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SIGNALING SYSTEM

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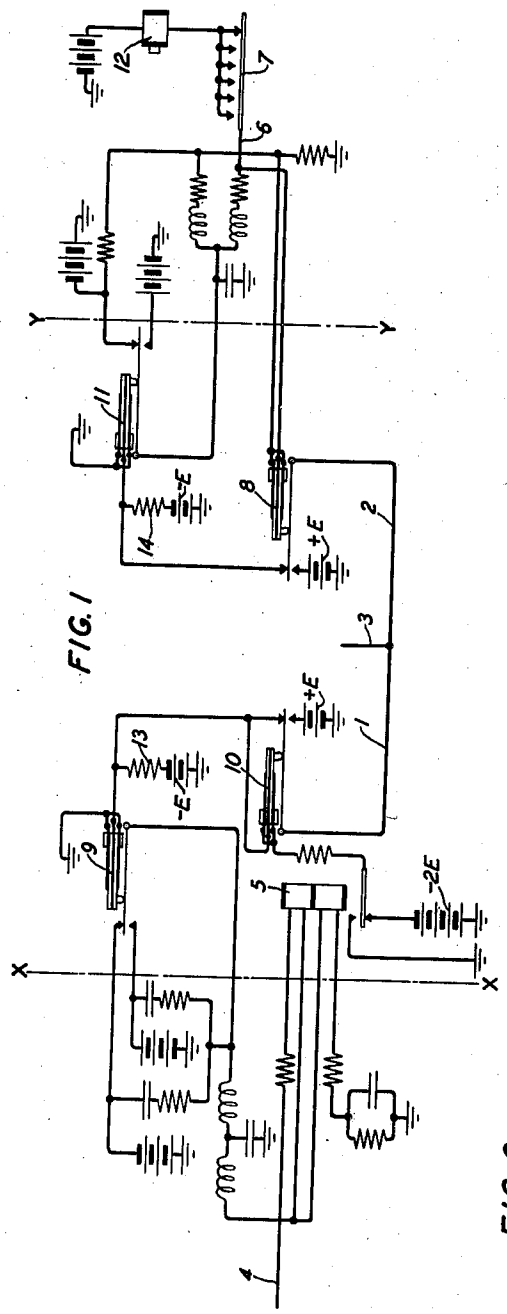

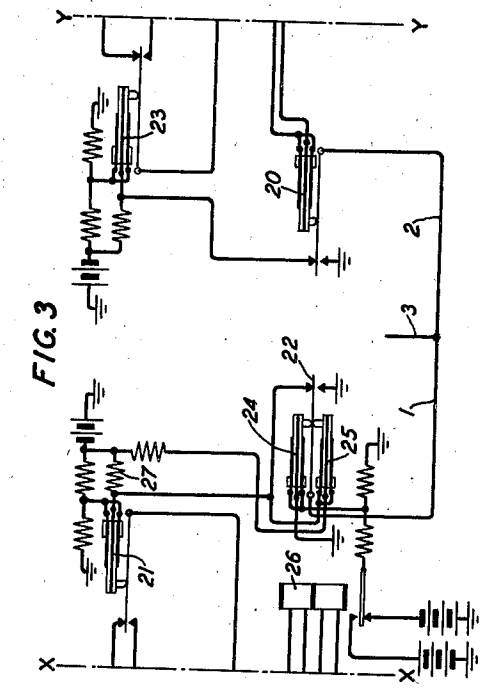

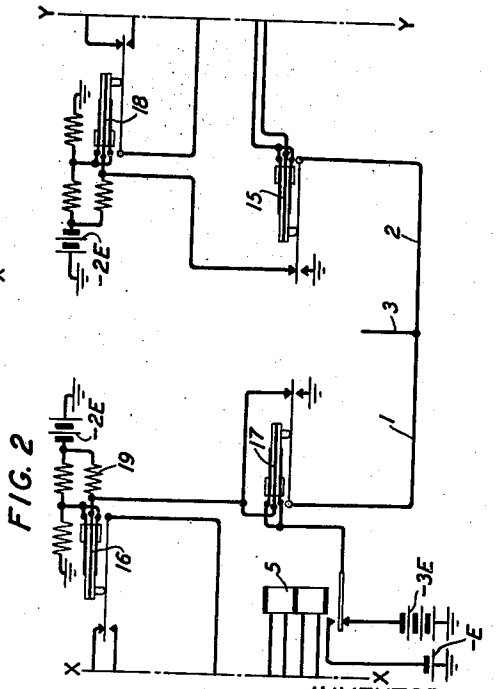

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SIGNALING SYSTEM

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5 Claims. (Cl. 178—2)

This invention relates to signaling systems and particularly to telegraph systems wherein a plurality of transmitting and receiving stations terminate in a common point which is provided with means and circuit arrangements so that any one of said stations may freely communicate with all of the others.

