

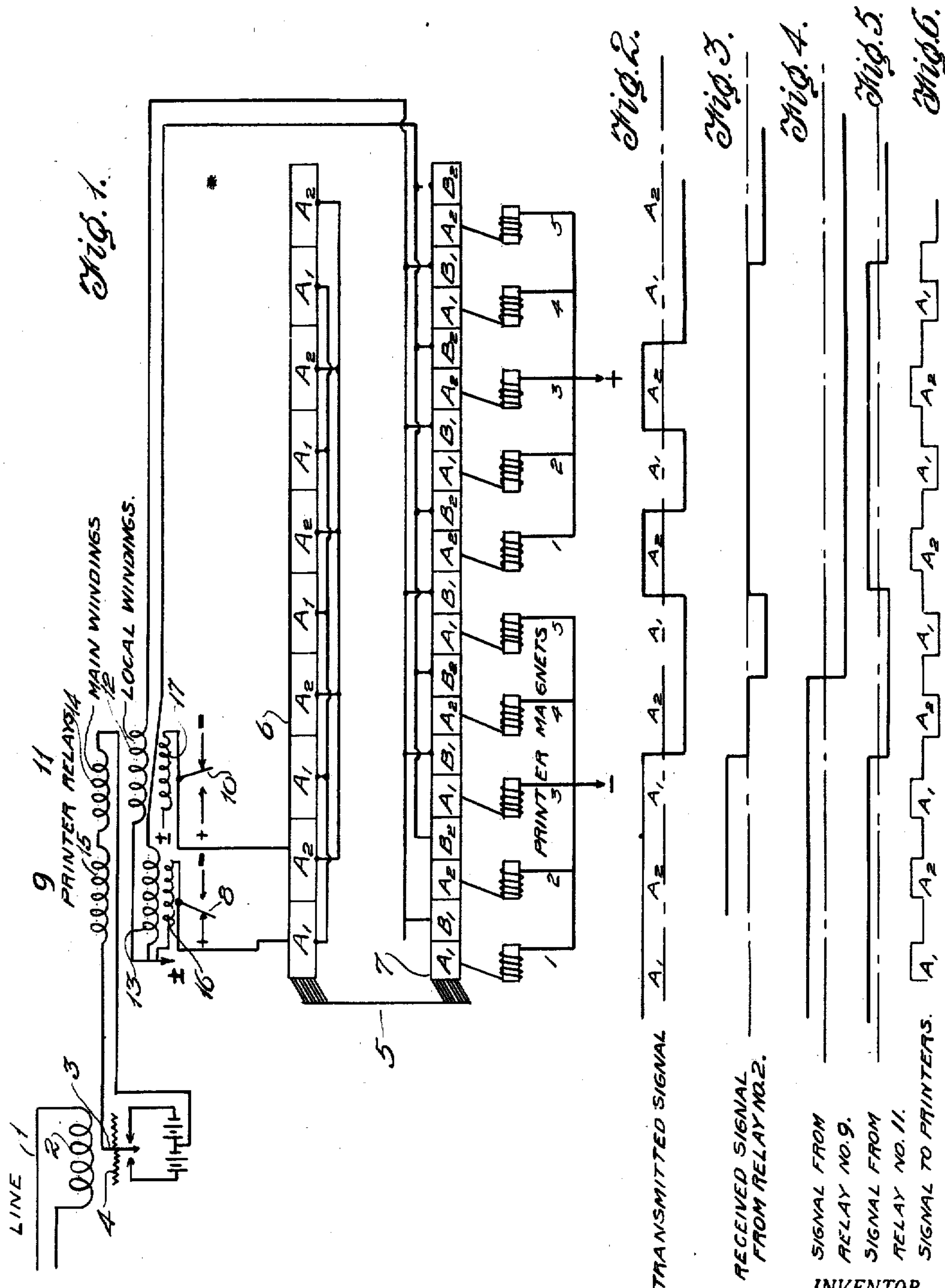
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TELEGRAPH SYSTEM

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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 or dot impulses 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 inherent in the Gulstad relays were made in the systems disclosed in patents granted to A. A. Clokey, Nos. 1,522,865 of January 18, 1925 and 1,521,870 of January 6, 1925. In these two patents, distributors are employed which rotate at the proper speed for maintaining the vibration of the armature of the relay operating as the 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 or 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, such as a relay, for the reception of attenuated impulses in such a manner that there is normally no wear on the armature part and greater reliability is provided since the chance of errors due to moving parts is eliminated, and the operation is automatically maintained in synchronism with the signal impulses.

