Nov. 16, 1926. 1,606,855

E. F. WATSON

DISTORTION MEASURING SYSTEM

Filed May 10. 1923 2 Sheets-Sheet 1

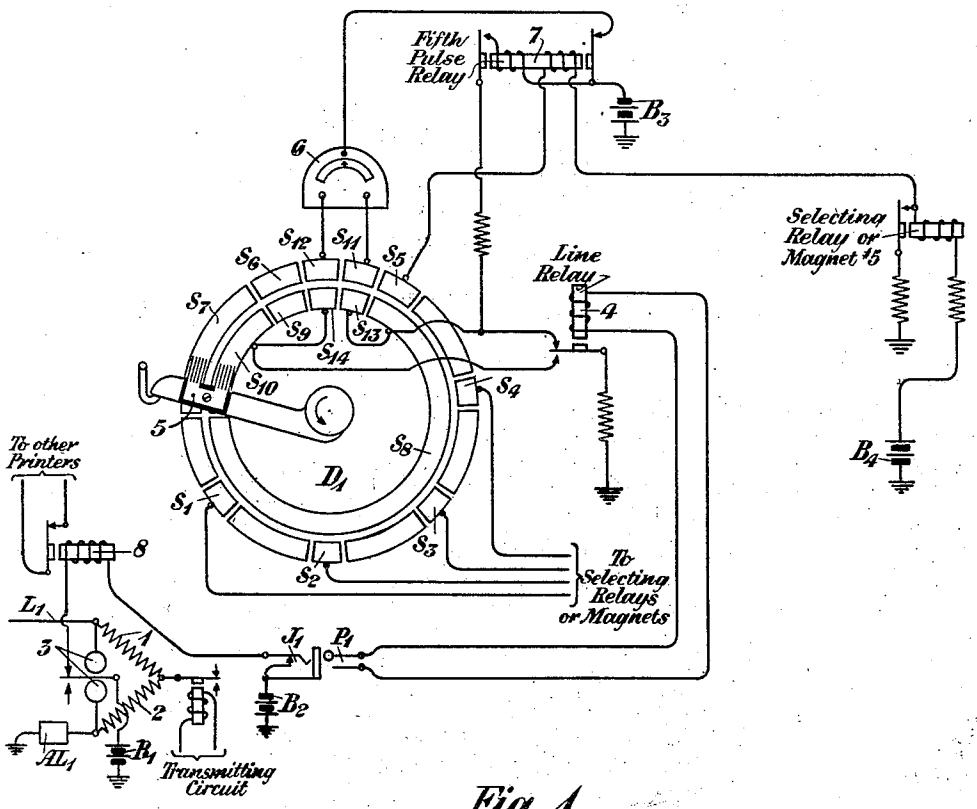


Fig. 1

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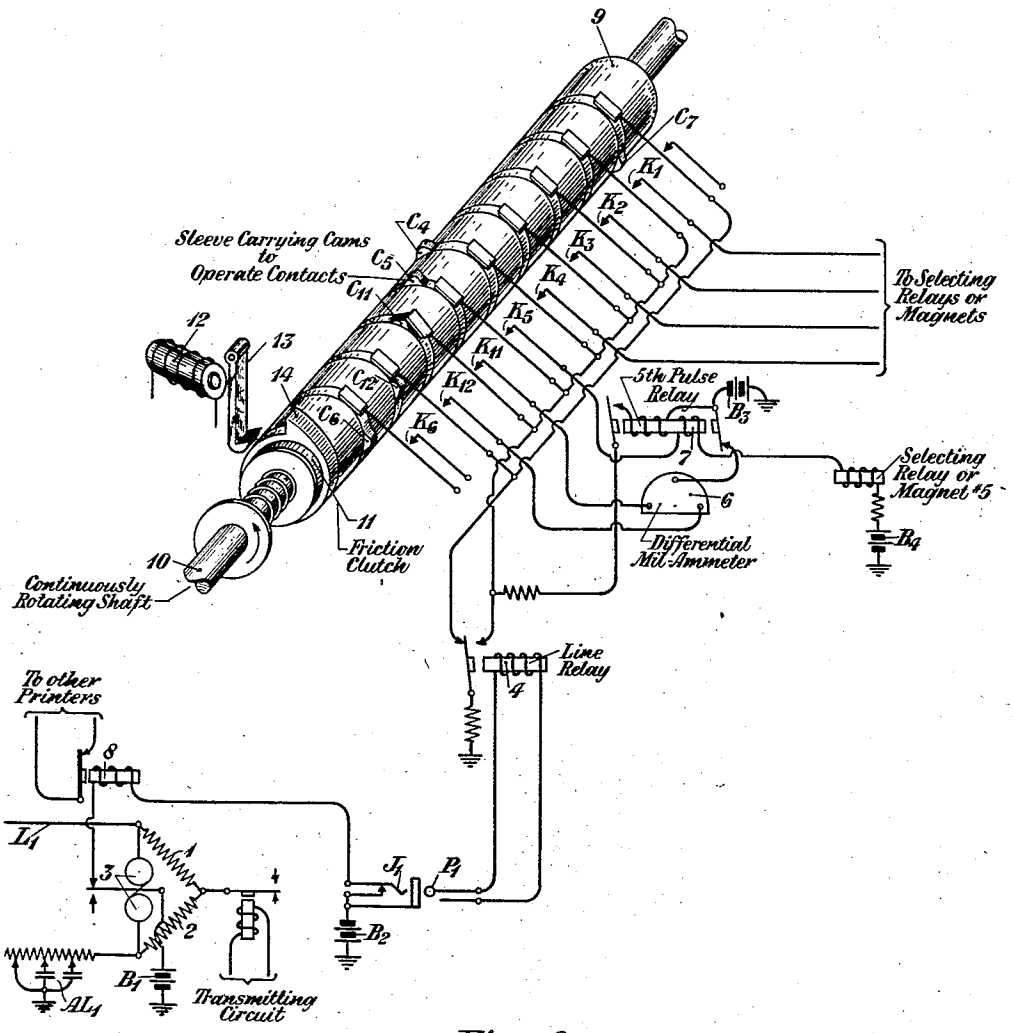


Fig. 2

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Patented Nov. 16, 1926. 1,606,855

UNITED STATES PATENT OFFICE.

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DISTORTION-MEASURING SYSTEM.

Application filed May 10, 1923. Serial No. 638,124.

This invention relates to electrical measuring systems and particularly to means for determining the existance and the magnitude of distortion of signaling impulses such as are used in printing telegraph systems.

In order to obtain efficient operation of printing telegraph systems, it is necessary to eliminate the effect of distortion upon the receiving apparatus connected with the line circuit. If a signal is distorted in the course of transmission over a line circuit an impulse of wrong polarity may be applied to a segment of the receiving distributor, which in turn would produce an incorrect signal character in the apparatus associated therewith. To determine the existance of distortion of telegraph signals at the present time, it is necessary to discontinue transmission of commerical service and send a series of predetermined impulses over the line, which method is obviously inefficient.

It is the object of this invention to provide means so associated with the segments of the distributing ring of the receiving distributor whereby the condition of the incoming signals, viz, the degree of distortion present may be readily determined while the circuit is used for commercial transmission.

This invention will be clearly understood from the following description when read in connection with the attached drawing of which Fig. 1 is an embodiment of the invention in a system using a brush distributor; and Fig. 2 the invention applied to a cam operated distributor.

In Fig. 1, L_1 represents a line over which signals may be transmitted from a distant station, not shown, to the station at which the apparatus shown in the drawing is located. The line L_1 is shown connected with the arms 1 and 2 of a bridged duplex telegraph system having connected therewith the artificial line AL_1 to balance the real line. Bridged across the outer ends of the arms 1 and 2 is a polar relay 3, the armature of which is connected with the grounded battery B_1 and one of the contacts of which is connected with the relay 8 and thence through the jack J_1 with the grounded battery B_2, the polarity of which is opposite that of B_1. The relay 8, which is responsive to the operation of the receiving relay 3, serves to actuate the receiving apparatus of the printing telegraph equipment at the subscribers' stations. The plug P_1, which is connected with the winding of the line relay 4, is adapted to be inserted in the jack J_1 so as to effectively connect the line L_1 with the line relay 4. It will be seen that when the plug P_1 is inserted in the jack J_1 the circuit connecting the batteries will include the winding of the line relay 4 in addition to that of relay 8.

