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SIGNALING SYSTEM

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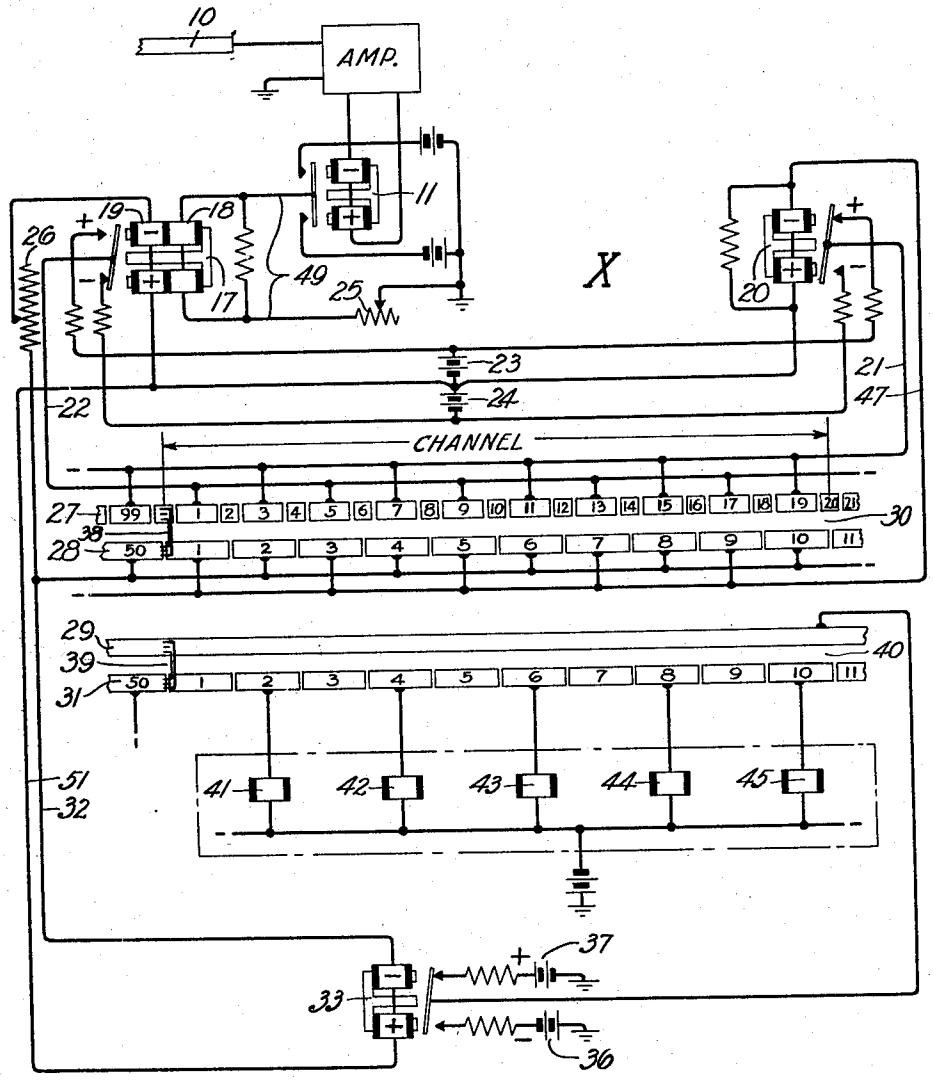

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SIGNALING SYSTEM

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This invention relates to transmission systems, and more particularly to systems adapted for long telegraph lines such as submarine cables.

An object of this invention is to reproduce more accurately at a receiving station high speed signals transmitted over a long telegraphic line.

In operating telegraph apparatus by reversals of current over long transmission lines the signaling currents are so reduced in strength by the action of the resistance, electrostatic capacity and inductance of the line that the speed of transmission is limited to that at which the short pulses after being amplified at the receiving end of the line are just strong enough to operate a line relay which is utilized for the purpose of regenerating the pulse currents, so as to effect a complete registration of the message. Moreover the effect of the attenuation of such lines on these transmitted signals is to reduce the amplitude of the short pulses to a greater extent than the long ones.

