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TRANSMISSION OF PICTURES BY ELECTRICITY

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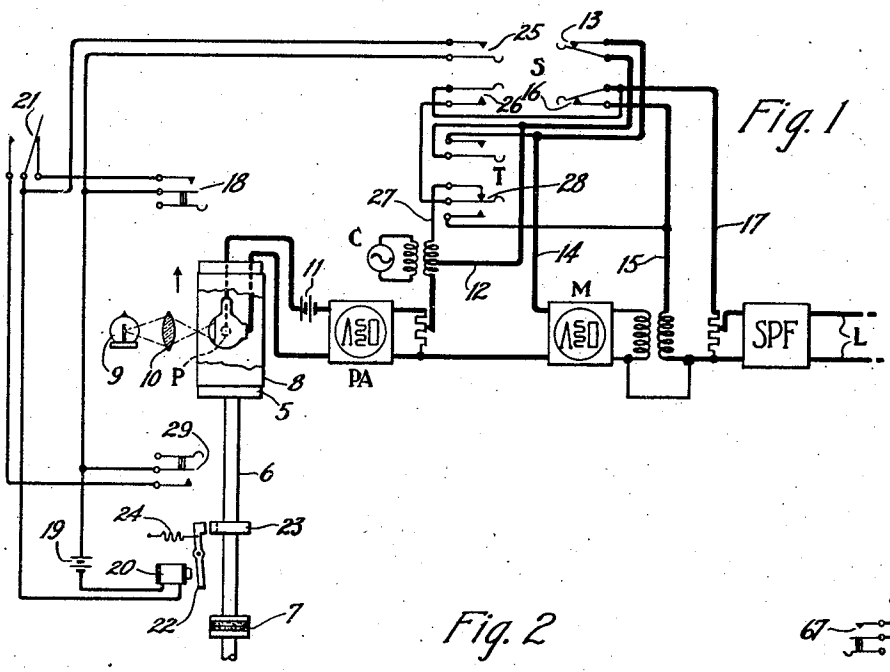
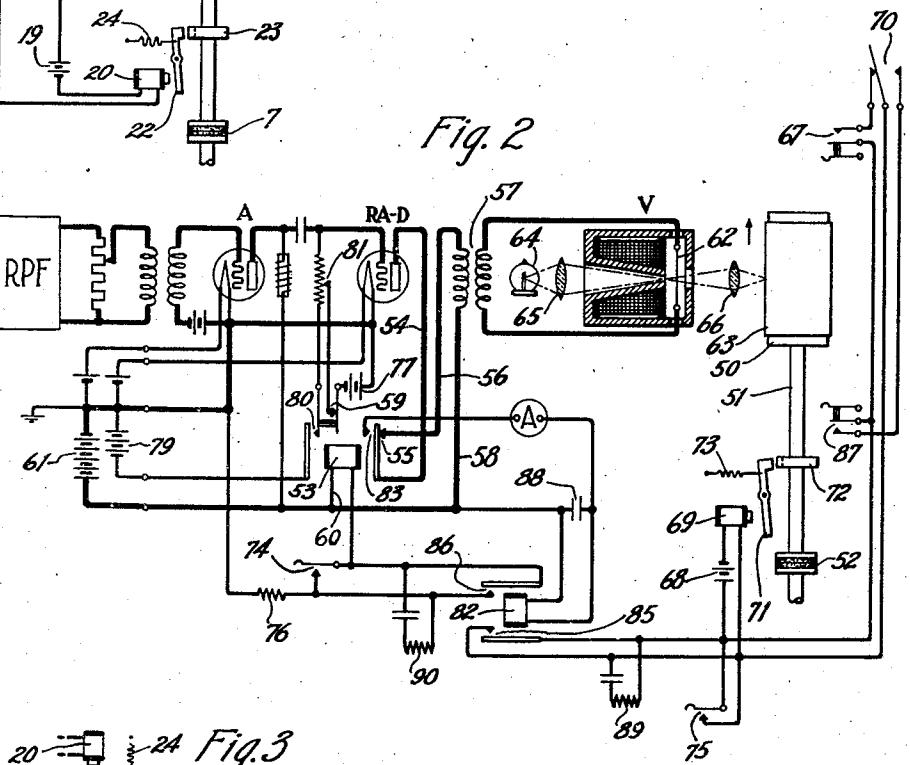



Fig. 1

Fig. 2



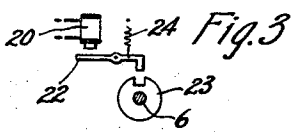


Fig. 3

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# UNITED STATES PATENT OFFICE.

