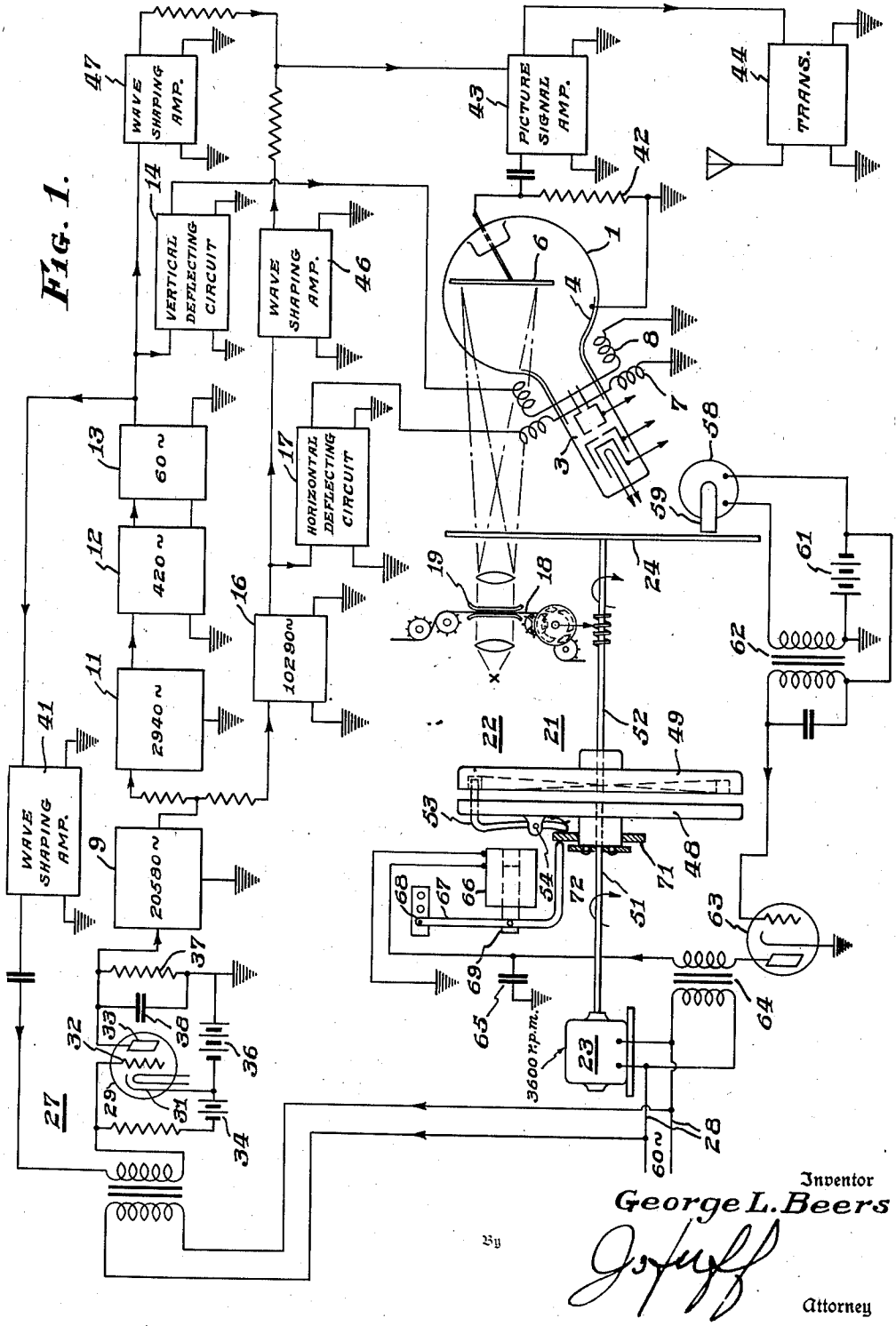
July 11, 1939. G. L. BEERS 2,165,778

TELEVISION TRANSMITTER

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Fig. 1.



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FIG. 2.

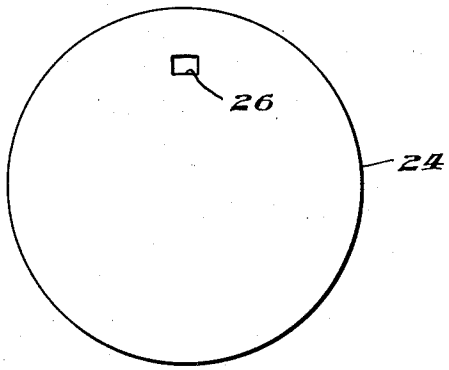


FIG. 3.

