Dec. 19, 1933. R. H. RANGER 1,940,016

SYNCHRONIZING SYSTEM

Filed Sept. 21, 1929

Fig. 1

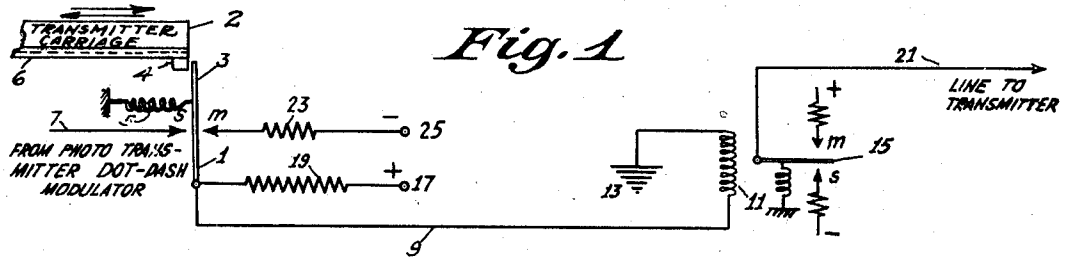


Fig. 2

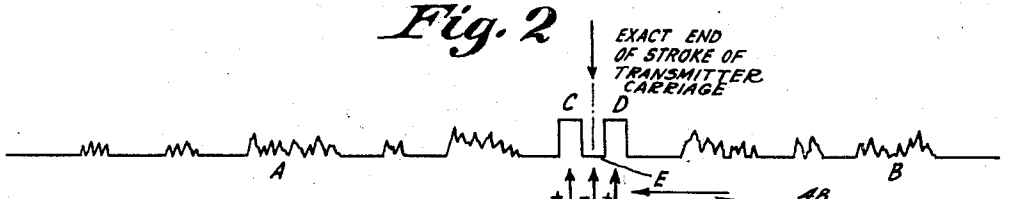


Fig. 3

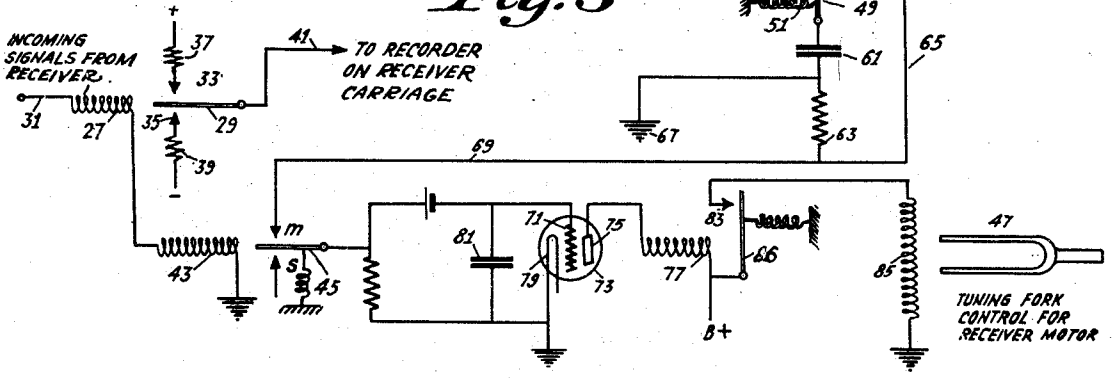
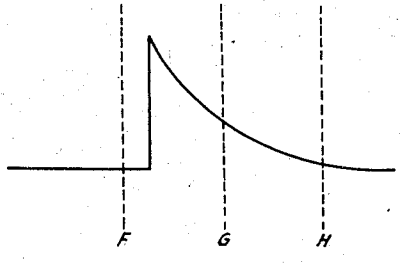


Fig. 4



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SYNCHRONIZING SYSTEM

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Serial No. 394,237

4 Claims. (Cl. 172—293)

The present invention relates to synchronizing systems, and especially to that type of synchronizing system which is principally applied to facsimile transmissions and the like, although it is to be understood that the invention likewise finds application in television synchronizing and in fact, all types of synchronizing systems wherein elements located at remotely spaced transmitting and receiving points must be maintained in synchronism.

