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 SYNCHRONISM CORRECTING DEVICE FOR A MULTI-CHANNEL
 TELEGRAPHY INSTALLATION
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2,934,604

FIG. 1

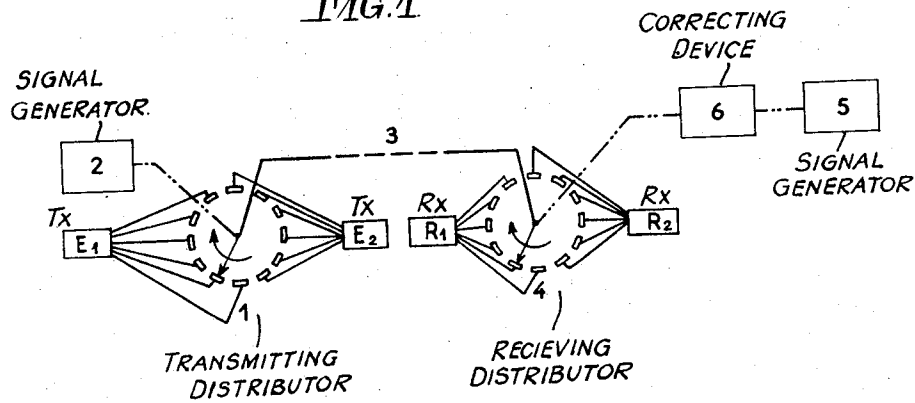
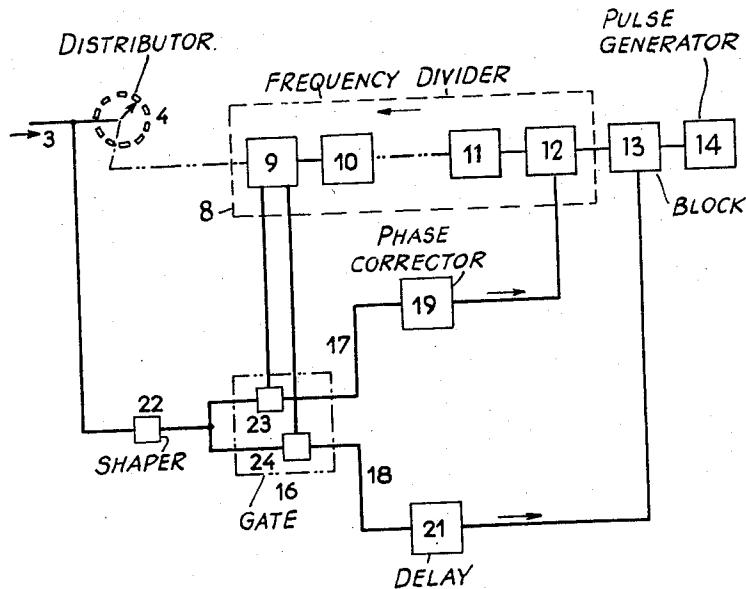


FIG. 2



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SYNCHRONISM CORRECTING DEVICE FOR A MULTI-CHANNEL TELEGRAPHY INSTALLATION

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2 Claims. (Cl. 178—53)

The present invention relates to a device for correcting synchronism in a multi-channel telegraphy installation. In equipments of this kind it is known to have at the transmitting station, a rotary distributor the various contacts of which receive the signals to be transmitted from the respective channels, there being at the receiving station a second rotary distributor, the various contacts of which correspond to the various channels to be received and the brushes of the said two distributors being connected together by the transmission line between the two stations.

For correct operation of such installations, it is obviously necessary for the synchronism between the rotational movements of the two distributors to be strictly maintained.

Figure 1 of the accompanying drawings illustrates diagrammatically such a known installation, and in this figure, 1 designates the transmitting distributor, represented by a ring comprising a number of segments insulated from one another and connected to the various signal transmitters of the various channels. Moving on this ring is a brush, or an electron beam, the rotation of which is controlled by a stable signal generator 2.

By way of example, there are shown in Figure 1, two transmitters E_1 , E_2 , each dealing with the potentials applied to six segments of a twelve-segment distributor.

The receiving station comprises an identical distributor 4 connected to the distributor 2 by the transmission line 3. The contacts of this distributor 4 are connected to each respective channel receiver, and the rotational movement of the brush or electron beam is similarly controlled by a signal generator 5, preferably identical to the generator 2 of the transmitting station R_1 and R_2 represent the receivers associated with the transmitters E_1 and E_2 respectively. However, in order to compensate for the possible differences between the frequencies of the generators 2 and 5, it is necessary to dispose a correcting device 6 between the generator 5 and the driving device of the corresponding distributor 4.

The correcting device compares the speed of rotation of the two distributors, using the signals transmitted along the line 3. For example, it compares the instant of the characteristic reversals of the signals received with the instant when these reversals should theoretically occur, the latter instant being defined by the passage of the brush of the receiver commutator past a reference mark on one of its segments.

