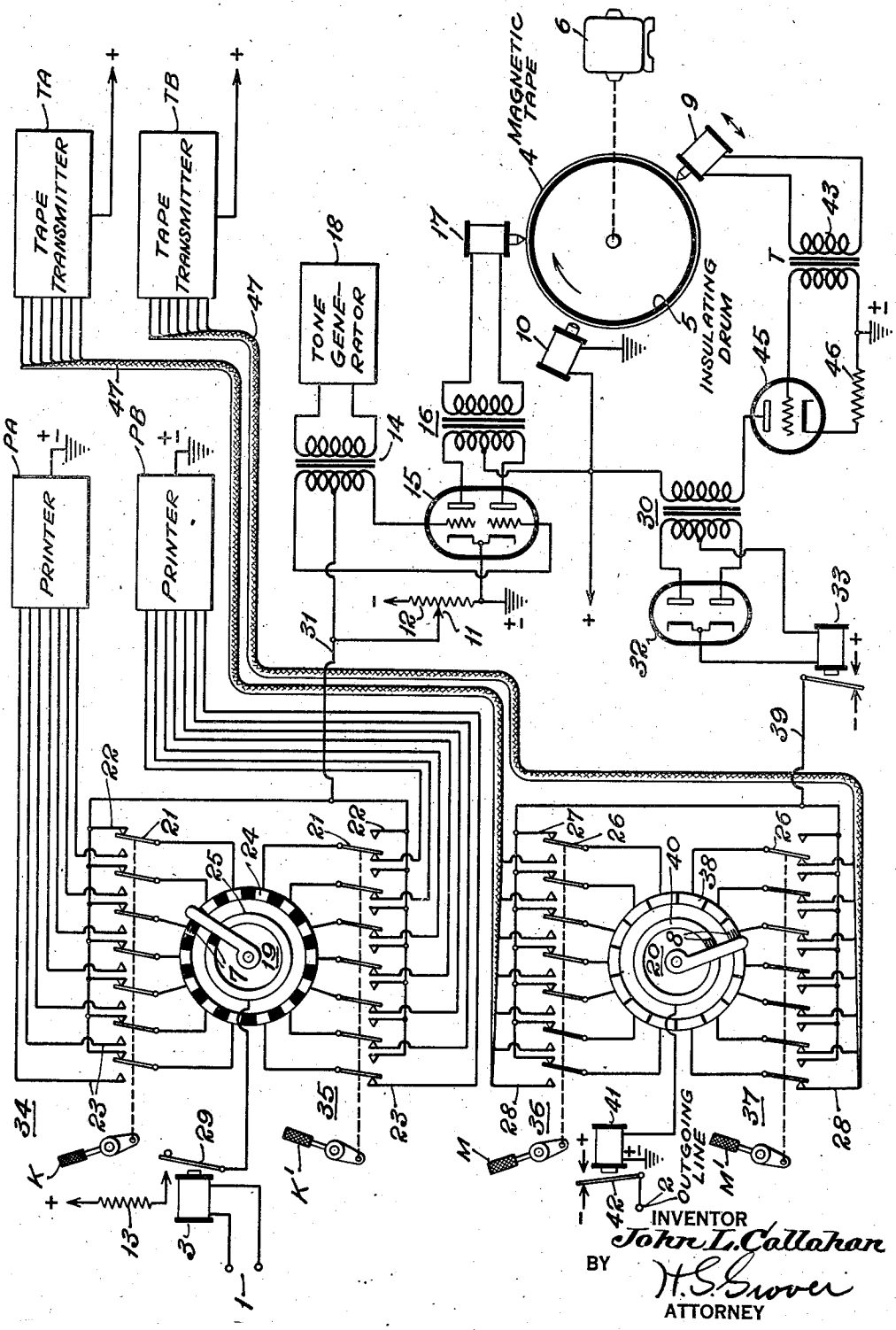
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PHASING DEVICE FOR SYNCHRONOUS TELEGRAPH SYSTEMS

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## PHASING DEVICE FOR SYNCHRONOUS TELEGRAPH SYSTEMS

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This invention relates to a phasing device for synchronous telegraph systems. When code signals having uniform length are employed in synchronous printing telegraph systems, it is frequently desirable to extend the transmission channel from one receiving station to another. It is also desirable in multiplex systems to adjust the phase of the multiplex signals originating at different points in the system so that they will not overlap the channels to which they are assigned. A distributor may be provided with individual segments for the code elements and may, for example, contain a sufficient number of segments to accommodate code signals in two or more multiplex channels. Simultaneous reception and retransmission may also be obtained if suitable arrangements are provided for delaying the effects of the received signals so that the several components of a character code signal may be impressed on appropriate segments of a transmitting distributor in proper phase relation to other operating parts of the system.

