

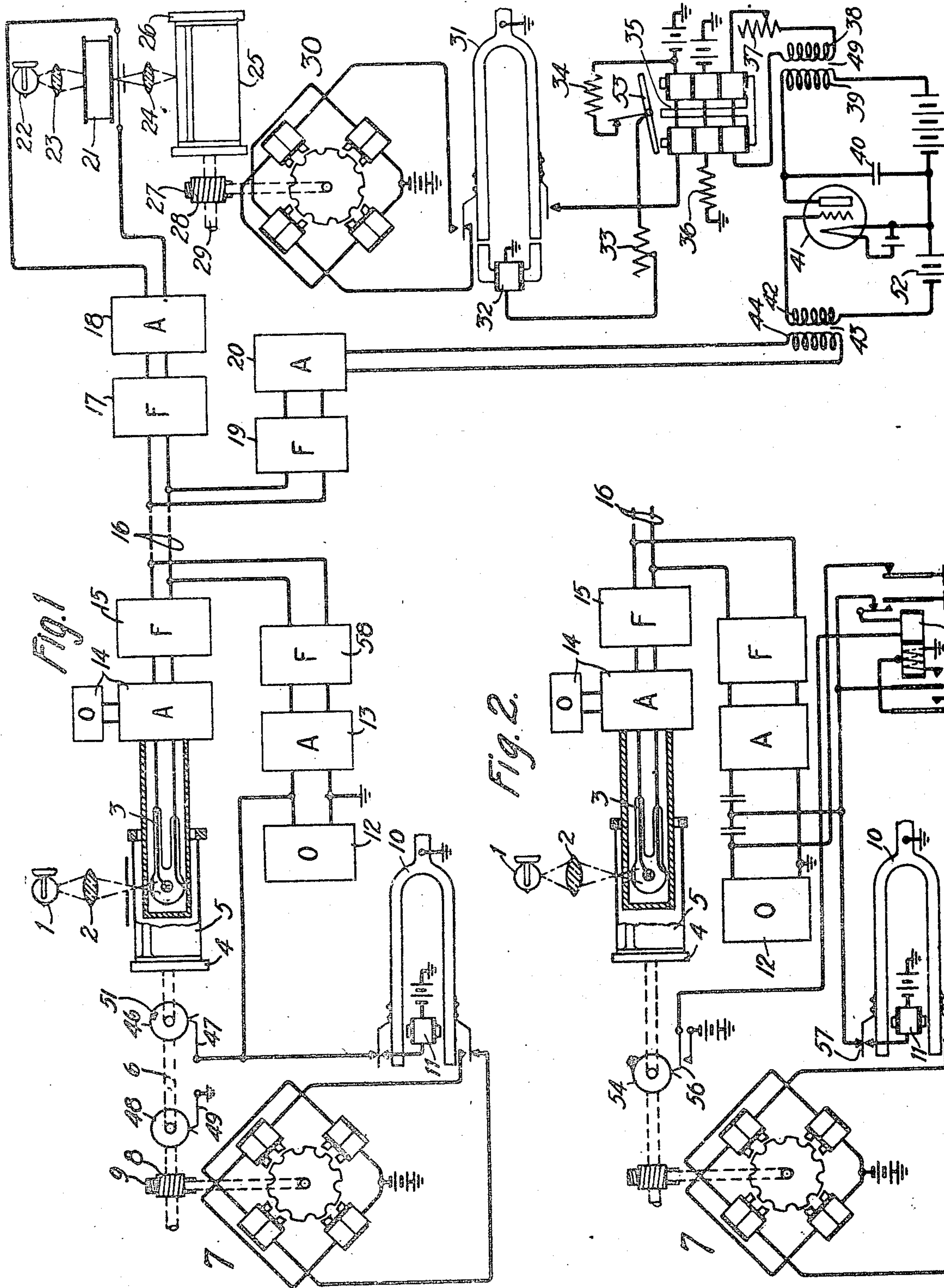
Dec. 20, 1927.

1,653,074

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TRANSMISSION OF PICTURES BY ELECTRICITY

Filed Feb. 1, 1926



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per

by

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Patented Dec. 20, 1927.

1,653,074

UNITED STATES PATENT OFFICE.

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TRANSMISSION OF PICTURES BY ELECTRICITY.

Application filed February 1, 1926. Serial No. 85,300.

This invention relates to synchronizing systems, and more particularly to the method and means for synchronizing the controlling and driving apparatus in picture transmission systems.

