

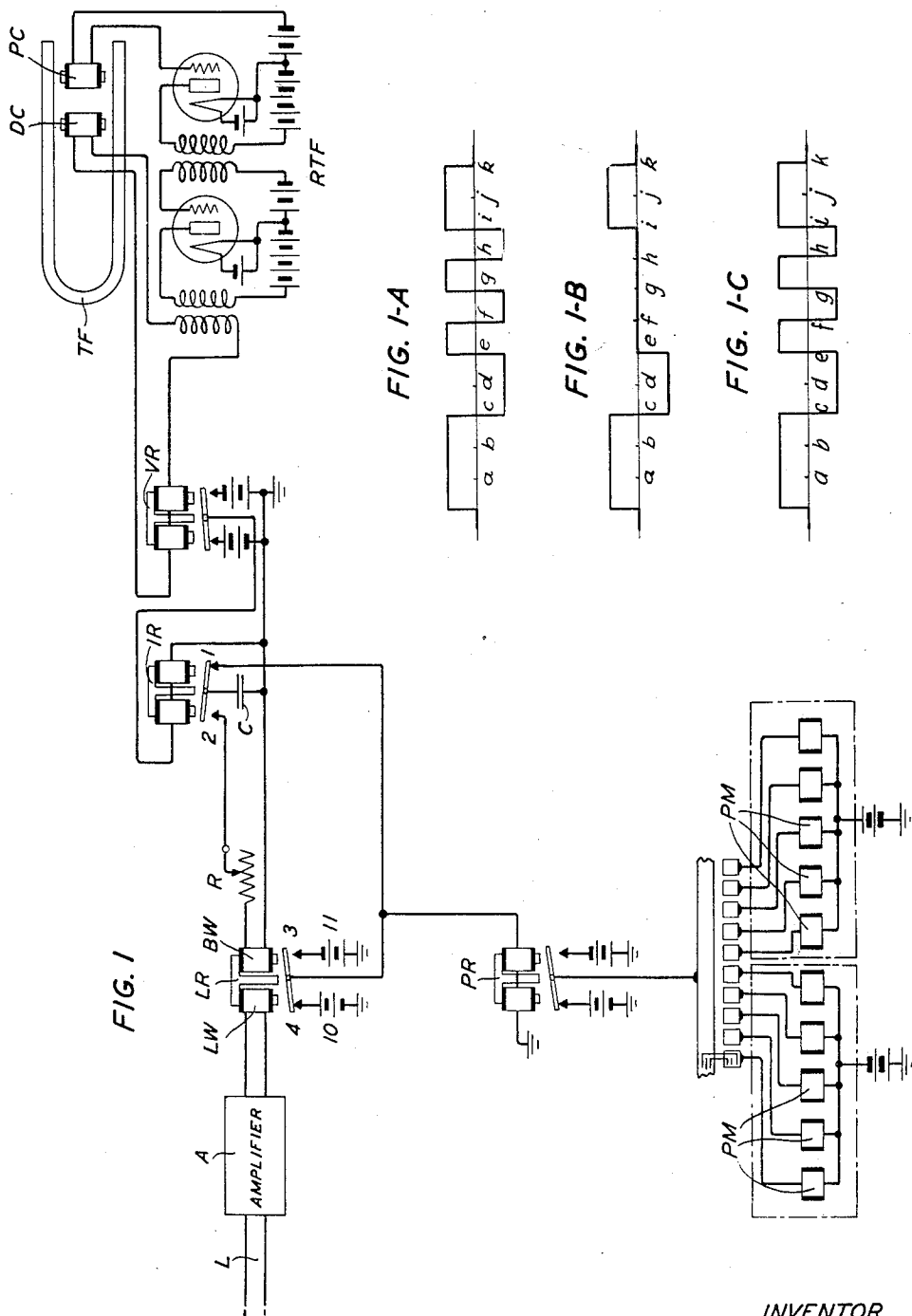
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G. A. LOCKE

1,934,364

IMPULSE RECEIVING SYSTEM

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INVENTOR
G. A. LOCKE
BY
J. W. Schmied
ATTORNEY

UNITED STATES PATENT OFFICE

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IMPULSE RECEIVING SYSTEM

George A. Locke, Glenwood, N. Y., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

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5 Claims. (Cl. 178—88)

The present invention relates to signaling systems and more particularly to systems adapted for long telegraph lines such as submarine cables.

An object of the invention is to improve the transmission efficiency of long line telegraph systems.

Another object of the invention is to simplify the apparatus required for receiving and for repeating telegraph signals over long lines.

A more specific object of the invention is to restore, at the receiving end or at a repeater station of a long telegraph line, the impulses which have been lost in transit, without requiring special distributor rings at the repeating or receiving station for this purpose.

