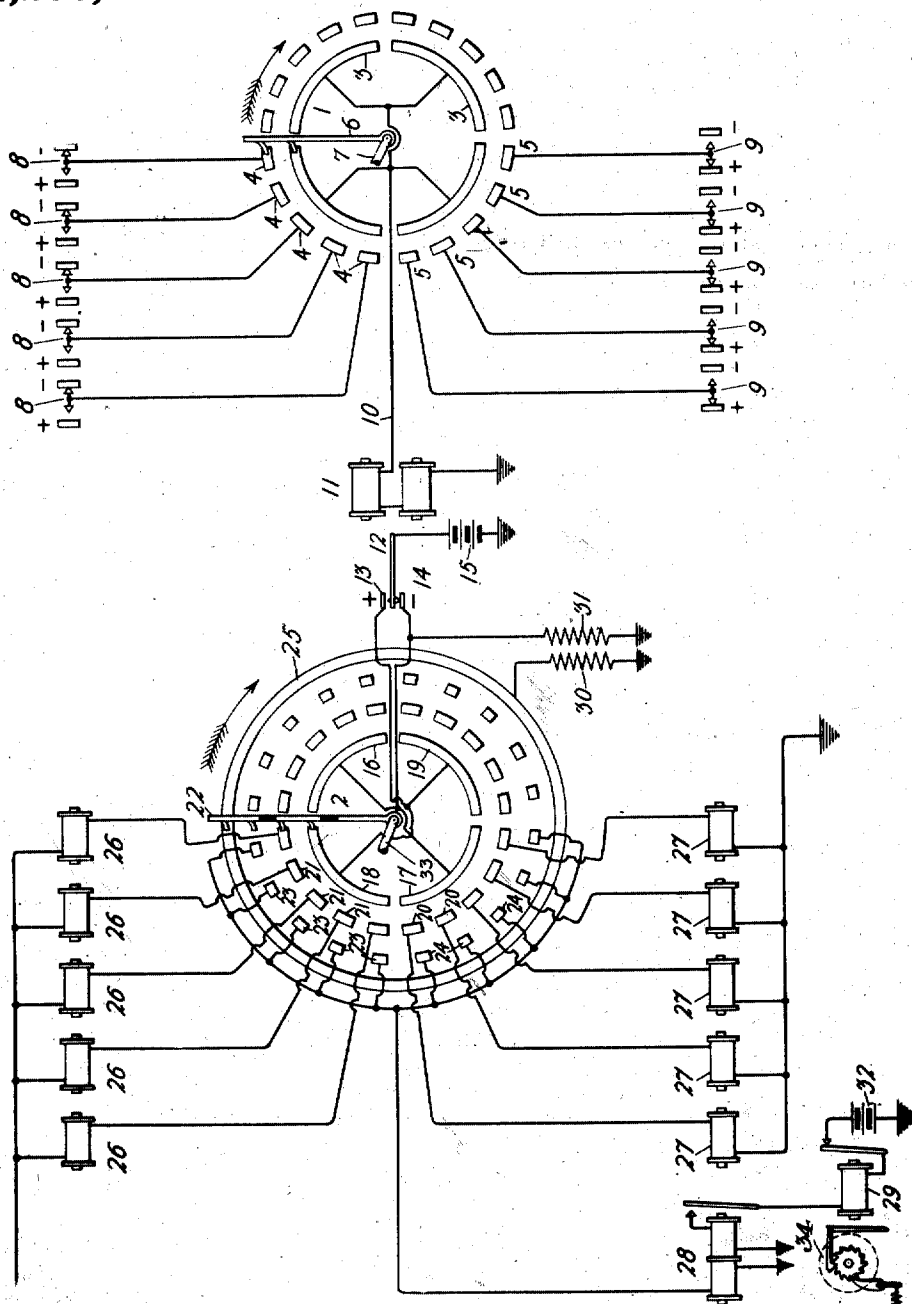


A. F. DIXON.
 SYNCHRONIZING SYSTEM.
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1,280,423.

Patented Oct. 1, 1918.



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UNITED STATES PATENT OFFICE.

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SYNCHRONIZING SYSTEM.

1,280,423.

Specification of Letters Patent.

Patented Oct. 1, 1918.