In order to accomplish successful facsimile transmissions and the like, it is imperative that the receiver be held rigorously in step with the transmitter so that there is no distortion of the received picture and in order to considerably increase the overall efficiency of the entire arrangement.

It has been the practice in the art to which this invention relates for many years to accomplish this synchronism of facsimile by either continuously transmitting a synchronizing signal, or by having a releasing signal supplied from the transmitter to the receiver at the end of each stroke of a transmitting apparatus, assuming that the picture is built up in line for line manner, or at each revolution of the transmitting carriage, assuming that the picture is to be built up along the path of a helix. Such arrangements have been found to be practical in many cases, but the danger is also encountered of getting a bad release due to the inaccuracies of the equipment and the quality of the signal.

Therefore, it has been the custom in many developments in synchronizing systems for facsimile apparatus to use time standards at both the transmitting and receiving end of the system in order to hold the equipment at a very constant rate and thereby avoid the necessity of anything more than minor hand adjustments to the apparatus from time to time.

According to the present invention, however, a system has been provided wherein time control may be supplemented by a signal control in such manner that the time control actually holds each end of the system in substantially rigorous control at a predetermined and substantially constant speed, but even such systems as these need frequent minor adjustments. However, in accordance with the present system, the absence of any adjusting or compensating signal at the end of each stroke or revolution of the transmitting apparatus will have no appreciable effect upon the speed of the receiver such as to throw it definitely out of step because, as will hereinafter appear, the corrections which are applied to the synchronizing system for the receiver are so slight that it requires a number of such corrections to accomplish any real and appreciable change in the receiver speed control.

As has been explained and described in my copending application, Serial No. 51,191, filed August 19, 1925 an arrangement has been provided wherein facsimile transmitting and receiving systems may be controlled through the use of tuning forks or other vibrating elements of constant period which may be corrected by accurate time elements. It is in accordance with the present invention that I propose to utilize at the transmitter end of the system for obtaining a constant speed of reciprocation or rotation such a system as has been disclosed in the above named copending application, and, for example, I may control the speed of the driving motor for driving reciprocating or rotating elements of the transmitter by means of a tuning fork and correcting this speed from time to time through the use of accurate clock mechanisms such as a seconds pendulum, for example, while at the receiving end of the system I preferably provide a similar constant period vibrating device such as a tuning fork, which, of course, is of like period to the vibrating element of the transmitter and apply corrections to this control element in accordance with transmitted signal pulses governed in turn by the secondary control of the transmitter control.

Therefore, as a principal object of my invention, I have sought to develop a method and means by which a system for receiving facsimile messages transmitted thereto over a wire, radio, or wired radio communication channel may be accurately synchronized with the transmitter, and have provided a system which, in the absence of any control or secondary control signal, will continue to function without any substantial observable effects to display inefficiencies in transmission.

Still another object of my invention is to provide a system wherein a receiving system for facsimiles or the like may be accurately synchronized with the transmitter at the exact end of each stroke of the transmitter, assuming, of course, that a reciprocating type of facsimile transmitting machine is utilized.

Still other objects of my invention are to produce and provide in a manner to be hereinafter set forth, a system for synchronizing transmitting and receiving elements of facsimile or television transmitting systems which is relatively simple in its construction and arrangement of

parts, a system which is easy and convenient to install, a system which may readily be set up and operated, a system which is efficient in its use, and which is also readily adaptable to the now existing types of transmitting and receiving systems.

Still other and further objects of my invention will become apparent and at once suggest themselves to those skilled in the art to which the invention relates by reading the following specification and claims in connection with the accompanying drawing, wherein:

I have diagramatically illustrated by Fig. 1 a suitable arrangement for the transmitting end of the system;

By Fig. 2 I have shown a diagram of the resultant types of signals which may be transmitted from the transmitter and picked up by the receiver;

By Fig. 3 I have shown schematically a wiring diagram of a receiver suitable for cooperation with a transmitting system of the type hereinabove described; and

By Fig. 4 I have graphically illustrated the logarithmic type of correction curve by which the results provided by the systems shown by Figs. 1 and 2 are accomplished.

