

June 1, 1943.

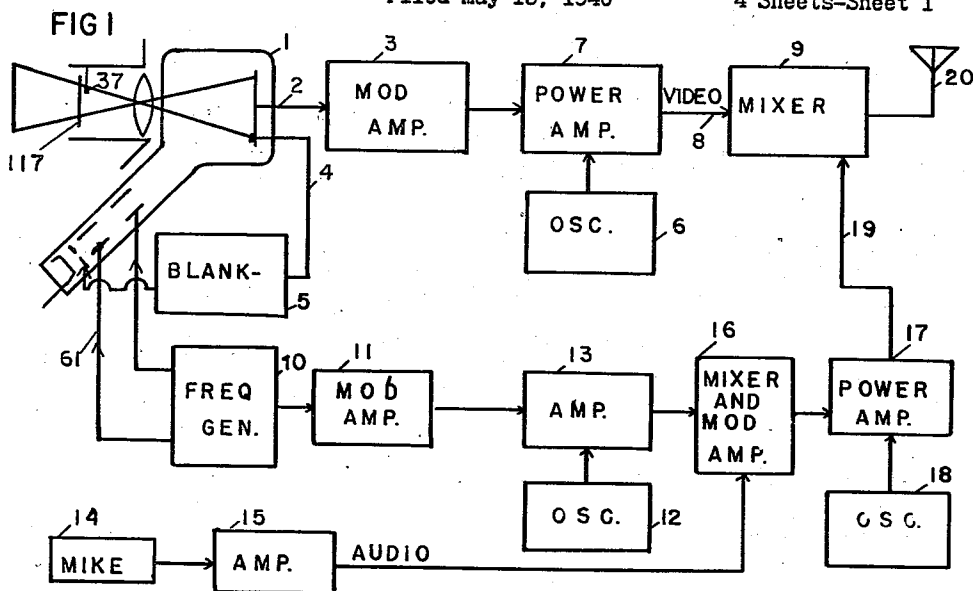
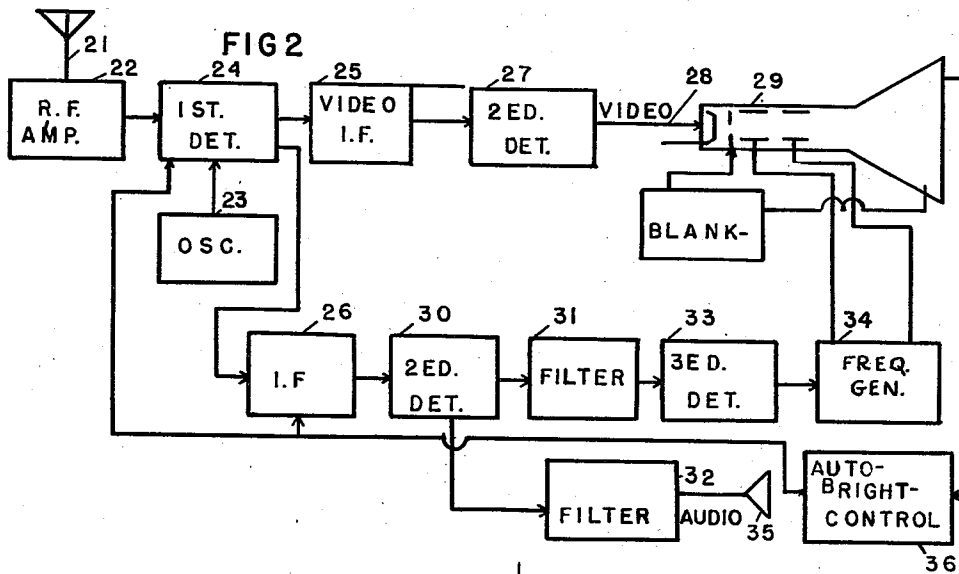
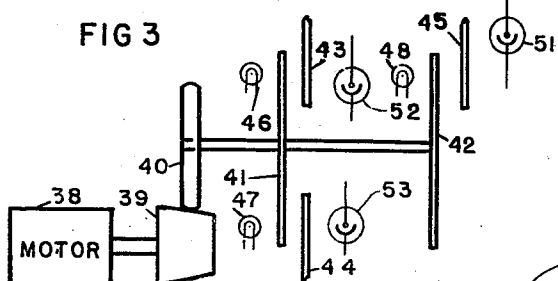
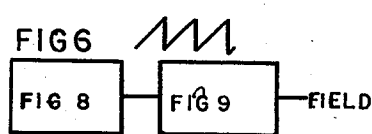
J. H. HOMRIGHOUS