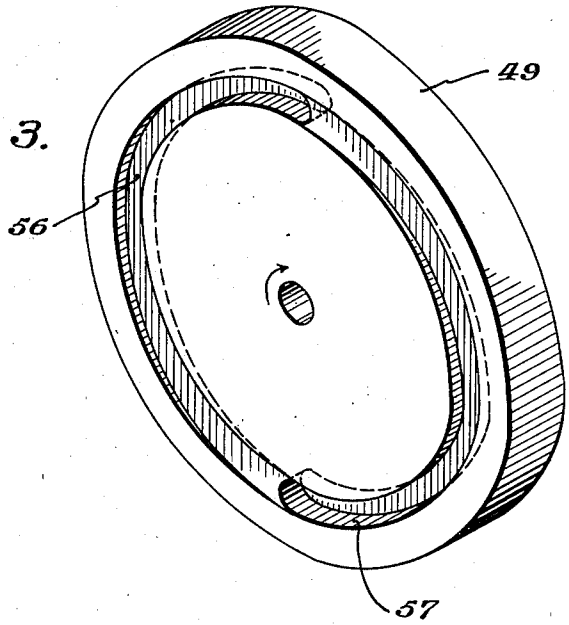
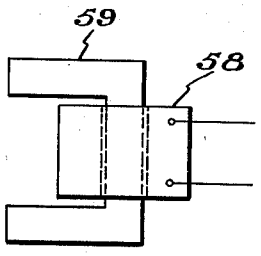


FIG. 4.



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UNITED STATES PATENT OFFICE

2,165,778

TELEVISION TRANSMITTER

George L. Beers, Collingswood, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application February 27, 1937, Serial No. 128,071

7 Claims. (Cl. 178—7.2)

My invention relates to television transmitters and particularly to apparatus for transmitting pictures from moving picture film.

In a television transmitting system of the character described and claimed in application Serial No. 729,730, filed June 9, 1934, in the name of Alda V. Bedford and assigned to the Radio Corporation of America, a cathode ray transmitting tube is employed for converting light images into electrical signals. This tube has a photo-electric mosaic having a storage effect whereby a picture image may be projected upon the mosaic, then interrupted by a shutter, and finally the resulting electrical image on the mosaic scanned by the cathode ray to produce the picture signals. To effect such operation, the moving picture film is moved into position intermittently for projection by an intermittent mechanism and the picture image is interrupted by a shutter while the film is being moved into position for projecting the next picture frame and while the mosaic is being scanned. Obviously, there must be a proper tie-in of the intermittent mechanism, the shutter, and the scanning or deflecting circuits.

This tie-in is obtained by mechanically connecting the intermittent mechanism and the shutter and by operating both the intermittent mechanism and the deflecting circuits in synchronism with an alternating current power supply such as a 60 cycle line. Such synchronous operation is obtained by keeping the deflecting circuits in synchronism with the 60 cycle line by means of a control circuit such as described and claimed in the above-mentioned application and by driving the intermittent mechanism by means of a synchronous motor connected to the same 60 cycle line.

In the above-described system the synchronous motor may lock in at a position for proper operation of the system or it may lock in 180 degrees out of phase with the correct position. Prior to my invention, it was the usual practice to open momentarily a switch in the motor line when it locked in out of phase. If the motor was still out of phase when the switch was closed, the operation was repeated.

It is an object of my invention to overcome the above-mentioned difficulty by providing automatic means for properly phasing the intermittent mechanism and shutter with respect to the scanning operation.

In the preferred embodiment of my invention the synchronous motor and the intermittent mechanism are coupled through a clutch which may be slipped 180 degrees if there is the wrong phase relation between the projection of the picture and the scanning. The clutch is magnetically operated and is slipped 180 degrees only when an electrical impulse produced by each rotation of the shutter disc is in the wrong phase relation to the 60 cycle current driving the synchronous motor.

The invention will be better understood by referring to the following description taken in connection with the accompanying drawings in which

Figure 1 is a view showing a television transmitter embodying my invention,

Figure 2 is an end view of the shutter shown in Fig. 1,

Figure 3 is a perspective view of a clutch element shown in Fig. 1, and

Figure 4 is a plan view of a magnetic unit shown in Fig. 1.

