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2,239,702

SYNCHRONIZING SYSTEM

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2 Sheets-Sheet 1

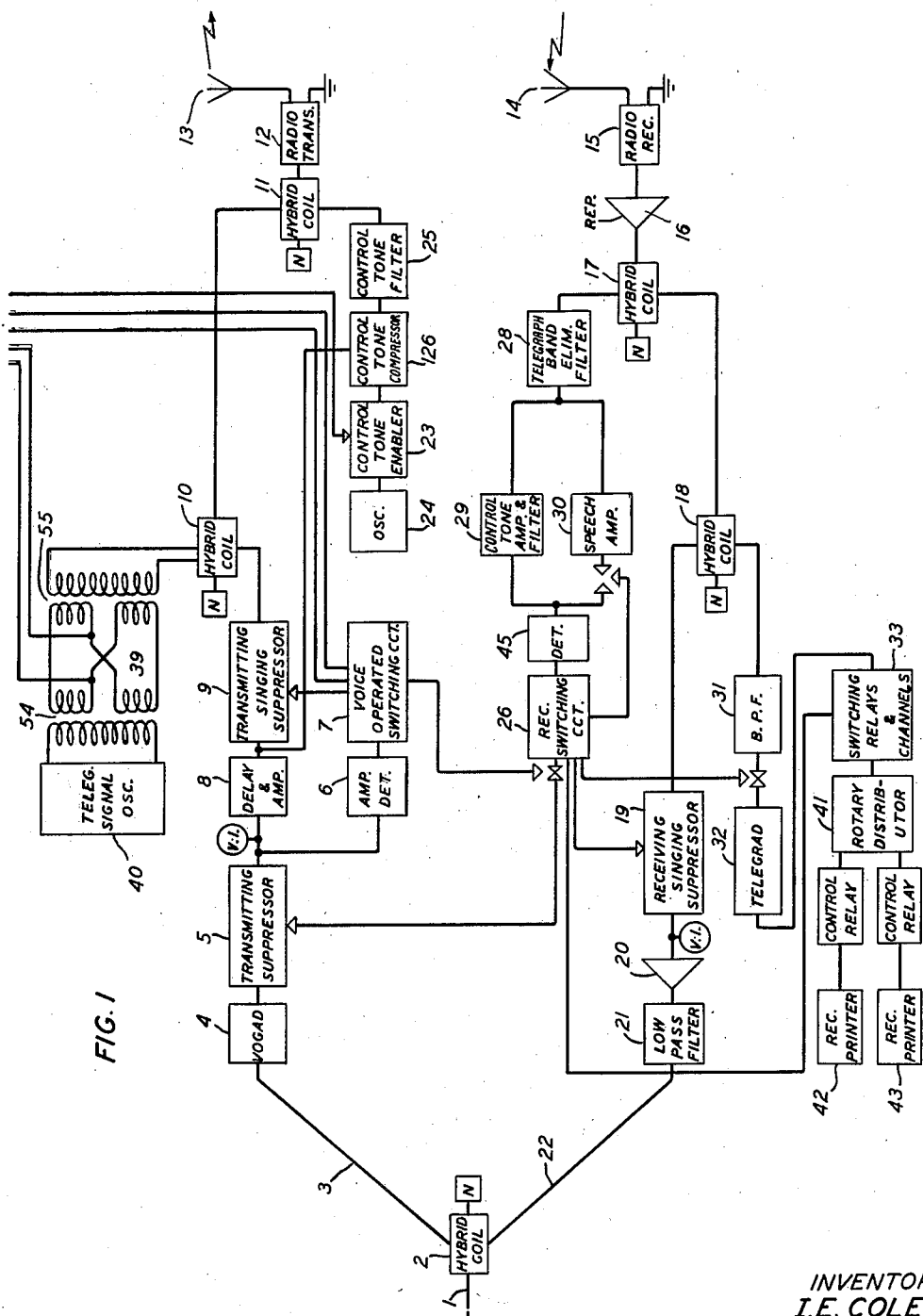


FIG. 1

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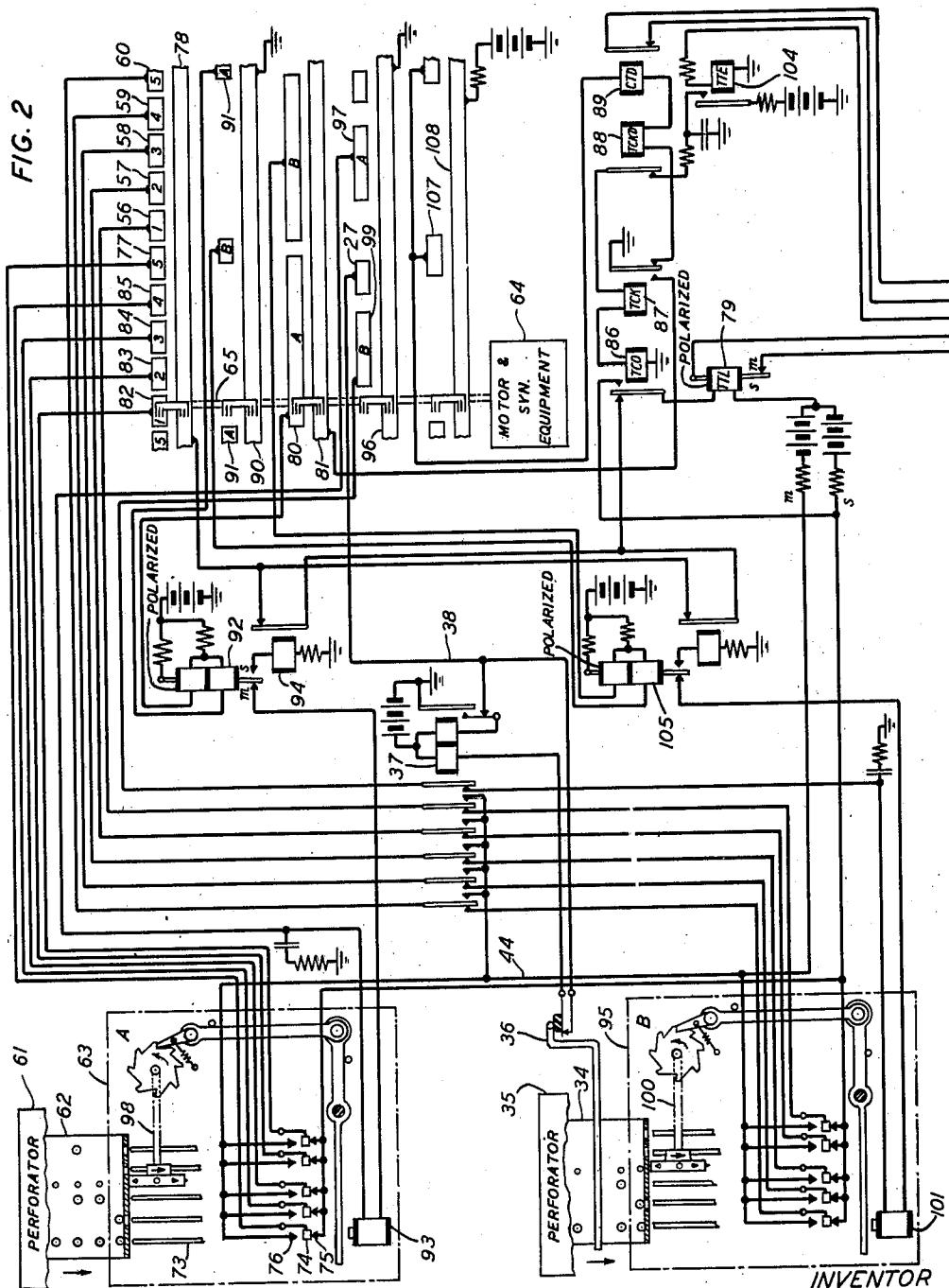
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2 Sheets-Sheet 2



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2,239,702

SYNCHRONIZING SYSTEM

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Application August 2, 1939, Serial No. 287,925

7 Claims. (Cl. 179—2)

This invention relates to communication systems and particularly to means for keeping a pair of distantly separated distributors in exact synchronism with each other. This invention is an improvement in the system disclosed in patent application Ser. No. 219,964, filed July 19, 1938, by Cole et al. now Patent No. 2,207,720, granted July 16, 1940.

An object of the invention is to provide means for insuring at least one effective transition from spacing to marking per cycle of operation of the distributors in a system wherein the corrected distributor is kept in synchronism with the distant correcting distributor through the action of correcting means responsive to transitions from spacing to marking. While communication is being carried on in at least one channel being served by the two distributors, there will always be one or more transitions from spacing to marking per cycle of operation, and while these may occur at random, yet they are effective to cause correction. However, when stoppage of communication occurs on all channels simultaneously, there may be comparatively long periods without a single transition and without an occasional opportunity at correction there is a possibility that the two distributors might fall out of step.

