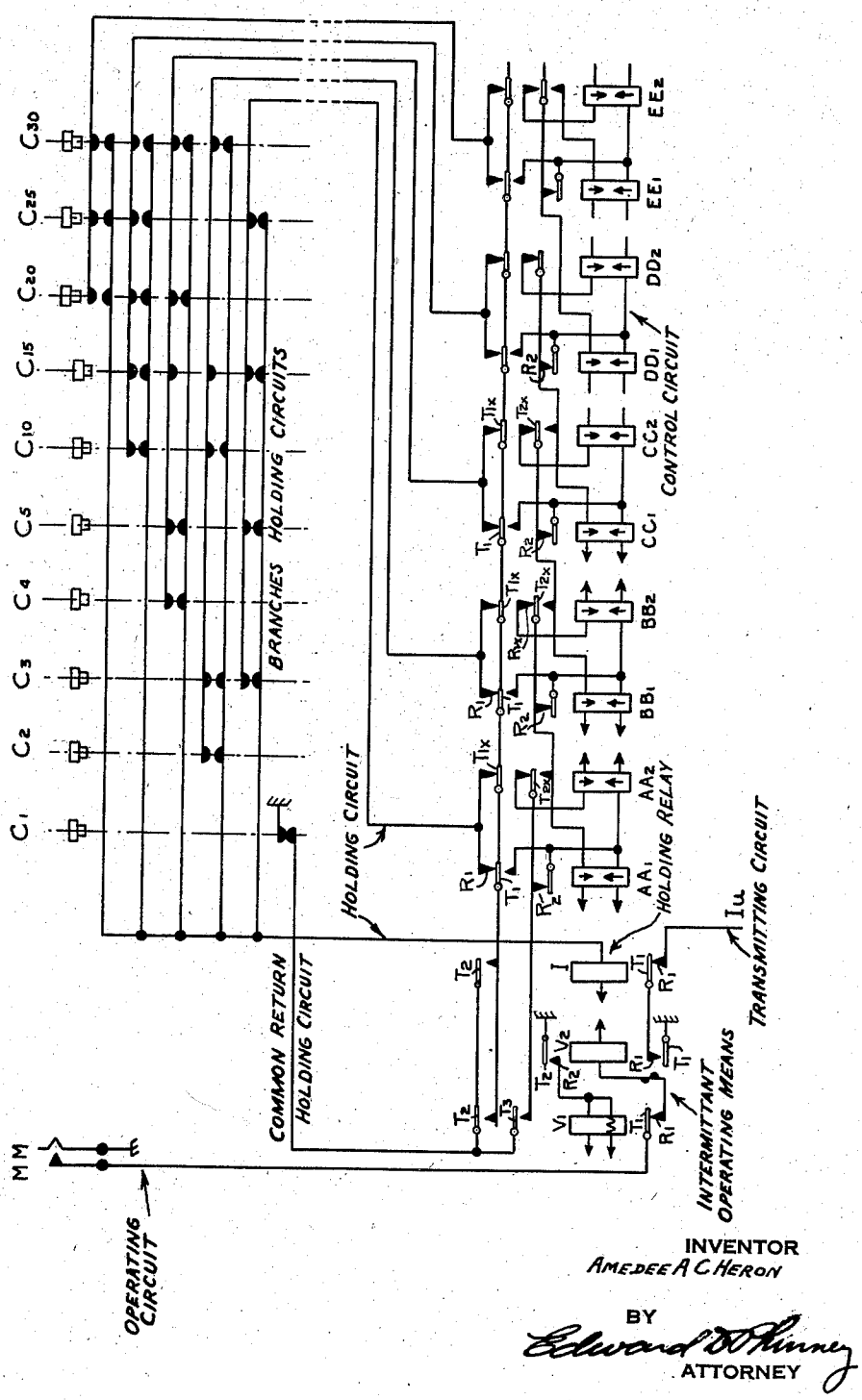
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ELECTRICAL SIGNALING SYSTEM

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ELECTRICAL SIGNALING SYSTEM

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1

The present invention relates to electric systems for automatic transmission of impulses of predetermined duration at set time intervals.