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## TRANSMISSION OF PICTURES BY ELECTRICITY.

Application filed May 8, 1924. Serial No. 711,748.

*To all whom it may concern:*

Be it known that I, DONALD M. TERRY, a citizen of the United States of America, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Transmission of Pictures by Electricity, of which the following is a full, clear, concise, and exact description.

This invention relates to the transmission of pictures by electricity and more particularly to means for controlling the reproducing process.

In the transmission of pictures by electricity by means of sending and reproducing drums and intermediate transmission equipment, it is not only necessary to drive the drums in exact synchronism but it is equally important to start them simultaneously. One arrangement for accomplishing this result in a simple manner is disclosed in a copending application of M. B. Long, Serial No. 681,347, filed December 18, 1923. In the Long arrangement, the light valve is operated by demodulated current from an electron discharge demodulator and the same current is used to energize the control apparatus. As disclosed in a copending application of E. C. Wente, Serial No. 701,016, filed March 22, 1924, an improved reproducing arrangement comprises a light valve upon which the modulated carrier wave is directly impressed and which functions itself as a demodulator. When such a light valve is employed, the Long control arrangement is not suitable.

The object of this invention is to accomplish the control of the drums in a picture transmission system of the type disclosed in the Wente application supra in a simple and effective manner.

According to one embodiment of the invention, the last discharge device at the reproducing terminal functions as an amplifier to impress modulated carrier current on the light valve for picture reproduction and as a detector to control the release mechanism of the reproducing drum for starting the process of reproduction. The changeover is effected by remote control of the carrier current at the sending terminal.

The novel features which are considered characteristic of this invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation together with other objects and advantages thereof, will be further explained in the following description having reference to the accompanying drawing consisting of the following figures:

Fig. 1 is a schematic circuit arrangement of sending terminal equipment according to this invention, showing the control apparatus.

Fig. 2 is a schematic circuit arrangement of reproducing terminal equipment also showing the control apparatus.

Fig. 3 is a schematic fragmentary sketch showing the drum detent arrangement.

At the transmitting terminal, a sending drum 5 is rotated and moved axially at the same time by the rotation of shaft 6. The shaft 6 is driven by means of friction drive 7. At the reproducing terminal, reproducing drum 50 is similarly rotated and moved axially by the rotation of shaft 51 which is driven by friction drive 52. Both shafts may be rotated in either direction by individual reversible motors (not shown). A suitable driving and synchronizing system is disclosed in the Long application supra.

Referring now to Fig. 1, a transparency 8 of the picture to be transmitted is mounted on the sending drum 5. Light from source 9 is concentrated by means of lens 10, upon a small area of the transparency 8. Light from source 9 passes through the transparency 8 and the transparent drum 5 into photo electric cell P, where it determines the amount of current flowing from battery 11 and consequently the potential impressed upon the input circuit of picture amplifier PA. Current from a source of carrier wave C is impressed upon a modulator M by way of conductor 12, contact 13 of switch S, and conductor 14. This carrier wave is modulated by the picture current in the modulator M from the output of which modulated current is impressed upon the line L through filter SPF by way of conductor 15, contact 16 of switch S, and conductor 17.

Referring now to Fig. 2, the incoming modulated carrier wave from line L, passes through filter RPF and amplifier A, by which it is impressed upon the input circuit of reproducing amplifier-detector RA-D. The output circuit of receiving amplifier-detector RA-D is connected through conductor 54, contact 55 of relay 53, and conductor 56 to one terminal of the primary winding

of transformer 57. The other terminal of this winding is connected through conductor 58, to the positive terminal of plate battery 61. The other terminal of battery 61 is connected to the cathodes of the electron discharge devices and to ground. The secondary winding of transformer 57 is directly connected to string 62 of light valve V. The vibration of string 62 controls the exposure of a light sensitive record blank 63 mounted on reproducing drum 50 by light from source 64 through lenses 65 and 66.

For the transmission of a picture line L of Fig. 1 is associated with line L of Fig. 2 through a circuit which is capable of transmitting voice frequency currents. This connection may be through an ordinary telephone line, a carrier telephone channel or a radio telephone channel.