To refer now more particularly to the drawing forming a part of this application, and first to Fig. 1 of the drawing, I have provided a contact arm 1 which may be moved back and forth between the contact points S and M at the end of the stroke of a reciprocating type of facsimile transmitting apparatus by reason of the fact that the motion of the transmitter carriage 2 may provide a means for moving the outer end 3 of the contact arm 1 away from the contact S and over to the contact M. This movement of the contact arm 1 is preferably provided by a stud 4 extending downwardly from the movable carriage of the reciprocating type of transmitting mechanism coming to rest upon the outer end 3 of the contact arm 1 so that as the transmitter carriage 2 is moved from left to right in the guides 6, looking at Fig. 1 of the drawing, the contact arm will be moved from contact S over to contact M. The transmitter carriage 2 is shown only in a small sectional view, but this may correspond to the type of apparatus shown and described in my United States Patent #1,770,493, granted on July 15, 1930, and may consist of a light pick-up apparatus moving longitudinally with respect to a record drum in a pair of guides such as have been conventionally shown herein by the numeral 6. When contact M is reached, it will carry the outer end of the arm 1 to exactly the end of the transmitting stroke, and then as the carriage reverses and moves from right to left, the contact arm 1 will follow the transmitting carriage until it comes to rest upon the contact S by reason of the fact that the spring 5 tends to always pull the contact arm, as shown, so as to tend to rotate the same in a counter-clockwise direction. On rotary equipment, this same movement may be accomplished by a projecting stud on the cylinder which will strike and depress the lever arm 1 once at the end of each rotation.

Signals coming from the photo transmitter dot-dash modulator of any well known and appropriate type may be impressed upon the contact S over a conductor 7 and will then flow through the contact arm 1, the conductor 9, the relay coil 11 to ground at 13 and will cause movement of the relay 15 in a manner to be hereinafter described and set forth. There is current flowing from +17 through resistance 19 also to the relay, but the resistance 19 is chosen of much higher value than the resistances (not shown) which govern the current from the picture transmitter, so that the picture signals absolutely predominate. When the contact arm 1 is moved off the rest position S, it breaks the dots and dashes which were coming from the photo amplifier or modulator to supply the picture impulses. At this instant, then, the positive current from a source 17 will be supplied through the resistance 19 so as to operate and move the relay 15 to the position indicated as M, if it is not already there. This will, therefore, give a marking impulse sent out over the line 21 to the transmitting system of any desirable type, such as a wire or radio transmitter.

The potential sources −25 and +17 are the normal plus and minus 125 volts to ground of the Edison three wire D. C. distribution system. Now the contact arm 1, by reason of the carriage motion, tends to continue to move a little further than the midway position between the contacts S and M shown so as to ultimately come to rest against the contact M. Since the resistance 23 connected with the source of negative potential 25 is of a lower value than that of the resistance 19 in the positive lead, there will be current flow from point 25 through resistance 23 to lever arm 1, through resistance 19 to 17. But most of the voltage drop will be in resistance 19, and, therefore, arm 1 will be negative with respect to the neutral point between −25 and +17, which is likewise ground potential as picked up at 13. Therefore, this negative voltage will give a current through the relay coil 11 which will cause the relay 15 to move from the position against the contact M over to its position against the contact S and this causes the relay 15 to go to a spacing position, of course, denoting the space and mark position of each relay by the general legend "S" and "M".

When the carriage of the transmitter has completed its stroke in one direction and causes the contact arm 1 to move over against the contact M, it will then start to return and the contact arm 1 will continue to remain on the contact M for an instant longer, continuing the spacing impulse, and then as the carriage starts along the return in the direction from right to left, looking at Fig. 1 of the drawing, the contact of the arm 1 with the contact M will be broken, and this will give the positive impulse from the source 17 supplied through the resistance 19 a chance to again control the relay 15 to send out a short marking impulse before the contact arm 1 finally returns to its position of rest against the contact S when the picture signalling impulses will again predominate, as they are likewise stronger than the positive current flowing through the resistance 19, and the picture signals will thus be continued during the return stroke of the transmitter carriage mechanism and until the above described happenings again occur.

