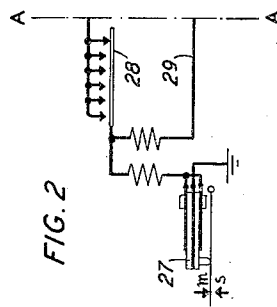
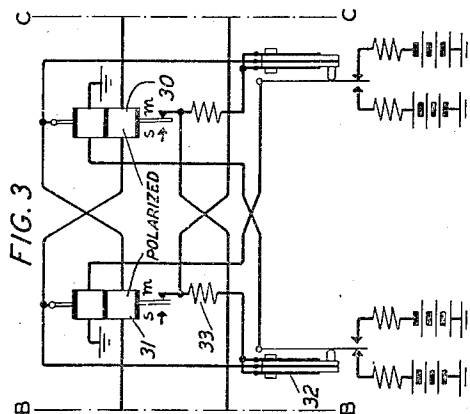
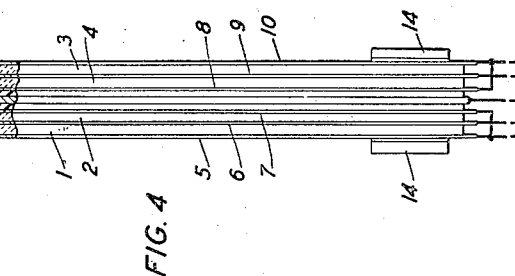
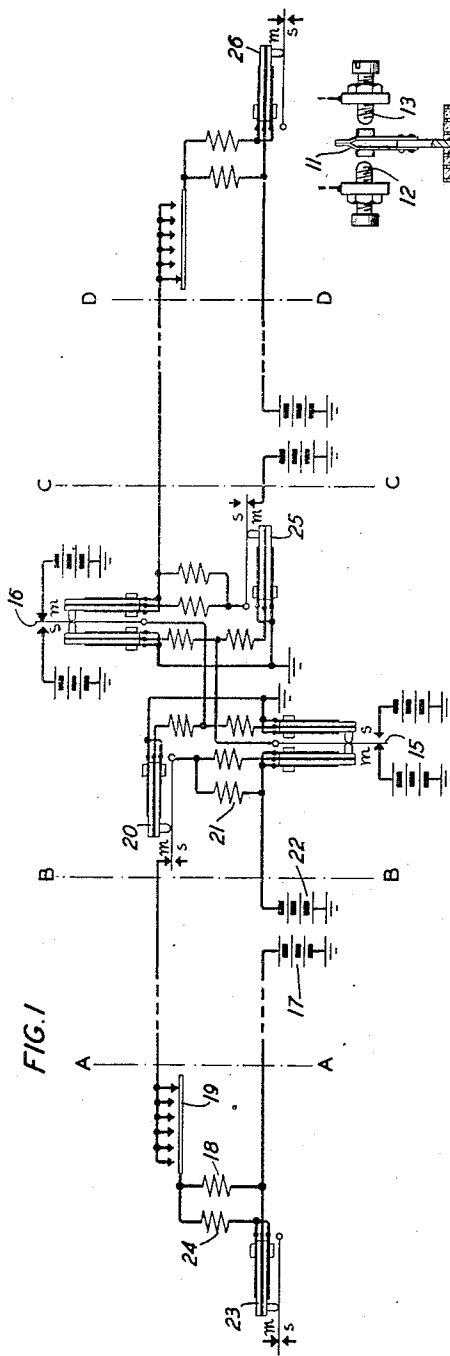


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SIGNALING SYSTEM
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SIGNALING SYSTEM

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5 Claims. (Cl. 178-71)

This invention relates to signaling systems and particularly to minute current telegraph systems either for manual or machine operation.

The object of the invention is to achieve increased economy and speed in operation while maintaining great reliability with inexpensive apparatus operated over lines which would be unsuitable for ordinary apparatus or alternatively would require higher grade more expensive apparatus.