In the circuit as shown, it is assumed that a picture is in the process of being transmitted. The motors driving shafts 6 and 51 are rotating in such a direction as to cause axial motion of the drums 5 and 50 in the direction indicated by the arrows. The rotation of drum 5 with its transparency 8 of the picture to be transmitted, causes the carrier wave from source C to be modulated with the picture characteristics in modulator M. As the drum 5 moves in the direction of the arrow, it will eventually engage stopping key 18, closing a contact which completes a circuit through battery 19, relay 20 and right hand contact of stopping switch 21. The energization of relay 20, attracts its armature 22 which engages with a notch in detent disc 23 to stop the rotation of shaft 6. The armature 22 is normally held in retracted position by spring 24.

The shape of the notch in disc 23 is clearly shown in Fig. 3. From that figure, it is clear that the armature 22 when in attracted position will prevent the rotation of shaft 6 in either direction.

Simultaneously with the closing of stopping key 18 at the transmitting terminal, the reproducing drum 50 will engage stopping key 67 at the reproducing terminal. The closure of key 67 will complete a circuit through battery 68, relay 69 and left hand contact of stopping switch 70. The energization of relay 69 attracts its armature 71, causing its engagement with disc 72 to stop the rotation of shaft 51. The armature 71 is normally held in retracted position by spring 73. The action of armature 71 in serving as a detent for disc 72 will be clear from a reference to Fig. 3 and the previous description thereof.

The transmitting process is thus automatically stopped. The light sensitive record blank 63 may now be removed from reproducing drum 50 and developed in well known manner.

The procedure of transmitting another picture or the same picture over again will now be described:

The transparency of the picture to be transmitted is mounted on sending drum 5. Starting key S is thrown to the left in which position contacts 13 and 16 are opened and contacts 25 and 26 are closed. The closure of contact 25 completes a circuit for relay 20 independently of the contacts of stopping key 18 and the right hand contact of stopping switch 21. The closure of contact 26 completes a circuit for carrier waves from source C to line L independently of the modulator M by way of conductor 27, contact 28 of test switch T, contact 26 of switch S, and conductor 17. Stopping switch 21 is then closed in its left hand position.

As the circuits now stand relay 20 is energized through contact 25 and shaft 6 is prevented from rotating. Carrier current is outgoing on the line L independently of the modulator M.

At the reproducing terminal of Fig. 2, another light sensitive record blank is placed on reproducing drum 50; stopping switch 70, thrown to its right hand position; and holding switch 75 is closed. Under these conditions, relay 69 is energized by a circuit completed at holding switch 75 and shaft 51 is prevented from rotating by detent 71. Starting switch 74 which is preferably a non-locking key, is closed long enough to energize relay 53 over a circuit including resistance 76, battery 61 and conductor 60.

The energization of relay 53 converts the receiving amplifier-detector RA-D from an amplifier to a detector by substituting negative grid polarizing battery 79 of 40 volts in place of battery 77 of 9 volts potential. Battery 79 is connected in series with the whole of resistance 81 at contact 80 of relay 53, before battery 77 is disconnected from the upper part of resistance 81 at contact 59 of relay 53. The upper part of resistance 81 has preferably a resistance of 7500 ohms and the lower part, 200,000 ohms. During the change-over, therefore, batteries 77 and 79 are connected in opposing relationship in series with 200,000 ohms, so that no excessive currents are present. The grid circuit of the amplifier-detector RA-D is thus never without a negative polarizing potential and large surges of plate current are thus not present during the change-over, as would be the case were the battery 77 disconnected from the grid before the battery 79 was applied thereto or vice versa. Were such surge not obviated, special precautions would need to be taken to insure that the light valve V was first disconnected, otherwise it would be thrown out of adjustment.

The energization of relay 53 also discon-

nects the output circuit of receiving amplifier-detector RA-D from the transformer 57 and connects it to the energizing winding of relay 82 by way of contact 83 of relay 53. The incoming carrier waves from the line L are thus detected to energize relay 82. The energization of relay 82 completes an energizing circuit for relay 69 at contact 85 independently of holding switch 75. It also completes a circuit for relay 53 at contact 86 independently of starting key 74. As soon as starting key S (at the sending terminal) is thrown to its left hand position and the starting key 74 (at the reproducing terminal) has been closed to energize relay 53, holding key 75 at the reproducing terminal may be opened. The system is now in condition to start the transmission of another picture. The driving motors, if not already rotating, are started in such a direction as to cause the drums 5 and 50 to move in a direction opposite to that indicated by the arrows.