An object of the present invention is to provide a system of this character which is dependable and whose speed is vastly increased over that of systems now in use.

A further object of the invention is to provide a system which requires but a small number of control elements yet permits of a great number of combinations of time intervals at which impulses may be transmitted.

In brief, I accomplish these objects of the invention by the use of differential relays insuring rapid action and by such correlation of elements that the possible number of different time intervals between successive impulses increases manifold by the addition of merely a few control devices.

Thus, in the system described by way of example in the following specification, 32 different intervals may be obtained by means of but 10 relays (AA_1, AA_2, BB_1, etc.).

Moreover, by adding merely two more relays, it is possible to obtain 64 combinations and so forth, the number of combinations being doubled by each pair of relays added.

With these and other objects in view, as will become more apparent hereinafter, my impulse transmission control system is fully described in the following specification and illustrated, by way of example, in the accompanying drawing.

In the drawing, element MM designates a starting key, button or similar element operating circuit. Members C_1, C_2, C_3, C_4, C_5, C_{10}, C_{15}, C_{20}, C_{25} and C_{30} are control contacts in the branches of a holding circuit which may be opened and closed by means of any conventional switch or the like (indicated in each instance as a push button switch) which permits actuation of these contacts in any desired order. The action of key MM may of course be combined with that of each of control contacts C_1, C_2, C_3, etc.

Reference letters I_u designate the transmitting circuit over which the impulses are to be transmitted at certain time intervals. Key MM and control contacts C_1, C_2 C_3, etc., are connected (over circuits fully described hereafter) to the vibrator relays V_1, V_2, the holding relay I and the various differential relays AA_1, AA_2, BB_1, BB_2, CC_1, CC_2, DD_1, DD_2, EE_1, EE_2. These relays cooperate with the respective contacts placed opposite them, such as T_1, T_2, T_3, R_1, R_2, T_{1x}, T_{2x}, as shown in the drawing.

If it is desired to transmit impulses at intervals

2

of $\frac{1}{10}$ of a second, for instance, the following circuit is set up:

First, starting key or button MM is depressed and the switching device put in position C_1 to separate contact pieces C_1. When key MM is depressed, vibratory relay V_2 is energized. In its working position, relay V_2 attracts its contact T_1 and completes transmitting circuit I_u. As a result, an impulse is transmitted. At the same time, relay V_2 attracts its contact T_2 and closes the energizing circuit of vibrator relay V_1. When the latter is energized, it attracts its contact T_1 and opens the energizing circuit of relay V_2. Relay V_2 thereupon releases its contacts and returns to rest position. As a result, transmitting circuit I_u is interrupted at contact R_1 of relay V_2, while the circuit of relay V_1 is interrupted at its contact R_2 and relay V_1 releases its contacts and returns to rest position. By releasing its contacts, relay V_1 re-establishes connection between its contacts T_1, R_1, whereby the energizing circuit of relay V_2 is restored. Relay V_2 is thereupon re-energized, and the cycle of operations just described repeats itself; vibrator relays V_1 and V_2 are alternately energized and deenergized and this pulsation causes the transmission of an impulse over transmitting circuit I_u at given intervals.

It will be clear that vibrator relays V_1 and V_2 may be replaced by any other system or device (for example a cam and motor of known type) which will close a contact, such as contact T_1 of relay V_2, at given intervals.

If it is desired to transmit impulses at $\frac{2}{10}$ of a second intervals, for example, the switch is placed in position C_2, before key MM is depressed. When key MM is depressed, it produces pulsations by means of vibrator relays V_1 and V_2 as just described. When relay V_2 is energized for the first time, an impulse is transmitted over wire I_u due to the closing of contact T_1 of relay I. The following circuits are thereupon established: First circuit: ground, upper contact C_1, contact T_2 of relay V_1 (when the latter is energized), contact R_1 of relay BB_1, contacts C_2, winding of relay I, battery. Relay I, when energized, attracts its contact T_1 and opens control circuit I_u. This interruption of control circuit I_u thus occurs after transmission of the first impulse. Relay I then holds its contacts over the same circuit by means of its contact T_2. Second circuit: ground, contacts C_1 (in rest position), T_3 of relay V_1, R_2 of relay AA_1, lower windings of relays AA_1 and AA_2, battery. Third circuit: ground, contacts C_1, T_3 of relay V_1, T_{2x}

of relay AA_2, upper winding of relay AA_2, battery.