It has been proposed heretofore to employ a pair of vibrating relays controlled from the distributor at the receiving station to supply pulses which may be lost in transmission. Such a system is disclosed in U. S. Patent 1,680,550, granted to M. B. Kerr on August 14, 1928, wherein a vibrating relay and an auxiliary vibrating relay are alternately operated in conjunction with the rotary distributor to reproduce the signals that are received and to interpolate impulses which have been lost in transmission. The main vibrating relay has one winding, which is responsive to signals received from the line through a three-position signal relay and is independent of the distributor, and a second winding which is connected through the distributor to the armature of the auxiliary vibrating relay. The auxiliary vibrating relay winding is connected through the distributor to the armature of the main vibrating relay. Also connected to the armature of the main vibrating relay is the winding of the printer relay and therefore any operation of the main vibrating relay is effective to operate the printer relay. In this circuit arrangement should a received signal impulse be a little too long, particularly the impulses of two or more unit lengths, due to either maladjustment of the three-position signaling relay or zero wander, the signal or holding current would operate or hold the main vibrating relay at the wrong time, thereby causing shortening of a printing impulse and possible incorrect operation of the printer relay.

To overcome this difficulty the present invention provides a circuit arrangement which effects a considerable decrease in liability of false operation of the printer. This is accomplished by operating the printer relay from the auxiliary vibrating relay instead of from the main vibrating relay, and inasmuch as the operating circuit of the auxiliary vibrating relay extends through the rotary distributor, any unduly long impulses are shortened to their proper length when the rotatable brush engages the dead segments of the distributor.

The above and other objects and advantages of this invention are set forth in the following description and appended claims, and may be more readily understood if considered in conjunction with the accompanying drawing illustrating the invention, in which the single figure shows a vibrating relay circuit including the two sets of segmented receiving rings at the receiving distributor.

Referring now to the drawing, there is disclosed the receiving apparatus at station X which is connected by submarine telegraph cable 10 to a distant station (not shown). Each station is provided with a special rotary distributor which is arranged to rotate in synchronism in accordance with practice well-known in the art. Of the distributor at station X, only the receiving section is shown and this section is shown in part only as representing the segments of one channel. Cable 10 is shown connected to the input circuit of a space discharge or other type of amplifier. To the output circuit of the amplifier there is connected a signal relay 11 of the polarized type arranged for three operating positions, name-

ly positive, negative and zero or neutral. When the transmission speed is increased a considerable amount, the unit length signaling impulses transmitted over the cable are damped down to such an extent that even after amplification they will not operate relay 11 and therefore are lost. In order to fill the gaps introduced in the received signals due to this condition current impulses in synchronism with the received signals are generated in a vibrating relay circuit which comprises a set of segmented rings 30 of the receiving distributor, line or vibrating relay 17, and auxiliary vibrating relay 20. Only the incoming line impulses of two or more units length are of sufficient strength after amplification to operate relay 11 and in response to such impulses the relay moves its armature to either its positive or its negative position in accordance with the polarity of the impulses in order to regenerate pulses corresponding to those which are received and are of sufficient strength to operate relay 11. Relays 17 and 20 are of the unbiased polarized type and are arranged to be so interconnected through the segments of ringset 30 that each controls the energizing circuit of the other to cause the armature of each to execute one circle of movement during each two unit intervals provided no out-of-phase signaling impluses of sufficient strength to control the vibration, are incoming over the line. The movement of the auxiliary vibrating relay armature controls the printer through the unbiased polarized printer relay 33. The armature of relay 33 vibrates in synchronism with the auxiliary vibrating relay armature to impress positive and negative potentials alternately upon the printer magnets 41 to 45 inclusive through the receiving rings 40, during successive signaling intervals providing the operation is not modified by incoming line impulses. The polarities of the pulses effected by relay 33 will always correspond to those effected by relay 20.

Relay 17 is provided with two polarizing windings, one characterized as a holding winding arranged to be energized by the incoming impulses, and the other as a vibrating winding arranged to be energized by the vibrating circuit. When relay 11 responds to a long pulse incoming over the line the circuit is closed through the holding or right-hand winding of relay 17 and the relay is so arranged that the current therethrough predominates over that which may be flowing through the vibrating or left-hand winding at the same time, and the vibration of the armature of relay 17 is checked, the armature resting against the contact corresponding in polarity to that of the incoming pulse and remaining in such position until the end of the pulse, when the vibrations are resumed. In this way the short pulses which are lost in transmission are replaced by these alternate impulses of positive and negative polarity in their respective positions in the signal combinations, and therefore a complete record of all the signals is obtained.