D_1 represents the receiving distributor of the printer located at the terminal room for monitoring purposes. It consists of two concentric segmental rings. The outer ring comprises a plurality of segments of equal size and equally spaced designated S_1 to S_6 inclusive which are connected with a plurality of selecting relays or magnets of which only one, viz, that connected with the segment S_5, is shown. The outer ring also includes the segments S_6 and S_7, the former of which is connected with the relay that controls the printing apparatus, and the latter of which controls the starting apparatus of the distributor. The segments which have been described perform the normal functions of the present type of receiving distributor and need no further explanation. They have associated with them corresponding segments S_8, S_9 and S_{10} of the inner ring by means of which the respective circuits are closed when the brush 5 moves over the corresponding pairs of segments during the rotation of the brush arm. Interposed between the segments S_5 and S_6 of the outer ring are two segments S_{11} and S_{12}; of the same size and similarly positioned between the segments S_8 and S_9 are two inner segments S_{13} and S_{14}. Each of the segments S_{11} and S_{12} is connected with its respective winding of the differential meter 6, which windings are connected together and the junction thereof is connected through the right-hand contact of the relay 7 with the battery B_3. The segment S_5 is connected through the right-hand winding of relay 7 and through the winding of the selecting relay 5 with the battery B_4. The battery B_3, is connected with the right-hand armature and also with the left-hand winding of relay 7 so as to form a locking circuit through the left-hand armature and the upper contact of relay 4 to ground. The said upper contact of relay 4 is also connected with the segments S_8 and S_{13}, and the lower contact thereof is connected with the segments S_{14}

and S_{10}. The selecting relay 5 and the other selecting relays, referred to but not shown, are connected with the receiving circuit, which, for the sake of simplicity is not shown since it forms no part of this invention.

Having in mind the foregoing description of the circuit in which the invention is embodied, the nature of the invention will be clear from the following description of the mode of operation of the circuit.

In the well known start-stop printing telegraph system, for each character transmitted there is always an open or start impulse followed by five selecting impulses which may be either open or closed, and a closed or stop impulse. By the term "open impulse" is meant an impulse of such character as a deenergize the line relay 4 and allow its armature to drop back, and similarily by the term "closed impulse" is meant an impulse of such type as to energize the line relay and to attack its armature. The existence and the magnitude of distortion is determined by investigating the condition of the sixth impulse, viz, that which if undistorted, is applied by the line relay 4 while the brush 5 is moving from segment S_{11} to S_{12}.

In order to get a clear picture of the nature of this invention, it is desirable to describe how the circuit operates when undistorted, unbiased signals are applied by the line relay 4 to the distributor and its associated circuits. As has already been mentioned, the segments S_{11} and S_{12} are of the same size and are so located that when the distributor is receiving unbiased signals the sixth impulse will start to be received midway between the segments S_{11} and S_{12}. Let it be assumed that the fifth impulse of the signal character received over the line L_1 is an open impulse. The armature of relay 3 would move to its lower contact thereby opening the circuit of the line relay 4 and allowing its armature to drop to its lower contact thereby disconnecting the ground from the segments S_8 and S_{13}. As the brush 5 moves over the segments S_5 and S_{11} and their corresponding inner segments S_8 and S_{13}, the circuit from the battery B_4, through the winding of the selecting relay 5 and the right-hand winding of the relay 7 will be open by virtue of the removal of the ground from the segments S_8 and S_{13}, and consequently relay 7 will not be energized. Furthermore current will not flow from battery B_3 over the right-hand contact of relay 7 and through the differential meter 6, because the circuit is open at the upper contact of the relay 4. Accordingly no indication is given by the meter. Since, as assumed, there is no distortion, the line relay 4 will be operated by the sixth impulse when the brush 5 passes the midpoint between the segments S_{11} and S_{12}. Since this impulse is closed, relay 4 will be energized and its armature will be drawn to its upper contact thereby disconnecting the ground from the segment S_{14}. Consequently the circuit from battery B_3 through the differential meter 6 to ground through the segments S_{12} and S_{14} will be open, and no indication will be given by the meter.