2,320,699

METHOD AND SYSTEM FOR TELEVISION COMMUNICATION

Filed May 13, 1940

4 Sheets-Sheet 1



INVENTOR

John H. Homrighous

June 1, 1943.

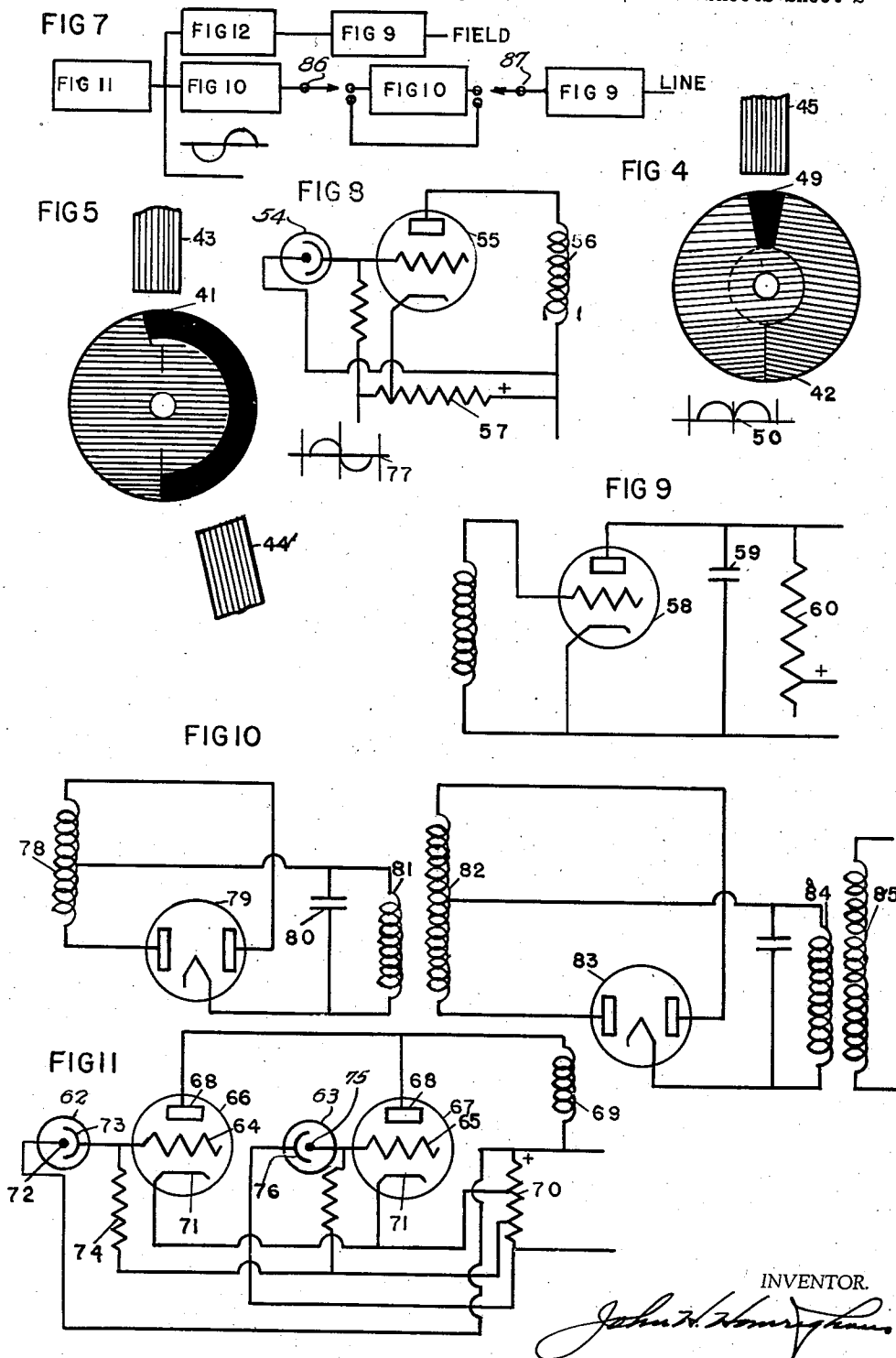
J. H. HOMRIGHOUS

2,320,699

METHOD AND SYSTEM FOR TELEVISION COMMUNICATION

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4 Sheets-Sheet 2



June 1, 1943.