When signals are thus transmitted over the line 21 to the transmitter, the net result is a series of signal pulses, as shown for example by Fig. 2 of the drawing, which is intended to schematically illustrate the picture signalling impulses, where the pulses A and B of the diagrammatic showing are intended to represent

picture signals, and the pulses C and D are intended to represent synchronizing impulses between which there occurs the spacing impulse, indicated as E. The exact position of the reversal of the carriage will, of course, be directly in the center of the spacing impulse E, as shown by the arrow midway between the end of the marking impulse C and the beginning of the marking impulse D.

To refer now to the receiving end of the system, under normal conditions, a relay coil 27 having an armature 29 is normally controlled over a line 31 connecting the relay with the wire or radio source of incoming signals and an appropriate amplifying system so as to move the armature 29 between a pair of contacts 33 and 35, each connected through resistances 37, 39 with appropriate sources of potential (not shown) so as to carry currents proportional to the picture marking impulse derived from the source of potential connected with the resistor 37 or 39 over a line 41 to any appropriate and desired type of recording mechanism. Also, in addition to the usual relay 27, 29, I have provided in this system an additional relay formed from the winding 43 and the armature 45, which will be hereinafter termed a "synchronizing" relay in that this relay has the function of making the special synchronizing signals, designated on Fig. 2 of the drawing as C, D and E, of use in holding the receiver absolutely in step with the transmitter, as will hereinafter be shown.

As has been above described, a tuning fork or other suitable and appropriate type of vibrating element 47 may be used at both the transmitter and receiver for controlling the speed thereof, and the accuracy of this vibrating element is sufficient to require only the smallest corrections from synchronizing impulses for three or maybe four strokes to make any material difference in the speed thereof. As was above described, the transmitter fork may be controlled in the normal manner by a clock correction, as has been described in my above referred to copending application, Serial No. 51,191.

Now, at the end of the stroke of the carriage of the receiver mechanism 48, of which only a section of the right hand end is shown but which in its entirety may correspond to that shown by my United States Patent No. 1,770,493, above mentioned, for reproducing the transmitted subject matter, corresponding to the end of the stroke at the transmitter, a contact arm 49, similar to the arm 1 of the transmitter, is arranged, and this arm 49 is adapted to be continually pulled toward the left, looking at Fig. 3, by a spring 51 anchored to any appropriate portion of the receiver frame work. As the receiver carriage 48 moves in the guides 50 or rotates, looking at Fig. 3, a stud or projection 52 thereon is adapted to press against the outer end 53 of the contact arm 49 and move this contact arm to the right, as was described in connection with the arm 1 of the transmitter system. The contact arm 49, by reason of a spring pull from the spring 51 exerted thereon, is normally adapted to rest against the contact point S so that positive current from a source 55 may be carried through the conductor 57 and the resistor 59 through the contact point S and down through the arm 49 so as to charge the capacity element 61. This means that there is a positive charge on the top of the condenser 61. Now, when the contact arm 49 moves over and away from the contact point S by reason of the carriage motion at the end of the stroke, this condenser will rapidly discharge through the resistance 63, by reason of the fact that the contact arm 49 has moved away from the contact S over to the contact M so that the resistance is then in circuit with the contact M through the connection 65 and the capacity element 61 may then discharge through the resistance 63 to ground at 67.

This discharge will be generally logarithmic as is suggested by the showing in Fig. 4. Now, if the relay 43, 45 closes upon contact M at the same time that the capacity 61 is discharged by the closing of contact arm 49 on the contact M, the positive pulse provided by the discharge of the capacity member 61 will likewise be carried through the conductor 69 and the contact M to positively bias the grid element 71 of the vacuum tube amplifier, since the armature 45 of the relay system 43, 45 when resting on contact M is in the marking position. This action will cause plate current to flow in the output circuit of the tube 73 including the plate member 75, the relay coil 77 and the source of positive potential indicated as B+ and complete the circuit through ground and the filament member 79 of the tube 73. Obviously, the time when the relay armature 45 moves to the marking position may be at various positions with regard to the time that the receiver carriage has moved to the end of the stroke. As is shown by Fig. 4, this may be in a position F, G or H, for example. If the closing occurs at the position F, no positive action will be given to the grid 71 of the tube 73. If the discharge of the capacity element 61 occurs in position G considerable positive charge will be applied to the grid 71 of the tube 73, and if the contact takes place at the position H little positive charge will be given to the grid 71 of the tube 73. Preferably, the position G is the working position.