Let us assume the other possible condition during the reception of unbiased signals, viz, that in which the fifth impulse is a closed one. The reception of a closed impulse over the line L_1 will energize the relay 4 and attact its armature to its upper contact thereby connecting the segments S_8 and S_{13} to ground. As the brush 5 moves onto segment S_5 a circuit will be established from battery B_4, winding of selecting relay 5, right-hand winding of relay 7, segments S_5 and S_8 and upper contact of relay 4 to ground thereby energizing relay 5 and also relay 7. The energization of relay 5 would operate the associated selecting magnet so as to transmit the proper signal impulse, which feature, however, forms no part of this invention. The operation of relay 7 opens the contact of its right-hand armature and closes the contact of its left-hand armature. By the opening of the contact of the right-hand armature, the circuit through the differential meter 6 will be opened, and no indication will be given thereby so long as the relay 7 remains energized, which will continue as long as the line relay 4 maintains its armature upon its upper contact. Since we have assumed the case of no distortion, the line relay 4 will remain energized by virtue of the fifth impulse, and will continue to be energized after the brush passes to the segment S_{12} since the sixth impulse is always a closed impulse. Consequently the circuit of the meter 6 is open and no indication will be given thereby under any condition when the fifth impulse is a closed one.

Assuming that there is bias, and that the fifth impulse is an open one, the manner in which bias is indicated is as follows. When the received signals are biased "light" viz, the armature of the line relay is quicker to release and slower to operate than when the signals are properly centered. The line relay will be unoperated when the brushes pass over segment S_{11} and will be unoperated also when the brushes pass on to segment 12 owing to the relatively slower operation of the line relay to respond to the sixth impulse which, as stated, is a closed one. Since the line relay 4 is unoperated when the brushes pass on to segments S_{12} and S_{14}, current will flow from battery B_3, right-hand contact of the relay 7, one of the windings of the differential meter 6, segments S_{12} and S_{14} to ground, thereby caus-

ing deflection of the needle of the meter 6. The extent of deflection of the meter depends upon the amount of bias of the signals and to some extent upon the speed of rotation of the distributor, so that for any given speed the amount of bias may be approximated from the meter deflection. When the signals are biased "heavy", viz, the line relay 4 releases slower and operates quicker than when the signals are unbiased, the sixth impulse will begin to be received when the brushes are on segments S_{11} and S_{13}, and a circuit will be closed from battery B_3, right-hand contact of relay 7 and through the other winding of the meter 6 and the contacts S_{11} and S_{13} to ground thereby causing a deflection of the needle of the meter. This deflection is in opposite direction from the previous one and indicates for any given distributor speed the approximate amount of biasing of the signaling impulse.

From the foregoing description it will be apparent that the differential meter will indicate the existence and the relative magnitude of distortion of a signal consisting of a plurality of impulses, except in those instances in which the fifth impulse is a closed impulse; and, except in such instances it will indicate whether the signals are properly centered, (that is whether the relays are biased "heavy" or "light",) by the direction of deflection of the needle, and will give an indication of the amount of bias by the magnitude of its deflection. The fact that it will not give an indication of bias when the fifth impulse is a closed impulse is not a serious disadvantage in view of the large number of a signal characters in which the fifth impulse is an open one.