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To all whom it may concern:

Be it known that I, AMOS FREDERICK DIXON, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Synchronizing Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to synchronizing systems for multiplex telegraphy, and its principal object is to provide an improved method of operation and system whereby synchronism normally obtained by signal current reversals can be automatically maintained during non-signaling intervals.

The invention as herein shown and as it is particularly designed to be utilized, is embodied in a printing telegraph system of the multiplex high speed type, for which distributors of the Baudot type are used, one of such distributors being located at the sending station and the other at the receiving station. As there is only a single line wire between the sending and receiving stations, it is necessary to synchronize the distributors either by sending extra synchronizing impulses over such line wire or by utilizing parts of a signal impulse for synchronizing. In synchronizing with extra synchronizing impulses it is found that time is wasted in sending the extra synchronizing impulses, and in synchronizing with signal impulses difficulty is encountered in maintaining synchronism at times when signals are not being sent. In accordance with a feature of the present invention two or more distributors are maintained in synchronism during the sending of a message by means of changes in polarity in the signaling impulses, and means are provided whereby, in case no signaling impulses are being sent or in case several similar signals are sent without change in polarity, the polarity of the current in the line is nevertheless periodically changed so that synchronizing impulses are produced and the distributors are maintained in synchronism.

In accordance with this feature of the invention, the connections of the distributors are so arranged that in alternate quadrants the selective impulses are of different polarity; thus in the first quadrant selective impulses may be positive, in the second negative, third positive, and so on. In order to accomplish this result all of the transmitters

associated with the first quadrant are so arranged that their movable contacts are normally connected to negative battery, and, when sending signals, positive selecting impulses are obtained by causing certain of the movable contacts to connect with positive battery, thus sending positive impulses. The contacts of the corresponding quadrant at the receiving station are so arranged that the line relay closes the local circuit to the selecting magnets of the printer for each positive impulse; similarly in the next quadrant the transmitters are arranged so that their contacts normally connect with positive battery, and the distributor at the receiving station is so arranged that the contacts of the corresponding quadrant are made operative when a negative impulse is impressed on the line. By virtue of this arrangement, whether or not signals are being sent each time that the distributor brushes move from one quadrant to the next, the polarity of the line current will change and will move the armature of the line relay from the positive to the negative contact, or the reverse, as the case may be, and will by so doing cause the production of a synchronizing impulse, which is in all respects similar to the synchronizing impulse which will be produced each time that the polarity of the current changes in a signal. This synchronizing impulse may be utilized in any known manner for altering the speed of the distributors and bringing them into synchronism. Also any one of the several well-known types of motors may be used for driving the distributors, and their speeds may be either mechanically or electrically altered to bring them into synchronism.

In the particular system which the applicant prefers to utilize and which is disclosed herein, the synchronizing impulses, under certain conditions, cause the operation of electro-responsive devices, which are adapted to either electrically or mechanically modify the speed of the distributors.

The above and other objects of this invention will be fully set forth in the following description and claims, and will be more readily understood by reference to the accompanying drawing in which the system is diagrammatically shown.

In the drawing, 1 and 2 denote generally the distributors at the sending and receiving stations. These distributors are of the

usual Baudot type and may be provided with as many sections and sets of contacts as the traffic conditions may demand. On the drawings, however, they are shown as being provided with four sections or quadrants and four sets of contacts. The sending distributor 1 is provided with four quadrants 3 which are electrically connected together and to the line. Corresponding to each quadrant 3 is a set of five contacts illustrated at 4 and 5. The brush carrying arm 6, which is rotated by power driven shaft 7 in the direction of the arrow, carries two brushes which are electrically connected and which contact respectively with the quadrants and contacts, being adapted to successively connect the contacts to the quadrants and to the line.

For the sake of convenience, the quadrant to which the contacts 4 are individual will be referred to as the first quadrant, and the quadrants to which the contacts 5 are individual will be referred to as the fourth quadrant, and the corresponding quadrants on the receiving distributor will be likewise referred to as the first and fourth quadrants. The contacts 4 are each connected with the movable contacts 8 of the transmitter, which movable contacts in their normal position, as indicated, are connected to negative battery and are adapted to be displaced in any combination to form a signal, and when displaced move to the positive side and connect positive battery to the contacts 4. The contacts 5 similarly are connected to the movable contacts 9 of the fourth transmitter, which contacts, as shown, are normally in connection with positive battery and may be moved to place negative battery on the contacts 5. Similarly the contacts of the second and third quadrants may be connected to the movable contacts of two other transmitters, the movable contacts of the transmitter of the second quadrant being normally in connection with positive battery, and of the transmitter of the third quadrant normally in connection with negative battery. As before stated any number of sections may be employed, it only being essential that the transmitters associated with adjacent sections should be arranged so that the movable contacts thereof are normally in connection with battery of opposite polarities.

