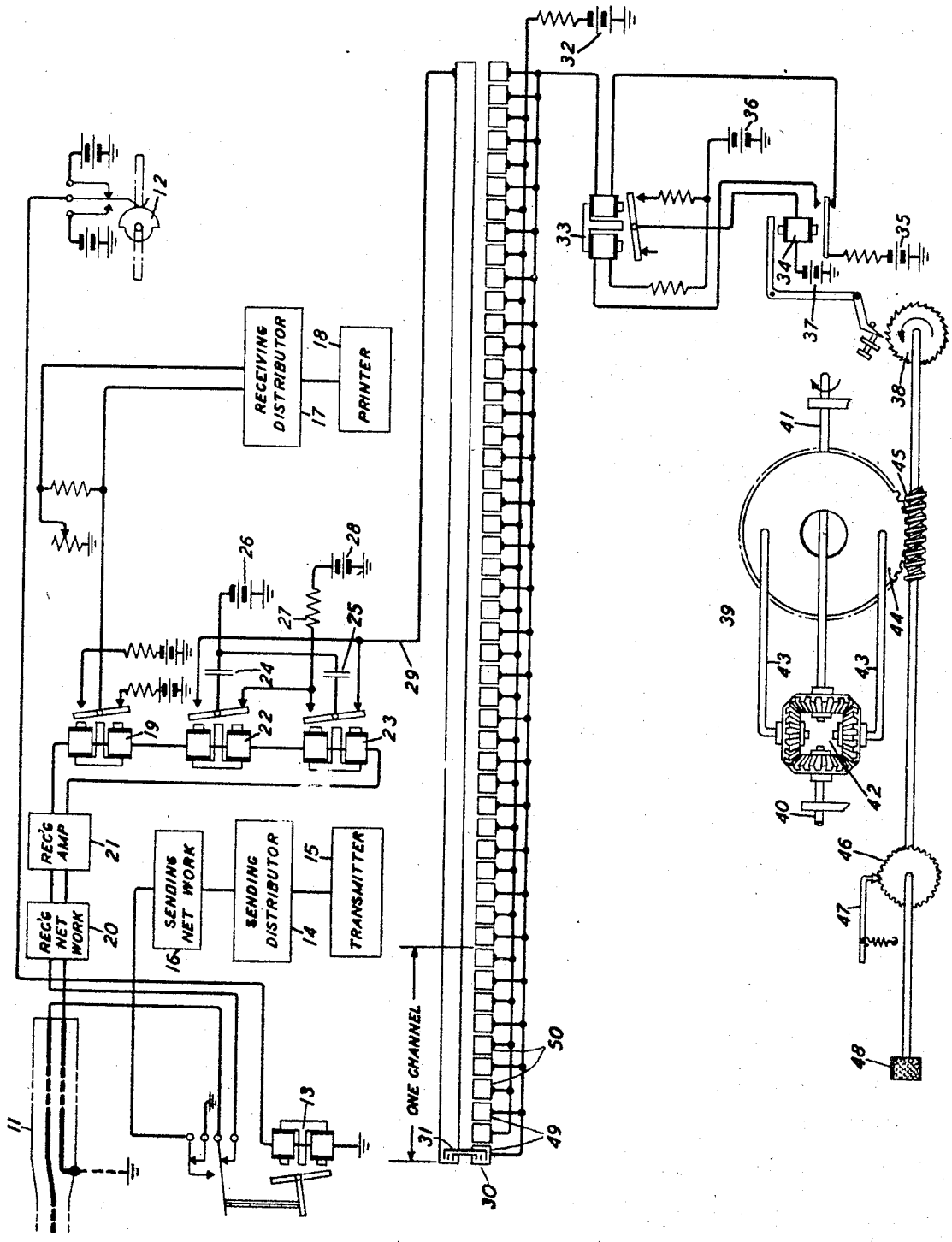
Feb. 23, 1932. G. A. LOCKE 1,846,883

SYNCHRONOUS SIGNALING SYSTEM

Filed June 28, 1930



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Patented Feb. 23, 1932

1,846,883

UNITED STATES PATENT OFFICE

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SYNCHRONOUS SIGNALING SYSTEM

Application filed June 28, 1930. Serial No. 464,498.

This invention relates to impulse transmission systems and more particularly to printing telegraph systems employing long submarine cables.

Its principal object is to improve the method and means for synchronizing transmitting and receiving mechanisms in systems of this type.

In multiplex operation of printing telegraph systems, as at present employed, mechanisms are used that enable a number of separate printing telegraph circuits at both ends of the line or cable to be connected in rotation so that each circuit at one end is successively connected over a cable to its corresponding circuit at the other end. In submarine cable operation, the cable may be operated simplex, that is, messages are transmitted in one direction only during a given interval of time and the direction of transmission is reversed automatically at stated intervals in order to handle traffic in both directions over one cable. This reversal of direction of transmission in present types of systems is generally effected by direction control apparatus operated automatically after having been once set to the desired proportions of time.