In operating telegraph apparatus by reversals of current over long transmission lines, such as submarine cables, for instance, the signaling currents are so reduced in strength by the line attenuation that the speed of transmission is limited to that at which the short or unit length impulses, after being amplified at the receiving end of the line, are just strong enough to operate the line relay. Such line signals as are constituted by a series of unit length impulses are usually attenuated to such an extent that they are either entirely or at least partly suppressed during the transmission.

In order to fill correctly the gaps corresponding to the lost or weakened impulses, various arrangements have been resorted to in the prior art. In British Patent 9,768 to W. Judd and B. Davies, complete accepted April 23, 1914, the missing unit length impulses are interpolated at the receiving end by a relay synchronized with the transmitting relay.

In accordance with United States patent to A. A. Clokey No. 1,522,865, granted January 13, 1925, the lost impulses are interpolated by a rotary distributor which has two sets of segments for regenerating the lost impulses and which works in combination with a receiving relay.

In accordance with United States Patent 1,680,550, August 14, 1928 to M. B. Kerr, two vibrating relays coact with the receiving distributor to supply impulses lost in transmission in such a manner that only one of the customary two sets of receiving rings is required to interpolate the lost unit length impulses.

The present invention further simplifies the receiving apparatus of long line high speed telegraph systems in that it eliminates all receiving rings except that required to operate the printer magnets, suitable correcting devices being assumed to be present.

In accordance with this invention the lost unit length impulses are restored locally by the co-operation of two vibrating polarized relays. One of these, the usual line relay, has a line winding and a biasing winding. The other, the correcting or interpolating relay, is adapted to vibrate at a frequency twice the line frequency and its armature is connected to a storing condenser which is included in a circuit connected to the biasing winding and controlled by the interpolating relay contacts in a manner to operate the line relay through its biasing winding whenever unit length impulses are transmitted over the line which are too attenuated to operate the line relay through its line winding.

The invention may be better understood from the following detailed description of its features and principles of its operation, in conjunction with the accompanying drawing, in which:

Fig. 1 represents a diagram of a receiving circuit embodying one particular embodiment of the invention; and

Figs. 1A to 1C are schematic illustrations of a succession of impulses transmitted over a line and corrected in accordance with the invention; the reference characters *a* to *k* in these figures are placed at the ends of the impulses.

In Fig. 1, RTF represents a regenerative vacuum tube tuning fork circuit for supplying an alternating current of constant frequency to the vibrating relay VR. This circuit comprises a tuning fork TF, a pick-up coil PC, a drive coil DC, and a two-stage vacuum tube amplifier connected between the coils. Each coil is threaded by a magnetic flux from a permanent magnet, the magnetic circuit of which is completed through the steel tuning fork. Vibration of the fork changes the flux threading the pick-up coil, which generates a feeble alternating current of substantially constant frequency. This current is amplified by the vacuum tube amplifier and applied to the drive coil where it reacts on the fork to maintain the latter in vibration.

The alternating current of constant frequency which is supplied by the circuit described is impressed upon a polarized vibrating relay VR and the system comprising the tuning fork circuit RTF and the polarized relays VR and IR is adjusted to operate at a frequency twice the frequency of the reception of signals over line L. An amplifier A may be inserted in the line and connected to the line winding or polarizing winding LW of the polarized line relay LR in the manner shown. The line relay LR comprises a biasing winding BW in addition to the line wind-

ing LW. The biasing winding is included in a circuit connected to the contacts of the interpolating relay IR and includes an adjustable resistance R for regulating the flow of current in the biasing winding. A printing relay PR and printer magnets PM (five for each receiving channel) typify any suitable receiving mechanism for recording or printing messages.

The operation of the system is as follows:
 Assume that the position of the relay armatures is such as shown in the drawing and that a succession of impulses such as represented in Fig. 1A is transmitted over the line L and amplified by amplifier A. For the positions of the armatures of relays LR and IR as shown, the condenser C is charged with a positive charge from battery 10. As stated above, the armature of relay IR vibrates continuously at a rate twice the line frequency. While the armature of relay LR is in the position shown (that is, it is held there by the line current), the armature of relay IR closes contact 2 and thus discharges condenser C into the biasing winding of relay LR in a direction tending to repel the armature to cause it to make contact with contact 3. Adjustable resistance R is adjusted to such a value that the current flowing in the biasing winding is smaller than any current in the line winding which would correspond to two or more successively received impulses. Therefore, in the present case, the contact 4 will remain closed until the reception of impulses *a*, *b* and *c* is completed. During the time interval of this reception, the printer relay PR will thus receive three marking impulses as shown in Fig. 1C. The succeeding portion of the message transmitted (Fig. 1A) is constituted by the two spacing impulses *d* and *e* which are transmitted by the reversal of the current flowing in the line and in the line winding of the line relay LR. Relay LR being polarized, the reversal of the current flow in its line winding will cause its armature to change its position to make contact with the negative terminal 3 of the battery 11. The change of the position of the armature of relay LR has a twofold effect: First, for the time interval during which the armature makes contact with the negative terminal of the battery 11 (i. e. for the duration of the two impulses *d* and *e*), a succession of two spacing impulses will be transmitted to the printer relay PR; see Fig. 1C. Second, immediately after the closure of contact 3, the condenser C will be charged with a negative charge from battery 11, and when contact 2 of relay IR closes, on the next half cycle of vibration of its armature, the condenser will discharge through winding BW in opposite direction to the previous discharge. This will tend to reverse the direction of the armature of relay LR, but since, as explained above, the current flowing in winding BW is weaker than that in winding LW, the armature of relay LR will not be moved from the negative contact of battery 11 and two spacing impulses *d* and *e* will be transmitted to the printing relay PR, as shown in Fig. 1C. The next current impulse received from line L is a single unit length marking impulse *f*. Such a unit length impulse, if received at all, after transmission over a relatively long line such as a submarine cable for instance, is attenuated to such an extent that even after amplification it is too weak to repel the armature of the line relay LR from its negative or spacing contact 3. Consequently, this impulse and the unit length impulses succeeding it, would not be received by the printer relay PR, and Fig. 1B illustrates the