Referring to Fig. 1, a television transmitter system is illustrated which includes a cathode ray transmitter tube 1 of the type described in an article by Dr. V. K. Zworykin which appears in the January, 1934 issue of The Journal of The Franklin Institute. This tube comprises an evacuated envelope having an electron gun 3, a focusing and accelerating anode 4 and a mosaic 6 of light sensitive elements thereon. Deflecting means, such as deflecting coils 7 and 8, are provided for deflecting the electron beam horizontally and vertically, respectively, in order to scan the mosaic 6 with the electron beam.

To produce the desired current flow through the deflecting coils 7 and 8 for deflecting the electron beam, an electric discharge tube impulse generator is provided. This generator comprises a main oscillator 9 from which are derived electrical impulses of the desired frequency for horizontal deflection and also electrical impulses of the desired frequency for vertical deflection. The main oscillator 9 may be a blocking oscillator of the type described in U. S. Patent 1,999,378 or it may be a multi-vibrator.

The voltage impulses produced by the oscillator 9 are impressed upon a chain of frequency dividers 11, 12, and 13, each of which may be a blocking oscillator operating the same as the main oscillator 9 but at a lower frequency. Each oscillator is locked in step with the oscillator of next highest frequency.

The frequency of the main oscillator output is divided in three steps of seven, as indicated on the drawings, to produce voltage impulses occurring at the rate of 60 per second, this being the desired vertical deflecting or frame frequency.

The 60 cycle impulses are supplied to the input circuit of a saw-tooth wave generator 14 which converts them into voltage impulses of the necessary shape for causing a flow of current having a saw-tooth wave shape, through the deflecting coils 8.

The horizontal deflecting impulses are obtained by impressing a portion of the output energy of the main oscillator 9 upon the input circuit of a frequency divider 16 which divides the frequency of the main oscillator output by two to produce 10,290 impulses per second. The output of the frequency divider 16 is impresed upon a saw-tooth wave generator 17 which has its output connected across the horizontal deflecting coils 7 for causing a flow of saw-tooth wave current therethrough.

It will be noted that the vertical deflecting and horizontal deflecting frequencies are such as to produce a 343 line picture, the scanning being interlaced. Although my invention is described in connection with an interlaced scanning system, it should be understood that it is of general application.

The motion picture film having thereon the pictures to be transmitted is indicated generally at 18. The picture frames are moved intermittently into position in a film gate 19 by means of an intermittent 21 of the type described and claimed in application Serial No. 653,947, filed January 28, 1933, in the name of Alda V. Bedford and assigned to Radio Corporation of America. The intermittent 21 is driven through a clutch 22 by a synchronous motor 23 at the standard speed whereby 24 pictures per second are projected upon the mosaic 6. As described in the above mentioned Bedford application, alternate picture frames are scanned twice while the remaining picture frames are scanned three times. A shutter disc 24 is also driven by the synchronous motor 23 through the clutch 22, it being rotated at 60 rotations per second. As will be explained hereinafter, means is provided, in accordance with my invention, for slipping the clutch 180 degrees.

As shown in Fig. 2, the shutter disc 24 has a single opening 26 therein for the purpose of cutting off periodically the light projected toward the mosaic 6.

In order to keep the scanning of the mosaic 6 in the correct time relation to the projection of pictures thereon, a control circuit 27 is provided for maintaining the oscillator 9 locked in with the 60 cycle power line 28 to which the motor 23 is connected. The control circuit includes an electric discharge tube having a cathode 31, a control grid 32 and an anode 33. The tube 29 is so adjusted that it functions as a distorting amplifier or detector. In one specific embodiment this is accomplished by maintaining the control grid 32 at a high negative bias by means of a biasing source, such as a battery 34, the negative bias being high enough to bias the tube beyond the cut-off potential. The anode 33 is maintained at a positive potential by means of a source of potential, such as a battery 36, having its negative terminal connected to the cathode 31 and its positive terminal connected to the anode 33 through the resistor 37. The resistor 37 is shunted by a filter condenser 38.

If oscillator 9 is a blocking oscillator, the resistor 37 is connected in series with the blocking oscillator grid leak resistor whereby any change in voltage drop across the resistor 37 causes a change in the bias on the control grid of the blocking oscillator. The filter condenser 38 has sufficient capacity to integrate current impulses and cause a substantially steady flow of current through the resistor 37.