To start the operation, the starting key S is first thrown to normal position in which condition each of the contacts 13, 16, 25 and 26 is open. The opening of contact 25, deenergizes relay 20 and releases shaft 6. The opening of contact 26 interrupts the flow of carrier waves to the line L. At contacts 13 and 16, the input and output circuits of the modulator are interrupted. At the reproducing terminal the interruption of incoming carrier waves releases relay 82 and opens contacts 85 and 86 thereof. The opening of contact 85, deenergizes magnet 69 and releases shaft 51. The opening of contact 86 deenergizes relay 53 and converts the receiving amplifier-detector RA-D from a detector to an amplifier by substituting battery 77 for battery 79.

Starting switch S is then thrown to its right hand position and the process of transmitting the picture continues in the manner hereinbefore described. When the picture surface has been traversed, drum 5 engages stopping key 29 and drum 50 engages stopping key 87 to automatically stop the drums in a manner similar to that described in connection with stopping keys 18 and 67.

To transmit another picture, the process is repeated except that the direction of rotation of the driving motors is such that the drums 5 and 50 move again in the direction indicated by the arrows.

Condenser 88 is provided to improve the detecting action of the receiving amplifier-detector RA-D. The resistance capacity networks 89 and 90, connected respectively in shunt of contacts 85 and 86, are provided to obviate sparking disturbances when these contacts are opened at the start of the transmission process.

An effective control arrangement is thus provided which operates with the drums moving in either direction. The last tube acts as an amplifier for picture transmission and as a detector for starting the transmission process. The starting of the reproducing equipment is remote controlled from the sending station over the same carrier channel that is normally used for transmitting the picture characteristics.

Electron discharge devices are preferably employed and their use is schematically indicated in the drawing. The filters SPF and RPF are designed according to the principles set forth in Campbell Patent No. 1,227,113, May 22, 1917 and serve the purpose disclosed in the Long application supra.

Various modifications of the specific embodiment of the invention which has been described may be made without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. In a system for the transmission of pictures by electricity comprising terminal stations and apparatus at each station for the transmission of pictures, the method which compries normally transmitting carrier waves from one station to the other, detecting said carrier waves at one station to delay the transmitting process, interrupting the transmission of carrier waves from the second station to start the picture transmission process at the first station, simultaneously starting the picture transmitting process at the second station, and amplifying the carrier waves at the first station where before they were detected.

2. In a system for recording intelligence, a movable record blank, a source of carrier waves modulated with the characteristics of the intelligence to be recorded, an amplifier for amplifying carrier waves from said source, means to record said intelligence from said amplified waves, and means to convert said amplifier into a detector to control the movement of said movable record blank.

3. In a system for reproducing pictures from electricity, a movable light sensitive record blank, a source of carrier waves modulated with the characteristics of the picture to be reproduced, an optical arrangement for exposing said record blank to reproduce the picture, an amplifier for carrier waves from said source for impressing amplified waves upon said optical arrangement, and switching means to convert said amplifier into a detector to control the movement of said movable record blank.

4. In a system for reproducing pictures from electricity, a reproducing drum, means to rotate said drum, a light sensitive record blank mounted on said drum, a source of carrier waves modulated with the characteristics of the picture to be reproduced, an elec-

tro-magnetic light valve and optical arrangement for exposing said record blank, an amplifier for amplifying modulated carrier waves from said carrier source and impressing the amplified waves upon said light valve, and switching means to convert said amplifier into a detector to control the rotation of said drum.

5. In a system for the transmission of pictures by electricity, a reproducing drum, a light sensitive record blank mounted on said drum, means to rotate said drum, a source of carrier waves modulated with the characteristics of the picture to be reproduced, an amplifier for amplifying carrier waves from said source, means to expose said record blank in accordance with demodulated current from said amplified waves, means to prevent the rotation of said drum, a relay arranged when energized to cause said amplifier to function as a detector, and a second relay energized by detected current to actuate said rotation prevention means.

6. In a system for the transmission of pictures by electricity, a source of carrier waves, means to modify carrier waves from said source in accordance with the elements of the picture to be successively transmitted, means including a movable element for reproducing the picture, means to detect the carrier waves from said source to control the movement of said movable element, and means to convert said detecting means to amplifying means to amplify the modified carrier waves for energizing said reproducing means.

7. In a system for transmitting pictures by electricity, a source of carrier waves, means including a movable element for modifying carrier waves from said source in accordance with the elements of a picture to be successively transmitted, restraining means to prevent the movement of said movable element, means including a second movable element for reproducing the picture, a second restraining means to prevent the movement of said second movable element, means to detect carrier waves from said source to control said second restraining means, means to convert said detecting means to amplifying means to amplify the modified carrier waves for energizing said reproducing means, and starting means to control both said first restraining means and carrier waves from said source.