Heretofore it has been the practice in the telegraph art to utilize storage means of one type or another such as banks of relays, for example, for delaying the transmission of relayed code signals so as to tie in properly with the channel time which is allotted to a given transmission of intelligence in a multiplex system. Such relays are expensive to build; their maintenance is costly; and the flexibility of adjustment is limited.

Accordingly it is an object of my invention to provide improved facilities for the storage of signals which may need to be retransmitted from one receiving station to another.

It is another object of my invention to provide a flexible arrangement of terminal equipment in a telegraph system such that incoming signals may either be applied locally to a printer or other responsive device, or, when the occasion arises, these signals may be switched into an outgoing channel of a multiplex or simplex synchronous telegraph system.

It is still another object of my invention to provide a relaying system which is characterized by having a minimum number of movable parts, maximum simplicity, and flexibility of adaptation.

It is still another object of my invention to provide receiving and retransmitting equipment in combination with initial code signal transmitting equipment such that incoming and outgoing signals may be handled independently when desired and at other times the incoming signals may be relayed to an outgoing channel.

The foregoing and other objects of my invention will be better understood in view of the following detailed description of a preferred embodiment of my invention. This description is accompanied by a drawing, the sole figure of which represents diagrammatically certain apparatus units and their circuit arrangements such as would be found suitable at a given telegraph station.

Referring to the drawing, I show an input circuit having terminals 1, and connected thereto is a relay 3, the armature of which is caused by marking signals to close a circuit through its front contact. This relay armature is connected to a continuous ring 25 on a distributor 19. A segmental ring comprises conductive segments 24 interspersed with insulating segments. The rotating brushes 7 connect the segments 24 successively with the ring 25.

The positive terminal of a suitable direct current source (not shown) is connected to the front contact of the armature 29 on relay 3. Said source has two sections between which is a grounded tap. The negative section provides a negative grid bias for an amplifier tube 15, as will be hereinafter explained. The brush 7 is rotated at a synchronous speed such that successive contacts 24 are wiped over by the brush at the baud rate of reception of the code signal elements.

The distributor 19 is shown having fourteen conductive segments 24, seven of which are appropriate to code elements of uniform length signals suitable for controlling a printer PA. Seven others of the conductive segments 24 are arranged to distribute code elements of the signals in another channel to selector means in a printer PB. Either of the printers PA or PB may be directly connected to the distributor segments by means of multipole double-throw switches 34 and 35.

Switch 34 has seven movable contacts 21 which may be simultaneously engaged with contacts 22 on one side or with contacts 23 on the other side. Printer PA is placed in service by moving the key lever K to the right. The selector mechanism in the printer is conventional and has not, therefore, been shown in detail. A suitable type of selector mechanism includes seven selector magnets and associated code unit latches and code bars operable to select the printer type bars for actuation. Each of the individual circuits from switch 34 to printer PA includes a selector magnet.

Printer PB is provided for local reception of incoming signals on a second channel of the multiplex system. The connections are similar

to those for printer PA, but are controlled by the multipole double-throw switch 35 having a key lever K'.

For purposes of relaying, either of the multipole switches 34 or 35 may be set in the positions shown, thereby to feed all of the local impulses representing marking signals through a single conductor 31 to a movable tap 11 on a potentiometer 12, this potentiometer being connected between the grounded neutral point and the negative terminal of the direct current source. The positive terminal of this source is connected through a resistor 13 to the front contact of relay 3. Conductor 31 is connected to a mid-point on the secondary of transformer 14, this secondary having terminals connected respectively with each of the grids in a twin triode tube 15. The common cathode of this tube is grounded. The anodes are connected to the terminals of a primary winding on a transformer 16. This primary winding has a mid-tap which is connected to the positive terminal of the direct current source.

A tone generator 18 has an output circuit connected to the primary winding on transformer 14. The output of this generator is, therefore, arranged to be keyed by the incoming signals. When the armature 29 is pulled up by relay 3 in response to a marking signal the grid bias in tube 15 is rendered positive in respect to the grounded cathode. Tube 15, therefore, amplifies the tone frequency output from generator 18. Upon release of the armature 29 a negative grid bias derived from the normal potential drop through potentiometer 12 causes tube 15 to be blocked. This condition prevails during a spacing signal and thereupon tube 15 delivers no output. The output from the amplifier tube 15 is coupled across transformer 16 to a circuit for actuating a recording magnet 17 on a suitable telegraphone unit. This unit comprises a magnetic recording tape 4 which may be carried on an insulating or non-magnetic drum 5. Alternatively, however, the tape may be carried on two pulleys, one at least of which is motor driven. The advantage of using a single drum 5 is that no slippage is possible and hence there is no risk of dephasing the recorded signals on the magnetic tape.

