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TELEGRAPH SYSTEM

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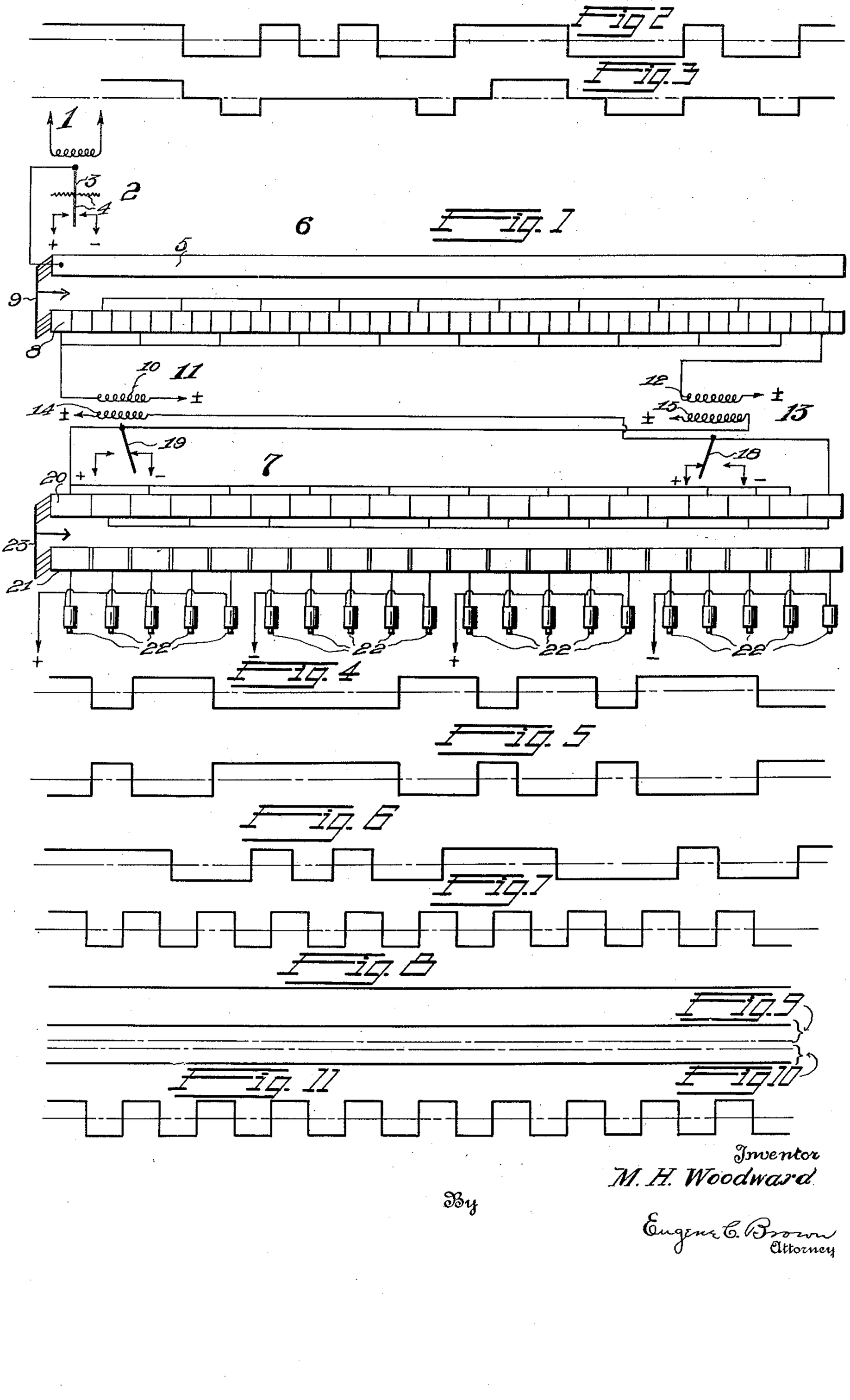

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

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TELEGRAPH SYSTEM.