The current flow through the control circuit resistor 37 is caused to vary in response to a phase shift between the frequency of the 60 cycle current from the power line 28 and the frequency of the impulse generator output by impressing the impulses from both the power line and the impulse generator upon the input circuit of the control tube 29.

Current from the 60 cycle line 28 is impressed upon the input circuit of the control tube 29 through a transformer 39 in such phase that it adds with 60 cycle impulses which are supplied from frequency divider 13 through a wave shaping amplifier 41 to the grid of control tube 29. The wave shaping amplifier 41 may be omitted, if desired, particularly when the distorting or detector tube 29 is biased to cut-off, as described.

It will be apparent from the foregoing description that the control circuit 27 and its associated circuits cause the mosaic 6 to be scanned synchronously with the projection of the picture frames thereon. The exact picture projection and scanning operation is not described in detail as it is, in itself, no part of the present invention.

The picture signals appear across a resistor 42 connected between the mosaic 6 and the second anode 4 and are impressed upon a picture signal amplifier 43 which amplifies them and impresses them upon a radio transmitter 44.

In order to maintain the scanning at the receiver synchronized with the scanning at the transmitter, the horizontal synchronizing impulses are impressed through a wave shaping amplifier 46 upon a suitable point in the picture signal amplifier 43. Likewise the vertical deflecting impulses are impressed through a wave shaping amplifier 47 upon a suitable point in the picture signal amplifier 43. Preferably, the horizontal and vertical synchronizing impulses are impressed upon such a stage in the amplifier 43 that they appear at the receiver with a polarity opposite to the polarity of the picture signals in the white direction whereby the synchronizing signals and picture signals may be more easily separated. It will be understood that in accordance with usual practice, the horizontal synchronizing impulses are transmitted at the end of each scanning line while the vertical synchronizing impulses are transmitted at the end of each picture frame whereby the picture signals and the synchronizing signals are not transmitted simultaneously.

Referring now to the clutch mechanism 22 and to the means for operating it, the clutch comprises two plates 48 and 49 which are keyed or otherwise fastened to the shafts 51 and 52, respectively. The plate 48 carries an arm 53 pivoted at the point 54, the outer end of arm 53 extending through an opening in the plate 48 whereby it may engage an opening or projection on the plate 49.

One suitable way of making the clutch plate 49 is illustrated more clearly in Fig. 3. The surface of plate 49 facing the plate 48 has two grooves 56 and 57 therein, each of which extends 180° around the face of the plate. Each groove begins as a shallow groove and gradually gets deeper until a point 180° away is reached at which point the other groove starts. Obviously, various other shaped openings or projections may be substituted for the one just described.

It will be seen from the foregoing description

that if the end of arm 53 is pulled away from the face of plate 49 momentarily, it will permit the plate 48 to rotate 180° ahead of plate 49. The apparatus for causing such an action in the event the moving picture projector starts up in the wrong phase will now be described.

Some suitable means is provided for causing an electrical impulse to be produced in response to each rotation of the shutter disc 24. For example, a magnet coil 58 on a U-shape iron core 59, as shown in Figs. 1 and 4, may be set close to the shutter disc 24. The coil 58 is energized by a battery 61, the primary of a transformer 62 being included in series with the coil and battery. The disc 24 is of magnetic material whereby an impulse is produced in the coil 58 each time the opening 26 comes opposite the core 59. This impulse is converted into a sine wave by the tuned secondary of transformer 62 and impressed upon the grid of an amplifier tube 63. The grid of this tube may be suitably biased by the battery 61.

The plate of tube 63 is connected through the secondary of a transformer 64 and through a magnet coil 66 to ground. The primary of transformer 64 is connected to the 60 cycle line 28 whereby the plate of tube 63 is made positive during the positive half of each cycle. If the grid of tube 63 is positive at the same time the plate is positive, current will flow through the magnet coil 66. However, if the phase of the grid and plate voltages is shifted 180°, no current can flow through the coil 66.

If a current impulse is supplied to magnet coil 66, a lever 67 pivoted at a point 68 is pulled towards the coil by a magnetic core 69 whereby a slidable washer 71 pushes the end of arm 53 against a spring 72 to cause a momentary disengagement of the arm 53 and the clutch plate 49. This lets plate 48 rotate 180° ahead of plate 49 before arm 53 engages plate 49 again. A condenser 65 may be connected across the magnet coil 66 to prevent chattering of the lever arms 67 and 53 due to the rapidly recurring impulses supplied to the coil 66.