The drum 5 may be driven by a synchronous motor 6 which is supplied with alternating current from a regulated or synchronized source, as is usual. If the drum 5 is to be driven at the same speed as that of the brush 7 (and this is a practical arrangement), then the code signals recorded by the magnet 17 will occupy an arc of 180° for each channel. In the arrangement shown, a complete code signal in channel A is transmitted and followed by a complete code signal in channel B. It is quite possible, however, to utilize interleaved signals in which each code element of channel A is followed by one code element of channel B. The latter arrangement is particularly useful when Morse or other code signals of unequal length are interspersed with uniform length code signals.

A pick-up magnet 9 is arranged to be adjustably positioned with its pointed pole-piece at any radial angle with respect to the pole-piece of the recording magnet 17. In this manner different intervals of delay may be obtained in the operation of a recording or a relaying device under control of the pick-up magnet 9. The means for adjustably positioning the magnet 9 are not shown, but as is well known, such means may, if desired, consist of a supporting arm which is rotatable about the axis of the drum 5, and stationary structure against which the arm can be clamped after suitable adjustment.

A wipe-out magnet 10 is disposed in position to de-magnetize the tape 4 immediately preceding its passage under the pole-piece of the recording magnet 17. Magnet 10 is continuously energized from the direct current source.

The currents induced in the pick-up magnet 9 correspond with those which energize the recording magnet 17 but are delayed in time by the passage of a given point on the magnetic tape from the pole-piece of magnet 17 to the pole-piece of magnet 9. This delay period is made adjustable in order that the relayed signals shall occupy mutually exclusive periods of channel time with respect to the channel time of other signal trains of the multiplex system. The energy picked up by the magnet 9 is preferably fed to a primary winding 43 on a transformer T. The secondary 44 of this transformer is disposed in the input circuit of an amplifier tube 45. This tube has the usual cathode, grid, and anode. A cathode resistor 46 is so disposed as to render the tube self-biasing. The end of the resistor 46 remote from the cathode is preferably connected to a neutral ground point.

The anode of tube 45 is connected through the primary winding of a transformer 38 to the positive terminal of the direct current source. The tone frequency energy derived from the pick-up magnet 9 is amplified by tube 45 and energizes the primary of transformer 38. The secondary of transformer 38 has its terminals connected to the two anodes in a twin diode tube 32. The common cathode of this tube is connected to one coil terminal of a relay 33. The other coil terminal of this relay is connected to a mid-point on the secondary of transformer 38.

Relay 33 has an armature which engages with an electrically positive front contact and a negative back contact. This armature is connected through conductor 39 to contacts 27 in each of two mutipole double-throw switches 36 and 37. These switches are each appropriate to one of two outgoing channels of the multiplex system. They are controlled by key levers M and M'.

The movable contacts 26 of the two multipole switches 36 and 37 are connected to individual segments on an outgoing signal distributor 20. This distributor is similar to distributor 19 except that its conductive segments 38 are separated by relatively thin insulating segments.

Distributor 20 has a rotatable brush 8, which is arranged to contact successively with the segments 38 and continuously with the ring 40. These segments are individually connected through switch contacts 26 and 28 and through multi-conductor cables 47 to keying contacts (not shown) in the tape transmitters TA and TB. Relay 41 can be switched into circuit with the direct current source, the tape transmitters PA and PB (or either of them) and the distributor 20 and responds to keying under control of the conventional perforated tape which is arranged to cntact successively with the segrate of passage of brush 8 over individual segments 38.

Relay 41 has an armature 42 connected to the outgoing line 2. The positive front contact and the negative back contact are arranged to feed current of suitable potential to the outgoing line in accordance with the marking and spacing

elements of the code signals, the latter being picked up by the brush 8 on distributor 20.

It may be well now to review the operation of the system when the switches 34 and 36, for example, are set in the position shown for relaying incoming channel A signals to an outgoing channel A. Relay 3 biases the tube 15 so as to amplify the output from the tone generator 18 upon reception of the marking elements of the code signals. The amplified tone impulse is recorded by magnet 17 on magnetic tape 4. The succession of marking elements interspersed with spacing elements is picked up by magnet 9 and the tone frequencies are amplified in tube 45. The marking signal pulses are then rectified in tube 32 and are used to energize relay 33. The armature of relay 33, when it pulls up, applies positive potential to whichever segments 38 are being traversed by brush 8. Relay 41 is thus energized and applies positive potential to the line 2 in accordance with the marking elements of the code signals.