Arrangements have heretofore been provided whereby one or more signals in a complete cycle of operation of such distributors have been inverted so that upon stoppage of communication in all channels there will be one or more transitions from spacing to marking for correcting purposes. However, such arrangements introduce complications into the circuits and make maintenance more difficult.

A feature of the present invention is a means for automatically inverting all the signals of one channel, leaving the signals of the other channels undisturbed, when there is stoppage of communication on the said one channel. Then when there is stoppage of communication on all channels there will be at least one effective transition from spacing to marking per cycle of operation of the distributors.

Another feature of the invention resides in a means for disconnecting the code segments of the correcting distributor from the code transmitter and connecting them automatically to a source of marking battery so that when stoppage of communication occurs on the one channel so equipped, a steady stream of marking signals will be transmitted in place of the steady stream of spacing signals.

Another feature is the use of a taut tape switch

for causing the changeover from spacing to marking during stoppage of communication as signalized by the tightening of the tape.

Still another feature is the use of a double wound multicontact relay for causing the automatic changeover from steady spacing to steady marking. The two windings, of the relay are arranged to oppose and neutralize each other so that when an impulse is periodically transmitted to such relay once per cycle of operation of the correcting distributor it will be ineffective unless one winding of the relay is opened by the taut tape switch. The relay then locks up and remains in this condition until the taut tape switch again closes its contact whereupon the two windings of such relay neutralize each other and the relay releases the circuit to its normal condition.

The drawings consist of two sheets, comprising Fig. 1 in the form of a block schematic diagram, and Fig. 2, a circuit diagram illustrating the invention. With Fig. 2 placed above Fig. 1, a complete diagram illustrating the invention is formed.

Fig. 1 is a general schematic of a system in which the invention may be employed. A speech path 1 leads to a hybrid coil 2 from which a path 3 for outgoing speech leads to a vogad 4. The outgoing speech then passes through a transmitting suppressor 5 and by means of an amplifier-detector 6 operates a chain of relays 7, here labeled as "voice operated switching circuit." This voice operated switching circuit controls a transmitting singing suppressor 9 so that the outgoing speech can pass from the transmitting suppressor 5 through the delay and amplifier 8 and the transmitting singing suppressor 9 to the hybrid coil 10. From the hybrid coil 10 the speech reaches another hybrid coil 11 and thence goes through the radio transmitter to an antenna 13. Through radio transmission, the speech will be received at some distant point and for purposes of explanation it will be assumed that the distant point has a receiving circuit similar in all respects to the lower part of Fig. 1. The speech, therefore, enters antenna 14, passes through a radio receiver 15 and a repeater 16 to a hybrid coil 17. From the hybrid coil 17 the speech goes into hybrid coil 18, thence through the receiving singing suppressor 19, the receiving repeater 20, a low-pass filter 21 and a path 22 to a hybrid coil, such as 2, whence it goes to the receiving subscriber over a line, such as 1.

The voice operated switching circuit 7 controls a control tone enabler 23 through the contact

and armature of the relay 39 so that a source of control tone 24 is passed through the control tone compressor 126 and the control tone filter 25 to the hybrid coil 11 and thus accompanies speech. The voice operated switching circuit 7 also controls a switching point leading from the receiving switching circuit 26 at the same terminal to the transmitting suppressor 5 so as to open this circuit during the periods that speech is going out from line 1 to antenna 13. During this time the voice operated switching circuit 7 also controls the telegraph control circuit shown in Fig. 2 by operating relay 104 in order to stop the action of the telegraph transmitting circuit during the time the voice is being transmitted from line 1 out over antenna 13.

At the receiving end the control tone with the usual modulation of the carrier frequency coming in over antenna 14 is demodulated in radio receiver 15 and passes through the hybrid coil 17 and thence through a telegraph band elimination filter 28 and into a control tone amplifier and filter 29. This operates the receiving switching circuit 26 which performs several functions as follows: first, the receiving switching circuit 26 controls a normally open circuit between the telegraph band elimination filter 28 and the receiving switching circuit 26, including a speech amplifier 30 so that when control tone is first received the switching circuit 26 will be operated thereby and then held operated thereafter by speech currents flowing through the amplifier 30. When the control tone is first transmitted it goes out into antenna 13 at high volume but after an interval determined by the delay introduced by the delay and amplifier 8 the speech operates a compressor 126 to reduce the volume of the control tone to avoid overloading the radio transmitter 12 by the combination of control tone and speech. This, of course, operates to advantage at the receiving end by giving an impulse of great strength through the control tone amplifier and filter 29 to operate the circuit 26 before the path through the speech amplifier 30 is closed.

