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ELECTRICAL SIGNALING SYSTEM

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Fig. 1

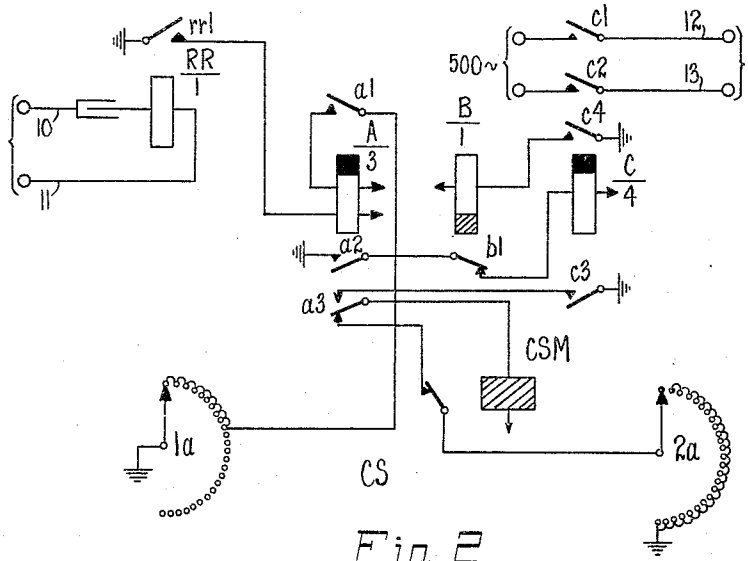
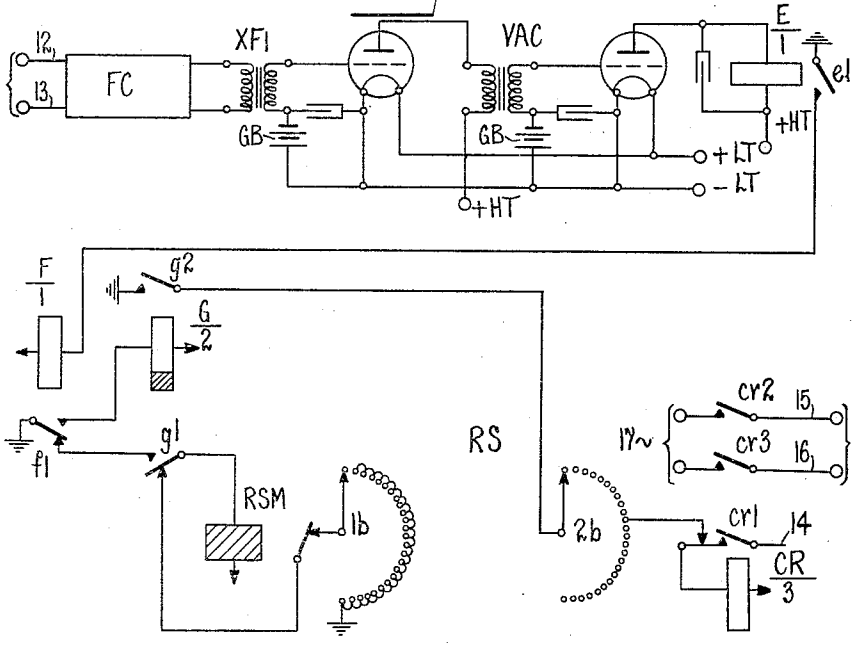



Fig. 2

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# UNITED STATES PATENT OFFICE

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## ELECTRICAL SIGNALING SYSTEM

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The present invention relates to long distance telephone transmission on systems including repeaters and more particularly concerns an improvement in the signaling means employed therein. In such systems it is generally well recognized that for signaling through repeaters it is desirable to employ frequencies of current lying within the speech band and in the arrangement used hitherto there has always been present the possibility of false operation of the signaling apparatus being conversation by reason of the normal speech frequencies which are passing over the circuit at this time.

The object of the present invention, therefore, is to provide an improved signaling circuit in which there is no possibility of false operations during the ordinary conversation, although voice current frequencies may still be employed for signaling purposes.

According to the invention the signaling currents which are transmitted at a predetermined frequency within the voice frequency range take the form of a predetermined number of impulses of the said frequency which are transmitted under the control of a timing element. In one application, for instance, the impulses may be of regular duration separated by regular periods of time and transmitted within a given period of time, so that impulses not conforming with these conditions will not be effective to cause the signal repeating devices to be operated. The transmitting device may conveniently include a slow relay for determining the duration of each impulse and a second slow relay for determining the pause between impulses while the repeating or receiving device may also include a slow relay to ensure that the pauses between impulses do not exceed a predtermined amount, or otherwise the receiving device is rendered ineffective.