Differential relays AA_1 and AA_2 have their windings arranged in opposition. Therefore, when both windings of relay AA_2 are traversed by current, as above described, they act in opposition to each other, with the result that relay AA_2 is balanced and is not put into operation. Relay AA_1, on the other hand, of which but the lower winding is energized, attracts its armature which is placed into working position. However, as soon as relay V_1 becomes de-energized, the upper winding of relay AA_2 is no longer supplied with current (due to the return to normal of the contacts of relay V_1), and relay AA_2 is energized over its lower winding, in parallel with relay AA_1, via T_1 of AA_1, T_2 of I, contacts C_1 and ground.

When relay V_1 is now re-energized, differential relay BB_1 is energized over the following circuit: battery, lower winding of BB_1, R_2 of BB_1, T_{2x} of AA_2, T_3 of V_1, C_1 and ground. It holds then over its contact T_1. On the other hand, differential relay BB_2 remains inoperative, the same as explained in connection with relay AA_2, namely, both its windings being supplied, their opposed actions prevent the energization of the relay. Furthermore, relay AA_1, whose upper winding is fed over the same circuit, across T_{2x} of AA_2, returns to normal, the action of its lower winding being balanced by that of its upper winding. When relay V_1 releases its contacts again, relay AA_2, which was held over R_2 of relay AA_1, is de-energized. However, relay BB_2, whose upper winding is no longer supplied over T_{2x} of AA_2, is energized over: battery, lower winding of BB_2, T_1 of BB_1, T_2 of I, contacts C_1, and ground. Relays BB_1 and BB_2 are thus energized, and as a result the circuit of relay I is broken at contacts T_1 of BB_1 and T_{1x} of BB_2. Relay I is thus de-energized and releases its contacts. Inasmuch as at this moment relay V_1 is deenergized and relay V_2 is energized, an impulse is transmitted over wire I_u over contacts T_1 of V_2 and R_1 of I. Due to the fact that relay I has returned to normal, as just explained, its contact T_2 is open and the holding circuit of relays BB_1 and BB_2 is broken. Relays BB_1 and BB_2 thus likewise return to normal. As soon as relay V_1 is re-energized, the energizing circuit of holding relay I is restored and relay I is re-energized. Thus, the operating cycle of relays AA_1, AA_2, BB_1 and BB_2 is repeated and an impulse is transmitted at the end of each cycle. It will be clear that this operating cycle is repeated as long as starting key MM of the vibrator relay or the like is kept in operating position.

If it is desired to transmit impulses at intervals of $\frac{5}{10}$ of a second, for example, the following cycle of operations takes place:

First, the switch is brought into position C_5. Key MM is then depressed and the operation of relays V_1 and V_2 takes place as previously described, a first impulse being transmitted over transmitting circuit wire I_u when relay V_2 is energized. As soon as relay V_1 is energized, the holding circuit of relay I is completed over: battery, winding of relay I, lower pair of contacts C_5, R_1 of relay AA_1, T_2 of V_1, contacts C_1 and ground. Moreover, relay AA_1 is energized, over the following circuit: ground, contacts C_1, T_3 of V_1, R_2 of AA_1, lower winding of relay AA_1. Relay AA_2, whose two windings are fed, remains inoperative as previously described. When relay V_1 releases its contacts, relay AA_2 is energized, because its upper winding is no longer fed. When relay V_1 is energized for the second time, relay BB_1 is energized and relay AA_1 releases its contacts, as explained in the aforegiven example. Likewise, as soon as relay V_1 releases its contacts again, relay AA_2 releases its contacts, in turn, and relay BB_2 is energized. Relay I, however, remains in holding position over the following holding circuit: ground, contact C_1, T_2 of I, T_1 of CC_1 (or T_{1x} of CC_2), upper pair of contacts C_5, winding of relay I, battery. When relay V_1 is energized for the third time, relay A_1 is re-energized as before. When relay V_1 releases again, relay AA_2 is energized in its turn. When relay V_1 is now energized for the fourth time, relay BB_2 is energized again and relay AA_1 releases its contacts. Also, relay CC_1 is energized over: battery, lower winding of CC_1, R_2 of CC_1, T_{2x} of BB_2, T_{2x} of AA_2, T_3 of V_1, contacts C_1 and ground. When relay V_1 releases again, relays AA_2 and BB_2 release their contacts and relay CC_2 is energized. When relay V_1 is thereupon energized for the fifth time, relay AA_1 is re-energized, while relays CC_1 and CC_2 remain in holding position.