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This invention relates to telegraph systems and apparatus. More particularly the invention applies to telegraph systems having long transmission lines in which the signals are considerably attenuated.

As the speed of transmission over a submarine cable or a long transmission line is increased the single impulses of dot length, whether positive or negative polarity, often become so attenuated, that is so reduced in strength and distorted or altered in wave shape form by the transmitting medium, that with the customary voltages applied, perfect reception at high speed is difficult. This condition also exists in signals of a length greater than the single or dot impulse in that the beginning of the impulse is attenuated so that the first part of the signal which corresponds to the first part of the combination is not correctly received.

The effect of such distortion and loss of energy is considerably minimized by the use of the Gulstad relay which comprises a three winding polarized relay. The usual Gulstad relay is provided with a line winding, an opposing winding, and an accelerating winding, the latter two being locally operated. By proper local circuit arrangements, including condensers and resistances, the current flowing through one of the local windings operates the relay armature to its opposite contact, which thereupon closes a circuit so that current of reverse polarity flows through the winding and the armature is moved back to its original position. If the armature vibrates between its contacts in synchronism with the transmission of the signals, the effect on the local apparatus is the same as if impulses of periodically reversed polarity were being received. In this manner attenuated impulses, although too weak to operate the line relay armature, are not lost. By adjusting the resistances and condensers in the local circuits, the relay tongue can be arranged to vibrate between its armature contacts at any desired frequency. However, considerable difficulty is experienced with this relay system due to the fact that no means is provided for insuring absolute synchronism between the vibration of the armature and the received signalling impulses. Considerable difficulty is also experienced due to the fact that the vibration causes continuous wear of the armature contacts.

Attempts to overcome the difficulties disclosed in the Gulstad relays were made in the systems disclosed in patents granted to A. A. Clokey, Nos. 1,522,865 of January 13, 1925 and 1,521,870 of January 6, 1925. In these two patents, distributors are disclosed which rotate at the proper speed for maintaining the vibration of the armature of the relay operating as a Gulstad relay in synchronism with the received impulses. The resistances and condensers of the Gulstad system are replaced partially by distributors which control the speed of relay operation. Here again however, the armature of the relay vibrates continually and there is therefore the same drawback of wear on the armature.

The present invention provides arrangements for operating electro-responsive devices of the Gulstad relay type in such a manner that there is normally no wear on the armature part and the operation is automatically maintained in syncronism with the signal impulses.

This invention also provides for operating electro-responsive devices in a similar manner to that of the Gulstad relay, but avoids any moving or vibrating parts, thus eliminating failures from this source on high speed circuits.

An object of this invention is to provide means for repeating attenuated received impulses.

Another object of this invention is to provide means for repeating attenuated signalling impulses by electro-magnetic means arranged in such circuits that their armatures do not vibrate while signals are not being received.

Still another object of this invention is to provide means whereby the printer selecting magnets may be safely operated for a greater percentage of the signal period than could normally be obtained under the Gulstad relay system.

There are other objects of this invention which together with the foregoing will appear in the specification which follows in which:

Fig. 1 illustrates the circuit arangement representing a preferred embodiment of the invention.

Fig. 2 shows the curve representing the wave shape of signals at the transmitting end of the system.

Fig. 3 shows the curve representing the wave shape of the signals at the receiving end.

Fig. 4 shows the wave shape of the signals repeated by one of the receiving relays.

Fig. 5 illustrates the wave shape of the signals repeated by the other of the reeeiving relays.

Fig. 6 illustrates the wave shape of the signals transmitted to the printer selecting magnets.

Fig. 7 illustrates the signal waves of a second combination of impulses at the transmitting end.

Fig. 8 illustrates the wave shape of the same signal at the receiving end.

Fig. 9 shows the wave shape of the signals repeated by one of the receiving relays.

Fig. 10 shows the wave shape of the signals repeated by the second receiving relay.

Fig. 11 illustrates the wave shape of the signals which are transmitted to the printer selecting magnets.

In Fig. 1, a cable 1, extending from a distant station and terminating at the local station, is connected in series with a receiving relay 2. The relay 2 is a three-position line relay which is so designed that its armature tongue 3, under the influence of springs 4, remains in a fixed central position touching neither of its contacts, when no signals are received.