These and other features of the invention will be better understood from the following description of one method of carrying it into effect, reference being had to the accompanying drawing which shows in Fig. 1 a group of inter-acting relays which are controlled by a rotary switch and comprises the sending equipment for transmitting the signaling impulses to the line by way of various repeater stations to the receiving equipment shown in Fig. 2, which consists of a filter circuit permeable only to the signaling frequency, a valve amplifying circuit, and a rotary switch which is responsive to the received signals.

Referring now to the detailed circuit operations, when it is desired to signal a distant exchange over a long line which includes repeater stations the normal exchange ringing current which may be conveniently of a frequency of 17 cycles is extended from the calling circuit over conductors 10 and 11 to operate the relay RR which in turn at its armature *rr*1 completes an operating circuit for relay A over its lower winding so that the relay may then lock independently over its upper winding by way of armature *a*1 to earth via the bank commoning and wiper 1*a* of the control switch CS.

Relay A in operating at armature *a*3 opens the homing circuit to the switch CS and at the make contacts of this armature prepares a stepping circuit to the driving magnet CSM, and moreover at armature *a*2 extends earth by way of the resting armature *b*1 to operate the slow to release relay C. Relay C in operating at armatures *c*1 and *c*2 applies the signaling frequency of conveniently 500 cycles to the line conductors 12 and 13, at armature *c*3 completes an energizing circuit to the control switch driving magnet CSM at armature *c*4 completes a circuit to the slow to release relay B, which in operating its armature *b*1 opens the holding circuit to relay C so that it releases after its slow period, to open the holding circuit to relay B and disconnect the circuit to the driving magnet CSM whereupon the wipers of the switch CS are advanced on to the second set of blank contacts.

Interaction therefore between relays B and C will cause impulses at a frequency of 500 cycles to be extended to the line circuit by way of the impulsing contacts of relay C, while it will be noted for each impulse transmitted the wipers of the control switch CS will be advanced one contact. With the ar-

rangement shown in the drawing as many as 10 impulses at 500 cycles will be extended to the line circuit whereupon wiper 1*a* of the switch CS will disengage the bank commoning thereby opening the holding circuit to relay A which releases to restore the circuit conditions to normal. Since at this time wiper 2*a* will be engaging the earth bank commoning the driving magnet CSM will then be energized in a self interrupted circuit so as to rotate the wipers of the switch CS to their home position.

Referring now to the receiving circuit shown in Fig. 2, it should be mentioned that the 500 cycle signaling impulses are extended over the conductors 12 and 13 by way of the filter circuit FC which may be of known type to the primary winding of the transformer XFL, from whence they are extended by induction into the secondary winding and passed via the valve amplifying circuit VAC to operate relay E which is connected in the plate circuit of the last valve. Relay E in operating at its armature *e*1, repeats the impulses to the relief relay F. Upon the first operation of relay F, a circuit will be completed to relay G which operates, thereby at armature *g*1 preparing a circuit to the driving magnet RSM of the receiving switch RS, and at armature *g*2 connects earth to wiper 2*b* of this switch, and since relay G is held operated owing to its copper slug during the subsequent impulsing of relay F, a circuit may be traced from earth at the resting armature *f*1, operated armature *g*1 to the driving magnet RSM so that the wipers of the switch RS are rotated in synchronism with the wipers of the switch CS. When now the full complement have been received, wiper 2*b* will then engage the contacts to which relay CR is connected, whereupon that relay then operates and at its armature *cr*1 locks up over conductor 14 to the resting contacts of a relay which will be subsequently operated when the called party replies. Moreover relay CR in operating its armatures *cr*2 and *cr*3 extends normal exchange ringing current, at conveniently 17 cycles over conductors 15 and 16 to operate the calling signal in the distant exchange. It will be noticed upon the release of relay G the driving magnet RSM will then be energized in a self interrupted circuit by way of earth at wiper 1*b* to cause the wipers to be rotated to their home position.

Considering the possibility of relay E operating during transmission of the normal speech frequencies, relay F will be operated as previously explained to bring in relay G and step the switch RS, but since it is unlikely that more than one or two impulses of the particular operating frequency will be received at any one time, relay G must eventually release to connect up the homing circuit to the driving magnet RSM so that the wipers will be rotated to the home position and relay CR will not be operated.

As the reception of intermittent impulses on the switch RS is not cumulative, it will be realized that the possibility of operating the switch its full ten steps is very remote, and therefore it is safe to assume that the calling signal will never be brought into operation during the conversation period.

What we claim as new and desire to secure by Letters Patent is:

1. In a telephone system, a line, a source of current of a particular voice frequency, means including a timing device for connecting said source to said line at intervals to transmit impulses thereover, and counting means for terminating the transmission of said impulses after a predetermined number have been sent.