Finally, when relay V_1 releases its contacts, and relay V_2 is energized, relay AA_2 is energized. At this moment, the holding circuit of relay I is broken, as follows: as to the lower pair of contacts of C_5, the circuit is broken at contact T_1 of AA_1 and contact T_{1x} of AA_2; and, as to the upper pair of contacts C_5, the circuit is broken at contact T_1 of CC_1 and contact T_{1x} of CC_2. Relay I thus returns to normal and brings about deenergization of relays AA_1, AA_2, CC_1 and CC_2 due to the opening of contact T_2 of I. On the other hand, relay V_2 is energized, and an impulse is transmitted over transmitting wire I_u.

The energizing circuit of relay I is restored by the return to normal of relays AA_1 and AA_2, CC_1 and CC_2. Relay I is re-energized when relay V_1 is energized again and the cycle of operations described repeats itself, an impulse being transmitted at the end of each cycle.

In the examples given above, transmission of impulses took place at intervals of $\frac{1}{10}$, $\frac{2}{10}$ and $\frac{5}{10}$ of a second. The accompanying drawing outlines the circuits for transmission of impulses at the following intervals: $\frac{1}{10}$ to $\frac{5}{10}$ of a second; and at $\frac{10}{10}$, $\frac{15}{10}$, $\frac{20}{10}$, $\frac{25}{10}$ and $\frac{30}{10}$ of a second. In each case, the cycle of operations is as already described, each new combination of contacts involving the energization of a group of differential relays or the return to normal of one or more of these relays.

It should be noted that the intervals mentioned in the foregoing specification are given merely by way of example without intention of limiting the invention thereto. Indeed, these particular intervals could be replaced by any other desired range of time intervals determining the pulsation frequency of the vibrator relays, or any other known equivalent device, without departing from the spirit and scope of the present invention. Similarly, the arrangement of the switching device and contacts could be modified so as to permit transmission of impules at intervals representing multiples of the interval range chosen, same amounting, in the above given example, to one to thirty-two.

I claim:

1. In a system of the character described, a transmitting circuit, operating means intermittently opening and closing said transmitting circuit to transmit intermittent impulses over the

same, a holding circuit including a holding relay supplied thereby, a first holding contact disposed in said transmitting circuit and opened and closed by said holding relay, said holding circuit including a plurality of branches terminating in a common return line, a second holding contact disposed in said holding circuit and adapted to be opened and closed by said holding relay, contact means disposed in said return line and operated by said operating means to intermittently open and close said return line, switch contacts disposed in said branches, switch means adapted to actuate a plurality of switch contacts of different branches simultaneously, to connect said branches to or disconnect same from said return line, control circuits associated with said branches, the said second holding contact, and said contact means, said control circuits being interconnected and adapted to be energized in sequence, each control circuit including relays under the control of said operating means connected to be operable to open different respective branches of the holding circuit and thereby permit closing of the transmitting circuit only after energizing of the preceding control circuits, whereby, depending upon the actuation of said switch contacts, various sequences of control circuits may be connected to said return line.