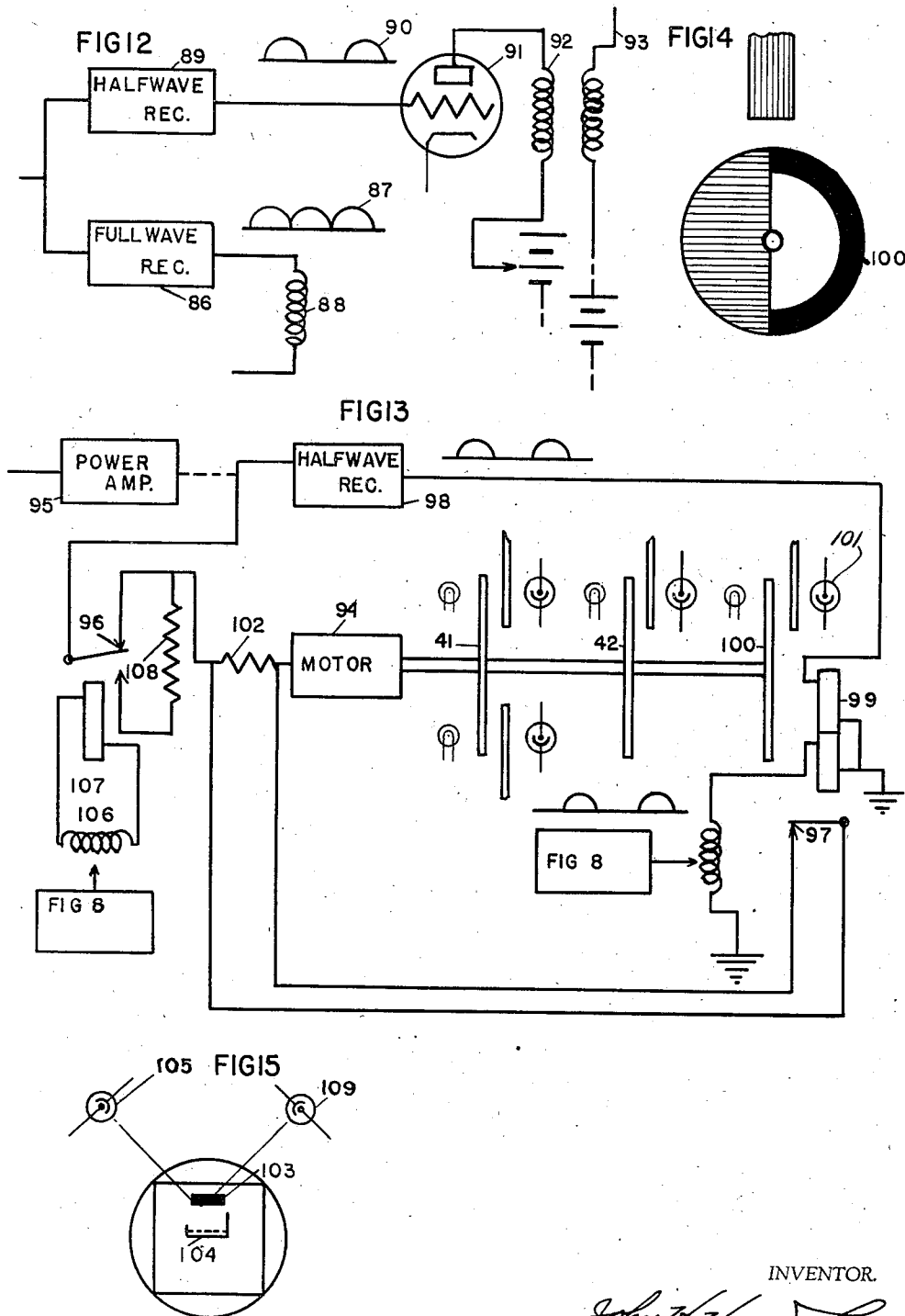
J. H. HOMRIGHOUS

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METHOD AND SYSTEM FOR TELEVISION COMMUNICATION

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4 Sheets-Sheet 3



INVENTOR.

