

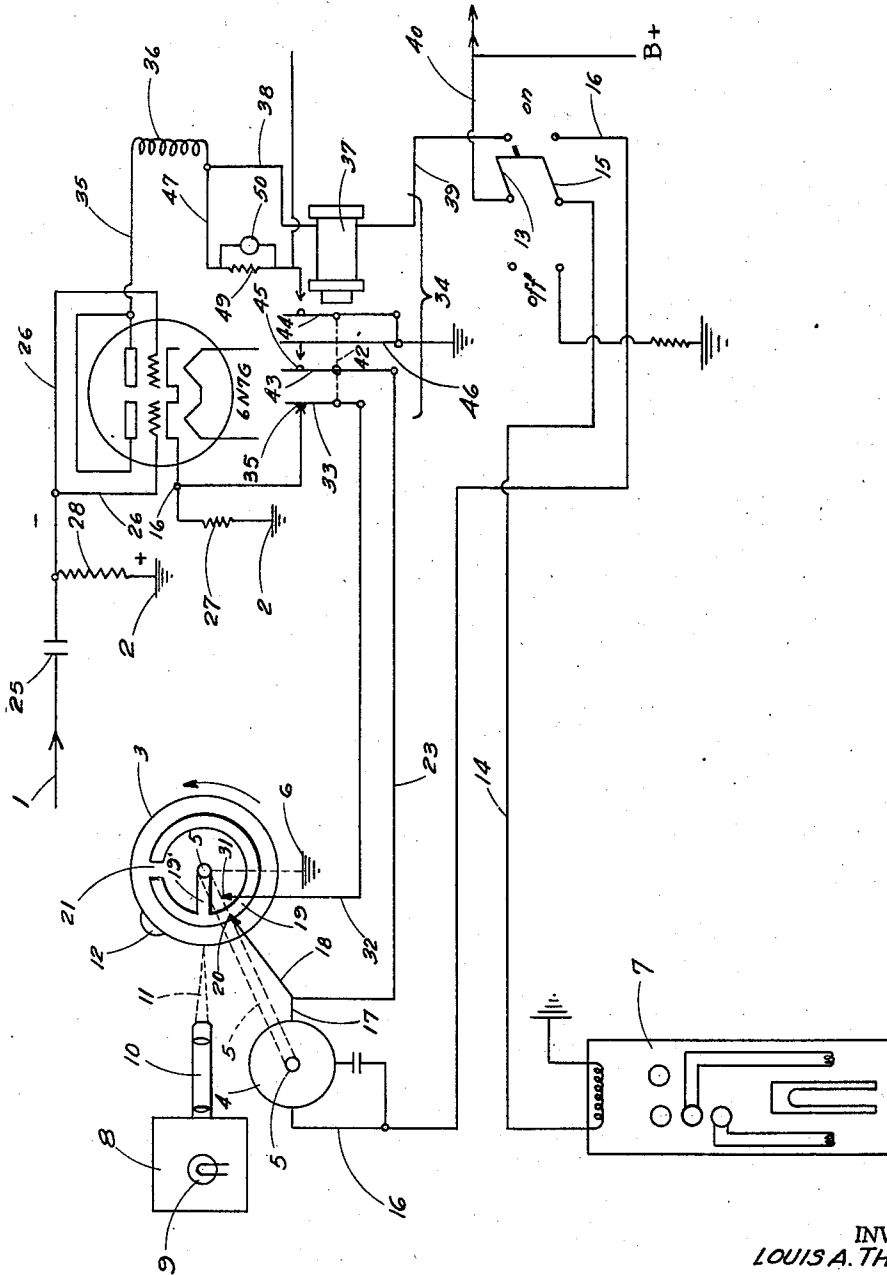
Sept. 16, 1941.

L. A. THOMPSON

2,256,364

PHASING SYSTEM

Filed May 16, 1940



BY

INVENTOR.
LOUIS A. THOMPSON
Richy & Watto.
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,256,364

PHASING SYSTEM

Louis A. Thompson, Lakewood, Ohio, assignor to
Acme Newspictures, Inc., New York, N. Y., a
corporation of Delaware

Application May 16, 1940, Serial No. 335,562

14 Claims. (Cl. 178—69.5)

This invention relates to phasing systems and more particularly to an improved method and circuit for phasing transmitters and receivers used in the transmission of pictures, facsimiles or the like. Although the invention about to be described will be described in connection with the transmission of pictures it should be understood that it will have other uses, and that the description in the interest of clarity shows merely one apparatus with which it may be used.