It can be seen that due to this arrangement when the movable arm 6 passes from the fourth to the first quadrant or from the first to the second or second to third or third to fourth, if no selective signals are being sent, the transmitter contacts being in normal position, the polarity of impulses impressed on the line 10 will change each time the distributor arm moves from the one quadrant to the adjacent quadrant.

The impulses of current impressed on the

line 10 pass through the line relay 11 and move the movable tongue 12 thereof either to the contact 13 or contact 14, depending upon whether the impulse is positive or negative, the relay being so arranged that the tongue 12 will stay in the position to which it is moved until the polarity of the current is changed. Connected with the armature 12 is a source of local battery 15 which is connected to either the contact 13 or 14, depending upon the operation of the relay 11. The contact 13 is connected as indicated to the quadrants 18 and 19, and the contact 14 to the quadrants 16 and 17 of the distributor at the receiving station, or, in other words, the contact 13 is connected to the first and third quadrants of the distributor, and the contact 14 to the second and fourth quadrants. Individual to each quadrant in this distributor is a set of contacts which correspond to the contacts 4 and 5 of the sending distributor. These contacts in the fourth and first quadrants being represented by the reference numerals 20 and 21 respectively. The receiving distributor is provided with a distributing arm 22, which is adapted to be rotated by shaft 33 in the direction of the arrow in synchronism with the distributor arm 6 of the sending distributor. The receiving distributor 2 is provided with an additional set of contacts for each quadrant which are the same in number as the contacts 21, and as shown are smaller than such contacts 21. These contacts which are the synchronizing contacts are designated in the first and fourth quadrants by the reference numerals 23 and 24. A continuous ring contact 25 is also provided and the distributing arm 22 is provided with two pairs of brushes, the brushes of each pair being electrically connected, the arrangement being such that as the distributor arm moves over the contacts, the contacts 20 and 21 will be successively connected electrically to the quadrants 17 and 18, and the synchronizing contacts 24 and 23 will be successively electrically connected to the ring contacts 25. The quadrants 16 and 19, as indicated, are also provided with sets of synchronizing contacts, as well as the contacts corresponding to contacts 20 and 21, the connections for convenience being shown only in the fourth and first quadrants. Connected to the contacts 21 is a set of selecting magnets 26, there being one selecting magnet connected to each contact, and the contacts 20 are similarly connected to a similar set of selecting magnets 27. The magnets 26 and 27 are associated with two different printing instruments and operate in the well-known manner, when energized in combinations determined by the combination of impulses sent by the corresponding transmitters at the sending station, to select the character which

it is desired to record and to cause the recording of such character. As printing instruments of this type are well known in the art it has only been deemed necessary to illustrate the selecting magnets thereof.

Synchronizing contacts 23, 24, etc., are connected in multiple and are connected to one winding of the relay 28. The other winding of the relay 28 acts as a locking winding when such relay is energized, and forms part of the circuit controlling the magnet 29. The magnet 29 may be employed for electrically correcting the speed of the driving mechanism of the receiving distributor in a manner similar to that disclosed in Patent No. 1,185,712, dated June 6, 1916, or it may be employed for mechanical correction, *i. e.*, the magnet 29 may be used for shifting the brush arms of the receiving distributor in a manner similar to that disclosed in applicant's copending application Serial No. 831,167, filed April 11, 1914. The ring 25 is connected to the secondary winding 30 of an induction coil, the primary winding 31 of which is connected to the contact 14.