8. In a system for the transmission of pictures by electricity, a source of carrier waves, means including a movable element to modify carrier waves from said source in accordance with the elements of the picture to be successively transmitted, means including a second movable element for reproducing the picture, separate restraining means to prevent the movement of said movable elements, means to detect carrier waves from said source to control one of said restraining means, means to convert said detecting means to amplifying means to amplify the modified carrier waves for energizing said reproducing means, and means for simultaneously controlling carrier waves from said source and said other restraining means.

9. In a system for the transmission of pictures by electricity, a source of carrier waves, means to modify carrier waves from said source in accordance with the elements of a picture to be successively transmitted, means including a movable element for reproducing the picture, means to detect carrier waves from said source to control the movement of said movable element, means to convert said detecting means to amplifying means to amplify the modified carrier waves for energizing said reproducing means, said converting means including means to prevent reconverting said amplifying means to detecting means by subsequent changes in the character of the carrier waves.

10. In a system for the transmission of pictures by electricity, a circuit over which carrier waves are received, a reproducing drum, a light valve, an electron discharge detector, means to lock said reproducing drum in response to the receipt of carrier waves by said detector, means to unlock said drum due to an interruption in the receipt of carrier waves and simultaneously to convert said electron discharge detector into an electron discharge amplifier.

11. In a system for the transmission of pictures by electricity, a circuit over which carrier waves are received, a reproducing drum, a light valve, an electron discharge detector, means to lock said reproducing drum in response to the receipt of carrier waves by said detector, means to unlock said drum due to an interruption in the receipt of carrier waves and simultaneously to convert said electron discharge detector into an electron discharge amplifier, and means to prevent a subsequent locking of said reproducing drum when carrier waves are again received.

12. In a system for the transmission of pictures by electricity, a circuit over which carrier waves are received, a reproducing drum, a light valve, an electron discharge detector, a relay circuit for locking the reproducing drum, and a second relay energized by current from said detector and adapted when carrier current is being received to cause the relay locking circuit to lock the drum and further adapted when carrier current is interrupted to unlock the drum and to simultaneously convert the detector into an amplifier.

13. In a system for the transmission of pictures by electricity, a circuit over which carrier waves are received, a reproducing

drum, a light valve, an electron discharge detector, a relay circuit for locking the reproducing drum, a second relay energized by current from said detector and adapted when carrier current is being received to cause the relay locking circuit to lock the drum and further adapted when carrier current is interrupted to unlock the drum and to simultaneously convert the detector into an amplifier, and a third relay controlled by said second relay for converting said detector into an amplifier and open-circuiting the energizing winding of the second relay so that it will not be energized when carrier waves are again received.

14. In a system for the transmission of pictures by electricity, a transmission circuit, a source of voice frequency carrier waves of one frequency, a sending drum, a transparency of the picture mounted on said drum, a photo-electric cell within said drum, an amplifier for amplifying picture currents flowing through said photo-electric cell, an electron discharge modulator to modulate said carrier waves in accordance with said amplified picture currents and to impress modulated waves upon said transmission circuit, a reproducing drum, a light valve, an electron discharge detector actuated by carrier current from said transmission circuit, a circuit including means for locking said sending drum in stationary position and for connecting said source to said transmission circuit, either independently of or through said modulator and for disconnecting said source from said transmission circuit, means to lock said reproducing drum in response to detected carrier waves received independently of said modulator, means to unlock said drum due to interruptions in the received carrier waves and to simultaneously convert said detector into an amplifier for actuating said light valve to reproduce the picture, and means to prevent a subsequent locking of said reproducing drum when carrier waves are again received.

15. In a system for the transmission of pictures by electricity, a circuit over which carrier waves are received, a reproducing drum, a light valve, a three-electrode electron discharge detector, a source of negative polarizing potential for said detector, a relay circuit to control the rotation of the reproducing drum, a second relay adapted to connect a source of lower negative polarizing potential to said detector before disconnecting said first mentioned source, and a third relay energized by current from said detector and adapted when current is being received to cause the relay drum control circuit to cause the drum to remain stationary and further adapted when carrier current is interrupted to cause rotation of the drum and to simultaneously control said second relay to effect the substitution of said lower potential source for said higher to convert said detector into an amplifier.

In witness whereof, I hereunto subscribe my name this 29th day of April A. D., 1924.

DONALD M. TERRY.