The object of the invention is to simplify the circuit arrangements of such junction points and to render their operation more certain and reliable.

A feature of the invention is the use of relay means, responsive to potential changes, requiring for their operation only that amount of energy which may be measured by the charging current of a small condenser. By way of example, such a relay is shown herein as a crystal relay having a movable element similar in construction and operation to the motor element used by Sawyer in his Reissue Patent No. 20,213, December 22, 1936. In general also, a relay of this nature is shown in Patent No. 2,166,763, issued to Warren P. Mason on application Serial No. 131,160, filed March 16, 1937.

The drawing consists of three circuit diagrams showing three alternative arrangements of hub circuits employing crystal relays. The hub circuit consists essentially of several lines terminating at a single point. In Fig. 1, lines 1, 2 and 3 all terminate at such a single point. Line 1 leads toward the left into what might be termed a line repeater, eventually leading to line 4, which may lead to another similar circuit and connect as line 4 does to a relay 5. Line 2 extends in the other direction toward what might be termed a loop repeater and which eventually extends over line 6 to a subscriber's station conventionally illustrated as a permutation code sending and receiving means, such as that used in a teletypewriter.

Permutation code impulses may be sent by means of the contacts 7 and in this instance will be of the open and closed circuit type. Such impulses will be followed by the receiving relay 8 which will affect the sending relay 9 of the line repeater and cause appropriate impulses to go out over line 4.

Line 3 from the hub point may extend to either a loop repeater or a line repeater and any impulses sent out by the receiving relay 8 will be repeated both into the loop repeater connected to line 1 and any other repeater connected to line 3.

In a similar manner impulses coming in over line 4 and affecting relay 5 will cause the receiving relay 10 to operate and this in turn will affect the sending relay 11 so that impulses are sent out over the line 6 to operate the receiving substation relay 12.

The relays 8, 9, 10 and 11 are what may be termed condenser relays since they consist essentially of two slabs of crystal exhibiting a piezoelectric effect. Each crystal is faced with a conducting sheet such as a light metal foil. The two outer sheets are connected together and a potential may be established then between the two outer sheets as one terminal and the middle sheet as the second terminal. Under the influence of this potential difference the crystals become distorted, one being shortened and the other lengthened, and since one end is rigidly mounted, the other end of the crystals will execute a slight mechanical movement which may be used to operate a contact. Relay 9, for instance, has its two outer conducting sheets permanently grounded and its center sheet connected to minus battery both through the resistance 13 and over the upper contact and armature of relay 10, armature and upper contact of relay 8, resistance 14 to negative battery. When, however, the relay 8 operates, its armature disconnects the hub circuit from negative battery through resistance 14 and connects directly to positive battery. This direct connection to positive battery changes the potential across the crystals of relay 9 and it operates its armature from its upper to its lower contact. This armature changing from negative to positive battery sends an impulse out over conductor 4 which will affect the distant relay 5 but will not affect the local relay 5.

The crystal relay 10 must respond to the movement of the armature of relay 5 so long as relay 8 remains as shown, that is, on its marking contact. When relay 8 goes to its spacing contact then relay 10 must fail to respond to relay 5. The manner in which this is achieved may best be shown by the following table in which column one marked "Relay 5" shows the position of the armature of relay 5, M designating marking (as shown) and S designating spacing (the alternate contact). Column two marked "Relay 8" shows the position of the armature of relay 8. Column three marked "Outer" shows the potential on the outer conducting sheets of relay 10 and column four marked "Inner" shows the potential on the inner conducting sheet of this relay. Column five marked "Outer-inner" shows the algebraic difference of these potentials and the last col-

umn shows the position of the armature of relay 10.

Relay 5	Relay 8	Outer	Inner	Outer-inner	Relay 10
M	M	−2E	−E	−E	M
M	S	−2E	+E	−3E	M
S	M	0	−E	+E	S
S	S	0	+E	−E	M

Thus it will be seen that relay 10 keeps its armature on its marking contact when the potential across its crystals is minus and thus responds to relay 5 except when relay 8 is operated to its spacing contact. This provision is made so that a break signal may be sent from the station connected to line 6.

The function of crystal relay 11 is the same as that of relay 9 and its action is similar and the action of crystal relay 8 is similar to that of relay 10 except that its action is not affected by that of relay 10.

When signaling impulses are being sent from the substation on line 6 relay 8 cannot affect relay 11, for when relay 8 is operated relay 11 is cut off. Also when relay 11 operates by opposing positive battery to positive battery the current in the loop circuit is reduced to zero so that if at such a time the loop were opened to send a spacing signal relay 8 would not be affected. The connections to the inner and outer conducting sheets of relay 8 are such that although the armature of relay 11 changes from negative to positive potential the polarity across these conducting sheets is not changed and hence relay 11 does not affect relay 8.