As is well known, pictures are usually transmitted by means of apparatus which includes a rotating drum about which the picture is secured. Means for scanning the picture is provided and includes a scanning head which moves longitudinally relative to the drum while the drum rotates; it has also been proposed to rotate and move the drum axially simultaneously, with the scanning head remaining stationary. Although the system herein described comprises rotating the drum and moving the scanning head longitudinally of the drum it is not limited in its application to such specific system. The receiver includes a drum about which a piece of sensitized film is secured and an optical unit which is energized by the signal from the transmitter to expose the rotating film in a manner similar to the scanning. The drums on the receiver and transmitter are operated in synchronism, i. e., the transmitter drum operates at exactly the same speed as the receiver drum. Since both the picture being transmitted and the sensitive film are secured to the drum by clamping means, usually a bar extending longitudinally of the drum, it is necessary that the drums not only be kept in synchronism but that they be in phase; that is, at the transmitter when the picture clamping bar or the meeting edges of the picture are passing the scanning head, the bar in the receiver or the meeting edges of the film should simultaneously be passing the pencil of light from the optical unit. In other words, the transmitter and receiver drums should be in phase, both clamping bars on the transmitter and receiver, the drums of which are traveling at the same speed (100 R. P. M.), passing by the scanning head and optical unit respectively simultaneously.

Many means for causing the phase alignment of the transmitter and receiver drums have been proposed. Although these means have been more or less effective there have been certain inherent disadvantages therein which it is the purpose of the present invention to overcome. The most apparent defects in the prior devices have been

the inability to exactly phase the drums; the length of time required to effect such phasing; and also the fact that the phasing operation entailed one more operation in the transmission of a picture, making the proposition of transmitting pictures still more difficult to those not having considerable operating experience.

By the present invention the phasing is accomplished automatically while the receiving operator is adjusting his machine to the proper amplitude for the reproduction of the picture. That is, the amplitude of the received signal must be amplified to a predetermined value in order that the full range of the different tone values of the picture being transmitted are capable of being recorded. One method of adjusting the receiver is accomplished by the transmission of so-called "picture-white," i. e., the transmitter is turned on and a certain portion of the drum which is white is scanned and a signal corresponding to this picture tone, which may be the highest amplitude is sent out by the transmitter which signal when picked up by the receiver is amplified and the amplifier controlled to furnish the maximum amplitude or white that the receiver will be called upon to reproduce. The gain of the receiver and the amplitude of the signal are determined by suitable indicators and when once adjusted the receiver is then ready to reproduce the picture.

In the drawing there has been illustrated diagrammatically that portion of a receiver circuit necessary to accomplish the phasing of picture drums according to my invention.

Briefly, the phasing is accomplished by sending a signal which comprises "picture-white" or maximum amplitude with an interrupted period usually obtained at the time the picture clamping bar, which is of light absorbing character, passes in front of the optical unit. For instance, with a transmitter operating at 100 R. P. M. and considering that this is the type of transmitter whereby the picture amplitude is impressed upon or mixed with a carrier wave in order to transmit the same, and assuming that the carrier frequency is 1800 cycles, there would be impressed on the line or other means of communication the signal to the receiver a series of signals comprising 100 pulses per minute; each signal including a relatively long 1800 cycle pulse with a $\frac{1}{40}$ of a second interval of no signal (pictures black) between the pulses. The $\frac{1}{40}$ of a second represents the time required for the clamping bar to pass in front of the scanning head.

At the receiver this signal is brought in and amplified and is used to control an electronic amplifier. Simultaneously, the receiver drum which is normally operated at the same speed as the transmitter drum, is provided with means to cause the receiver drum to gradually fall behind the transmitter drum. Means is also provided connected to the receiver drum and to the previously mentioned electronic amplifier to also control the amplifier in such a manner that when the control from the transmitter on the amplifier and the control from the local receiver on the amplifier become coincident due to the receiver drum falling behind the transmitter drum, the power in the amplifier suddenly increases, which increase in power is utilized to operate a relay which locks out the means for causing the receiver drum to fall behind the transmitter and thus places the transmitter and receiver drums in phase and synchronism.