The receiving switching circuit also controls the receiving singing suppressor 19 to open up the speech path. The receiving switching circuit 26 also controls a normally closed path between the band-pass filter 31 and the telegrad 32 so that, while speech is being received, the telegrad 32 will be disabled. At the same time, the receiving switching circuit 26 controls the switching relay 33 for two telegraph channels.

During pauses in the speech, either when the subscriber at the distant end is talking into channel 1 or during the time when the subscriber on channel 1 pauses during his talk out over the antenna 13, the telegraph apparatus shown in Fig. 2 is in operation. This comprises perforators 61 and 35 working respectively into tape transmitters 63 and 95 and thence into the rotary distributor shown in the upper right-hand corner of Fig. 2 and here designated generally by the numeral 64, indicating the motor and synchronous equipment for driving such distributor. The rotary distributor works through the control circuit comprising various relays of Fig. 2 and by means of relay 79 controls the telegraph signal converter 39. This signal converter is a circuit controlling device disclosed in Patent 1,749,851 to H. C. Silent, March 11, 1930. When the relay 79 is on its marking contact, then the telegraph signal suppressor is in such a condition that alternating current coming from the telegraph signal oscillator 40 passes freely into hybrid coil

10 for transmission out over the antenna 13. When the relay 79 has its armature driven to its spacing contact, then the suppressing action of the telegraph signal converter 39 blocks off the telegraph signaling current and no current will, therefore, get into hybrid coil 10.

At the distant end these telegraph signals in the form of spurts of alternating current of the usual form of a carrier of the oscillator frequency with side-bands about seventy cycles wide caused by the modulation of the carrier by the telegraph transmitter are received over antenna 14 by the radio receiver 15 and thence through the repeater 16 whence they pass through the hybrid coils 17 and 18 to the band-pass filter 31. Thereafter the signals enter the telegrad 32 and are converted from varying strength alternating current signals to uniform strength direct current signals of practically the same strength at which they were received over the antenna 14. For a complete description of the telegrad, reference is made to application Serial No. 283,368, filed July 8, 1939, by Barney et al. These direct current signals then pass through the switching relay circuit 33 and the rotary distributor 41 to the two printers 42 and 43. During the reception of telegraph signals the receiving switching circuit 26 is unoperated and the speech path is blocked off by the receiving singing suppressor 19.

The rotary distributor 41 is kept in synchronism with the distant rotary distributor whose shaft 65 is rotated by the rotor 64 and which is shown in the upper right-hand corner of Fig. 2 by means generally described in the Cole et al. Patent No. 2,207,720 and in particular by the means disclosed in a patent granted to L. A. Meacham No. 2,207,748, granted July 16, 1940.

For purposes of the present description, it is only necessary to mention the fact that the rotary distributor 41 will be kept in perfect synchronism with the distributor of Fig. 2 if there is an occasional transition from a spacing to a marking impulse, that is, if there is an occasional operation of the relay 79. Such transitions are caused during the normal operation of either the A channel or the B channel, here represented by tape transmitters 63 and 95, respectively. If there is a stoppage of transmission over both channels at the same time so that neither transmitter 63 nor transmitter 95 is in operation, then the novel means of the present invention is provided to cause an occasional operation of the relay 79. Specifically, as shown, the relay 79 will go through one cycle of operations per cycle of operation of the rotary distributor of Fig. 2.

In operation, if no voice currents are being transmitted from line 1 and the voice operated circuit, therefore, is unoperated, the telegraph apparatus of Fig. 2 will be fully enabled with relay 104 in the position shown.

The tape transmitter 63 has five pins, such as 73, which will engage perforations in the tape 62. When this occurs, the contact 74 is moved from its lower contact 75 to its upper contact 76. The upper contact 76 represents a marking condition and the lower contact 75 represents a spacing condition. When in the course of operation of the distributor the shaft 65 brings a brush into position to make the contact between segment 77 and ring 78, either spacing current from contact 75 or marking current from contact 76 will be extended through the telegraph transmitting line relay 79. If marking current is transmitted, then the polar relay 79 will be left in the position shown, whereby the secondaries of transformers

54 and 55 are closed and the tone from source 40 is transmitted into the hybrid coil 10 and thereafter out over antenna 13. If spacing current is transmitted through the relay 79, then the armature will move to the left and the telegraph signal converter 39 will prevent any tone being transmitted into the hybrid coil 10, thus establishing a spacing signal condition.