A feature of the invention is the use of what may be termed condenser type relays, that is, relays which respond to a difference in potential rather than an electric current and which require 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 20,213, December 22, 1936. In general also a relay of this nature is shown in Patent 2,166,763, issued to Warren P. Mason on July 18, 1939, application Serial No. 131,160 filed March 16, 1937.

Crystal relays of the nature herein used prove to be extremely quick in action, to be reliable, to require little maintenance and to have a long life. The peculiar advantage of these relays, however, is that they respond to potential differences and hence their use in circuits of this nature is advantageous since their operation is not slowed up through electrical impedance nor their response limited materially by the length or the condition of the line. Ordinary high resistance lines or leaky conditions which on other electromagnetically operated lines would seriously interfere with the operation of the system will not here cause faulty operation and hence the cost of maintenance of the system will be lower or alternatively the provision of more expensive and more sensitive apparatus will be avoided.

The drawing consists of one sheet containing four figures.

Fig. 1 is a diagram of a completed connection from one signaling station conventionally illustrated as permutation code sending and receiving means to another over their lines and a repeater at a central point;

Fig. 2 is a diagram of an alternative form of station circuit;

Fig. 3 is a diagram of an alternative form of a repeater at a central point; and

Fig. 4 is a representation of a relay made up of two pairs of crystals.

Let us first consider Fig. 4. Here we have four pieces of crystal preferably made of Rochelle salts and which exhibit a piezoelectric effect. Other piezoelectric bodies may be used. These crystals 1, 2, 3 and 4 are each faced by conducting sheets 5 to 10, inclusive. The conducting sheets 5 and 7 are connected together so that when a potential is applied between conducting sheet 6 and paired sheets 5 and 7, the crystals 1 and 2 will be distorted so as to tend to move the central contact 11 in one direction or the other toward either contact 12 or 13. Similarly when a potential difference is placed between conducting sheet 9 and the paired sheets 8 and 10, the crystals 3 and 4 will be distorted so as to move the central contact 11 either toward contact 12 or contact 13. All four of these crystals and their conducting sheets are rigidly mounted on base 14 so that through the distortion of the crystals the central contact 11 is rendered movable.

In Fig. 1 there are two such relays now identified by their movable contacts 15 and 16, respectively. For clarity, however, these relays 15 and 16 are not shown as compactly as the relay of Fig. 4.

The operation of a signaling system using relays of this nature is illustrated in Fig. 1. Current will flow from positive battery 17 out over the station loop through the resistance 18, signaling contacts 19, marking contact of relay 20, resistance 21 to negative battery 22. At the station a crystal relay 23 will have full positive potential on the conducting sheet between the two crystals and will derive a negative potential on its two outer conducting sheets over resistance 24, closed contacts 19 and thence to battery 22. This potential difference on the conducting plates of the crystal relay 23 will distort the crystals in such a manner as to keep the armature on its upper or marking contact. Similarly the left-hand pair of crystals of relay 15 will have a potential difference across their conducting sheets so as to distort the crystals in a left-hand direction. The right-hand pair of crystals of relay 15 will be energized by potential between ground on the two outer conducting sheets and negative battery on the armature and marking contact of relay 16. This potential will distort the crystals of the right-hand pair of relay 15 toward the right with the net result that the armature of relay 15 will remain on its left-hand or marking contact. Relay 20 will be energized in the same manner as the right-hand pair of crystals of relay 15 and will maintain its armature on its upper or marking contact.

When permutation code signals are sent by the contacts 19 they will be in the form of open or closed circuit impulses. The closed circuit impulses will maintain the system in the state just described. When the contact is opened, however, it will be noted that both the outer and central conducting sheets of relay 23 will come to the same potential with the result that the strain on the crystals of relay 23 will be removed and the armature will be moved to its lower or spacing contact. At the same time and in a similar manner the potential difference existing on the conducting sheets of the left-hand pair of crystals of relay 15 will be removed and all of these conducting sheets will come to the same potential with the result that the strain on this left-hand pair of crystals will be removed and the armature 15 will move to its right-hand or spacing contact. As armature 15 moves to its right-hand contact it changes positive battery to negative battery and since this armature is connected to the inner conducting sheets of the left-hand pair of crystals of relay 16, it will change the direction of distortion so that now the armature of relay 16 will be pressed even more tightly to its right-hand contact. On the other hand, relay 25 will open its contact and in a manner similar to that described with relation to the station circuit at the left-hand end of this figure will cause the operation of relay 26. Relay 26 performs the usual functions of a receiving relay at the other end of this line. Thus impulses created by opening and closing a circuit through which current is flowing will create potential differences at the far end of the line to operate a crystal relay.