More specifically, as previously stated, at the start of a transmission the transmitting operator transmits picture-white pulses, interrupted for a duration of approximately $\frac{1}{40}$ of a second at each revolution of the drum. This is accomplished by having a zone of white on the edge of the drum, or the zone of white may be the border of the picture, and by using a clamp which is black or other light absorbing material to clamp the picture on the drum. The clamp does not necessarily have to be black throughout its entire length, it need only be of light absorbing material at the point where picture-white is being transmitted for phasing and gain determining purposes.

It is well known to those in the art that this signal may be effected by focusing a beam of light on the drum, picking up the light in a photoelectric or photovoltaic cell and using this current to modulate a suitable carrier which for the purpose of this explanation will be considered as being generated by an 1800 cycle oscillator. For this particular example the drum of the transmitter and the receiver both rotate at 100 R. P. M. under the control of tuning fork amplifier power supplies. The clamp for holding the picture onto the drum is of sufficient width so that it takes approximately $\frac{1}{40}$ of a second for it to pass in front of the scanning beam. The operator, therefore, sends out a signal which, because the scanning beam is scanning picture-white, is of high amplitude being unmodulated since there is but one color and that the amplitude is reduced to zero or to a sufficiently lower value than the maximum amplitude at the point where the light absorbing bar passes in front of the scanning beam to cause the current differential to accomplish the operation of the invention. The aforementioned signal is sent to the receiving station where it is taken into a suitable amplifier and amplified. The figure of the drawing shows the final stage of such an amplifier, the input being a line 1 and the ground 2. It should be understood, however, that this invention is by no means confined to attachment to the final stage, as it can be applied in any stage where sufficient power may be taken from the stage to operate the relay hereinafter mentioned or can be a separate circuit connected into the receiver at any desired point.

In the receiver the receiving drum is indicated at 3 and is driven by a synchronous motor 4 through the common shaft 5 which is grounded as indicated at 6. The motor is preferably of the capacitor start type as indicated in the drawing

and as previously stated is driven by a tuning fork controlled power supply 7, the output being 60 cycle A. C. at 110 volts. The scanning head 8 is mounted opposite the axis of the drum on a lead screw not shown and includes the usual light source 9 and lens system 10, designed to direct a pencil of light rays 11 on the surface of the drum. In the receiver and the transmitter the drums are arranged to rotate while the scanning head traverses the drum longitudinally by means of the lead screw.

The negative material is held onto the drum by a clamp 12. The tuning fork power supply is connected to a suitable source of current such as 110 volt city current, and the output from the tuning fork is connected to the receiver through the double-pole double-throw switch indicated generally at 13. When the signal is heard from the transmitting station through a suitable monitor (not shown), the switch is thrown to the "on" position. Current flows from the tuning fork power supply through the line 14, through the switch blade 15 to the line 16 and thence to the motor. The motor is a synchronous motor of a three wire capacitor start type. The return lead 17 from the motor is connected by the lead 18 to a conductor ring 19 disposed on the end of the drum, a suitable brush indicated diagrammatically by the arrowhead 20 being provided for effecting such contact.

The ring 19 is of any conducting material and is preferably set into a Bakelite base secured to the end of the drum but is not a continuous ring, being broken at one point as indicated at 21. The space between the broken ends is filled with insulating material so that the brush rides smoothly as the drum is driven in the directions indicated by the arrow. A stem or bar 19' is provided for the ring extending radially from the inner edge of the ring to the center, which bar is connected to the shaft 5, the shaft 5 being grounded as indicated at 6. The clamping bar 12 for the negative material is disposed on the drum a predetermined distance in advance of the gap 21 of the ring.