Let us assume that the shaft 65 is just coming to a position where it will make a connection from segment 80 to ring 81 and where the brush working on ring 78 will successively pass over the segments 82, 83, 84, 85 and 77, comprising the five code segments from the channel A transmitter. Under the assumption that the voice circuit is not being used at this time, the relays 85, 87, 88 and 89 will be in the positions shown. As just previously mentioned, a connection has been made between ring 90 and segment 91, thus connecting ground to the lower winding of relay 92. Relay 92 will then have moved its contact to the position shown so that battery is connected to one side of the stepping magnet 93 in the channel A tape transmitter 63. This magnet is not energized at this time. Since relay 87 is in the position shown, the connection between common ring 81 and segment 80 is ineffective and, therefore, relay 92 is left in the position shown. Now, as the brush successively passes over segments 82, 83, 84, 85 and 77, the marking or spacing signal current, as the case may be, is transmitted through the back contact and armature of relay 94 to the contact and armature of relay 86, winding of relay 79, to the common point of the marking and spacing batteries.

As the brushes connected to shaft 65 pass further along and are now in the position of transferring the record from tape transmitter 95, a connection will be made from ring 96 to segment 97 and thence to the other side of stepping magnet 93 so that, while the record from tape transmitter 95 is being transmitted, the shaft of tape transmitter 63 will be rotated and the tape advanced to the next set of code perforations. In a similar manner, during the movement of the shaft 65, a connection will be made to segment 99 while the record from tape transmitter 63 is being transmitted and shaft 100 will be rotated through the energization of magnet 101. In this manner the record of the two transmitters will be alternately transmitted by the relay 79.

Let it be assumed now that there is a stoppage of transmission over the B channel. This means that the tape 34 will become taut and the taut tape switch 36 will operate to open the circuit between the left-hand winding of relay 37 and conductor 38. Prior to the operation of taut shape switch 36, a connection will be made between ring 96 and segment 27 once per cycle of operation of the rotary distributor and at a time just after the brush has left the segment 99. This results in the placing of ground on the conductor 38 leading in parallel to the two windings of relay 37. These windings, however, are equal and opposed so that the relay 37 does not become operated at this time. However, when the taut tape switch 36 is operated, then the next time that connection is made between the ring 96 and the segment 27 the right-hand winding of relay 37 alone will be energized and, since there is now no opposing force, the relay 37 will operate and through its right-hand armature and front contact will lock in an operated position. The left-hand armatures of this multicon-

contacts from the distributor contacts 56, 57, 58, 59 and 60 to conductor 44, leading to the marking battery. Therefore, as long as relay 37 is operated, the telegraph transmitting line relay 79 will be driven to its marking contact while the brush on shaft 65 is passing over segments 56 to 60, inclusive.

If during this time the channel A becomes idle, then spacing current will be connected to the segments 82, 83, 84, 85 and 77 and hence the telegraph transmitting line relay 79 will send out first five spacing signals and then five marking signals and will repeat this operation as long as there is stoppage of transmission on both channels. Thus, there will be at least one transition from a spacing to a marking impulse per cycle of operation of the rotary distributor.

When transmission is resumed on channel B, the perforation of more tape will cause the taut tape switch 36 to operate to the position shown, hence, when the brush of the rotary distributor again makes contact between ring 96 and segment 27, the left-hand winding of relay 37 will be energized. Since the right-hand winding is already energized, the result will be equal and opposed and the relay 37 will become deenergized. Therefore, as the shaft 65 of the rotary distributor proceeds and the segments 56 to 60 are reached, normal conditions will exist and proper transmission of the codes will take place.

The operations of the relays 86 to 89, inclusive, are fully explained in the Cole et al. application Ser. No. 219,964. In general, when the voice takes command of the circuit and the voice operating circuit 7 is operated, then relay 104 becomes operated and, in turn, causes the operation of relays 86 and 87. Thereupon the transmission of telegraph signals is stopped through the operation of relay 92 and its companion relay 105, which prevent the operation of the stepping magnets 93 and 101, respectively.

If the transmission of code is at a critical point, as when a connection is being made between ring 103 and segment 107, the relays 88 and 89 will be operated so as to prevent the operation of relay 104 from operating the relays 86 and 87 to stop the transmission of a telegraph code. This condition, however, lasts for only a very short interval and relays 88 and 89 will return to normal so that relays 86 and 87 may become operated in the usual manner.