It will be seen that, if the apparatus is so adjusted that when the projector is properly phased with the scanning, there is no current flow in the plate circuit of tube 63, the clutch 22 and associated control circuit will automatically correct the phase relation if the motor 23 locks in at the wrong place. Thus, if motor 23 locks in at the wrong place, the plate and grid of tube 63 will be made positive at the same time, the arm 53 will be pulled out of engagement with clutch plate 49, and there will be a 180° shift between motor 23 and shutter disc 24.

It will be understood that I have shown one embodiment of my invention merely by way of example and that many changes may be made therein without departing from the spirit and scope of my invention.

I claim as my invention:

1. In a television transmitter for the transmission of pictures on a moving picture film, a cathode ray tube having a screen structure, a moving picture projector for projecting said pictures upon said screen structure at a rate at least equal to that of persistence of vision, a synchronous motor for driving said projector, means for effecting a scanning action in said cathode ray tube for deriving picture signals from said screen structure, means for maintaining a fixed time relation between said scanning action and said picture projection, and means for shifting automatically the phase relation between said scanning and the projection of said pictures in response to said projector starting up in an undesired phase relation with respect to said scanning.

2. The invention according to claim 1 characterized in that said last means includes a clutch through which said motor is connected to said projector, said clutch having relatively movable parts which may be shifted in steps of 180° with respect to each other.

3. In a television transmitter for the transmission of pictures on moving picture film, a cathode ray tube having a screen structure, means including an intermittent mechanism and a shutter for projecting said picture upon said screen structure, a synchronous motor connected to drive said intermittent mechanism and shutter, said motor being supplied with power from a certain power line, means for effecting a scanning operation in said cathode ray tube for deriving picture signals from said screen structure, means for maintaining a fixed time relation between said scanning and the frequency of said power supply, and means for changing automatically the phase relation of said intermittent mechanism and shutter with respect to said motor in response to an incorrect phasing of said picture projection and said scanning.

4. The invention according to claim 3 characterized in that said last means includes a magnetically operated clutch which slips 180° in response to a current impulse being supplied thereto.

5. In a television transmitter for the transmission of pictures on a moving picture film, a cathode ray tube including a mosaic of elements capable of storing a charge thereon and including means for producing a cathode ray and directing it against said mosaic, intermittent mechanism for moving said film into position intermittently for projecting picture frames successively upon said mosaic, a synchronous motor for driving said intermittent mechanism, means for causing said cathode ray to scan said mosaic in a fixed time relation to the projection of said scanning, and means for shifting automatically the phase relation between said scanning and the projection of said pictures in response to said motor locking in an undesired position.

6. In a television transmitter for the transmission of pictures on a moving picture film, a cathode ray tube having a screen surface, a moving picture projector for projecting said pictures upon said surface at a rate at least equal to that of persistence of vision, a synchronous motor, a clutch, said motor being connected through said clutch to drive said projector, means for causing the cathode ray in said tube to scan said surface to produce signals, means for maintaining a fixed time relation between said scanning and said picture projection, means for producing electrical impulses in synchronism with and in response to the operation of said projector, an electric discharge tube having a plate circuit and a grid circuit, means for energizing one of said circuits by said electrical impulses, means for energizing the other of said circuits and said motor from the same power source whereby current flows in said plate circuit only when said impulses and the current from said power source are in a certai nphase relation, and electro-magnetic means for slipping said clutch a predetermined amount, said plate circuit being coupled to said electro-magnetic means whereby said clutch is slipped in response to an undesired

phase relation between said impulses and said current.

7. In a television transmitter for the transmission of pictures on a moving picture film, a cathode ray tube having a screen surface, a moving picture projector for projecting said pictures upon said surface at a rate at least equal to that of persistence of vision, a synchronous motor, a clutch, said motor being connected through said clutch to drive said projector, means for slipping said clutch 180° in response to an electrical impulse being supplied to said means, means for causing a cathode ray in said tube to scan said surface to produce picture signals, means for maintaining a fixed time relation between said scanning and said picture projection, means for producing electrical impulses in synchronism with and in response to the operation of said projector, an electric discharge tube having a plate circuit and a grid circuit, means for energizing said plate circuit and said motor from the same power source, means for energizing said grid circuit by and a connection from said plate circuit to said clutch slipping means for supplying an electrical impulse thereto and thereby shifting the phase of said scanning and said picture projection in response to a predetermined phase relation of voltages in said plate circuit and grid circuit.

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