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.

A further object of my invention is to insure greater reliability of operation since the relay armatures do not move when supplying single dot impulses to the printer magnets.

Other objects of this invention will appear in the following detailed description in which reference will be made to the accompanying drawings.

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

Fig. 2 shows the curve representing the wave shape of the 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 receiving relays.

Fig. 6 illustrates the wave shape of the signals transmitted to the printer selecting magnets or other electro-responsive devices.

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 mid-position touching neither of its contacts, when no signals are received.

The armature 3 of the relay is connected in series with windings 15 and 14 of relays 9 and 11. The relays 9 and 11 are two position relays equipped with three windings, main windings 15 and 14, respectively arranged in series with each other and with the armature 3, local windings 13 and 12 connected to the ring 7 in a manner to be described, and locking windings 16 and 17 for maintaining the armatures in either position.

The receiving distributor in part comprises rings 6 and 7, ring 6 being divided into a number of segments, one for each printer selecting magnet of each channel and ring 7 being divided into twice the number of segments as that of ring 6, two adjacent segments of ring 7 being associated with each segment of ring 6.

The odd segments of ring 6 are multiplied to each other and connected to the armature 8 of relay 9 and the even segments of ring 6 are similarly multiplied to each other and connected to armature 10 of relay 11.

The alternating even numbered segments of ring 7, that is, the second, sixth, tenth, etc., are multiplied to each other and connected to one winding 12 of the relay 11 and the remaining even numbered segments, that is, the fourth, eighth, twelfth, etc., are multiplied to each other and connected to winding 13 of relay 9. The odd numbered segments of ring 7 are individually connected to printer receiving magnets.

The operation of the arrangement disclosed is as follows:—

When no current is flowing in the main line, the armature 3, of the relay 2, assumes a mid-position between its contacts. With this condition there is no current flowing in the windings 15 and 14 of the relays 9 and 11 respectively. If, at this time, the armature 8 of relay 9 is in engagement with its left hand contact and the brush is wiping over the segment A_1 of ring 6, a circuit is completed for the first printer magnet from the positive side of battery, the left hand contact and armature 8, through the segment A_1 of ring 6, the brush 5, the seg-

ment A_1 of ring 7 and through the winding of the printing magnet to the negative side of battery.

As the brush 5 moves over the ring 7, it engages the segment B_1 , and a circuit is completed for the local winding 12, from the positive side of battery over the left hand contact, armature 8 and over the segment A_1 of ring 6 and brush 5, segment B_1 of ring 7 and through the winding 12 of the relay 11 to the mid-point of the battery. This current is of such a polarity as to move the armature 10 into engagement with its right-hand contact. As the brush 5 now moves into engagement with the segment A_2 of ring 6, the second printer magnet is connected to negative battery through the right-hand contact and armature 10, and through the segment A_2 of ring 6 and brush 5, the segment A_2 of ring 7 and through the printing magnet back to the negative or same side of battery and hence no current will flow through the printer magnet and no selection is made. As the brush moves on into engagement with the segment B_2 of ring 7, a circuit is completed for the winding 13 from the negative side of the battery, the right-hand contact and armature 10, through segment A_2 of ring 6, brush 5, segment B_2 of ring 7, through the winding 13 of relay 9 to the mid-point of battery.

The current flowing through the winding 13 is of such polarity as to hold the armature 8 in engagement with its left-hand contact. In this manner, the windings 13 and 12 are each controlled by the armature of the other, and the circuits are such that normally with no current flowing through the windings 15 and 14, the armatures 8 and 10 are maintained in engagement with batteries of opposite polarity, each under the control of the other, so that current is transmitted to the printer magnets periodically of reverse polarity, thereby producing the same effect as if impulses of dot character were periodically being received over the line.

If at the instant the brush 5 is in engagement with the segment A_2 of ring 6 and B_2 of ring 7, an impulse is received over the cable or line 1 which actuates the line relay 2 so as to move the armature 3 into engagement with its right-hand contact. A circuit is thereby completed from the negative side of battery to the right-hand contact and armature 3, and through the windings of relays 15 and 14 in series to the mid-point of the battery. As a result of this current flowing through the main windings 15 and 14, the armatures 8 and 10 are moved into engagement with their right-hand contacts, thereby completing a circuit for the receiver magnets and furnish thereto in proper sequence the same polarity of battery as is denoted by relay 2, which in this case is negative battery.