The difference between these two instants may be due to the speed differences of the two distributors, or to nonlinear distortion of the receiving members of the various channels, or to the characteristic distortion due to the transmission line, or to these different causes simultaneously. Thus, the fact that a current reversal takes place at a receiver of one channel later than its correct theoretical occurrence, may be due either to an excess of speed of the distributor of the receiving sta-

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tion, or, more frequently, to lengthening of the elemental interval preceding the said current reversal.

In certain known synchronism-correcting devices, such an error of position of a characteristic reversal of the signal current along the transmission line, to whatever cause it may be due, produces a backward phase shift $-\phi$ of the receiving distributor. The angle ϕ is the same regardless of this difference, and represents only a very small proportion of the angle ψ through which the distributor turns during a characteristic interval of the telegraphic modulation (if there are k elemental intervals during the period of one revolution of the distributor, the angle ψ is equal to $2\pi/k$). The phase shift ϕ therefore has substantially no immediate action on the operation of the distributor.

On the other hand, if the following characteristic reversal occurs before its theoretical position, i.e. early, the difference in position determines a forward phase shift of $+\phi$ of the receiving distributor.

This method of correction is usually referred to as the "clock hand" method.

The distortions of the signals produce no disturbance in the operation of the distributor, and if there is no speed difference between the two distributors the sum of the elemental phase corrections is zero.

The same is not the case when there is a speed difference between the distributors, because the distribution of the characteristic instants at the reception is then no longer centered on the instants observed in the case of an ideal transmission. The corrections in one direction are then more numerous than those in the other, so that it is possible to restore equality of the mean speeds of the two distributors.

A main object of the present invention is to provide an improved device for effecting the aforementioned elemental phase corrections, and accordingly the invention provides in a multi-channel telegraphy installation having transmitting and receiving stations each with a rotary distributor and driving means therefor, a device for correcting the synchronism of said receiving distributor with said transmitting distributor comprising, a stable pulse generator of pulse period T connected to actuate said receiving distributor driving means through a series connected blocking device and a frequency divider, said frequency divider consisting of n electronic flip-flops in series, the last of which supplies to said driving means an output of period $2^n T$ equal to the theoretical elemental interval of the signals received, a gate having one input connected to said last flip-flop and another input connected to means receiving the incoming signal and having one output connected to the first flip-flop of said divider through a phase shifter and another output connected to the control circuit of said blocking device through a delay network, said gate being adapted to supply a pulse to said first flip-flop if the incoming signal precedes the operating instant of said last flip-flop and, alternatively, to said blocking device if said signal succeeds the operating instant of said last flip-flop.

In order that the invention may be more clearly understood and readily carried into effect, one embodiment thereof will now be described with reference to Fig. 2 of the accompanying drawings which illustrates diagrammatically a receiving station comprising a correcting device of the invention. In this figure, 3 designates, as before, the incoming signal line, and 4 the distributor connected to the end of said line. The distributor is rotated by an electromechanical system fed by a pulse generator 14, through a blocking device 13 and a frequency divider 8 consisting of any number n of binary flip-flops such as 9, 10, 11, and 12 connected in series. If T is the repetition period of the pulses supplied by

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the generator 14, then the period of the square wave received at the output of the divider, that is to say, of the last flip-flop 9, is $2^n T$. T is so chosen that the period $2^n T$ is equal to the elemental interval τ of the signals received along the line 3, and it is this square wave which determines by its half-cycle the times of connection of the brush to the segments of the distributor.

A gate 16 is controlled by the last flip-flop 9 and by the occurrence of the characteristic reversal on line 3 and, if a characteristic reversal occurs at the line 3 before the correct theoretical instant, defined by the instant of the change-over of the flip-flop 9, the gate applies a pulse to its output 17. If a characteristic reversal occurs at the line 3 after its correct theoretical instant then a pulse is applied to the output 18.

For this purpose, a shaping device 22 provides, to correspond to each characteristic reversal of the entering modulation, regardless of its direction, a brief pulse, which is always of the same sign and which is applied to the gate device 16. The latter consists of two blocking devices 23 and 24, each controlled by one of the outputs of the flip-flop 9. The blocking device 23 is conductive during the elemental half-interval preceding the change-over instant of the flip-flop 9, taken as reference. The blocking device 24 is conductive during the elemental half-interval succeeding this change-over instant.

If a pulse is set up at the output 17 of gate 16, it is transmitted, if necessary through a phase correcting device 19, to the first flip-flop 12 of the divider, whereby an additional reversal of the said flip-flop is produced. The succeeding period of the said flip-flop is therefore only

$$(2^n - 1)T = \left(1 - \frac{1}{2^n}\right)\tau$$

If the correcting device does not operate again, the flip-flop 8 resumes its normal periods, but by reason of the shortened cycle which has preceded them, their change-over instants are phase-advanced by an angle

$$\phi = \frac{\psi}{2^n}$$

Since the number n of flip-flops may be chosen as desired, the angle ϕ may be very small, and the phase shift introduced has no immediate effect on the operation of the distributor 4.