Mechanisms for transmitting and receiving consist of so-called distributors comprising transmitting rings, receiving rings and correcting rings. The correcting rings at each station are used for maintaining synchronism between the distributor at that end of the line or cable and the signals transmitted from the opposite end of the line or cable.

The present invention is applicable to systems of this general character and comprises means including a correcting ring of the distributor at one end of the cable orientable in relation to the associated transmitting ring whereby the system may be adjusted, before the actual transmission of messages begins, to maintain synchronism during successive reversals of the direction of transmission. By this means different amounts of time lag due to the transmission characteristic of the cable may be compensated for and the tendency on the part of the sending and receiving distributors to fall out of synchronism, during the intervals when the reversals of direction of transmission take place, is overcome. Furthermore, after reversal, and before transmission of messages in the opposite direction begins, the receiving distributor may be accurately synchronized.

This invention has been illustrated in the accompanying drawing in connection with a multiplex printing telegraph system comprising two terminal stations interconnected by a submarine cable, the equipment of only one terminal station being shown and only such of that equipment that is necessary for a clear understanding of the invention. The equipment shown herein is somewhat similar to that shown and described in Locke Patent 1,670,461 issued May 12, 1928. The equipment provided at the station not shown is identical with that shown in the drawing.

In the present invention the distributor at one station is set to run at a speed slightly slower than that of the distributor at the other station and for the purpose of illustration the distributor at the station shown is set to run at the lower speed. Therefore the distributor at the station shown is arranged to correct in a forward direction, that is, the brushes thereof shift, when being corrected, in the direction of their rotation and the distributor at the other station is arranged to correct in a backward or opposite direction. The object of the present invention is accomplished by providing two condensers, either of which is normally charged from a local source to a potential of one polarity and in response to each change in polarity of the incoming signals, this charge is impressed either directly to ground or to ground through the winding of a two-position polar relay, the charge in either case being impressed first on the correcting distributor. When one condenser is impressing a charge on the distributor, the other condenser is receiving its normal charge. The corrector distributor comprises a continuous and a segmented ring interconnected by a rotating brush. The segmented ring has two segments for every segment in the corresponding ring of the receiving distributor and these corrector segments are alternately connected

to form two multiples, one of which contains the even numbered segments and is connected directly to ground, and the other containing the odd numbered segments is connected to ground through the winding of the polar relay. Should the corrector brush be in phase with the incoming signals, the charge from either condenser will be impressed on the multiple of segments connected directly to ground and no correction is effected. But should there be a loss of phase, the condenser charge will be impressed on the other multiple of segments through the winding of the relay to ground. The relay operates momentarily, causing the momentary operation of a corrector magnet which subsequently causes the distributor brush, through the medium of a differential gear correcting mechanism, to shift in a forward direction one step in response to each change in polarity of the incoming signals, the operation being continued until phase is restored. The correction at the station, not shown, is made in the same manner just described except that the distributor brush thereat is shifted in the same manner, but in a backward direction.

Referring to the drawing, the equipment shown represents that at a station positioned for receiving in a system arranged for simplex operation. Only sufficient equipment to describe the invention is shown in detail, the remaining equipment being shown in diagrammatic form to show the applicability of the invention to a simplex operated system.

The direction of transmission over cable 11 is under the control of direction control apparatus which is indicated in part only by cam 12. A clear understanding of the operation of this apparatus may be had from U. S. Patent 1,689,328 issued to A. M. Curtis on October 30, 1928. Cam 12, which is controlled by timing apparatus, not shown but described in the Curtis patent, is provided to operate transfer relay 13 to either of its two positions at predetermined intervals, whereby the direction of transmission is reversed automatically at stated intervals in order to handle traffic in both directions over cable 11. A rotary transmitting distributor with associated group of impulse transmitting devices and a sending network are represented diagrammatically by blocks 14, 15 and 16 respectively, and are shown to be disconnected by transfer relay 13 from cable 11, to indicate that the equipment at the terminal shown is positioned for receiving signal impulses from cable 11. A rotary receiving distributor and its associated group of printers are represented diagrammatically by blocks 17 and 18 respectively and are shown connected, in series, to the armature of line or receiving relay 19. Relay 19, which is of the two-position type, is at this time connected, in series, with cable 11 over the closed contacts of transfer relay 13, receiving network 20 and receiving amplifier 21. In the latter arrangement, the incoming signals are reshaped, amplified and impressed on relay 19 which operates to reproduce the incoming signals for distribution to the printers 18 through receiving distributor 17.