As the brush 5 moves into engagement with the segment B₁ of the ring 7, a circuit is completed for the winding 12 similar to that traced above, except that the polarity is reversed by reason of the fact that the armature 8 is now in engagement with its right-hand contact and connected to the negative side of battery. This current will tend to move the armature 10 into engagement with its left-hand contact in opposition to the magnetic effect of the current flowing through the winding 14. However, the magnetic effect of the current flowing through the winding 12 is not sufficient to move the armature 10 and the armature therefore remains in engagement with the right-hand contact. This is assuming, of course, that the current is still flowing in the main line and the armature 3 is maintained in engagement with its right-hand contact, during this period, thereby continuing the current through the winding 14.

As the brush 5 moves into engagement with the segment A₂ of the ring 6 and the segment A₂ of the ring 7, a circuit is completed for the printing magnet 2, similar to that traced above. If on the other hand, the current flowing over the line 1 had ceased by the time the brush 5 engaged the segment A₂ of the ring 6, and the segment A₂ of the ring 7, the current flow in the local winding 12 from the armature 8, (due to the fact that it is in engagement with its right-hand contact and therefore is causing current to flow through the winding 12 of reverse polarity from that originally traced), will cause the armature 10 to move into engagement with its left-hand contact, and a circuit will thereupon be completed for the printer magnet to the negative side of battery, as distinguished from the condition when the current continued to flow in the line winding and the armature 10 remained in engagement with its right-hand contact.

It will be evident from the description above, that while no signals are being received, the printer magnets are operated by periodic reversals of polarity, received from the armatures 8 and 10 which are maintained in engagement with contacts connected to polarities opposite from each other. These armatures are maintained in engagement with these contacts each under the control of the other. As soon as an impulse of a predetermined polarity is received over the signalling line, the armatures 8 and 10 are moved in accordance with the received impulse, so that the relays 9 and 11 operate in response to the received impulse. As long as the received impulse operates the line relay, the armatures 8 and 10 are maintained in engagement with the proper contacts according to the polarity of the received impulse to operate the printer mag-

net. As soon, however, as the impulse ends, the armature of the relay associated with the segment upon which the brush is in engagement at the time the impulse ends, will cause the armature of the other relay to move to an opposite position.

It will be noted that by the arrangement on ring 7, the printer magnets are operated only in response to a portion of the received impulse period, while the remaining portion is utilized for operating the local winding of the other receiving relay. By the arrangement disclosed in this system, the armatures 8 and 10 are maintained in engagement with predetermined contacts notwithstanding the fact that the printer magnets are operated by periodic reversals of polarity similar to the effect produced by a reception of dot impulses over the cable or signalling line. The armatures 8 and 10 are only moved in response to received signals and only following the reception of such signals are they again positioned to opposite polarity contacts.

No problem of synchronization of relays is involved, since there is no vibrating part, as in the case of the Gulstad relay. It is only necessary to keep the distributor 5 rotating in synchronism with the signalling impulses in a manner well known in the art.

Figs. 2 to 6, illustrate respectively the wave shapes of the signals which are transmitted and received, and which actually operate the printer relays. In the particular illustration the first signal comprises a dash impulse equal in length to three dots; the succeeding signal is a dash impulse which is equal in length to two dots, while the third, fourth and fifth signals are dot impulses.

Referring to Fig. 3, it will be noted that the first part of the dash impulse is not received, due to the fact that this portion has been attenuated by the long cable or signalling line to such a degree that no effect is produced on the receiving relay.

Figs. 4 and 5, show the effect of the receiving impulse on the main windings 15 and 14 of the relays 9 and 11. The first portion of the dash impulse, it will be noted, affects the relays 9 and 11 alike, due to the fact that the relays are connected in series. However, as soon as the impulse ends, and the relays 9 and 11 are deenergized, the brush being in engagement at this time, with the segment A₁ of the ring 6 and segment B₁ of ring 7, the segments being respectively the third and the sixth, the relay armature 8 remains in engagement with its contact under control of the line impulse, while at the same time, a current is transmitted to the winding 12, which, as will be seen by reference to Fig. 5, causes this armature to reverse and engage its opposite contact. Referring to Fig. 6 it will be noted that the printing magnets are operated by

impulses exactly in accordance with those transmitted. The zero position shown between the impulsing periods is due to the fact that only a part of each impulsing period is utilized for operating the receiving relay.