Obviously the phase relation between the incoming and outgoing signals may be adjusted to meet any multiplexing requirement simply by orienting the pick-up magnet 9 with respect to the recording magnet 17.

When it is desired to utilize a local tape transmitter, such as the unit TA or the unit TB, in connection with an outgoing multiplex channel, then the appropriate switch 36 or 37 is set to connect the segments of distributor 20 to individual ones of the code unit contactors in the tape transmitter units, as hereinabove described. Moreover, when the incoming signals are to be locally recorded and not relayed, all of the units PA, PB, TA, and TB may be operated simultaneously, if desired. Then again, if the in and out channels A are to be associated for relaying while the in and out channels B are to be rendered independent, then all of the multipole switches will be set in the positions shown. At this time, printer PA and tape transmitter TA will both be idle; printer PB will be fed with incoming signals; and tape transmitter TB will be operatively connected to the outgoing channel B.

It will be apparent to those skilled in the art that in place of the distributors 19 and 20, I may, if desired, utilize distributors having a sufficient number of conductive segments 24 and 38 so that three or more channels may be comprehended in the multiplex system. It is also apparent that in the transmission of code signals each code combination transmitted on one channel may be in succession to a code combination of another and, alternatively, the code elements of differently channeled signals may be interleaved simply by connecting alternate segments 24 to one printer PA and intervening segments to the other printer PB. And similarly, alternate segments 38 may be connected to tape transmitter TA while intervening segments are connected to transmitter TB.

In the foregoing description I have referred to the sole figure of the diagram for explaining a preferred embodiment of my invention and also an obvious modification thereof.

In another modification it is apparent that the receiving distributor 19 and possibly the sending distributor 20 may be dispensed with in cases where the system as shown and described is to be used solely for relaying the incoming signals to a selected outgoing channel or to a plurality of different outgoing channels. In such installations the bias control circuit for the tri-ode tube 15 does not include the distributor 19, but is directly connected from the tap 11 on potentiometer 12 to the armature 29 on relay 3. Furthermore, the functions of relays 33 and 41 may be combined in one output signal relay if no provision is made for using the local transmitters TA and TB, in which case the distributor 20 would also be eliminated.

Other modifications will readily suggest themselves to those skilled in the art and may well be comprehended within the scope of the claims.

I claim:

1. In a multiplex telegraph system the method of repeating a train of signals received on a selected channel and relayed to a selected outgoing channel, which comprises magnetically recording and reproducing said signals, establishing a predetermined delay period between the instant of recording and the instant of reproduction and so adjusting the value of said delay period that the relayed signals shall be in proper phase relation to signals transmitted over other channels of the multiplex system, thereby to avoid overlapping of the signals in different channels.

2. The method of producing concurrent responses to signal trains of different channels in a multiplex system, said responses having a phase relation such that the channel times appropriated by each train are mutually exclusive, said method comprising the steps of magnetically recording incoming signals on a constantly moving medium, picking up said signals by magnetic induction after a predetermined delay period, and adjusting said delay period to avoid over-lapping of said channel times.

3. In a multiplex telegraph system a station having receiving and outgoing channel terminals, means for magnetically recording signals received on the receiving terminals, magnetic pick-up means operable to repeat said signals, means for so adjusting the pick-up means that a desired delay period is maintained between the instant of recording and the instant of pick-up of said signals, utilization devices individual to different communication channels of said system, means for allocating said signals to appropriate ones of said utilization devices, and means for delivering a desired portion of said signals to a remotely located utilization device by way of said outgoing channel terminals.

4. In a system according to claim 3 a code keying device and means for multiplexing the transmission of signals repeated by said pick-up means with signals produced by said keying device, the signals from both sources being sent out by way of said outgoing channel terminals.

5. In a multiplex telegraph system, incoming and outgoing channels wherein a fixed phase displacement is to be maintained between incoming and outgoing signals, a relay responsive to incoming signals, a tone generator subject to keying by said relay, a magnetic tape signal storage device having a recording magnet, responsive to tone frequency energy from said generator as keyed by said relay, a distributor for dividing the outgoing channel time between a plurality of signal trains, a tape transmitter arranged to deliver one signal train through said distributor to said outgoing channel, and an adjustably orientable pick-up magnet in said storage device effective in combination with an amplifier, a rectifier and a second relay, to deliver suitably phased code signals to said outgoing channel for multiplexing with said signal train which is delivered by said tape transmitter.

