

UNITED STATES PATENT OFFICE

2,166,505

INTEGRATING PHASE CORRECTION
MECHANISM

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Application November 30, 1936, Serial No. 113,490

5 Claims. (Cl. 178—53)

This invention relates to synchronous telegraph systems and particularly to mechanical phase correctors for multiplex telegraph distributors.

5 In multiplex telegraph systems of the Baudot type in which the brushes of the rotary distributors at the transmitting and receiving stations are driven by constantly rotating motors of the La Cour type, it has been the practice to operate the distributor at the transmitting station at the desired signal transmitting speed and the distributor at the receiving station at a very slightly greater speed. The brushes of the distributor at the receiving station (designated as the "corrected distributor") were maintained in synchronism and in phase with the brushes of the "correcting distributor" at the transmitting station by stepping the brushes backward independently of the driving motor whenever the angular shift between the brush and the motor shaft was required to restore proper phase relation between the two distributors.

15 In the correction method disclosed in Patent No. 1,298,622 granted to Yorke and Benjamin, March 25, 1919, each current reversal affecting the correcting relay affords an opportunity for correction; but the correction mechanism operates only when, at the time of one or more of such reversals, one distributor is sufficiently out of phase with respect to the other distributor, to require correction.

20 The control mechanism of most types of correctors consists of pairs of equal segments, the first and second segments of one pair being connected to the first and second segments respectively of every other pair. A typical pair of correcting rings 2, are shown in the drawing and comprise a segmented ring composed of a plurality of pairs of segments A and B. In the usual correcting system, in which the brush of the corrected distributor is retarded to effect a correction, if the distributor brush is rotated in synchronism with the signals, each reversal will always occur while the brush is on one of the B segments. In this event no correction will be applied. However, if the distributor brush gains relative to the rate of signal transmission, so that a reversal occurs while the brush is on one of the A segments, a correcting impulse is produced which actuates the magnet of the corrector mechanism to set the brush back, relative to the driving motor shaft so as to restore it to the proper B segment.

25 Due to irregularities and distortion in the shape of the received signal wave, which may be caused

by extraneous currents, variations in line characteristics etc., the instants of reversal may vary considerably from the theoretically correct point so that the brush may be sufficiently out of phase to require a succession of correcting impulses to restore it. It is evident therefore that there is an area of uncertainty in which the point of current reversal may occur.

30 If the corrector is of the type that operates by retarding the brushes of the receiving distributor, it is necessary to adjust the speed of the driving motor so that the brushes will have a tendency to gain in phase with respect to the brushes at the transmitting station. This will cause a slow creep of the area of uncertainty over the segments in the direction of brush rotation. As the area tends to creep on to the forward one or A segment, it will only be able to reach a position such that the proportion of the area that extends over the A segment will just contain the number of reversals necessary to effect the required retardation and it will "hunt" back and forth as the control mechanism attempts to hold that portion of it necessary for compensation over the segment.

35 One purpose of my invention is to provide a correction system which follows the mean position of a series of signal current reversals and thus is controlled by the phase relation between the average received reversal and the corrector ring, thereby overcoming the tendency to "hunt" and the irregularity of prior edge corrector devices. Other objects will be apparent from the following description in connection with the accompanying drawing, which is a diagram illustrating one embodiment of my averaging reversal corrector system.

40 The corrector relay 1 receives the incoming signal impulses and has its armature connected to a grounded condenser C₀ of small capacity, which picks up positive or negative charges from corrector rings 2 of the synchronous receiving distributor, while the corrector relay is on its marking contact, the polarity of these charges being determined by the phase relation between the signal reversal and the corrector brush 3, at the instant the corrector relay leaves its marking contact. The condenser C₀ discharges into a larger charging condenser C₁, while the corrector relay is on its spacing contact s, producing an increment or decrement in the voltage of charging condenser C₁, the magnitude of which is dependent on the ratio of the two capacities.

45 The resistance 4 prevents condenser C₀ from completely discharging between successive re-

versals when the signal frequency is high, while permitting said condenser C_0 to completely discharge between reversals when the signal frequency is low, thus making the effect of a signal reversal dependent upon the number of correcting opportunities afforded.

If we assume that the storing condenser C_1 is discharged, it is evident that, if the phase relation of the signal reversals to the corrector brush is such that a preponderance of negative polarity increments are received, the condenser C_1 will gradually acquire a negative charge at a rate dependent upon the ratio of negative to positive impulses per unit of time, which is in turn a function of the phase relation between the received signal and the corrector ring brush.

For the purpose of interpreting this increase in negative potential in terms of corrections required per unit of time, a normally energized neutral relay 5 provided with tongues 6 and 7, is connected in the plate circuit of a vacuum tube 12, the grid of which is under the control of the potential across condenser C_1 . As the charge of C_1 becomes more negative, the current in the plate circuit gradually decreases to a value such that the armatures of relay 5 are released. The release of the armatures 6 and 7 accomplishes three functions, viz:

(a) Armature 7 removes the short circuit around resistance 8 at its front contact, thus inserting an additional resistance in the plate circuit to insure the release of the armatures;

(b) Armature 7 applies battery at its back contact to the corrector magnet 9, thereby causing the mechanical corrector to step the brushes of the receiving distributor in the manner disclosed in said Yorke-Benjamin Patent No. 1,298,622, to which reference is made for the construction.