2. In a telephone system, a line, a source of current of a particular voice frequency, timing means including two slow-acting relays for connecting said source to said line to transmit impulses of equal duration and separated by equal intervals over said line, a ringing circuit at the distant end of said line, and counting means for completing said ringing circuit after a predetermined number of said impulses have been received.

3. In a telephone system, a line, a source of current of a particular voice frequency, timing means for connecting said source to said line to transmit impulses of equal duration and separated by equal intervals over said line, a step-by-step switch at the distant end of the line operated each time an impulse is received, signaling means, and means effective when said switch reaches a predetermined position for operating said signaling means.

4. A signaling repeater having an incoming and an outgoing line, a source of voice frequency current, a pair of interrupter relays for connecting said source to said outgoing line at regular intervals to transmit impulses thereover, means responsive to low frequency alternating current received over said incoming line for starting the operation of said interrupter relays, and counting means for stopping the operation of said relays after a predetermined number of said impulses have been transmitted.

5. A signaling repeater having an incoming and an outgoing line, a source of voice frequency current, a pair of interrupter relays for connecting said source to said outgoing line at regular intervals to transmit impulses thereover, a start relay operated responsive to low frequency alternating current received over said incoming line for starting the operation of said interrupter relays, a locking circuit for said start relay, a counting switch, means for advancing said switch one step each time an impulse is transmitted, and means for opening said locking

circuit to stop the transmission of impulses after said switch has taken a predetermined number of steps.

6. In a signaling system, a transmitting and a receiving station, means at the transmitting station responsive to a received signal of low frequency alternating current for transmitting a predetermined number of current impulses of predetermined voice frequency to said receiving station, said impulses being of a predetermined length and separated by definite predetermined intervals, means at said receiving station responsive to said impulses for repeating said signal, and a slow-acting relay for rendering said last means ineffective if said impulses are separated by intervals greater than said predetermined intervals.

7. In a signaling system, a transmitting and a receiving station, means at said transmitting station for transmitting a predetermined number of current impulses of a particular frequency to said receiving station, said impulses being of predetermined length and separated by predetermined intervals, a relay at said receiving station responsive only to current impulses of said frequency, a switch advanced one step for each response of said relay, an outgoing signaling circuit, and means effective when said switch is operated to a predetermined position by impulses received at said intervals for completing said signaling circuit.

8. In a signaling system, a transmitting and a receiving station, means at said transmitting station for transmitting a predetermined number of current impulses of a particular frequency to said receiving station, said impulses being of predetermined length and separated by predetermined intervals, a switch at said receiving station, means for advancing said switch one step each time an impulse of said frequency is received, signaling means operated when said switch is operated to a predetermined position responsive to said impulses, and means for rendering said signaling means inoperative and for returning said switch to its normal position when said impulses are received at intervals greater than said predetermined intervals.

9. In a signaling system, a receiving station having an outgoing signaling circuit, a receiving device responsive only to current impulses of a particular frequency, a counting device for registering each impulse received, means controlled by said counting device for completing said signaling circuit when a predetermined number of said impulses have been registered, and means for wiping out the registration on said counting device whenever the interval between two successive impulses is greater than a predetermined amount.

10. In a telephone system, a line, means for transmitting current impulses of a particular voice frequency over said line, a receiving station, a ringing circuit, means responsive to the receipt of a predetermined number of said impulses received at predetermined intervals for completing said ringing circuit, said means including a counting device for counting the impulses as they are received, and means for preventing the completion of said ringing current by voice currents of said frequency transmitted over the line during conversation, said means comprising means for releasing and restarting said counting device whenever two successive impulses are separated by an interval greater than said predetermined interval.

11. The method of signaling by voice frequency currents over a line without interference by actual voice currents during conversation, which consists in applying to the line at the sending end a predetermined number of current impulses of voice frequency, in separating the impulses by intervals of predetermined length, in filtering out all frequencies except the signaling frequency at the distant end of the line, in counting the impulses as they are received, in performing the signaling operation when the predetermined number have been received, and in preventing the performance of the signaling operation by actual voice currents of the signaling frequency by restarting the counting of the impulses each time an interval of more than the predetermined length occurs between impulses.

12. The method of signaling by voice frequency currents over trunk lines in telephone systems which consists in transmitting a predetermined number of current impulses of a particular voice frequency over a line, in counting the impulses of the signaling frequency received at the distant end of the line, in completing the signaling circuit when the predetermined number of impulses have been counted within a predetermined time, and in restarting the counting of impulses whenever the spacing between impulses exceeds a predetermined amount.

In testimony whereof I have signed at American Consulate, Liverpool, England, this 6th day of February, 1931.

JOSEPH SMITH.

In testimony whereof I have signed at American Consulate, Liverpool, England, this 6th day of February, 1931.

GEORGE DEAN TURTON.