Before beginning a detailed description of the operation of the arrangement shown in the drawing, it would be well to note that the receiving section of the distributor at station X comprises two sets of rings 30 and 40 which have, for the sake of clearness, been shown developed. Section 30 consists of two rings 27 and 28, both divided into segments, which are adapted to be bridged by brush 38, and set 40, likewise consisting of two rings 29 and 31, has one ring continuous and the other ring segmented, both rings being bridged by brush 39. Brushes 38 and 39 are secured to an arm (not shown) which is arranged to be continuously rotated by means of the motor (also not shown). Assuming that the distributor is designed to transmit over five channels the ring 28 is divided into fifty equal segments, ten of which are shown as representing one channel. Ring 27 is divided into one hundred segments of two different lengths, the odd numbered segments representing those of the long length and the even numbered segments, those of the short length. The odd numbered segments are alternately interconnected to form two groups which are respectively connected to the armatures of vibrating relays 17 and 20. The even numbered segments are left dead and are provided as buffers to prevent short circuits between the armatures of the relays 17 and 20 as the brush passes from segment to segment. The segments of ring 28 are likewise interconnected alternately and arranged in two groups, one group being connected to the vibrating winding of relay 17 and the other to the winding of relay 20. The odd numbered or long segments of ring 27 are arranged so that their centers are located on radial lines with the centers of their respectively adjacent segments of ring 28. The ring set 40 which constitutes the receiving rings proper has its continuous ring 29 connected to the armature of relay 33 and its segmented ring 21 which is divided into fifty equal parts, is arranged to have its even numbered segments connected to the selector magnets of five printers, the magnets of only one printer being shown in the drawing which is sufficient for the purpose of describing the invention. The odd numbered segments of ring 31 are left dead and serve as buffers to permit a positive break between the successive pulses to the selector magnets.

The operation of the arrangement shown in the drawing is as follows: When no cur-

rent flows through the holding winding 18 of the vibrating relay 17, the passage of brush 38 over segments 99 and 50 of rings 27 and 28 respectively, closes a circuit from the positive pole of battery 23, armature and plus or upper contact of auxiliary relay 20, conductor 21, segments 99 and 50 interconnected by brush 38, rheostat 26, through the vibrating winding 19 of relay 17 to the negative pole of battery 23, and the current flowing through winding 19 in this circuit will operate relay 17 to thereby move the armature thereof into the same position as that of the auxiliary relay 20, that is, interconnection with its associated plus or upper contact. The operation of relay 17 then prepares a circuit which is closed when brush 38 in rotating reaches segment No. 1 of ring 27 and which extends from the positive pole of battery 23, plus or upper contact and armature of relay 17, conductor 22, segments No. 1 of both rings 27 and 28, conductor 47, through the windings of relay 20 to the negative pole of battery 23. Relay 20 now operates and moves its armature into connection with its minus or lower contact which position is opposite to that now assumed by relay 17. When brush 38 reaches segment No. 3 of ring 27 a circuit is closed extending from the negative pole of battery 24, minus or lower contact and armature of relay 20, conductor 21, segments Nos. 3 and 2 of rings 27 and 28 respectively, rheostat 26, through winding 19 of relay 17 to the positive pole of battery 24, and relay 17 now moves its armature into engagement with its minus or lower contact. As brush 38 continues rotating and engages segment No. 5 of ring 27 a circuit is closed extending from the negative pole of battery 24, lower contact and armature of relay 17, conductor 22, segments Nos. 5 and 3 of rings 27 and 28 respectively, conductor 47 through the windings of relay 20 to the positive pole of battery 24, and relay 20 now operates to move its armature over to its plus or upper contact. If this brush operation were continued while no effective impulses were incoming over the line, relays 17 and 20 would continue vibrating. Relay 17 always moves into the same position assumed by relay 20 and immediately thereafter relay 20 moves over to its opposite position.

It will be noted that conductor 32 and winding 19 of relay 17 are connected in parallel through ring set 30, over the armature of relay 20 to either of batteries 23 or 24 and therefore printer relay 33 and vibrating relay 17 are similarly responsive to the impulses received over the contacts of relay 20 over a circuit completed every time brush 38 engages a segment connected to conductor 21. Relay 33 therefore operates from the armature of auxiliary relay 20 through ring set 30 instead of directly from the armature of relay 17 as has heretofore been the practice. By causing the reproduced impulses to flow through the distributor instead of directly to the printer relay the dead segments of ring 27 are utilized to shorten any unduly long impulses repeated by signal relay 11 and therefore the impulses energizing relay 33 are more nearly a true length.