(c) Armature 6 removes the grid side of the condenser C_1 from the control circuit at its front contact and connects it at its back contact through a large resistance 10 to positive battery.

The condenser C_1 therefore discharges at a rate which is dependent upon the value of resistance 10 and when its negative charge decreases to a sufficiently low value, the potential of the grid permits a sufficient increase of current in the plate circuit to actuate the relay 5, thereby causing—

(a) Armature 7 to close the above circuit around resistance 8 at its front contact, thus increasing the current in the plate circuit which holds the neutral relay 5 securely locked;

(b) Armature 7 releases the corrector magnet 9 at its back contact;

(c) Armature 6 restores the grid side of condenser C_1 to the control circuit at its front contact.

It will be evident that the operations described above will be repeated at a rate which is determined by the rate at which the negative potential increases on the condenser C_1 and therefore upon the phase relation between the average received current reversal and the corrector ring brush. Furthermore it will be seen that since the resistance 10 determines the rate at which condenser C_1 is discharged during the interval that the relay 5 is released, the value of resistance 10 controls the length of the operating pulses furnished by the relay 10 to the mechanical corrector.

With the system in operation as described, the brushes will be maintained at an average position such that the difference between the number of reversals falling on an A segment minus the

number falling on a B segment will be sufficient to maintain a rate of correction equal to the difference in speed between the brushes at the sending and receiving stations.

The integrating or averaging corrector system described follows the mean position of a series of signal current reversals as distinguished from the "edge" correction of the Yorke-Benjamin method. By connecting a leak resistance 12 to negative battery across condenser C_1 the corrector can be made to function when a number of signal reversals fail to arrive or in case of a momentary failure of the line and thus cause the mechanical corrector to step the distributor brushes at an approximate average rate.

I claim:

1. A synchronizing system for telegraph apparatus comprising a distributor, a brush rotating with respect thereto, means for rotating said brush, mechanical means for changing the angular displacement of said brush with respect to said distributor, a line relay responsive to signaling impulses transmitted over the line, means under the control of said relay for producing incremental correcting impulses corresponding to the incoming impulses and of a polarity dependent upon the phase relation of said brush with respect to the respective received impulses, storing means for receiving said produced impulses, a thermionic device having its input controlled by the average charge on said storing means, electromagnetic means in the output circuit of said thermionic device to control the operation of said brush displacement means, and a normally shunted resistance in said output circuit, said electromagnetic means operating to remove the shunt from said resistance and connect the input side of said storing means to a high resistance charging circuit.

2. In a synchronizing system as set forth in claim 1, a leak circuit including a resistance connecting the grid side of said storing condenser to a source of negative potential, to thereby cause the corrector to function upon the failure to receive a number of signals or the momentary failure of the line, thus causing the mechanical corrector to step the distributor brushes at an approximate average rate.

3. In a synchronizing system, a line relay responsive to signal impulses transmitted over the line, a rotary distributor having mechanical brush correction mechanism including an operating magnet therefor, a distributor brush, means for rotating the brush, a charging condenser charged by the operation of the line relay with incremental charges of a polarity dependent upon the phase relation of said brush with respect to the received line impulses, a storing condenser of larger capacity than said charging condenser, for transferring the charges from said condenser by the operation of the relay and means for utilizing the average charge on said storing means to actuate the operating magnet of said brush correction mechanism.

4. In a synchronizing system for telegraph apparatus having a distributor, a brush cooperating therewith, a motor for rotating said brush, and a line relay responsive to signaling impulses transmitted over the line, corrector means for the distributor, comprising a mechanical brush correction device including an operating magnet for changing the angular displacement of said brush with respect to said distributor, a small capacity charging condenser, means for impressing an incremental correcting charge on

said condenser in response to each received impulse, said incremental charges having a polarity dependent upon the phase relation of said brush with respect to said received signaling impulses, a storing condenser for transferring the charges from said charging condenser by the operating of said relay, means for utilizing the average charge on said storing condenser to control the operation of said magnet, and a resistance in the circuit connecting said charging condenser and said storing condenser to retard the discharge of said charging condenser between successive reversals when the signal frequency is high, while permitting said condenser to completely discharge between reversals when the signal frequency is low.

5. A synchronizing system for telegraph apparatus, comprising a distributor, a brush rotating with respect thereto, means for rotating said brush, a mechanical device for changing the angular displacement of said brush with respect to said distributor, a line relay responsive to sig-

naling impulses transmitted over the line, a small capacity condenser, means under the control of said relay for impressing incremental correcting charges upon said condenser corresponding to the incoming impulses and of a polarity dependent upon the phase relation of said brush with respect to the respective received impulses, a storing condenser for transferring the charges from said condenser by the operation of said relay, a thermionic device having its input controlled by the average charge on said storing condenser, electromagnetic means in the output circuit of said thermionic device operating to control said brush displacement device, means in the output circuit of said thermionic device operating upon a predetermined negative input potential to actuate said brush displacement device and to connect said storing condenser to a source of positive potential through a resistance which determines the charging rate and the operating period of said device.

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