It is the general practice in synchronizing distributors to normally run one of the distributors, which is termed the correcting distributor, at as constant a speed as is practicable, and, by means of slight corrections, to automatically adjust the speed of the other or corrected distributor to keep the two in the proper phase relation. Thus, the corrected distributor may be adjusted to normally run faster or slower than the correcting distributor, speed corrections being made by respectively slowing down or speeding up the corrected distributor, or adjustments may be made to a mean speed, corrections being made by either raising or reducing the speed of the corrected distributor as it gains on or falls behind the other distributor. Assuming in this case that the distributor 1 at the sending station is a correcting distributor and is adjusted to run at a constant speed, and that the receiving distributor 2 is the corrected distributor and is adjusted to normally run at a slightly higher speed than the correcting distributor, if the two distributors are running in exact synchronism and are sending a given character while the distributor arms are passing, for instance, over the first quadrants, impulses will be sent out over the line in accordance with the set condition of the transmitter associated with the first quadrant. As the distributor arm 6 contacts with the first contact 4 of the set, if the first transmitter contact 8 has been moved over to the positive side a positive impulse will be sent out on the line, and, if the contact has not been moved, a negative impulse will be sent out on the line. Consequently the armature 12 of the line relay 11 will be moved against the positive or negative contacts 13 or 14, as the case may be.

If moved against the positive contact a circuit will be closed from battery 15 with the armature 12 and contact 13, quadrant 18, distributor arm 22, contact 21 and selecting magnet 26, and for a given signal set up on the transmitter the magnets 26 will be energized or not, in accordance with the combination of impulses sent from the transmitter. The operation of the transmitter, the contacts of which are shown at 9, and the selecting magnets 27, both being of the fourth quadrant, are identically the same, with the exception that the fourth quadrant selecting magnets will be energized only when negative impulses are sent, a negative impulse of the fourth quadrant being equivalent to a positive impulse of the first quadrant as far as the effect on the selecting magnets is concerned.

Thus, assuming that a given character is represented in the alphabet by two positives, a negative and two positives in the first quadrant, the same character will be represented in the fourth quadrant by two negatives, a positive and two negatives. This will not, however, necessitate any change in the transmitter mechanism associated with alternate quadrants, except as regards the normal position of the movable contacts thereof.

It will be noted that in sending the characters described above, the polarity of the current changes twice, irrespective of the quadrant from which such signal is being sent, and as the majority of the characters of the Baudot alphabet require a change of polarity under normal conditions, such changes of polarity will be very frequent in transmitting the ordinary message. It will be observed that for every change of polarity the armature 12 of the line relay will be moved either from the contact 13 to the contact 14, or reversely. If the two distributors are running in exact synchronism, this movement of the armature 12 will have no other effect than that of energizing certain of the selecting magnets, as the change in polarity will occur just before the outer set of brushes make contact with the synchronizing contacts 23, or just as the brushes leave one contact 21 and move toward the next contact 21. If, however, the distributor 2 is moving faster than distributor 1, as assumed, before this change of polarity occurs, the brushes on the distributor arm 22 will make contact with the synchronizing contact, and will electrically connect one of said synchronizing contacts with the ring contact 25. As a synchronizing contact 23 or 24, as the case may be, is then connected to the ring 25, the change of polarity in the current and the consequent moving of the armature 12 will cause an induced pulsation of the current to pass through the relay 28. For instance, if the armature 12 moves from contact 13 to 130

contact 14, a circuit will be closed through the primary coil 31 of the induction coil. This will induce an impulse of the secondary coil 30, which will pass by way of the ring 25 and synchronizing contact 23, all of which are connected in multiple to the left-hand winding of the relay 28. The relay 28 will thereupon be energized and close at its contact a locking circuit for itself from battery 32, back contact of magnet 29, winding of magnet 29, front contact of relay 28 to ground. The energization of the magnet 29 will break the locking circuit of relay 28. In the embodiment herein illustrated magnet 29 is arranged to effect a mechanical correction of the corrected distributor. In this case each energization of the magnet 29 will cause it to attract its armatures and, by means of pawl 34, a suitable ratchet mechanism will be rotated to move the brushes of the corrected distributor back or forward one step as the case may be. Just so long as the corrected distributor is running faster than the correcting distributor, a synchronizing impulse will be brought into action for each reversal of polarity in the line current to step back the brushes of the corrected distributor until it is again in synchronism with the correcting distributor.