2. In a system of the character described, a transmitting circuit, operating means intermittently opening and closing said transmitting circuit to transmit intermittent impulses over the same, a holding circuit including a holding relay supplied thereby, a first holding contact disposed in said transmitting circuit and opened and closed by said holding relay, said holding circuit including a plurality of branches terminating in a common return line, a second holding contact disposed in said holding circuit and adapted to be opened and closed by said holding relay, contact means disposed in said return line and operated by said operating means to intermittently open and close said return line, switch contacts disposed in said branches, switch means adapted to actuate a plurality of switch contacts of different branches simultaneously, to connect said branches to or disconnect same from said return line, control contacts associated with said branches and said return line, control circuits associated with said branches, the said second holding contact and said contact means, said control circuits including control relays adapted to actuate said control contacts, said control circuits being interconnected and adapted to be energized in sequence, each control circuit including relays under the control of said operating means connected to be operable to open different respective branches of the holding circuit and thereby permit closing of the transmitting circuit only after energizing of the preceding control circuits, whereby depending upon the actuation of said switch contacts, various sequences of control circuits may be connected to said return line.

3. In a system of the character described, a transmitting circuit, operating means intermittently opening and closing said transmitting circuit to transmit intermittent impulses over the same, a holding circuit including a holding relay supplied thereby, a first holding contact disposed in said transmitting circuit and opened and closed by said holding relay, said holding circuit including a plurality of branches terminating in a common return line, a second holding contact disposed in said holding circuit and adapted to be opened and closed by said holding relay, contact

means disposed in said return line and operated by said operating means to intermittently open and close said return line, switch contacts disposed in said branches, switch means adapted to actuate a plurality of switch contacts of different branches simultaneously, to connect said branches to or disconnect same from said return line, a pair of differential relays assigned to each branch, each differential relay having a pair of opposite windings and a feeding circuit therefor, a plurality of control contacts associated with said return line in the respective branches thereof and adapted to be operated by said differential relays, the latter being interconnected so as to be operative in sequence, each differential relay being under the control of said operating means connected to be operable to open different respective branches of the holding circuit and thereby permit closing of the transmitting circuit only after energizing of the preceding differential relays, whereby, depending upon the actuation of said switch contacts, various branches may be connected to said return line to control the sequence of the respective differential relays, the sequence of energization of the latter determining the time interval during which said holding circuit is closed and said transmitting circuit held open against closing by the operating means.

4. In a system of the character described, a transmitting circuit, operating means intermittently opening and closing said transmitting circuit to transmit intermittent impulses over the same, a holding circuit including a holding relay supplied thereby, a first holding contact disposed in said transmitting circuit and opened and closed by said holding relay, said holding circuit including a plurality of branches terminating in a common return line, a second holding contact disposed in said holding circuit and adapted to be opened and closed by said holding relay, contact means disposed in said return line and operated by said operating means to intermittently open and close said return line, switch contacts disposed in said branches, switch means adapted to actuate a plurality of switch contacts of different branches simultaneously, to connect said branches to or disconnect same from said return line, a pair of contact pieces connecting the terminal end of each branch to said return line, a cooperating contact disposed opposite the first contact piece of each pair, a pair of differential relays associated with each pair of contact pieces, each differential relay having oppositely arranged windings, a control circuit for each winding, the control circuits of the different windings including other relays under the control of said operating means connected to be operable to open different respective branches of the holding circuit and thereby permit closing of the transmitting circuit only after energizing of the preceding control circuit, conductive means connecting the first pair of differential relays to said contact means, intermediate contacts connected to said conductive means and the control circuits of said first pair of differential relays, the latter controlling said intermediate relays, whereby said control circuits are intermittently closed by said contact means and said branches disconnected in sequence according to the actuation of said switch contacts, whereby said holding circuit is closed and the transmitting circuit held open against closing by the operating means for such interval of time as is consumed for energization of the selected sequence of differential relays.

5. The system claimed in claim 4, in which the lower windings of each pair of differential relays are connected in parallel.

6. The system claimed in claim 4, in which the control circuit of the upper winding of the first differential relay of the first pair is connected to both lower windings of the second pair and the upper winding of the second relay of the second pair and so forth.