At this point it should be noted that the motor 4, being a synchronous motor and driven by a power supply 7 closely regulated to give the same frequency and power output as that of the transmitter motor supply, once being started attempts to travel in synchronism with the motor at the transmitter, assuming of course that the power supply for both transmitter and receiver are so regulated as to give exactly the same type of output. It should be further noted, however, that the return lead of the power supply to the receiver motor is through the ring 19, the other lead 23 which connects the motor and extends to the relay circuit being at this stage open, as shown. The motor, therefore, having been energized, quickly picks up its speed, but inasmuch as the ground return of the motor is through the broken ring 19, when the brush 20 reaches the brake 21 the ground return is cut off and the power supply thus interrupted. The inertia of the drum, however, causes the drum to rotate until the brush is again grounded after the gap is moved past the brush. The motor again immediately picks up speed, obtaining in a part of a revolution its full synchronous speed. The general effect of this arrangement, however, which comprises a short discontinuance of power supply for each revolution of the motor, is to cause the motor and the drum to fall behind the steadily turning transmitting motor and drum, although at some time

during each part of its revolution it does attain its synchronous speed.

It will thus be seen that the bar 12 passing in front of the light pencil which, if the motor power was steady, would be in synchronism with the bar passing in front of the optical unit at the transmitter although there might be some phase displacement, gradually changes its displacement; eventually it will have rotated changing its displacement relative to that of the bar in the transmitter and will be in phase with the transmitter. This condition of interrupted power supply, if maintained continuously, would cause the receiver to keep falling behind the transmitter until it again comes in phase therewith.

The signal through the line 1 from the transmitter is fed into a 6N7 type tube. This tube is connected as a class A power amplifier and the elements are connected in parallel to give greater power output. The signal is impressed through the capacity 25 onto the grids of the tubes through the lines 26. This signal being a signal of relatively high amplitude and reduced substantially to zero periodically according to the instant the light absorbing and picture holding bar passes in front of the scanning beam, drives the grids negative during the high amplitude signal period. By rectification current flows in the grid circuit from the grid to the cathode, through the cathode resistance 27 to ground 2 and from ground 2 through the grid resistance 28 back to the grid. This causes a relatively large potential drop across the grid resistance 28, because this resistance has a considerably higher value than the cathode resistance 27. Thus the grids get a more negative bias and normal plate current will drop from 5½ ma. to 3 ma. during the picture-white period of transmission, returning back to 5 ma. (normal plate current) during the low amplitude pulsations (picture-black).

All this time the bar 19' of the drum ring is intermittently contacting a second brush indicated by the arrow 31 and which brush is connected by the lead 32 through the arm 33 of the relay, indicated generally at 34, and its contact points 35 to the cathode lead at 16, shorting out the cathode resistance 27 by way of the lead and the bar 19', motor shaft 5 and ground 6. This shorting of the cathode resistance occurs each revolution of the motor for a fraction of a second. It has, however, little or no effect upon the 6N7 tube, because the large potential bias across the grid resistor 28 holds the current in the tube down due to the high amplitude signal being received.

The shorting out of the cathode resistance on each revolution of the drum, however, is occurring at a time approaching closer each revolution to the time when the low amplitude signal is being sent from the transmitter or the time when no signal is being sent. There finally comes a time when there is a lack of signal or when the picture-black portion of the signal of low amplitude from the transmitter is impressed upon the tube grids and the cathode bias resistor is shorted simultaneously by the ring stem 19'. The tube then at this instant has no bias on the grids and no bias on the cathodes.

The result is, that this coincident cooperation resulting from the removal of grid and cathode bias simultaneously causes the plate current in the tube to jump to comparatively high value; in the nature of 15 ma. This plate current passes from B+ through the lead 40, switch 13, the lead 39 to the relay 37; then through the relay wind-

ing, the other lead 38 of which is connected through the coupling coil 36 to the lead 35 at the plates of the 6N7 tube. The coupling coil 36 may be the primary of a transformer which couples the amplifier to the optical unit or the oscilloscope in the scanning head 8. This relative large flow of plate current causes the winding 37 of the relay to be energized, attracts the armature 42, which has connected to it the three movable switch blades. The arm 33 breaks the contacts at 35 and the short across the cathode resistor is removed and the tube is returned to normal operating condition for the purpose of receiving the picture. Simultaneously, the arm 43 makes contact at 45 and grounds the motor through the lead 46, terminating the interrupted power supply to the motor and causing the power supply to be continuous. The arm 44 connects the plate lead through a resistance 49 to ground. An indicator tube 50 is connected across the resistance 49 and because of this voltage drop across the resistance 49 the neon tube glows and indicates that the relay has tripped and that the receiving drum is now in phase with the transmitting drum. The current passing through the relay and back to ground through the contact 44 holds the relay closed.