The receiving distributor comprises two sections, 6 and 7. The section 6 consists of a continuous ring 5 and a second ring 8 divided into segments. A brush 9 as it rotates bridges the continuous ring 5 and the segmented ring 8. The ring 8 has its alternate odd member segments, that is, the first, fifth, ninth, etc., multipled and connected to the winding 10 of the repeating relay 11 and the other group of alternately odd numbered segments, that is, the third, seventh, eleventh, etc., multipled and connected to the winding 12 of repeating relay 13.

The relays 11 and 13 are two-position relays equipped with two windings, main windings 10 and 12 and local windings 14 and 15. One side of each of the main windings 10 and 12 is connected to the mid-point of the battery, while the other side is connected to the segmented ring 8 as described above. The local winding 14 of relay 11, it will be noted, is controlled by armature 18 of relay 13, while local winding 15 of relay 13, is controlled by armature 19 of relay 11. The magnetic effect of these windings, while sufficient to move their respective armatures, is overcome by the magnetic effect of the current flowing through windings 10 and 12, which can move the armatures in opposition to force exerted by windings 14 and 15.

Ring 20 is divided into segments each of which is equal in length to two of the segments of ring 8 and positioned so as to cover a space opposite two adjacent successive odd and even segments of ring 8. The odd numbered segments of ring 20 are multipled to each other and connected to the armature 19 of the relay 11 and the even numbered segments are similarly multipled to each other and connected to the armature 18 of the relay 13. The ring 21 is divided into segments equal or approximately equal, in length to those of ring 20 and the printer magnets 22 are connected to each of the individual segments of the ring 21. A brush 23 bridges the rings 20 and 21 as it rotates. This brush is mechanically connected to brush 9 and is rotated therewith by means of a motor (not shown). The operation of the arrangement shown is as follows:—

When no current is flowing in the main line 1, the armature 3 of the relay 2 assumes a mid-position between its contacts. As the brush 9 passes over ring 5 and the segments 8, no circuit is completed for the windings 10 or 12 by reason of the fact that the armature 4 is at its mid-point and is not connected to either the positive or negative side of the battery.

If the armature 19 of the relay 13 is, at this time, in engagement with its right hand contact as shown, a circuit is completed for the winding 15 of the relay 13 over a circuit from the negative side of the battery to the right hand contact and armature 19 and through the winding 15 of the relay 13 to the mid-point of the split battery. The direction of this current flowing through the winding 15 is such as to move the armature 18 to its left hand position and it therefore contacts with the positive side of the battery. As a result of the armature 18 engaging its left hand contact, a circuit is completed for the winding 14 of the relay 11 from the positive side of the battery to the left hand contact and armature 18 and through the winding 14 of the relay 11 to the split of the battery. The current flow in this circuit will tend to hold the armature 19 in engagement with its right hand contact as shown. In this manner, while no impulses are being received, the armature 19 remains in engagement with its right hand contact and the armature 18 remains in engagement with its left hand contact.

The brush 23 mechanically connected to the brush 9 and rotating therewith, will alternately connect the armatures 19 and 18 to the receiving printer magnets 22. As the brush 23 wipes over the segments of rings 20 and 21, alternate negative impulses from the armature 19, and positive impulses from the armatures 18 are impressed upon the printer receiving magnets 22.

If now, as the brush 9 passes over the first segment of ring 8, an impulse is being received over the cable 1, of such a polarity as to move the armature 3 into engagement with