Also connected across the input circuit of the vacuum tube 73 I have provided a capacity element 81 which is intended to drag out or extend the action of the positive pulse supplied from the discharge of the capacity element 61 upon the grid 71 of the tube, as, otherwise, any positive biasing impulse imparted to the tube 73 from the discharge of the capacity 61 might be of insufficient duration to pass sufficient plate current through the tube 73 to actuate the relay armature 83 associated with the relay coil 77.

Now, if the relative phase of the closing of the two relays 49, 45 is as shown at G in Figure 4, considerable positive action will be given to the grid of the tube 73 and this will, therefore, act to give plate current in the tube which will close the relay armature 86 over against the contact 83, and this, in turn, will pass current in the corrector coil 85 associated with the fork 47 to speed up the fork. With the fork speeded up to the desired amount, the next action of the two relays will be of a slightly more advanced phase relationship such that the position H will be approached on the next stroke of the receiver carriage from left to right, looking at Fig. 3. This may be insufficient speeding-up action on the fork to hold the receiver as fast as the transmitter, and, therefore, the next succeeding stroke of the receiver carriage from left to right may find this phase back again towards the position G on Fig. 4. There will be obviously a certain amount of hunting back and forth until the receiver finds an average position between positions G and H, shown on Fig. 4, which just meets

the relative rate difference between the transmitting and receiving forks. The receiving fork is purposely set a trifle slow. This arrangement, therefore, acts to hold the receiver continuously in step with the transmitter.

From the above description it will become apparent to those skilled in the art that various changes in the embodiment and set-up of the arrangement may be made, and I, therefore, believe myself to be entitled to make any and all of these modifications such as fall fairly within the spirit and scope of the invention as hereinafter claimed.

Having now described my invention, what I claim and desire to secure by Letters Patent is the following:

1. A system for synchronizing the movements of two remotely spaced bodies which comprises a system for receiving message signals and synchronizing signals occurring therewith at widely separated time intervals relative to the periods of duration thereof, means for storing electrostatic charges during the time periods separating successive synchronizing signal indications, and means responsive to the synchronizing signals for causing said electrostatic charges to become effective to control the speed of the receiving bodies during time periods separating successive synchronizing signalling indications.

2. In a facsimile system, a synchronizing means which comprises means for storing electrical energy for predetermined time periods, means for continually releasing the stored electrical energy at time periods widely separated and of short duration relative to the time period over which the electrical energy charges are accumulated, means for receiving at time intervals corresponding substantially to the time period of discharge of the stored electrical energy signals to indicate the movement of driving elements located at remote points, and means responsive to variances in the time of discharge of the stored electrical energy and the time of receipt of said signals to indicate the motion at the remote points for effecting speed changes at the local point to produce motion corresponding to that of the remote point.

3. The system claimed in claim 2 which comprises, in addition, means for prolonging the effect of the release of the stored electrical energy for a time period corresponding substantially to the time spacing between successive local releases of the stored electrical energy.

4. In a facsimile system for coordinating the speed of driving elements located at the point of reception with corresponding elements located at the point of transmission, means for operating said driving elements at each of said points at speeds substantially identical one with the other, means for storing electrical energy of predetermined quantities for time periods determinable by the rate of motion of the driving elements at the point of reception, and means responsive to signalling indications of the rate of movement of the driving elements at the point of transmission separated by time intervals great with respect to the time interval of duration thereof for causing said stored electrical energy to effect in accordance with variances in the time of release thereof and the time of receipt of said signalling indications a control of the motion of the receiving bodies.

RICHARD HOWLAND RANGER.