The arrangement shown in Fig. 2 shows the application of this invention to a printing telegraph system which is, in general, similar to that show in Fig. 1 but differs therefrom by employing a cam-operated distributor in place of the rotary brush distributor shown in Fig. 1. The same reference characters have been used in both figures to represent the same parts. The cam-operated distributor shown in Fig. 2 comprises a sleeve 9, which carriers a plurality of cams, some of which, such as C_7, C_4, C_5, C_{11}, C_{12} and C_6 may be seen while others which will be designated C_1 to C_3 inclusive are (for the position of the sleeve shown in the figure) on the opposite side thereof, away from the observer. The sleeve 9 is carried by a continuously rotating shaft 10. This sleeve, however, operates only when a start impulse flowing through the winding of the magnet 12 withdraws its armature 13 from engagement with the cam 14 and thereby allows the friction clutch 11 to effectively connect the sleeve 9 with the shaft 10. As the sleeve carrying its plurality of cams rotates in the direction indicated by the arrow, various contacts will be closed in succession in the same manner in which the movement of the brush 5 of the rotary distributor of Fig. 1 closes in succession the various contacts of the said distributor. The closing of contacts K_1 to K_4 inclusive controls the operation of selecting relays or magnets of the printer in the same manner in which the closing of the contacts S_1 to S_4 inclusive did in the operation of the distributor of Fig. 1. Connected with contact K_5 is a fifth impulse relay 7, one winding of which is connected in series with the No. 5 selecting relay or magnet. The structure of this relay and its connection with the differential meter 6 is similar to the arrangement shown in Fig. 1. The contacts K_{11} and K_{12}, connected with two terminals of the windings of the differential meter 6, are likewise similar functionally to the segments S_{11} and S_{12} in Fig. 1.

The operation of the system in which the afore-described distributor is employed is as follows: Let it be assumed that the first four impulses of the signal character have been received and that each has operated the line relay 4 coincidentally with the operation of the contacts K_1 to K_4 inclusive by means of the corresponding cams C_1 to C_4 inclusive of the sleeve 9. We will furthermore assume that the fifth impulse is an open one inasmuch as the invention is not designed to indicate the presence of distortion when the fifth impulse is a closed one. Since the fifth impulse is open, the line relay 4 will be deenergized and its armature will touch and connect the left-hand contact to ground. As the sleeve 9 continues to rotate in the direction shown by the arrow, the cam C_5 will move out of the engagement with its associated spring, thereby opening the contact K_5, and closing contact K_{11} by the engagement of the cam C_{11} with its associated spring. As in the system shown in Fig. 1, the line relay 4 remains under the control of the fifth impulse of the signal character throughout the time that the contact K_{11} remains closed, assuming, of course, that the signal impulse is undistorted. As the cam sleeve continues to rotate, the contact K_{11} opens and K_{12} closes. If the sixth impulse which, as stated, is a closed impulse, is undistorted, the line relay 4 will be energized and will operate coincidentally with the closing of contact K_{12} by the engagement of the cam C_{12} with its associated spring. The operation of relay 4 grounds its right-hand contact so that the circuit through the differential meter 6 from the battery B_3 and the contact K_{12} will be open. It will be seen, therefore, that if the fifth and sixth impulses are undistorted, no indication is given by the differential meter 6.

With the presence of distortion, the system shown in Fig. 2 operates in substantially the same manner as that of Fig. 1. When the received signals are biased "light", that is, when the armature of the line relay 4 is quick to release and slow to operate, the line relay will be unoperated when the contact K_{11} opens and remains so for some time after the contact K_{12} closes. This means that for an indefinite time after the closing of the contact K_{12} the armature of relay 4 remains in contact with its left-hand contact point. It will be seen, therefore, that current will flow from the grounded battery B_3 over a circuit embracing the right-hand contact of relay 7, the right-hand winding of the meter 6, contact K_{12} and left-hand contact of relay 4, and consequently the needle of the meter 6 will be deflected. The extent of the deflection depends upon the amount that the signals are biased and to some extent upon the speed of rotation of the distributing device.