its left hand contact, a circuit is completed for the winding 10 of the relay 11 from the positive side of the battery through the left hand contact and armature 3, over the ring 5, brush 9, the first segment of the ring 8 and through the winding 10 of the relay 11 to the mid-point of the battery. The energization of the winding 10 provides a magnetic force which overcomes the energizing effect of winding 14 with the result that the armature 19 is moved into engagement with its left hand contact. As a result of armature 19 engaging its left hand contact, a circuit is completed for the winding 15 with a current flow of opposite polarity from that in the circuit for this relay previously traced, with the result that the armature 18 is moved into engagement with its right contact. A further result of the movement of the armature 19 into engagement with its left hand contact is to complete a circuit of opposite polarity from that previously traced for the printing magnet. If the received impulses over the cable 1 continue of the same polarity and strength, the armature 3 remains in engagement with its left hand contact and as the brush 9 moves into engagement with the next odd numbered segment 3, a circuit is completed from the positive side of the battery through the left hand contact and armature 3, the ring 6, brush wiper 9, and number three segment of the ring 8, and through the winding 12 of the relay 13 to the split of the battery. The current flowing through the winding 12 of this relay will overcome the magnetic effect of the current flowing through the winding 15 with the result that the armature 18 is moved into engagement with its left hand contact and a positive impulse is again transmitted to the printer receiving magnet.

If, on the other hand, no signal is received as the brush 9 moves into engagement with the third segment of the ring, there will be no current flowing through the winding 12 and the current flow through the winding 15 will be such as to maintain armature 18 in engagement with its right hand contact.

If the signal being received when the brush 9 engages the first segment of ring 8 is of the opposite polarity from that originally assumed and armature 3 is moved into engagement with its right contact, the circuit completed for winding 10 is the same as that traced above except that the polarity of the current is reversed. As a result, the current flowing through windings 10 and 14 acts accumulatively to hold armature in engagement with its right hand contact. As the brush 9 moves into engagement with the third segment of ring 8, a circuit is completed for winding 12 as traced above except that the polarity is reversed. This current flowing through 12 reverses the armature 18, moving it into engagement with its right hand contact.

In this manner, it will be noted that with no signals being received, relays 11 and 13 tend to maintain their respective armatures on contacts associated with opposite polarities. As long as dot impulses are being transmitted, these are too weak when received to operate the receiving relay. By thus maintaining armatures 18 and 19 associated with opposite battery polarities, impulses are transmitted to the printer receiving magnets as if relayed from the line impulses.

As soon as a long impulse of a predetermined polarity is received, this impulse will reverse the armature of one or the other of the repeating relays 11 and 13, depending on the brush position at the instant the impulse is received, in the manner described above and maintain control as long as the impulse is being received.

Referring to Figures 2 to 11 the wave shape of signals as transmitted, received, and relayed to the printer magnets are shown. In Fig. 2, the wave shape of a code combination of impulses, at the transmitting end is shown. In Fig. 3, the wave shape of the same code as received is shown. It will be noted that the first or dash impulse transmitted is received only in part, the first portion being too attenuated to operate the receiving relay. Only a predetermined interval after the impulse has been impressed on the line at the transmitting end is the the impulse received. Similarly, only a part of the second signal which also is a dash impulse is received. The next three or dot signals are not received at all.

Referring to Figs. 4 and 5, the effect of the code impulses on the repeating relays 11 and 13 is shown. During the first period, no effect of the code impulses is produced and relay 11 is shown transmitting a positive pulse. Ordinarily, this would be followed by a negative pulse from relay 13, but during the second period, the dash impulse is received and reverses the armature of relay 13 as shown in Fig. 5. Since a printer magnet is under control of the relay 13 at this time, an impulse of the same polarity as in the preceding period is impressed on the printer magnet as shown in Fig. 6. The remaining portion of curves shown in Figs 4 and 5 are self-evident when considered in connection with the above description. It will be noted, upon examination, that Fig. 6 is a duplicate of that shown in Fig. 2. That is, the impulses operating the printer magnets are of the same shape as those transmitted, notwithstanding the attenuation of those signals over the long transmitting line.

Similarly, Figs. 7 to 11 show the effect when dot impulses are being transmitted. According to Fig. 8, none of these signals are received. Figs. 9 and 10 illustrate the

impulses repeated by relays 11 and 13 and Fig. 11 illustrates the impulses actually operating the printer magnets which, as will be noted, are similar to those transmitted as shown in Fig. 7.