gap extending from *e* to *i* which this suppression of the unit length impulses would produce in the continuity of the signaling impulses as received by the printer relay PR. While the armature of relay LR keeps contact 3 closed, condenser C is charged with a negative charge from battery 11. As the current flow in the line winding LW is reversed (at the end of impulse *e*, Fig. 1A), the condenser C discharges its negative charge into winding BW in a direction such as to move the relay and armature to the positive contact 4. A positive or marking impulse is, therefore, transmitted to the printer relay PR and to the condenser C. The closing of contact 2 of relay IR causes this positive charge to be discharged into winding BW in a direction to reverse the position of the armature of relay LR since the line current corresponding to the unit length impulses *e* to *i* is too weak to operate the armature of relay LR. As long as the line current is suppressed or is too weak to operate the armature of relay LR, the vibration of the armature of relay IR causes the alternate charging and discharging of condenser C and thus maintains relay LR in vibration at a frequency half of that of relay IR, that is at the line frequency, since as stated above, relays VR and IR vibrate at a constant frequency which is twice the line frequency. As soon as other than unit length impulses are received by the line winding LW, the current therein is again sufficiently strong to control the movements of the armature and the relaying of positive and negative current impulses from batteries 10 and 11 to the printer relay PR.

What is claimed is:

1. A high speed vibrating relay system comprising a line, a source of current having a constant frequency of twice the line frequency, an interpolating relay responsive to the constant frequency current, a line relay normally responsive to line impulses and responsive to impulses from the interpolating relay when unit length line impulses received over the line are of strength insufficient to operate the line relay.

2. A regenerative telegraph repeating system comprising a receiving relay having a line winding and a biasing winding, a source of current for biasing said winding, a second relay for controlling the biasing current, said second relay being adapted to vibrate at a frequency twice the normal line frequency and comprising means for receiving a charge from said source of current, the polarity of said charge being controlled by the position of the armature of the receiving relay, and means for storing said charge and transferring it to the biasing winding, whereby the polarity of the biasing current is determined by the position of the receiving relay armature.

3. In a signaling system, means for producing a series of electrical correcting impulses of constant periodicity twice the periodicity of unit signaling impulses to periodically and alternately open and close a pair of contacts, a line, a polar receiving relay having a line winding controlled by said line, a biasing winding and an armature, a second relay having its armature contacts supplied with current of polarity dependent upon the position of the armature of said line relay over a circuit controlled by the contacts of said line relay, said second relay being operated by impulses from said means, a condenser charged by the make of one contact of said second relay and discharged through said biasing winding upon the make of the other contact whereby said receiving relay is actuated by said discharge from said

condenser when unit length line impulses in said line are of strength insufficient to operate the line relay.

4. A signal impulse interpolating system comprising a source of constant frequency of twice the frequency of the signal impulses, a condenser, two sources of current, two polarized relays of which one has a line winding and a biasing winding and of which the other is responsive to the impulses of constant frequency to alternately charge the condenser from one or the other of said sources and to discharge the condenser through the biasing winding of one of the relays, wherein the position of the armature of the line relay determines the polarity of the condenser charges in such a manner that when impulses of unit length are being lost in said line, the line relay is actuated at one-half the frequency of the interpolating relay in a manner to restore the missing impulses.

5. An impulse interpolating system comprising a signaling line, a polar line relay having a line winding and a biasing winding, a polar interpolating relay, a condenser, means including a circuit and the armatures of both relays for charging said condenser, means including a circuit and the armature of the interpolating relay for discharging said condenser through the biasing winding of the line relay, whereby the condenser is placed alternately in series with one of said circuits to be charged by said source of current, and in the other of said circuits to be discharged in the winding of the line relay whenever there is no current in the line winding thereof, the polarity and direction of the discharge being determined by the position of the armature of said line relay.

GEORGE A. LOCKE.

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