It should also be noted that the line 3 at the hub may extend to one or more line circuits like line 1 or one or more loop circuits like line 2 or to one or more of either. In any case when signals are coming in over, let us say line 2, they are repeated in all the others alike and simultaneously.

In Fig. 2, which may be connected in Fig. 1 as indicated by the lines XX and YY, the relays 15, 16, 17, and 18 correspond to relays 8, 9, 10, and 11, respectively, and function in exactly the same manner though the circuit arrangement of relays 16 and 18 is somewhat different. In this case the two outer conducting sheets of relay 16 instead of having full ground potential connected thereto, have a potential intermediate of ground and negative battery and the inner conducting sheet has the full potential of the negative battery. Relay 15, instead of changing the line 2 from negative to positive battery, changes it to ground so that due to the resistance 19 relay 16 becomes energized by a reversal of its potential, direct ground being placed on its inner conducting sheet.

For the operation of relay 17 a table similar to that above is provided:

Relay 5	Relay 15	Outer	Inner	Outer-inner	Relay 17
M	M	−3E	−2E	−E	M
M	S	−3E	0	−3E	M
S	M	−E	−2E	+E	S
S	S	−E	0	−E	M

Thus in a similar manner relay 17 follows relay 5 except when relay 15 is on its spacing contact.

In Fig. 3 relays 20, 21, 22 and 23 again correspond to relays 8 to 11, inclusive, respectively, and these relays function in the same manner as heretofore. Relays 21 and 23 have the same circuit arrangements as relays 19 and 18, respectively, and relay 20 is arranged like relay 15. Relay 22, however, here designated by its armature, actually is equipped with two crystal relay elements 24 and 25. Element 24 has its inner conducting sheet permanently connected to ground and its outer conducting sheets connected to the armature of relay 26, which under normal condition places negative battery on these two outer conducting sheets and when operated changes this to positive battery. Under normal conditions element 24, therefore, acts in such a manner that the armature 22 is pushed up against the upper contact but when following relay 26 it acts downwardly so as to allow the armature 22 to go into connection with the lower contact. Under normal conditions both the middle and two outer conducting sheets of element 25 are connected to negative battery. When relay 20 operates, however, a ground connection to the armature of relay 20 and over the armature 22 and its upper contact will cause current to flow through the resistance 27 to negative battery and the outer conducting sheets of element 25 will have ground potential whereas the middle sheet will still have the potential to the negative battery. This will cause the element 25 to push upwardly so that the armature 22 is held even more firmly to its upper contact. If at this time relay 26 should move its armature to spacing and the element 24 should push downwardly it could not overcome the upward thrust of element 25 and thus relay 22 will follow relay 26 except when relay 20 is operated.

What is claimed is:

1. A signaling system comprising a plurality of stations each equipped with means for sending and receiving signals, a hub circuit, lines from each of said stations to said hub circuit, a hub circuit termination for each of said lines comprising a sending relay responsive only to potential changes in said hub circuit, a receiving relay for changing the potential of said hub circuit and a potentiometer connection, said relays requiring for their operation only that amount of energy measured by the charging current of a small condenser, each of said receiving relays having means to render the potentiometer circuit of all other hub circuit terminations effective whereby the potential of said hub circuit is changed and each sending relay of said all other circuit terminations is operated.

2. A signaling system as claimed in claim 1 wherein said relays comprise piezoelectric crystals interleaved with conducting sheets.

3. A signaling system as claimed in claim 1 wherein said relays comprise piezoelectric crystals of Rochelle salts.

4. A signaling system comprising a plurality of stations each equipped with means for sending and receiving signals, a hub circuit, lines from each of said stations to said hub circuit, a hub circuit termination for each of said lines comprising a sending relay responsive only to potential changes in said hub circuit, a receiving relay for changing the potential of said hub circuit and a high resistance battery connection through contacts of said receiving relay to said hub circuit for maintaining a given potential on said sending relay and for acting as a potentiometer when the receiving relay of any other hub circuit termination is operated for maintaining a different given potential on said sending relay, said sending and receiving relays comprising crystal elements interleaved with conducting elements and requiring for their operation only that amount of en-

ergy measured by the charging current of a small condenser.

5. A signal repeating system comprising a one-wire multiple, a plurality of condenser type relays each comprising crystal elements interleaved with conducting elements and having one of said conducting elements connected to said multiple for response to a space potential from said multiple, a potentiometer connection to said conducting element for maintaining a given potential on said conducting element and contact means connected and operable to apply spacing potential to said multiple for changing the potential applied to said conducting element by said potentiometer connection and simultaneously disconnect one of said conducting elements from said multiple to prevent response by its relay.

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