The invention has for its main object to provide a novel combination of means for controlling the synchronous movement of the sending and receiving devices of a picture transmission system, or of any signaling system wherein synchronous movement of apparatus located at widely separated points is required.

The invention contemplates a picture transmission system wherein correcting or synchronizing impulses are transmitted from a sending station to a receiving station once per revolution of the drums carrying the picture films. This portion of the drum revolution provides the so-called "underlap" period and corresponds to the section of the drum included between the film edges. During this period the picture currents are replaced by synchronizing impulses. Because of the short duration of the underlap period as compared with the picture transmission period, the number of correcting impulses that are transmitted is relatively small. It is highly important, if the correct number of impulses are to be sent, that means be provided for preventing the mutilation of these impulses.

Accordingly it is one of the main features of the invention to provide means for preventing the splitting of current impulses used for synchronizing purposes.

Another feature relates to the novel method and means for locally operating a speed controlling device at a receiving station and for periodically correcting the operation of such a device by means of carrier impulses.

The invention is in the nature of an improvement on the system shown and described in a copending application of J. W. Horton et al., Serial No. 714,466, filed May 19, 1924. Reference may be had to said application for a detailed description of apparatus and methods of operation which are shown and described in a general manner in the present application.

It is believed that a better understanding of a preferred form of carrying out the invention may be attained from a consideration of the following description when taken in

conjunction with the accompanying drawing, in which Figure 1 shows in comparative detail the main for sending and receiving synchronizing and picture current over a transmission line. Fig. 2 is a schematic diagram partly in detail of the special means for insuring the transmission of the correct number of synchronizing impulses.

Detailed description.

The picture to be transmitted, in the form of a transparent film 5, is mounted on the transparent drum 4. Film 5 is not wide enough to cover the complete surface of the drum so that the portion of said drum between the picture edges is presented to the light once per revolution. This portion of the drum revolution is termed hereinafter the underlap period. Drum 4 is mounted for rotation on shaft 6 and is also adapted to be moved in a longitudinal direction by means of threaded shaft 6 as described in the application of Horton et al., Serial No. 714,466, referred to hereinabove. Shaft 6 carries two commutators 46 and 48 and is driven through suitable gearing by means of the phonic wheel motor 7. The speed of motor 7 is controlled by tuning fork 10 in the well-known manner.

Light from a suitable source 1 is focused by means of an appropriate optical system, represented schematically by lens 2, upon the film 5, and after passing through the film and the transparent drum 4, correspondingly illuminates the photoelectric cell 3. In accordance with the varying degrees of transparency of the exposed picture elements, cell 3 generates photoelectric currents which are impressed upon suitable amplifying and modulating devices represented generally by rectangles 14. After passing through filter 15, the amplified picture currents are then impressed upon line 16 leading to the receiving station where they pass through the receiving filter 17 and are again amplified by the receiving amplifier 18. The output of amplifier 18 is connected in series with the string of light valve 21. The varying amplitude of the current from amplifier 18 correspondingly varies the amount of light from source 22 falling upon the receiving film 25 in the manner described in detail in the Horton et al. application to which reference has been made. The receiving film 25 is mounted upon the drum 26 which is driven

through gears 27 and 28 from the phonic wheel motor 30.

For the purpose of maintaining accurate synchronism of the motor 30 with motor 7, a tuning fork 31 is provided. Fork 31 is adapted to operate locally under control of the vibrating relay 35. In addition, fork 31 exercises a mutual control over relay 35 by means of the circuit traceable from battery through the upper windings of said relay, the lower interrupter contacts of fork 31 to ground. Relay 35 by means of this circuit tends to vibrate at the natural period of fork 31, and interrupts the circuit traceable from battery through resistance 34, contacts of relay 35, resistance 33, fork driving magnet 32 to ground. In addition to the above traced circuit for vibrating relay 35, another circuit exists and comprises the secondary winding 38 of transformer 49, resistance 37 and the lower windings of relay 35. The primary winding of transformer 49 is connected in the output circuit of the rectifying device 41. The device 41 is adapted to rectify the synchronizing impulses transmitted from the sending station. These impulses are generated by the oscillator 12 and during the underlap period are impressed upon the line 16 after passing through the amplifier 13 and control filter 58. At the receiving station the synchronizing impulses only pass through the filter 19 and are then impressed upon the primary winding of transformer 43 after being amplified by suitable apparatus represented by rectangle 20.