When the signals are biased "heavy", that is, when the line relay releases more slowly and operates more quickly than when the signals are unbiased, the sixth impulse will operate the line relay 4 while the contact K_{11} is still closed and, therefore, before the operation of contact K_{12}. It will be seen, therefore, that while contact K_{11} is closed current will flow from the grounded battery B_3 over a circuit embracing the right-hand contact of relay 7, the left-hand winding of the meter 6, contact K_{11} and the right-hand contact of the line relay 4, causing a deflection of the needle of the meter. Since in this instance the current is flowing through a different winding of the meter 6 from that in which it flowed in the instance previously described, the direction of deflection will be opposite from that in the previous instance. It will, therefore, be seen that this method serves to show not only the existence and, to some extent, the magnitude of distortion of the received signals but also serves to indicate, by the direction of deflection, the character of the biasing.

The invention possesses the great merit of simplicity, requiring only a small amount of additional apparatus in order to effect the measurement of distortion of signals. While this arrangement may be applied to any printing telegraph distributor, its use would probably be limited to the printing telegraph equipment located at the terminal office through which the printing telegraph circuits are looped, inasmuch as such equipment is intended to be used to monitor the service that is being given to various subscribers for printing telegraph service.

While this invention has been disclosed as embodied in a particular form and arrangement of parts, it is to be understood that it is not so limited but is capable of embodiment in other and different forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a printing telegraph system the combination with a source of current impulses of a relay responsive to the said impulses, switching means having a plurality of contacts normally operating in synchronism with the said relay, a plurality of impulse registering means operable by the joint operation of the said relay and the said switching means, and an indicating device connected with predetermined contacts of the said switching means to show any distortion of a preselected impulse due to lack of synchronism between the operation of the said relay and the said switching means.

2. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a line circuit of a line relay controlled by impulses received from said line and a printing telegraph distributor containing a pair of concentric segmental rings, and a brush adapted to successively connect the radially corresponding segments of the outer and inner rings, and a current indicating device connected between certain segments of the rings of the said distributor and a source of potential to indicate the degree of biasing of the signal impulses actuating the said line relay.

3. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a relay responsive to signal impulses of a rotary distributor containing a pair of concentric segmental rings and having a brush arranged to successively connect the radially corresponding segments of the outer and inner rings, and a current indicating device connected between certain segments of the rings of the said distributor and a source of potential to indicate biasing of the signals actuating the said relay.

4. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a rotary distributor containing a pair of concentric rings, each ring having a plurality of signal and control segments and a plurality of distortion measuring segments between the said signal and the said control segments of a differential current indicating device, each winding of which is connected with its respective distortion measuring segment of the said distributor and a source of potential effectively connected with the said indicating device.

5. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a rotary distributor containing a pair of concentric

rings, one of which has a plurality of signal impulse segments, a printing impulse segment, and distortion measuring segments interposed between the last of the said signal impulse segments and the said printing impulse segment and a differential current indicating device, each of the windings of which is connected with its respective distortion measurement segment, a source of potential connected with the said indicating device and means for controlling the time during which the circuit through the said indicating device may be closed.

6. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a distributor comprising a plurality of switching means of a differential current indicating device connected with certain of said switching means, a relay arranged to control the effective application of the received impulses to the said distributor, and a second relay adapted to effectively open the circuit through the said indicating device when the last signal impulse is a closed impulse.

7. In a printing telegraph system in which each signal character comprises a plurality of impulses, the combination with a line circuit of a relay controlled by impulses received from the said line circuit and having its armature grounded, a printing telegraph distributor having in its outer ring two segments of equal size interposed between the last signal impulse segment and the printing impulse segment and having two radially corresponding segments in the inner ring of the said distributor, the latter segments being connected with the upper and lower contacts respectively of the said line relay, a differential current indicating device having each of its windings connected with one of the said two segments in the outer ring of the said distributor and having a source of potential connected therewith, whereby any distortion of the "stop impulse" may be detected, and a relay actuated whenever the last signal impulse is closed to open the circuit through the said indicating device whereby a false indication of distortion may be prevented.

In testimony whereof, I have signed my name to this specification this 8th day of May, 1923.

EDWARD F. WATSON.