This operation all occurs in a matter of a fraction of a second. That is, at the start of the operation when the operator hears the signal he turns the switch 13 to the on position, the receiving drum starts, falls into a phase which is indicated by the light and the operator then adjusts his receiver amplitude to the desired value as indicated on a meter dial and the receiver is then ready to receive the picture; all of which can be accomplished in approximately ten seconds.

It will thus be seen that phasing is accomplished automatically in an exceedingly short space of time. This is of considerable value because, as previously stated, the phasing is exact. The operator does not have to rely on any manual operation including the reading of dials to know when the phasing is right, since it automatically is taken care of. Inasmuch as only such a short time is necessary, it reduces the amount of time for transmission, which is of considerable importance when transmissions are being handled over long distances, resulting in an obvious economy.

After transmission the off-on switch is thrown to the "off" position, which releases the relay and terminates the tuning fork power supply in a load resistance equal to the impedance of the motor, thus preventing an abnormal open circuit condition in the power supply, and preparing the machine for subsequent receptions.

Although I have described my invention in a specific embodiment thereof, I am aware that numerous and extensive departures may be made therefrom by those skilled in the art, but without departing from the scope or spirit of the invention. The invention, therefore, is not to be limited to the specific embodiment shown, the limitations merely being delineated by the accompanying claims.

I claim:

1. The method of synchronizing and phasing two rotating members which comprises driving said members at a synchronous speed, using one of said members to generate a phasing signal and control a thermionic circuit thereby, interrupting the drive of said other member to cause said member to shift its phase relation relative to the

first and using said second rotating member to provide additional periodic control each revolution for said thermionic circuit, and locking out said interrupted drive with said thermionic circuit when a predetermined phase relationship between the rotating members is established.

2. The method of phasing the drums of telephoto transmitters and receivers, which comprises generating a voltage at the transmitter which varies in amplitude for a portion of each cycle at a predetermined position of the drum, using the receiver drum to control an amplifying circuit and using said generated voltage to exercise additional control on said circuit and causing said receiver drum to fall behind the transmitter drum and using the output of said amplifier circuit when the receiver control and received voltage become coincident to lock said receiver drum in phase with the transmitter.

3. The method of phasing the drums of telephoto transmitters and receivers, which comprises generating a signal at the transmitter which varies in amplitude for a portion of each cycle at a predetermined position of the drum, and applying said signal to the grid circuit of a vacuum tube amplifier at the receiver, using the receiver drum to control the cathode circuit of said amplifier, interrupting the power supply to said receiver drum to cause said receiver drum to fall behind the transmitter drum and using the output of said amplifier circuit when the receiver control and received voltage become coincident to lock said receiver drum in phase with the transmitter.

4. The method of phasing the drums on telephoto transmitters and receivers which comprises generating a signal at the transmitter which is interrupted in accordance with the position of the drum relative to the point of scanning, driving the drum at the receiver in synchronism with the transmitter and interrupting the drive of the receiver drum to cause the receiver drum to fall behind the transmitter drum a predetermined amount for each revolution, using the received signal to control an amplifier and controlling the amplifier with the receiver drum to cause said amplifier to lock said drum driving circuits when a predetermined phase relation is established between the transmitter and the receiver.

5. The method of phasing telephoto transmitters and receivers which comprises generating a signal in the transmitter of high volume and changing the amplitude of said signal at a frequency dependent on the drum speed, receiving said signal at the receiver; driving said receiver at a speed nearly that of the transmitter by interrupting the drive for part of the time, causing the transmitted signal and the interrupted receiver drive to control the operation of an electron amplifier using the output of said amplifier to lock said receiver and transmitter into step when the receiver falls behind the transmitter to the point where the interruption in the received signal coincides with the interruption in the receiver drive.

6. A phasing system for two rotating members which includes means connected to one of said members for generating a voltage which varies in amplitude in timed relation to the rotating member, a thermionic amplifier electrically connected to said circuit and including a plate circuit, a grid circuit and a cathode circuit; said signal being fed into the grid circuit of an amplifier and operable to control the grid bias in

said circuit; said other rotating member having retarding means to cause a periodic phase shift in relation to said first member, and means operated by said second member and connected to said amplifier to change the cathode circuit bias in timed relation to the rotation of the second member, and means in the plate circuit of the amplifier operable upon a predetermined rise in plate current to remove said retarding means for said second member.