As mentioned hereinbefore two commutators 46 and 48 are provided on shaft 6 and are in electrical communication therewith. Brush 49 bears on commutator 48 during the complete revolution of shaft 6, while during the underlap period brush 47 engages the insulating portion 51 in commutator 46. Consequently, while picture currents are being transmitted, the output circuit of oscillator 12 is short circuited by means of ground which is extended through brush 49 and commutators 48 and 46 and brush 47. At the beginning of the underlap period, brush 47 engages insulating segment 51 and removes the above traced short circuit from the oscillator 12. Another short circuit for the oscillator is, however, provided by means of the contacts of the tuning fork 11. Assuming that the frequency of current from source 12 is of the order of 400 cycles per second and that the fork 10 has a natural period of 60 cycles per second, then the correcting current consists of 60 impulses per second of 400 cycle carrier current. Since the control oscillator frequency is different from the frequency used for the picture carrier, the filter 19 is designed to pass only the control impulses, whereupon these impulses after being amplified by the ampli-

fier 20, are impressed upon the primary winding of transformer 43. By means of battery 52, the static potential of the grid of rectifier 41 is such as to maintain the impedance of said rectifier substantially infinite when transformer 43 is not energized and no current flows in the primary or secondary windings of transformer 49 nor in the lower windings of relay 35. Under this condition the armature of relay 35 vibrates solely under the control of the fork 31 and the contacts of said relay. When, however, during the underlap period control impulses are allowed to flow from the source 12, the impedance of rectifier 41 is reduced and current flows through the lower windings of relay 35.

Since the frequency of fork 10 has been assumed at 60 cycles per second, there will flow through the lower winding of relay 35 a series of impulses also having a frequency of 60 cycles. When the fork 31 and fork 10 are in exact synchronism, the armature of relay 35 also vibrates at the same period. Should fork 10 slow down, the frequency of the impulses through the lower windings of relay 35 is reduced, thus tending to decrease the period of vibration of the armature 53 and consequently decreasing the period of vibration of fork 31. On the contrary, should fork 10 increase in speed, the frequency of the impulses through the lower windings of relay 35 is increased, thus tending to increase the speed of armature 53 and the times of fork 31. It is to be noted that the frequency at which armature 53 and fork 31 vibrate is dependent upon the impedance of the circuit looking from the relay 35 toward the transformer 43. Consequently, this frequency is dependent not only upon the amplitude of the received control impulses but also on the value of resistance 37.

When the impedance of the detector tube 41 is decreased below a certain value depending upon the amplitude of the received control carrier and also determined by the capacity of condenser 40, etc., the fork 31 ceases vibrating. To reduce this damping effect within working limits, the coupling between relay 35 and rectifier 41 may be lessened by the variable resistance 37. It is found by experiment that when resistance 37 exceeds a certain value, the incoming control impulses have apparently no effect upon the frequency of vibration of fork 31 regardless of the impedance of the tube circuit, and as resistance 37 is reduced, the control of the incoming impulses over the fork frequency becomes correspondingly more pronounced. In practice, therefore, resistance 37 may be adjusted corresponding to a given amplitude of the control carrier to provide the best working limits for the control of fork 31.

Inasmuch as the total length of the under-

lap period is small as compared with the picture transmission period, the correcting impulses transmitted during each revolution of the sending drum may be few in number. It is relatively important, therefore, that the beginning and ending of the underlap period should bear a definite relation to the opening and closing of the contacts of fork 11. A preferred form of insuring this proper relation is disclosed in Fig. 2. This figure shows a sending station with apparatus similar to the station shown in Fig. 1 and the apparatus in Fig. 2 bears the same designations to corresponding apparatus in Fig. 1. In this case, however, a special relay is provided which acts in conjunction with a commutator 54 and fork 10 to preserve a constant relation between the beginning and end of the underlap period and the opening and closing of the control contacts 57 of fork 10. During the picture transmission portion of the revolution of drum 4, contacts 56 are open and the output of oscillator 12 is short circuited by means of ground which is extended through the outer right contacts of relay 55. When the underlap period of reached, contacts 56 close and, assuming contacts 57 to be closed, an energizing circuit exists for relay 55 traceable from battery, through contacts 56, right winding of relay 55, break-before-make contacts of said relay to ground through the contacts 57 of fork 10. Relay 55 is immediately locked by means of the above traced battery, and ground which exists at its make-before break contacts. Relay 55, when thus operated, removes the short circuit from the oscillator 12 and allows the control impulses to go to line 16. If, however, contact 57 of fork 10 should be open when the contacts 56 first close, relay 55 remains normal until contacts 57 again close. Thus, the first correcting impulse is sent out only when contact 57 closes, insuring a definite relation between the contacts of fork 10 in the beginning of the underlap period. At the end of the underlap period, if contacts 56 open while contacts 57 are closed, the circuit through the right winding of relay 55 is broken and the left differential windings of said relay being both energized, relay 55 releases, thus insuring the termination of the control impulses when contacts 56 open and contacts 57 close. Should contacts 56 open while contacts 57 are open, the above traced circuit through the right winding of relay 55 is broken and the circuit through the left-hand portion of the differential winding is also broken, but the right-hand portion of the differential winding remains energized to hold the armatures of relay 55 attracted. Thus, relay 55 does not release to terminate the correcting impulses until contacts 57 again close.