Due to the distortion and phase shift of line signals it is desirable to utilize only a portion of each signal impulse for operation. Referring again to Fig. 1, it will be noted that only 50% of the signal period is utilized, all of the even numbered segments of ring 8 being left idle. The odd numbered segments are each positioned to connect windings 10 and 12 to the armature 3 at the mid-portion of the signals.

Although only 50% of the signal period is utilized for operating the relays 11 and 13, the printer selecting magnets may be operated for any percentage of the signal period up to and including 100%. By means of this feature more time is available for operating the printer magnets at any given speed than is the case under the Gulstad relay system. This feature is particularly advantageous for a high speed circuit.

The invention has been disclosed in connection with an even number of channels, but it is evident that the apparatus could be easily modified to operate for an odd number of channels by merely taking care of the odd impulse. It is also evident that the three-position relay 2 is not a necessary part of this invention. The signalling circuit could be directly connected through the distributor to the relays 11 and 13.

Although this invention has been disclosed in connection with printer selecting magnets at a terminal receiving station, obviously the printer selecting magnets may be replaced by other electro-responsive devices, such as retransmitting relays, the circuits disclosed herein would function as a repeater at an intermediate relay station. These relays may transmit through distributor for brush transmission or direct into line. It is to be understood that such use as repeaters is covered in my claims.

Although the invention is shown as applied to a specific arrangement, it is not to be taken as limited to this form but only in so far as set forth in the appended claims.

I claim—

1. In a signalling system, a transmission line, a plurality of printing magnets, electro-magnetic means provided with armatures for relaying impulses received from said transmission line to said receiving printer magnets, means including circuit arrangements for maintaining the armatures of said electro-magnetic means in engagement with a predetermined contact while no impulses are being received over said line, and means including the armatures of said electro-magnetic means for periodically reversing the polarity of impulses to said receiving printer magnets while no impulses are being received over said line.

2. In a signalling system, the combination with an incoming transmission line, of receiving printer magnets, electro-magnetic means for relaying impulses received over said transmission line to said printer magnets, and means for maintaining said electro-magnetic means non-operative when no impulses are being received while repeating impulses of reverse polarity to said printer magnets.

3. In a signalling system, over which the signalling impulses transmitted are so attenuated that the dot impulses are not received printed receiving magnets and electro-magnetic means including armatures therefor arranged to operate said printer magnets in accordance with said signalling impulses transmitted over said signalling line, said electro-magnetic means being arranged to hold their armatures in engagement with a predetermined fixed contact while operating said printer magnets in response to the dot impulses.

4. In a signalling system over which the signalling impulses transmitted are so attenuated that the first portion of each impulse is not received at the receiving end, printer receiving magnets, and circuit arrangements including electro-magnetic means for operating said printer magnets in accordance with the transmitted signalling impulses, said electro-magnetic means being arranged to be non-operative during the transmission of the dot signals while relaying said signals to said printer magnets.

5. In a signalling system, a plurality of printer receiving magnets, means for transmitting impulses of periodic reversed polarity to said printer magnets, said means being maintained in a predetermined fixed position while transmitting said impulses of reversed polarity, and means for operating said first mentioned means in response to signalling impulses transmitted over said signalling system.

6. In a signalling system, a transmission line, means for transmitting signalling impulses over said transmission line, printer receiving magnets, means for transmitting impulses of reversed polarity to said printer receiving magnets while maintaining said means in fixed position and means for operating said first mentioned means in response to received impulses.

7. In a telegraph system, a plurality of receiving magnets, electro-magnetic means including armatures therefor for transmitting impulses of reversed polarity to said receiving magnets, said armatures being maintained in engagement with their fixed contacts while transmitting said impulses and

means responsive to received impulses for operating said armatures to their reversed position.

8. In a telegraph system, a signalling line over which the signalling impulses are attenuated, a plurality of receiving magnets, electro-magnetic means, a distributor, means including said electro-magnetic means, and said distributor for operating said receiving magnets in accordance with the operation of said electro-magnetic means, and means independent of said distributor for operating said electro-magnetic means, in accordance with received impulses.