Connected in series with the winding of relay 19 are the windings of corrector relays 22 and 23, also of the two-position type, which likewise respond to the incoming signal impulses. The armatures of relays 22 and 23 are respectively connected through condensers 24 and 25 to grounded negative battery 26. The lower contact of relay 22 and the upper contact of relay 23 are connected, in parallel, through resistance 27 to grounded positive battery 28. The upper contact of relay 22 and the lower contact of relay 23 are connected in parallel over a common conductor 29, as shown, to a corrector distributor ring set 30 which comprises a segmented and a continuous ring interconnected by a rotatable brush 31. Relays 22 and 23 always operate simultaneously to the same corresponding position and consequently in response to the simultaneous operation of relays 22 and 23, one of the condensers 24 and 25 receives a positive charge from battery 28 and the other condenser impresses its stored charge on distributor 30.

Distributor 30 is of the rotary type and is shown here as being developed for the purpose of illustration. The segmented ring is divided into twice as many segments as there are in each of the sending and receiving distributor ring sets. Therefore, there are five pairs of segments for each channel to correspond to the five-unit Baudot code. The segments are alternately connected to form two groups, one of which is connected directly to a grounded negative battery 32 and the other is connected through the right-hand winding of an auxiliary corrector relay 33, back contact and armature of magnet 34 to grounded negative battery 35. Relay 33, which is also of the two-position type, is responsive through its right-hand winding to the condenser charges which are impressed on the distributor through the second group of segments. When relay 33 operates in response to each of these charges, it closes an operating circuit for magnet 34, which circuit may be traced from grounded positive battery 36, right-hand contact and armature of relay 33, through the winding of magnet 34 to grounded negative battery 37. When magnet 34 operates, it opens at its back contact the circuit extending through the right-hand winding of relay 33 and closes at its front contact a circuit extending from grounded negative battery 35, front contact and armature of magnet 34, through the left-hand winding of relay 33 to grounded positive battery 36, which restores the armature of relay 33 to its left-hand position. The res-

toration of the armature of relay 33 opens the operating circuit for magnet 34. Therefore, the operation of magnet 34 is momentary in response to each charge received from either of condensers 24 and 25.

This momentary operation of the corrector magnet 34 causes a stepping operation of the ratchet wheel and pawl mechanism 38 which, in turn, gives an angular shift to the distributor brushes in a forward direction, that is, with respect to the direction of rotation of the distributor brushes, it being assumed that the transmitting distributor at the opposite end of cable 11 is arranged to rotate at a slightly faster speed than the distributor shown in the drawing. The shift of the distributor brush is effected by means of corrector mechanism 39 which is located between the motor (not shown) for driving the distributor and the distributors themselves. The shaft 40 is driven by the motor and the shaft 41 drives the arms on which the brushes, such as 31, for the distributors are mounted. These arms are arranged to drive the brushes over the various distributors in a manner well known in the art.

The corrector mechanism comprises differential beveled gear arrangement 42 interposed between the motor shaft 40 and the brush shaft 41 and the gears that link these two shafts together are mounted on supporting frame 43 secured to a worm pinion 44 that meshes with a worm 45. Any change in the angular position of the worm pinion changes the angular position of the linking gears and this, in turn, changes the angular position of the brush shaft 41 with respect to the motor shaft 40. The worm 45 is rotatable to shift the angular position of the worm pinion through a small angle by means of corrector magnet 34. In order to hold the worm 45 firmly while magnet 34 is not rotated, a separate ratchet wheel 46 and a pawl 47 are provided. This wheel and pawl also limit the movement of the worm 45 to one step each time the corrector magnet 34 operates. It is seen, therefore, that by this mechanism, corrections in a forward direction can be effected while the distributor brushes are being rotated by the motor and hence synchronizing effects may be produced between the brushes of the distributors at different stations.

A knurled handle 48 is provided on shaft 49 for manually adjusting the system in order to set it to a synchronous condition.