7. A phasing system for the drums of telephoto receivers and transmitters which includes means connected to the transmitter for generating a voltage which varies in amplitude in timed relation to the rotating drum, a thermionic amplifier electrically connected to said transmitter and including a plate circuit, a grid circuit and a cathode circuit, said transmitter signal being coupled to the grid circuit of an amplifier and operative to control the grid bias in said circuit which in turn controls the plate current flowing in the amplifier; said other receiving drum having means to interrupt the drum drive each revolution of the drum to cause a periodic phase shift of the drum relative to the transmitter drum; means operated by said receiving drum and connected to said amplifier to change the cathode circuit bias in timed relation to the rotation of the receiving drum, and relay means in the plate circuit of the amplifier operable upon a predetermined rise in plate current due to coincident operation of the grid and cathode bias-controlling means to remove said interrupted receiver drum drive and cause said drive to be uninterrupted.

8. A telephoto transmitter and receiver phasing system comprising means at the transmitter for generating a constant signal of maximum value to be transmitted interrupted at one point per each revolution of the transmitter drum to reduce the signal to a lower amplitude, means for receiving the signal at the receiver and amplifying the signal to a higher amplitude than that normally used for recording the picture, said receiver including a receiving drum, and drive means to rotate the receiver drum in synchronism with the transmitting drum, means connected to said receiver drum drive means to interrupt said driving means for a portion of the revolution of the drum to cause said receiving drum to change its phase relation with the transmitting drum, circuit means connected to and operable by the receiving drum to control the operation of an electronic amplifier, said amplifier also being controlled by said received signal, a relay connected to said amplifier output and operable upon a predetermined increase in current in the amplifier due to coincident operation of the control means for the amplifier to lock said receiver in phase with the transmitter.

9. In combination with a picture transmitter and receiver each having a synchronously driven drum and a scanning head, the transmitter having means to transmit a high amplitude signal which is varied in amplitude at the time when the meeting edges of the picture pass by the scanning head, retarding means for the receiver to cause the receiving drum to fall behind the transmitting drum, electronic means for disengaging said retarding means for the receiving drum, including an electronic amplifier, said transmitted signal connected to said amplifier, and means connected to the receiving drum and operable when the meeting edges of the film pass in front of the scanning head and connected to

said electronic amplifier, said signals from the transmitter and receiver co-acting in said electronic amplifier when the edges of the films in the transmitter and receiver pass in front of the light beam to control the electronic amplifier to disengage said drum retarding means and establish phase relations between the transmitting and receiving drum.

10. A picture transmission system, including a transmitter having a drum for holding a picture to be transmitted, clamping means extending longitudinally along the drum and holding the edges of the picture, a scanning head having a light source and a lens system for directing a pencil of light on said picture and a photo-electric responsive means for picking up said reflected light from said picture, a synchronous motor for rotating said drum at a predetermined speed and a source of power supply for said motor, said clamp in the end zone of the drum being provided with a light absorbing surface, and said drum being provided with a light reflecting surface in the end zone, and means to amplify said signal from the photo responsive means and direct said signal to a point remote from the receiver, said signal upon operation of said transmitter and scanning said end zone constituting a signal of high amplitude interrupted by a space of different amplitude when said clamping bar passes in front of said pencil of light, a receiver for receiving said transmitted signal and including an amplifier for amplifying said signal, a receiving drum for holding and rotating a light sensitive film and a synchronous motor for driving said drum at exactly the same speed as the transmitter, a power supply for said motor and connected to said motor through a stationary brush and a contact ring on the drum, said contact ring being broken at one point to cause said motor circuit to be broken during each revolution of the drum and operable to cause said receiving drum to fall behind said transmitting drum a part of a turn during each revolution of said drums, means to establish an unbroken current supply to said receiving drum when a predetermined phase relation between the said drums is established, comprising a vacuum tube circuit and a relay disposed in the output thereof, said signal from the transmitter being conducted to the grid circuit of said vacuum tube and operable to maintain a high grid bias during the high amplitude periods of the signal and maintain a lower than normal plate current and to lower the grid bias during the low amplitude signal periods, means on said receiving drum connected to said vacuum tube circuit to intermittently reduce the cathode bias on said tube, the timed relation of the removal of bias from said grid and cathode circuits of the vacuum tube circuit varying with the phase relation of said drums, said plate current in said tube circuit increasing to a high value when the bias on the grid and cathode circuit occur simultaneously, said high plate current adapted to operate said relay and said relay adapted to lock out said interrupted current supply for the receiving drum and hold said relay closed with said drums in phase with each other.