John H. Homrighous

June 1, 1943.

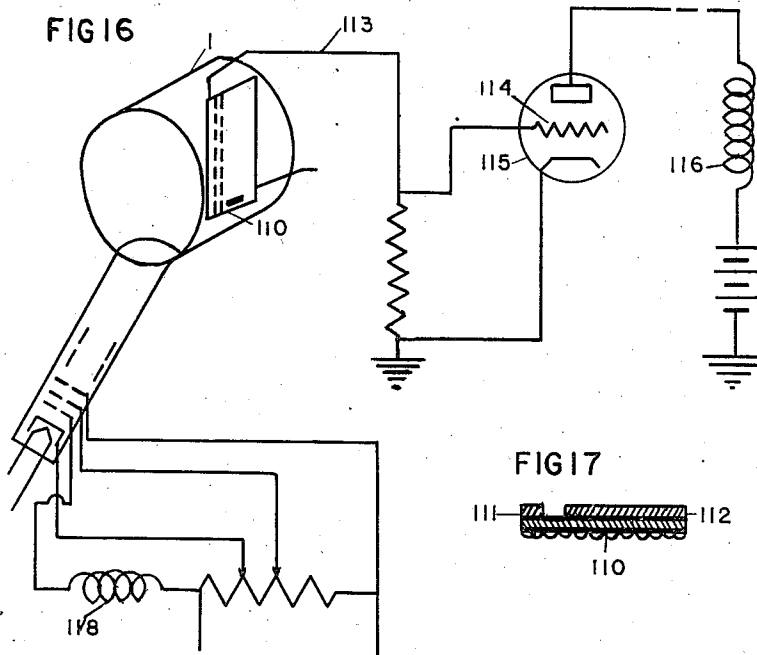
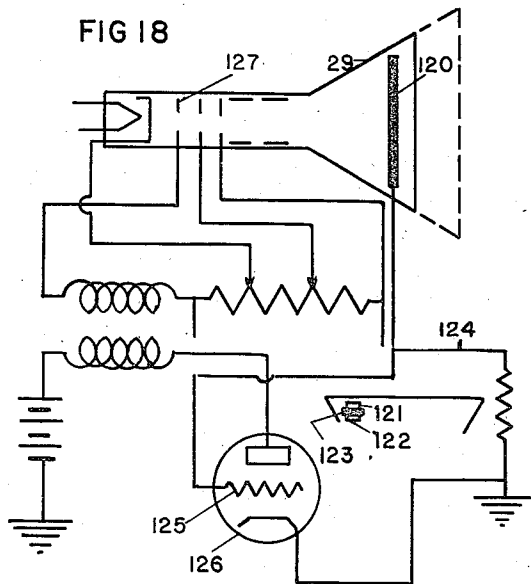
J. H. HOMRIGHOUS

2,320,699

METHOD AND SYSTEM FOR TELEVISION COMMUNICATION

Filed May 13, 1940

4 Sheets-Sheet 4



INVENTOR.

