lamp l_{11}. The supervisor on verifying the correctness of the change, will restore the key to normal. This operation will cause the release of relays Cr_1 and Br_1, after which switch SM_1 is restored to the normal position over its own interrupter and arc a_{11}.

Fig. 2 has been added to the drawing in order to illustrate the manner in which the new signalling system may be used in connection with a phantom circuit, derived from a pair of signalling wires used for other signalling purposes, by means of two additional transformers T_3. The operation of the system remains unchanged by this arrangement.

What is claimed is:

1. In an electrical remote control system, a first station, a second station, a transmission line extending between said stations, a step-by-step selector switch at each station each said selector including a wiper and an associated bank of contacts and a magnet for moving the wiper a step responsive to an energization and a deenergization thereof, a first source of alternating current of a first frequency at said first station, a second source of alternating current of a second different frequency at said second station, means at each station for applying to and disconnecting from said transmission line alternating current from the source thereat, frequency selective means at each station responsive only to the frequency of the alternating current source at the other station, means at the first station responsive to the respective application and disconnection of the second alternating current source at the second station for de-energizing and energizing the magnet at said first station and for controlling the disconnection and application of the first alternating current source at said first station, and means at the second station responsive to the respective application and disconnection of the first alternating current source at the first station for energizing and de-energizing the magnet at said second station and for controlling the application and disconnection of the second alterating current source at said second station.

2. In an electrical remote control system a first station, a second station, a transmission line extending between said stations, a step-by-step selector switch at each station each said selector switch including a wiper and an associated bank of contacts and a magnet for moving the wiper a step responsive to an energization and a de-energization thereof, a first source of alternating current of a first frequency at said first station, a second source of alternating current of a second different frequency at said second station, frequency selective means at each station, switch means at said first station for each of a number of controls at said second station, relay means at said first station for closing an energizing circuit for the magnet at said first station and for connecting said first source of alternating current to said transmission line, means at said first station responsive to the operation of a selected one of said switch means for energizing said relay means and for applying a marking potential to a contact in the bank of the switch thereat to determine the setting of the selector switch at said second station, means at said second station only responsive to the alternating current of said first source for closing an energizing circuit for the magnet at said second station and for connecting to said transmission line said second source of alternating current, other relay means at said first station only responsive to the alternating current of said second source for de-energizing said first-mentioned relay means to open the energizing circuit of the magnet thereat and for disconnecting said first source of alternating current from said transmission line, means at said second station responsive to the disconnection of said first source for opening the energizing circuit of the magnet thereat and for disconnecting the alternating current of said second source to cause the re-energization of said first-mentioned relay means and the repetition of the stepping cycle at the first and second stations, and means responsive to the engagement of said marked contact by the wiper of the first switch for opening the circuit of said first-mentioned relay means to terminate the cyclic operation.

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