It is to be understood that the present invention is not limited in its application to the interpolated telephone and telegraph system above described but may with equal usefulness be incorporated in any telegraph system wherein a distant distributor is to be kept in synchronism with a near distributor through the method of correcting by transitions from spacing to marking conditions.

What is claimed is:

1. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served over said distributors, correcting means responsive to transitions from one type of communication signal to another type of communication signal, and means automatically responsive to stoppage of communication on one of said channels for changing the type of signal transmitted during such stoppage whereby there will be at least one transition of signals per cycle of operation of said distributors.

2. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of

communication channels served over said distributors, correcting means responsive to transitions from one type of communication signal to another type of communication signal, means associated with one of said communication channels for indicating stoppage of communication over said channel, and means responsive to said last means for changing the character of the signals over said channel during stoppage of communication whereby there will be at least one transition of communication signal type per cycle of operation of said distributors.

3. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served over said distributors, means for communicating over said channels by permutations of different electrical conditions, said last means including means for continuously transmitting one of said electrical conditions over said channels during stoppage of communication thereover, correcting means responsive to transitions from one electrical condition to another, means associated with one of said communication channels for indicating stoppage of communication thereover and means responsive to said last means for changing said continuous transmission of one of said electrical conditions to continuous transmission of another of said electrical conditions, whereby under condition of stoppage of communication on all said channels there will be at least one effective transition from one condition to another per cycle of operation of said distributors for operating said correcting means.

4. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served over said distributors, a plurality of code segments on said distributors for each said channel, means for alternatively placing marking or spacing conditions on said segments for communicating by permutation codes, means during stoppage of communication over any one channel for placing spacing condition on all code segments of said channel, correcting means at the said corrected distributor responsive to transitions from one condition to another, means associated with one of said communication channels at the correcting distributor for indicating stoppage of communication over said channel, and a multicontact relay responsive to said last means for placing marking condition on all code segments of said channel whereby under condition of stoppage of communication on all said channels there will be at least one effective transition from spacing to marking per cycle of operation of said distributors for operating said correcting means.

5. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served by said distributors, a plurality of code segments on said distributors for each said channel, a transmitter for each channel for communicating over said channel by permutations of marking and spacing conditions placed on the code segments of said channel, said transmitter placing spacing conditions on all code segments of its channel during idle periods thereof, correcting means at the said

corrected distributor responsive to transitions from one condition to another, means associated with one of said transmitters responsive to the idle condition thereof, and a multicontact relay responsive to said last means for placing marking condition on all code segments of said channel whereby under condition of stoppage of communication on all said channels there will be at least one effective transition from spacing to marking per cycle of operation of said distributors for operating said correcting means.

6. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served by said distributors, a plurality of code segments on said distributors for each said channel, a tape transmitter for each channel for communicating over said channel by permutations of marking and spacing conditions placed on the code segments of said channel, said transmitter placing spacing conditions on all code segments of its channel during idle periods thereof, correcting means at said corrected distributor responsive to transitions from one condition to another, a taut tape switch associated with one of said transmitters, and a multicontact relay responsive to said taut tape switch for placing marking condition on all code segments of said channel whereby under condition of stoppage of communication on all channels there will be at least one effective transition from spacing to marking per cycle of operation of said distributors for operating said correcting means.

7. In a synchronizing system, a correcting distributor, a corrected distributor, a plurality of communication channels served by said distributors, a plurality of code segments on said distributors for each said channel, a tape transmitter for each said channel for communicating over said channel by permutations of marking and spacing conditions placed on the code segments of said channel, said transmitter placing spacing conditions on all code segments of its channel during idle periods thereof, a stepping segment for each channel on said correcting distributor for advancing the tape in said transmitter, correcting means at said corrected distributor responsive to transitions from one condition to another, a taut tape switch associated with one of said transmitters, a multicontact relay for placing marking condition on all code segments of said channel, said relay having two equal and oppositely acting windings thereon, one of said windings being included in the circuit of said taut tape switch, and means including another segment on said correcting distributor for closing the circuit of said relay once per cycle of operation of said distributor, whereby said circuit closing means is effective to energize said relay when one winding is opened by said taut tape switch, and is effective to deenergize said relay when said one winding is closed by said taut tape switch, whereby under condition of stoppage of communication on all channels there will be at least one effective transition from spacing to marking per cycle of operation of said distributors for operating said correcting means.

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