11. A transmitter and a receiver, each including a scanning head and a picture drum adapted to have a picture clamped thereon, synchronous motors for each of said drums for rotating them in synchronism, said motor circuit for the receiving drum being connected through a commutator on the drum to interrupt the power supply to the motor once each revolution to cause said receiv-

ing drum to shift its phase relation to the transmitting drum, means to shunt out said commutator connection for the receiving drum and supply uninterrupted power supply therefor comprising a shunt controlling relay, and means to operate said relay when the receiving and transmitting drums are in phase comprising an amplifier including a thermionic tube, said relay being disposed in the output circuit of the tube, and control means on the transmitter and receiver operable in timed relation to said drums to control the output of the tube.

12. A transmitter and a receiver, each including a scanning head and a picture drum adapted to have a picture clamped thereon, synchronous motors for each of said drums for rotating them in synchronism, said motor circuit for the receiving drum being connected through a commutator on the drum to interrupt the power supply to the motor once each revolution to cause said receiving drum to shift its phase relation to the transmitting drum, means to shunt out said commutator connection for the receiving drum and supply uninterrupted power supply therefor comprising a shunt controlling relay, and means to operate said relay when the receiving and transmitting drums are in phase comprising an amplifier including a thermionic tube, said relay being disposed in the output circuit of the tube, and control means on the transmitter and receiver operable in timed relation to said drums to control the output of the tube, said control means adapted to control the grid and cathode bias respectively of the tube and operable upon predetermined coincident control to increase the plate current sufficiently to operate the relay.

13. A picture transmission system, including a transmitter having a drum for holding a picture to be transmitted, means on the drum and holding the edges of the picture, a scanning system for scanning the picture, photo electric responsive means for picking up said reflected light from said picture, a motor for rotating said drum at a predetermined speed, and means to amplify said signal from the photo responsive means and directs said signal to a point remote from the receiver, said signal upon operation of said transmitter constituting a signal of high amplitude interrupted by a space of different amplitude, a receiver for receiving said transmitted signal, a receiving drum for holding and rotating a light sensitive film and a motor for driving said drum at the same speed as the transmitter, a power supply for said motor and connected to said motor through a contact ring on the drum, said contact ring being broken at one point to cause said motor circuit to be broken during each revolution of the drum to cause said receiving drum to fall behind said transmitting drum a part of a turn during each revolution of said drums, means to establish an unbroken current supply to said receiving drum comprising a vacuum tube circuit and a relay disposed in the output thereof, said signal from the transmitter being conducted to the grid circuit of said vacuum tube and operable to maintain a high grid bias during the high amplitude periods of the signal and maintain a lower than normal plate current and to lower the grid bias during the low amplitude signal periods, means on said receiving drum connected to said vacuum tube circuit to intermittently reduce the cathode bias on said tube, the timed relation of the removal of bias from said grid and cathode circuits of the vacuum tube circuit varying with the phase relation of said drums, said plate cur-

rent in said tube circuit increasing to a high value when the bias on the grid and cathode circuit occur simultaneously and adapted to operate said relay and said relay adapted to lock out said interrupted current supply for the receiving drum and hold said relay closed with said drums in phase with each other.

14. The method of synchronizing and phasing two rotating members which comprises driving said members at synchronous speeds, shifting the phase relationship between the two members by interrupting the drive of one of said members

during a portion of each revolution, generating a phasing signal with the first rotating member and periodically controlling a circuit thereby, periodically controlling said circuit with said second rotating member at a periodicity continuously varying from the first and causing coincident operation of said periodic controls to lock out said interrupting drive with said controlled circuit when a predetermined phase relationship between the rotating members is established.

LOUIS A. THOMPSON.