7. The system claimed in claim 4, in which the lower windings of each pair of differential relays are connected in parallel and the control circuit of the upper winding of the first differential relay of the first pair is connected to both lower windings of the second pair and the upper winding of the second relay of the second pair and so forth.

8. In a system of the character described, a transmitting circuit, operating means for intermittently interrupting said transmitting circuit to transmit impulses over same, a first holding contact in said transmitting circuit, a holding circuit, a relay adapted to be energized by said holding circuit, said holding relay controlling said first holding contact to open or close said transmitting circuit independently of said operating means, said holding circuit comprising a plurality of branches terminating in a single return line, a second holding contact disposed in said return line and controlled by said holding relay, interrupting means disposed in said return line and controlled by said operating means to intermittently open or close said return line, switch contacts for connecting and disconnecting the individual branches, switch means adapted to open or close a pair of control relays assigned to each branch, energizing circuits for said control relays, a return line common to all said branches and said energizing circuits; a second holding contact disposed in said return line and controlled by said holding relay to open or close said holding circuit, control contacts associated with said control relays and said return line, said control relays being adapted to successively act upon said return line through the respective control contacts in order to keep said holding circuit closed during work position of said operating means, the number of control relays energized depending upon the number and combination of switch contacts closed by said switch means, whereby said second holding relay will keep the holding circuit closed and said transmitting circuit open against closing by the operating means during a predetermined number of interruptions by said operating means, representing the interval of time corresponding to the position of said switch.

9. The system claimed in claim 1, in which said operating means comprises an operating circuit, a first relay energized by said circuit, a first cooperating contact disposed in said transmitting line and controlled by said first relay; an interrupter circuit, a second relay disposed in said interrupter circuit, a second cooperating contact disposed in said interrupter circuit and controlled by said first relay; a third cooperating contact disposed in said operating circuit and controlled by said second relay and a key to open and close said operating circuit, whereby in closed position of said key said transmitting circuit is intermittently opened.

10. The system claimed in claim 1, in which said operating means comprises an operating circuit, a first relay energized by said circuit, a first cooperating contact disposed in said transmitting line and controlled by said first relay; an interrupter circuit, a second relay disposed in said interrupter circuit, a second cooperating contact disposed in said interrupter circuit and controlled by said first relay; a third cooperating contact disposed in said operating circuit and controlled by said second relay, the latter cooperating with said contact means; said contact means comprising a pair of contacts, one of the latter being connected with said control circuits and the second of the latter contacts being connected to said return line; and a key to open and close said operating circuit, whereby in closed position of said key said transmitting circuit is intermittently opened.

11. In a system of the character described, a transmitting circuit, operating means for transmitting intermittent impulses over said transmitting circuit, a holding circuit including a holding relay, first holding contacts disposed in said transmitting circuit and controlled by said holding relay to open and close said transmitting circuit, said holding circuit comprising a plurality of branches terminating in a common return line, second holding contacts disposed in said return line and adapted to open and close the holding circuit; third holding contacts disposed in said return line and intermittently opened and closed by said operating means, switch contact associated with each branch, switch means adapted to open and close a plurality of switch contacts of different branches, simultaneously, to connect one or more of said branches to said return line in selected combinations; said third holding contacts, when closed by said operating means, close said holding circuit over a plurality of branches according to the position of said switch, causing closing of said first holding contacts, a plurality of control circuits associated with said branches and said second holding contacts to maintain the latter in closed position, said control circuits being interconnected and adapted to be closed independently by said third holding contacts and said second holding contacts, said control circuits being interconnected for operation in sequence, each control circuit including relays under the control of said operating means connected to be operable to open different respective branches of the holding circuit and thereby permit closing of the transmitting circuit only after energizing of the preceding control circuits, whereby said holding circuit remains closed interrupting transmission of impulses until the last control circuit of the sequence cut in by said switch has been energized, whereupon said holding circuit is broken, an impulse transmitted and the cycle of operations repeated.

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