9. In a telegraph system, a distributor, a first relay including an armature, a local circuit, a second relay, means including said local circuit arranged to produce a magnetic effect on the armature of said first relay to cause movement of the armature, said local circuit being independent of said distributor and receiving magnets, and means including said distributor for operating said receiving magnets in accordance with the operation of said first relay.

10. In a telegraph system, the combination with a signalling line over which the signalling impulses transmitted are so attenuated as not to be received, and electro-magnetic means including an armature therefor at said receiving end for relaying said impulses, said electro-magnetic means being arranged to move the armature only in response to the received signals.

11. In a telegraph system, a signalling line over which signalling impulses transmitted are so attenuated that the dot impulses are lost, receiving electro-magnetic means including armatures, printer magnets, means including the armatures of said electro-magnetic means for operating said printer magnets in accordance with the signals transmitted over said signalling line, and means including circuit arrangements whereby the armatures of said electro-magnetic means are moved only in response to impulses received.

12. In a telegraph system, means for transmitting code combinations of impulses over said signalling line, means whereby only certain of said impulses are received, and electro-magnetic means including the armatures therefor for relaying all of the impulses transmitted over said signalling line, said electro-magnetic means being operative to move its armatures only in response to actually received impulses.

13. In a telegraph system, a signalling line over which impulses transmitted are attenuated, a first and a second electro-magnetic means, receiving magnets, means including said electro-magnetic means for transmitting impulses of a reversed polarity to said receiving magnets, each of said electro-magnetic means being under the control of the other and means for operating said electro-magnetic means in accordance with the impulses impressed on said signalling line.

14. In a telegraph system over which signalling impulses are so attenuated that they do not operate receiving apparatus, receiver relays, repeating means for repeating impulses received over said line to said receiver relays, said means being normally non-operative while impulses are attenuated, and means including circuit arrangements whereby said first mentioned means repeats said attenuated impulses to said receiver relays.

15. In a telegraph system, the combination at a terminal station or a repeating station, of an incoming transmission line, electro-responsive devices, means serving to supply impulses of reversed polarity to said electro-responsive devices while maintaining said means in a predetermined position.

16. In a telegraph system, the combination at a terminal station or a repeating station, of an incoming transmission line, a plurality of electro-responsive devices, means for supplying impulses of periodic reversed polarity to said electro-responsive devices, said means being maintained in a predetermined fixed position while transmitting said impulses of reversed polarity, and means for operating said first mentioned means in response to signalling impulses transmitted over said line.

17. In a telegraph system as set forth in claim 8, said distributor being arranged to actuate the receiving magnets during substantially 50% of a unit signal impulse period while permitting the transmission of impulses to the printer magnets for any desired percentage of the unit signal impulse period up to 100%.

18. In a telegraph system, an incoming transmission line, a plurality of receiving magnets, a pair of relays having armatures for transmitting impulses of reversed polarity to said receiving magnets, said armatures being maintained in engagement with their fixed contacts when transmitting said impulses, and means for transmitting signalling impulses received over said line in alternation to said relays.

19. In a signalling system, a transmission line, a plurality of electro-responsive devices, electro-magnetic means provided with armatures for relaying impulses received from said transmission line to said electro-responsive devices, means including circuit arrangements for maintaining the armatures of said electro-magnetic means in engagement with a predetermined contact while no impulses are being received over said line, and means including the armatures of said electro-magnetic means for periodically reversing the polarity of impulses to said electro-responsive devices while no impulses are being received over said line.

In testimony whereof I affix my signature.

MARION H. WOODWARD.

DISCLAIMER

1,699,418.—*Marion H. Woodward*, Brooklyn, N. Y. TELEGRAPH SYSTEM. Patent dated January 15, 1929. Disclaimer filed November 9, 1929, by the assignee, *The Western Union Telegraph Company*, patentee, said *Woodward* concurring.

Hereby enters this disclaimer limiting said claim 9 of said patent as follows, to wit:

In claim 9, restricting the expression "said local circuit being independent of said distributor" so that it shall be interpreted and construed as though it read "said local circuit being independent of any distributor."

[*Official Gazette December 3, 1929.*]