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.

The receiving relay 2 is shown as being connected directly to line but it may, of course, be connected in the output of an amplifier such as is usually interposed between the cable relay and the local relays. While it is advantageous to use a three-position receiving relay 2, yet it is evident that it may be eliminated, the relays 9 and 11 being connected to the cable relay or in the output of an amplifier.

I have illustrated my invention as used at a receiving terminal station but it will be understood by telegraph engineers that by substituting a set of five relays or other electro-responsive devices, for the printer magnets, this invention may be used at a repeating station, the signals being repeated either by direct transmission or through a distributor for brush transmission.

I claim:—

1. In a telegraph system, a plurality of receiving magnets, electro-magnetic means including armatures therefor, for transmitting impulses of reversed polarity to said magnets, a distributor, means including said distributor for operating the armatures of said electro-magnetic means, each electro-magnetic means being under the control of the other, and means independent of said distributor for operating said armatures of said electro-magnetic means in response to impulses received over a cable or signalling line.

2. In a telegraph system, a cable or signalling line over which 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 printer magnets in accordance with the operation of said electro-magnetic means, means including said distributor for operating each of said electro-magnetic means under control of the other of said electro-magnetic means, and means independent of said distributor for operating said electro-magnetic means in accordance with impulses received over said line.

3. In a telegraph system, a distributor, a relay including an armature, a local circuit, a second relay arranged to produce a magnetic effect on the armature of said first relay in accordance with the movement thereof, said local circuit including said distributor and receiving magnets, and

means including said distributor for operating said receiving magnets in accordance with the operation of said first relay.

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

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

6. In a signalling system, a transmission line, means for transmitting impulses over said transmission line, printer receiving magnets, a distributor, second means together with said distributor for transmitting impulses of reverse polarity to said printer receiving magnets, while maintaining said second means in fixed position, and means independent of said distributor for operating said second mentioned means in response to received impulses.

7. In a signalling system, a signalling line over which the impulses sent are so attenuated that the first portion of each impulse is not received at the receiving end, printer receiving magnets, a distributor, means together with said distributor for operating said printer magnets in accordance with said received impulses, said means being maintained normally non-operative during the transmission of dash signals while repeating said dash impulses to said printer receiving magnets.

8. In a telegraph system, printer receiving magnets, electro-magnetic means for transmitting impulses of reversed polarity to said printer magnets periodically, a distributor, means together with said distributor whereby said electro-magnetic means controls the operation of said receiving magnets while remaining non-operative.

9. In a signalling system, a transmission line over which the signalling impulses transmitted are so attenuated that the dot impulses are not received, a plurality of printer magnets, a first and a second electro-magnetic means, each of said electro-mag-

netic means being under the control of the other over circuits including a distributor, means for operating said electro-magnetic means in response to impulses received over
5 said signalling line, said means being independent of said distributor, and means for operating said printer magnets, under control of said electro-magnetic means, said means including said distributors.

10 10. In a signalling system, a signalling line over which impulses transmitted are so attenuated that the impulses of dot character are not fully received, a plurality of printer magnets, a first and a second electro-
15 magnetic means, a distributor, means including said distributor for operating each of said electro-magnetic means under control of the other, means including said distributor for operating said receiving magnets
20 under the control of said electro-magnetic

means, said printer magnet, being operated in accordance with the impulses transmitted over said signalling line, and means for operating said electro-magnetic means only in accordance with the impulses received over
25 said signalling line.

11. In a telegraph system, the combination at a terminal station or a repeating station, of an incoming signalling line, electro-responsive devices, a distributor, second means
30 together with said distributor for transmitting impulses of reverse polarity to said electro-responsive devices, while maintaining said second means in a predetermined
35 position, and means independent of said distributor for operating said second mentioned means in response to received signal impulses.

In testimony whereof I affix my signature.

LEE R. FOSTER.

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DISCLAIMER

1,657,384.—*Lee R. Foster*, River Edge, N. J. TELEGRAPH SYSTEM. Patent dated January 24, 1928. Disclaimer filed November 9, 1929, by the assignee, *The Western Union Telegraph Company*, patentee, said *Foster* concurring.

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

In claims 1, 2, 6, and 11, restricting the element "means independent of said distributor" so that it shall be interpreted and construed as though it read "means independent of any distributor."

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

[*Official Gazette December 3, 1929.*]

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