While in the foregoing description the

control impulses have been assumed as applied to the line, only during the underlap period, it is to be understood that the invention is not to be so limited. These control impulses may be effective during the complete revolution of the sending drum without departing from the spirit of the invention. Furthermore, separate sources of oscillation are provided for the picture currents and the control currents, but it will be understood that a single source may be used and appropriate switching means employed. In this case, at the receiving station the filters may be replaced by appropriate switching means to switch the incoming carrier currents from the picture channel to the control channel at the beginning of the underlap period. Furthermore, it is to be understood that the invention is not to be limited to a picture transmission system utilizing wires for the transmitting medium, but may equally well be applied to so-called radiant energy systems wherein driving apparatus at widely separated points is to be maintained in synchronism.

What is claimed is:

1. In combination, a first tuning fork, a second tuning fork, a vibrating relay, means controlled by contacts of said first fork for delivering current impulses to said relay at a frequency corresponding to the frequency of said first fork, means controlled by contacts of said second fork for delivering current impulses to said relay at the same frequency as the frequency of said second fork, and means controlled by the combined sets of impulses for maintaining the ratio of the frequencies of said forks constant.

2. In combination, a first motor, a second motor, a tuning fork for each motor for controlling the speed thereof, a vibrating relay having a plurality of windings, means controlled by contacts of said first fork for energizing one of said windings with current impulses of a frequency corresponding to the frequency of the first fork, means comprising contacts of said second fork for energizing another of said windings with current impulses of the same frequency as the frequency of said second fork, and means controlled by the joint energization of said windings for maintaining the vibration of said second fork at the same rate as that of said first fork.

3. In combination, a first motor, a second motor, a tuning fork for each motor for controlling the speed thereof, a vibrating relay associated with the fork for the second motor and having a plurality of windings, a circuit through one of said windings comprising contacts of said second fork, and a circuit through another of said windings adapted to be energized by impulses controlled by contacts of said first fork.

4. In a system of transmitting pictures by

electricity, a source of picture currents, a source of control currents, means including a rotatable element for modifying said picture currents according to the successive elements
5 of the picture to be transmitted, means including a second rotatable element for reproducing the picture, a tuning fork for each rotating element, a vibratory relay, means for applying current impulses to said
10 relay at a frequency equal to the frequency of one of said forks, means for simultaneously applying current impulses to said relay at a frequency equal to the frequency of the other of said forks, and an armature
15 controlled by both of said sets of impulses to maintain the ratio of vibrations of said forks constant.

5. In a picture transmission system, a sending drum, a receiving drum, a tuning
20 fork associated with each drum for controlling the speed of rotation thereof, a vibratory relay associated with the fork for the receiving drum, a driving magnet for said last mentioned fork, a circuit for energizing
25 said relay comprising contacts of the associated fork, and a circuit for said driving magnet comprising contacts of said relay, said relay being adapted to be energized by current impulses controlled by the fork as-
30 sociated with the sending drum.

6. In combination, a first driving shaft and speed control means therefor, a second driving shaft and speed control means there-

for, a set of contacts on the first shaft and a set of contacts on the associated control
35 means to control the transmission of a definite number of impulses to periodically correct the second mentioned control means, and means common to said first shaft and the associated control means for maintain-
40 ing a definite relation between the opening and closing of both sets of contacts.

7. In a picture transmission system, a sending drum on which is mounted a picture
45 for transmission, a receiving drum adapted to be moved in synchronism with said receiving drum, each revolution of said sending drum comprising a picture current transmission period and a synchronizing
50 current transmission period, speed control means associated with each of said drums, contacts on the control means associated with the sending drum for controlling the transmission of synchronizing currents to the control means associated with the re-
55 ceiving drum, and means comprising a relay operated by contacts on the control device for the sending drum to insure the transmission during the synchronizing period of the correct number of impulses to the con-
60 trol means associated with the receiving drum.

In testimony whereof, I have signed my name to this specification this 30th day of January, 1926.

ALLAN WEAVER.