6. A system according to claim 5 and including a printer responsive to incoming signals and an incoming signal distributor arranged to so segregate the signals of different trains that one train is applied for control of said printer while another train is applied to the first said relay for keying the output from said tone generator.

7. Apparatus for translating code unit signals, comprising a composite signal channel, a magnetic tape storage device having recording, reproducing and wipe-out magnets in juxtaposition to an endless recording tape, the recording magnet being energized by signals received on said channel, and the wipe-out magnet being continuously energized, means for orienting the reproducing magnet with respect to the recording magnet thereby to obtain a predetermined delay period for the reproduction of signals, a second composite signal channel arranged to be fed with signals from different sources, and means for utilizing said storage device as one of said sources.

8. In a multiplex telegraph system, a relaying device comprising receiving terminals and transmitting terminals, means including a magnetic tape recording unit and a printer unit, both responsive to signal potentials of multiplexed signaling channels impressed on said receiving terminals, means for scanning the record made by said unit, means for segregating portions of the scanned record which are appropriate to a given one of the multiplex channels, means for tone modulating the signal potentials to which said tape recording unit is responsive, an independent source of outgoing signals, and phasing means for maintaining a suitable channel time separation of said signals from the output of said scanning means.

9. A phasing device for a synchronous telegraph system comprising magnetic tape signal recording and signal reproducing means, a receiving circuit for applying incoming signals to said recording means, a printer having character selecting means responsive to signals applied thereto from said receiving circuit, switching means for effecting concurrent operation of said recording means and of said printer when desired, and for effecting independent and sole operation of said recording means or said printer when desired, a code keying device operable at the same code element speed as that of the incoming signals, an outgoing signal channel, means for relaying a desired portion of the recorded and reproduced signals to said outgoing channel, means for multiplexing said reproduced signals with signals derived from said keying device, and means for so adjusting the phase relation between the signals derived from said reproducing means and the signals derived from said keying device that said signals are caused to occupy mutually exclusive portions of the outgoing channel time.

10. In a multiplex telegraph system having incoming and outgoing channels and synchronizing means for maintaining time division of said channels with respect to different trains of signals, a plurality of printer units arranged for control by incoming code signals, a plurality of code signal keying units arranged to deliver signal potentials to selected ones of said outgoing channels, a signal storage device including magnetic tape recording and pick-up means, a phase adjuster for obtaining a suitable time lapse between the instant of recording a given signal and the instant of reproducing the same by said pick-up means, switching means settable at will to allocate incoming signals of a desired channel to one of said printer units or to said storage device, and other switching means settable at will to draw upon said pick-up means or upon one of said keying units for signals to be applied to a desired outgoing channel.

11. In combination, a signal storage device including magnetic tape recording and pick-up means, a source of incoming code signals applicable to said storage device, a code signal keyer constituting a second signal source, means providing transmission of the signals from the two said sources at a uniform baud rate, distributor means for multiplexing the signals from the two said sources, and means for so adjusting the delay period introduced by feeding the incoming signals through said storage device that a suitable phase relation is maintained between the signals from the two said sources.

12. In a multiplex telegraph system for locally receiving, locally sending, and relaying code signals the elements of which are of uniform length, an incoming signal distributor, an outgoing distributor, a plurality of printers, a plurality of code keyers, selective circuits extending through said incoming distributor to said printers, collating circuits extending from said keyers to said outgoing distributor, a tone modulator subject to control at mutually exclusive times by the code elements of different trains of incoming signals, switching means for determining the manner of utilization of the incoming code signals by said printers, said tone modulator, or either of them, other switching means for determining the sources of different trains of signals to be applied to said outgoing distributor, and incoming signal storage means having a continuously movable tape of magnetizable material in cooperative relation to a magnetic recording element, a magnetic reproducing element and a "wipe-out" magnet, said storage means being arranged to suitably delay the relaying of signals from said tone modulator to said outgoing distributor, whereby such signals and signals produced by either of the keyers are multiplexed.

13. The method of phasing one train of code signals with respect to another such train, where the two trains are derived from mutually synchronized but phase displaced sources and require transmission on an outgoing time division multiplex channel, said method comprising locally generating a tone frequency wave, keying said wave by marking elements of the signals in one of said trains, electromagnetically recording and reproducing said keyed wave, introducing a predetermined storage period between said recording and reproduced steps with respect to a given element in said train, amplifying and rectifying said wave, and relaying the code elements derived from said rectified wave and from the other said train to said outgoing multiplex channel.

14. The method according to claim 13 and including the step of locally translating the intelligence of one train of incoming signals in an incoming multiplex channel while simultaneously utilizing another train derived from said incoming multiplex channel to key said tone frequency wave.

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