On the other hand, if a pulse is applied to the output 18 it is applied to the blocking device 13 through a delay network 21, which then prevents the passage of one, and one only, of the pulses from the generator 14 to the input flip-flop 12. The succeeding period of the output flip-flop 9 is then brought to

$$(2^n + 1)T = \left(1 + \frac{1}{2^n}\right)\tau$$

In the absence of a further correction, the subsequent periods retain their value $2^n T = \tau$, but by reason of the lengthened cycle which has preceded them they are retarded by a phase delay equal to the angle ϕ .

If the speeds of rotation of the distributors at the transmitting station and at the receiving station are identical, after a small number of characteristic reversals at the transmission line 3, the number of lengthened cycles supplied to the output of the frequency divider 8 is exactly equal to the number of shortened cycles, and the resultant mean phase shift of the distributor of the receiving station is zero.

If the speeds of the two distributors are different, the resultant mean phase shift is not zero. If the speed difference is constant, this mean phase shift increases linearly with time.

In one constructional embodiment, the duration of one revolution of the distributor 7 is 150 milliseconds, corresponding to the translation of $k=50$ elemental signals of duration $\tau=3$ milliseconds transmitted through the line

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3. The period T of the pulses from the generator 14 is $\frac{3}{16}$ millisecond.

The divider 8 consists of four binary flip-flops in cascade, so that the period of the wave supplied by the fourth flip-flop is

$$\frac{3}{16} \times 2^4 = 3 \text{ milliseconds}$$

i.e. two half cycles of 1.5 milliseconds, in the absence of any correction. This wave feeds on the one hand the device driving the distributor 4, and on the other hand the gate 16.

If a characteristic current reversal occurs at the input end of the line 3 in advance of its correct theoretical position, it sets up a pulse at the output 17 of the gate 16. Thus a pulse appears at the output of the phase correcting member 19 which pulse coincides with the end of the succeeding half-cycle of the wave supplied by the output flip-flop 9, that is to say, with a delay between 0 and 1.5 milliseconds. The pulse at the output of the phase correcting device 19 therefore imparts to the flip-flop 12 of the divider 8 an additional reversal, as hereinbefore explained, and the succeeding cycle of the wave supplied by the output flip-flop 9 is shortened by $\frac{3}{16}$ millisecond.

If, on the other hand, a pulse received at the line 3 is retarded in relation to its theoretical position, a corresponding pulse is obtained at the output 18 of the gate device 16, which pulse excites the device 21, which acts on the blocking device 13 to prevent the passage of one pulse emanating from the generator 14. The device 21 is then reset by the next pulse from the generator 14, which pulse cannot pass through the blocking device 13. Since a single pulse emanating from 14 has been prevented from passing through the blocking device 13, the succeeding cycle of the wave supplied by the flip-flop 9 is lengthened by $\frac{3}{16}$ millisecond.

In either case, the phase shift imparted to the distributor 4 is equal to

$$\pm \frac{\psi}{16}$$

i.e. 6.25% of the elemental interval at the line 3, or again

$$\frac{2\pi}{16 \times 50}$$

i.e. a rotation of 0.45° of the distributor 4. This isolated phase shift has no immediate effect on the operation of the said distributor. The duration of the rotation of the distributor is equal to the sum of the fifty cycles, corrected or uncorrected, of the wave supplied by the fourth flip-flop 9.

It will be understood that correcting systems of greater complexity but of greater efficiency may be employed in some cases, in which systems not only the direction of the deviation of the characteristic current reversal from its theoretical position is registered, but also its value. Depending upon this direction and this value, it will be possible either to block one or more pulses of the generator or to generate one or more elemental pulses, which are transmitted either to the first stage of the divider or to different stages.

I claim:

1. In a multi-channel telegraphy installation having transmitting and receiving stations each with a rotary distributor and driving means therefor, a device for correcting the synchronism of said receiving distributor with said transmitting distributor comprising, a stable pulse generator of pulse period T connected to actuate said receiving distributor driving means through a series connected blocking device and a frequency divider, said frequency divider consisting of n electronic flip-flops in series, the last of which supplies to said driving means an output of period $2^n T$ equal to the theoretical elemental interval of the signals received, a gate having one

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input connected to said last flip-flop and another input connected to means receiving the incoming signal and having one output connected to the first flip-flop of said divider through a phase shifter and another output connected to the control circuit of said blocking device through a delay network, said gate being adapted to supply a pulse to said first flip-flop if the incoming signal precedes the operating instant of said last flip-flop and, alternatively, to said blocking device if said signal succeeds the operating instant of said last flip-flop.

2. A multi-channel telegraphy installation as claimed in claim 1 further comprising means for registering the value of the difference between the instant of reception of the incoming signal and its correct theoretical instant

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of reception, and means for producing, in accordance with the direction and the value of this difference, the introduction of at least one additional pulse at the frequency divider, if the reception instant is early and the suppression of at least one pulse emanating from the generator if the reception instant is late.

References Cited in the file of this patent

UNITED STATES PATENTS

10	2,546,316	Peterson -----	Mar. 27, 1951
	2,568,336	Houghton -----	Sept. 18, 1951
	2,622,153	Schuler -----	Dec. 16, 1952
	2,769,857	Liguori -----	Nov. 6, 1956