When the incoming signals, that is, those of two or more pulses are of sufficient strength after amplification to operate relay 11 a current impulse is sent through a signal loop 49 and the holding winding 18 of relay 17. If the current thus produced in winding 18 is opposite to that flowing simultaneously in winding 19, relay 17 will be prevented from vibrating and the armature thereof will be held in the position in which it was previously moved. The auxiliary relay 20 will also be prevented from vibrating and the polarity of the next vibrating impulse through the winding 19 of relay 17 will be the same as the previous one, thereby again tending to move the armature of relay 17 away from the contact against which it is resting. The polarity of the holding winding 18 is so arranged that the current impulses flowing therethrough cause the armature of relay 17 to move in the same direction as that of the relay 11 and by adjusting the relative strengths of the loop and vibrating current impulses by means of rheostats 25 and 26 respectively, the current in the loop circuit is made stronger than that in the vibrating circuit so that relay 17 will follow the operations of relay 11 irrespective of the polarity of the current impulses sent simultaneously through the vibrating winding 19. The minimum strength of the current pulses in the vibrating current relay is caused by the rheostat 26 to be just strong enough to operate relay 17 when the signal loop 49 is open. With this arrangement the vibrating impulses control the operation of relay 17 only when the signal loop is open.

Inasmuch as brush 38 is mounted on the same brush arm (not shown) as the receiving brush 39, the vibrating impulses will be in synchronism with the unit impulses of the signals received from the line or cable, provided, of course, that brush 39 is in synchronism with such signals. It is clear then that if any of the unit length impulses of the received signals are dropped out by failure of the signal relay 11 to make contact on either side, there will always be a vibrating pulse flowing in the vibrating winding 19 at the same instant so as to cause relay 17 to operate thereby operating relay 20 to reinsert such pulses. Therefore the operations of relay 17 resulting from the combined control of the holding and vibrating windings operate relay 20 which actually

reproduces the signals as they were originally sent out from the distant sending distributor and these signals are sent to the printer by the relay 33, where a record is made to show the complete signal combinations as originally transmitted.

What is claimed is:

1. In a telegraph system, a signaling line, a plurality of receiving magnets, a device for repeating impulses of reversed polarity to said magnets, a distributor, electromagnetic means operating in conjunction with said distributor for operating said device, other electromagnetic means, said means being arranged to control each other, and means responsive to impulses received over said line for controlling the second mentioned electromagnetic means independently of said distributor and the first mentioned electromagnetic means.

2. In a telegraph system, a signaling line over which signaling impulses are attenuated, a plurality of receiving magnets, a device for repeating impulses of reversed polarity to said magnets, a distributor, electromagnetic means operating in conjunction with said distributor for operating said device, other electromagnetic means comprising a pair of energizing elements, one of said elements being arranged to be energized from the impulses received from the first such electromagnetic means through said distributor, and the other arranged to be energized from the impulses received over the line independent of said distributor.

3. A telegraph system comprising a line, a plurality of receiving magnets, a device for repeating impulses of reversed polarity to said magnets, a pair of electromagnetic devices arranged to control each other through a distributor, characterized in this that one of said electromagnetic devices is responsive to impulses received from the line, and the other of said electromagnetic devices is effective to operate the repeating device through said distributor.

4. In a telegraph system, an electromagnetic device, a plurality of receiving magnets responsive to said device, a pair of electromagnetic devices including armatures therefor for transmitting impulses of reversed polarity to the first of said devices, and means including a distributor for operating the armatures of said pair of electromagnetic devices, the first mentioned devices being under the control of the other of said devices through the distributor.

5. In a telegraph system, an electromagnetic device, a plurality of receiving magnets responsive to said device, a pair of electromagnetic devices arranged to operate alternately to produce alternate impulses of positive and negative polarities, a distributor for effecting the alternate operation of said pair of devices, and means for effecting the operation of the first mentioned device directly through said distributor.

6. In a telegraph system, a distributor, a relay including an armature, a second relay including an armature and a third relay arranged to produce through said distributor a magnetic effect on the armatures of said first and second relays simultaneously.

7. In a signaling system, a transmission line over which the signaling impulses transmitted are so attenuated that the dot impulses are not received, a plurality of printer magnets, a first and second electromagnetic means, each of said electromagnetic means being under the control of the other over circuits including a distributor, means for operating the first of said electromagnetic means in response to impulses received over said line, and to impulses received from the second of said electromagnetic means when no impulses are received over the line, and means under the direct control of the second electromagnetic means and distributor for operating said printer magnets.

In witness whereof, I hereunto subscribe my name this 29th day of June, 1929.

WILLIAM A. KNOOP.