If, at the time when no selective signals are being sent, the distributors are not running in synchronism, the system will operate as follows to maintain such distributors in synchronism. It will be observed that when the arm 6 of the distributor 1 is passing over the fourth quadrant and no signals are being sent, positive impulses will be impressed on the line 10, and armature 12 of the line relay 11 will be maintained in contact with contact 13. However, as soon as the distributor arm passes from the fourth to the first quadrant, the armature 12 will move over to contact 14, as negative impulses will be impressed on the line in the first quadrant. This change of polarity, provided the distributors are not in exact synchronism, will be utilized exactly as in the case of a change of polarity when a signal is being sent to bring the distributors into synchronism. Similarly when the distributor arm passes from the first to the second quadrant a change of polarity will occur, and from the second to the third quadrant another change of polarity will occur, making in all in the system disclosed four changes of polarity for each complete rotation of the distributor. These changes in polarity will either cause battery to be impressed upon the primary coil 31 of the induction coil, or removed therefrom, as the case may be. In either case an impulse will be induced in the secondary, which impulse will pass by way of the ring contact 25 to the synchronizing contacts 23, 24, to the relay 28, causing the operation of the magnet 29 to slow down the

corrected distributor. Thus it will be seen that the synchronizing impulses will be produced and the distributors maintained in synchronism, irrespective of whether or not signals are being sent on any, or all, of the quadrants. It will also be apparent from an inspection of the drawing that if the movable contacts of any transmitter are in normal position, *i. e.* if no signals are being sent, none of the selecting magnets of the receiver controlled by such transmitter will be energized, as the line relay will be shifted to break the circuit at its contacts. Thus in the case of the first quadrant the movable contacts 8 will be normally connected to negative battery and the armature 12 will be moved against contact 14. This will place the potential of battery 15 on the contacts of the second and fourth quadrants, which will be without effect as the arm 22 is at this time moving in the first quadrant.

An advantage of the system of the invention resides in the fact that synchronism is maintained while no signals are being sent, without the use of any extra or complicated apparatus, it only being necessary to alter the normal polarities of the contacts of the transmitters associated with alternate quadrants.

The invention claimed is:

1. In a multiplex telegraph system, in combination with a transmission line, a plurality of transmitting stations, means for successively connecting said stations to said line, each of said stations when at rest being arranged to send to line current of a polarity different from that sent to line by the preceding and succeeding transmitting stations whereby the line current is periodically reversed, a receiving distributor having a plurality of receiving sections corresponding in number to the number of said transmitting stations, a local source of current, and means responsive to said reversals of line current for connecting said local source of current to alternate ones of said receiving sections when line impulses of one polarity are received and to intervening ones of said receiving sections when line impulses of the opposite polarity are received.

2. In a multiplex telegraph system in combination with a transmission line, a plurality of transmitting stations, means for successively connecting said stations to said line, each of said stations when at rest being arranged to send to line current of a polarity different from that sent to line by the preceding and succeeding transmitting stations whereby the line current is periodically reversed, a receiving distributor having a plurality of receiving sections corresponding in number to the number of said transmitting stations, a local source of current, means responsive to said reversals of line current for connecting said local source of current

to alternate ones of said receiving sections when line impulses of one polarity are received and to intervening ones of said receiving sections when line impulses of the opposite polarity are received, and other means responsive to said reversals of line current for maintaining said receiving distributor in synchronism with said transmitting distributor.

3. In a multiplex telegraph system in combination with a transmission line, a plurality of transmitting stations, a sending rotary distributor for successively connecting said stations to said line, each of said stations when at rest being arranged to send to line current of a polarity different from that sent to line by the preceding and succeeding transmitting stations whereby the line current is periodically reversed, a receiving rotary distributor having a plurality of receiving sections corresponding in number to the number of said transmitting sta-

tions, a local source of current, means responsive to said reversals of line current for connecting said local source of current to alternate ones of said receiving sections when line impulses of one polarity are received and to intervening ones of said receiving sections when line impulses of the opposite polarity are received, a transformer, circuit connections for sending a pulse of current through the primary of said transformer upon each reversal of the line current, and means connected with the secondary of said transformer and responsive to said pulse for maintaining said receiving distributor in synchronism with said transmitting distributor.

In witness whereof, I hereunto subscribe my name this 30 day of October A. D., 1914.

AMOS F. DIXON.

Witnesses:

E. EDLER,
K. L. STAHL.