Since the operation in the reverse direction is similar in all respects it will not be further described.

Fig. 2 shows an alternative form of station circuit. In this instance the crystal relay 27 is energized by potential difference existing between ground and a negative potential derived over the line leading through contacts 28 to a negative battery. When the circuit is broken at a relay similar to relay 20 of Fig. 1, then the negative potential placed on the outer conducting plate to this relay becomes a positive potential over the line 29 and the relay operates in the opposite direction.

If Fig. 3 is placed in the position of the corresponding circuit in Fig. 1 then in the marking condition current flows from negative battery 22 through the marking contact and armature of relay 30, lower winding of relay 31, thence over the station circuit and back to positive battery 17. When the contacts 19 are operated, this circuit is opened with the result that relay 31 operates its armature to its spacing contact. Crystal relay 32 which until this time has been short-circuited by the contact and armature of relay 31 now receives positive potential through the lower winding of relay 30 on its inner conducting sheet and negative potential over resistance 33 on its two outer conducting sheets whereupon it moves its armature from its left-hand or marking contact to its right-hand or spacing contact. Relay 26 now operates as before so that a spacing signal sent by the contacts 19 will be recorded on relay 26 as a spacing signal.

The movement of the armature of relay 32 reverses the current flow in the upper winding of relay 30 so that even though the lower winding of relay 30 is open this relay will maintain its armature on its marking contact.

The operation in the reverse direction is similar in nature and will not be further described.

What is claimed is:

1. A signaling system comprising an established connection from one subscriber's station over a subscriber's loop, another subscriber's loop to another subscriber's station, means at either subscriber's station for interrupting the continuity of the associated subscriber's loop for sending impulses to the said other subscriber's station, means for translating said interruptions into potential changes and a condenser type relay comprising crystal elements interleaved with conducting elements responsive to potential changes at each of said subscribers' stations for receiving said signals.

2. A signaling system comprising an established connection from one subscriber's station over a subscriber's loop, a repeater, another subscriber's loop to another subscriber's station, means at either subscriber's station for interrupting the continuity of the associated subscriber's loop for sending impulses to the said other subscriber's station, means in said repeater for translating said interruptions into potential changes and a condenser type relay comprising crystal elements interleaved with conducting elements responsive to potential changes at each of said subscribers' stations for receiving said signals.

3. A signaling system comprising an established connection from one subscriber's station over a subscriber's loop, a repeater, another subscriber's loop to another subscriber's station, means at either subscriber's station for interrupting the continuity of the associated subscriber's loop for sending impulses to the said other subscriber's station, an electromagnetic relay in said repeater responsive to said interruptions for translating said interruptions into potential changes and a condenser type relay comprising crystal elements interleaved with conducting elements responsive to potential changes at each of said subscribers' stations for receiving said signals.

4. A signaling system comprising an established connection from one subscriber's station over a subscriber's loop, a repeater, another subscriber's loop to another subscriber's station, means at either subscriber's station for interrupting the continuity of the associated subscriber's loop for sending impulses to the said other subscriber's station, means for translating said interruptions into potential changes, a condenser type relay responsive to potential changes in said repeater for sending corresponding potential changes to the said other subscriber's station and a condenser type relay comprising crystal elements interleaved with conducting elements responsive to potential changes at each of said subscribers' stations for receiving said signal.

5. A signaling system according to claim 1, wherein said condenser type relays are constructed of Rochelle salt crystals.

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