Operation

Assuming that the synchronous condition has been obtained, signal impulses are received over cable 11, re-shaped by network 20, amplified in amplifier 21 and applied to receiving relay 19 and relays 22 and 23, in series. Relays 22 and 23 respond to each reversal of the signal current to reverse the positions of their respective armatures which, when positioned, are always in engagement with corresponding contacts, that is, they are always in the same position with respect to their respectively associated contacts. If it is assumed that the relays are in the positions opposite to those shown, and a signal current reversal occurs which moves the armatures into the positions shown, a stored positive charge in condenser 25 is impressed on the continuous ring of distributor 30 over conductor 29, while a new positive charge is stored on condenser 24. At the next current reversal, the charge on condenser 24 is impressed on the continuous ring over conductor 29 and another charge is stored in condenser 25. This action is repeated as long as current reversals occur. The condensers are, therefore, alternately connected to the corrected distributor over conductor 29. As brush 31, which is continuously rotating passes over its associated continuous rings, the circuits for effecting the discharge of the condensers are completed over segments 49 or 50 of the segmented ring. As long as the distributor 30 is in proper phase relation with respect to received signals, the brush 31 will be on one of the segments 50 at the time relays 22 and 23 reverse the positions of their respective armatures and either one or the other of the condensers will be discharged through negative battery 32 shown connected to segments 50 and no correction will be produced. The distributor brush 31, however, is said to rotate at a speed slightly slower than that of the transmitted distributor brushes, not shown, at the opposite end of cable 11. Therefore, brush 31 will be constantly shifting back and eventually be in engagement with one of the segments 49 at the time relays 22 and 23 reverse the positions of their respective armatures. As a result of this, the charges from condensers 24 and 25 will be successively applied in continuous rotation as long as current reversals occur, through brush 31, segments 49, through the right-hand winding of relay 33 and over the back contact and armature of magnet 34 to negative battery 35. This causes the armature of relay 33 to shift momentarily in response to each condenser charge, to the position opposite to that shown in the drawing whereby positive battery 36 is connected over the right-hand contact and armature of relay 33, through the winding of magnet 34 to negative battery 37. This causes magnet 34 to momentarily operate and shift the distributor brushes forward through the differential gear mechanism. A correction takes place whenever brush 31 drops back far enough to engage with the segments 49 at the time signal reversals occur and, therefore, maintains the distributor 30 at all times in phase with the signals received over cable 11.

When transmission from the distant cable 11 has continued for a predetermined period, the direction of transmission is reversed. The manner of switching the cable 11 from the receiving equipment to the sending equipment is described in Patent 1,689,328, supra. When transmission is in the opposite direction to that just described, that is, from transmitters 15, the correction of the other end of cable 11 is effective in the same manner except that the direction of correction is backward, that is, with respect to the direction of rotation of the distributor brushes at that end of the cable. This difference in direction of brush shift, as stated above, is due to distributor brushes at the opposite end of the cable being arranged to rotate at a speed slightly faster than the speed of brush 31.

What is claimed is:

1. A receiving system comprising a device normally operating in fixed phase relation to incoming signaling impulses, a charge storing device and a local source for charging it, a circuit opening and closing means controlled by incoming impulses to charge said device, means for causing said device to discharge as a result of every change in polarity of incoming current, a corrector, a circuit over which the current discharged by said storing device controls said corrector, and means whereby said corrector effects in response to every change in polarity of the incoming current a correcting operation when said fixed phase relation has departed materially from normal.

2. A synchronous impulse system comprising receiving means connected to a transmission circuit, charge storing elements connected to said receiving means, and a source of potential for alternately charging said elements in response to reversals in polarity of the signal impulses incoming from said circuit, characterized in this, that a circuit is provided over which the charge stored in either of said elements is discharged on succeeding reversals in polarity of the incoming signals to restore said means to synchronism with the incoming impulses.

3. In a synchronous impulse transmission system comprising transmitting and receiving means and a transmission circuit interconnecting said means, a method of maintaining synchronism between said means which consists in charging from a local source of potential one or the other of a plurality of charge storing elements every time the polarity of signal impulses incoming from said circuit reverses, discharging when correction is desired the charge stored on one of said elements through a repeating device on a subsequent reversal of polarity of the incoming signals, and impressing the output of said repeating device on a correcting mechanism.

4. A synchronous impulse transmission system comprising a transmitting and a receiving means, a transmission circuit interconnecting said means, storing condensers connected to said receiving means, and a source of potential for alternately charging said condensers in response to reversals in polarity of the signal impulses incoming from said circuit, characterized in this that the charge stored in either of said condensers is utilized on succeeding reversals in polarity of the incoming signals to restore said means to synchronism with the incoming impulses.

5. A synchronous impulse transmission system comprising transmitting and receiving means, a transmission circuit interconnecting said means, a plurality of devices connected in series in said circuit and arranged to respond to reversals in polarity of signal impulses incoming from said transmission circuit, charge storing means under the control of two of said devices, a local source of potential for charging said storing means alternately, a corrector mechanism, a device for selecting the charges on said storing means alternately to operate said corrector mechanism only when said transmitting and said receiving means are out of synchronism.

6. A synchronous impulse transmission system comprising transmitting and receiving means, a transmission circuit interconnecting said means, a plurality of electromagnetic devices connected, in series, in said circuit and arranged to respond to reversals in polarity of signal impulses incoming over said circuit, a plurality of condensers under the control of some of said devices, a local source of potential for charging said condensers alternately, a corrector mechanism, a device for selecting the charges on said condensers alternately to operate said corrector mechanism only when there is a loss of synchronism between said transmittting and said receiving means.

In witness whereof, I hereunto subscribe my name this 27th day of June, 1930.

GEORGE A. LOCKE.