John H. Homrighous

UNITED STATES PATENT OFFICE

2,320,699

METHOD AND SYSTEM FOR TELEVISION
COMMUNICATION

John H. Homrighous, Oak Park, Ill.

Application May 13, 1940, Serial No. 334,864

12 Claims. (Cl. 178—516)

My invention relates to improvements in methods and systems for television communication and particularly to systems for producing synchronizing signals for controlling and timing the various impulses required for the production of a picture at both the transmitter and receiver.

One of the objects of my invention is to provide improved cathode ray deflecting systems for producing interlace scanning by applying a different electrical condition to the vertical deflecting means in alternate fields or by changing the time interval of every other field.

Another object of my invention is to provide a synchronizing signal generating mechanism for producing the various impulses necessary for the control of scanning in a cathode ray tube with provision for adjusting the speed of the mechanism to develop substantially wide frequency range of impulses.

Another object of my invention is the provision of synchronizing signal mechanism at the receiver which permits greater flexibility so that such mechanism may respond to signals representing different picture rates and also different number of lines per picture.

One of the main objects of my invention is an improved method of altering the number of picture changes or frames in a given time in order to televise motion picture film at 24 frames per second, or, the standard for television practice of 30 frames per second, or at any other desired number of frames per second.

Another object of my invention is the provision of a switching device for changing the number of horizontal lines per field or frame without changing the frame frequency.

Another object of my invention is the provision of an element in the cathode-ray picture tube to initiate pulses of current to be used for blanking purposes or for reducing the intensity of the electron beam during the retracing period or backward movement.

Another object of my invention is the provision of elements in the cathode-ray reproducing tube to initiate pulses of current to blank or reduce the intensity of the electron beam during the retracing period.

Another object of my invention is the provision of means for automatically adjusting the lines horizontally in each image field.

Another object of my invention is the provision of means sensitive to variations of light in the reproduced images for controlling the brightness of the images.

A feature of my invention is the generation of an alternating voltage wave and the actual transmission of this wave to the receiver whereby the same wave form and frequency may be regenerated and other frequencies may also be generated from the source of power at the receiver.

Several methods for producing interlace scanning have been devised. One system, known as the even line system, requires that the up and down movements of the cathode ray be of unequal length, which has been very difficult to obtain. In my present invention, I have devised a more positive method for developing control impulses giving alternate short and long spaced periods of time. Another system, known as the odd line method, has been devised which requires a whole number of lines plus a fraction of a line in each field so that the electron ray will start the second field at a fraction of a line distant from the start of the first line in the first field. This system depends upon equal field length and exactly alike vertical deflecting means for all fields. In the preferred embodiment of my invention, I apply a different electrical condition to the vertical deflecting means in alternate fields to shift the electron ray vertically the distance equal to the space of one horizontal line.

In none of the present systems can the number of pictures in a given time be changed from 24 to 30 pictures to televise motion picture film at a much lower rate, 24 frames per second, than the proposed standard rate for television, 30 frames per second, as described further along.

None of the above systems show elements added to the cathode-ray tubes to initiate voltage pulses for blanking purposes.

In my prior application, Serial #306,537, filed Nov. 28, 1939, the picture signals are combined with control and sound or audio signals in such a manner that all three are transmitted and reproduced as picture or video signals.

According to a preferred embodiment of my present invention, a voltage wave at the frame frequency is generated at the transmitter, and combined with the audio signals on a separate intermediate carrier frequency, which in turn is modulated on the video carrier frequency and transmitted by radio to the receiver.

Another advantage of my invention is the generation of blanking pulses by the pick up and viewing tubes, thereby eliminating the transmission of these signals by radio and the necessary filtering equipment.

Other objects, features, and advantages of my invention will appear from the following description taken in connection with the accompanying drawings, illustrating an embodiment thereof in which:

Figures 1 and 2 are simplified diagrammatic view of a television transmitting station and a television receiving station, respectively, illustrating the principles applied in this invention.

Figure 3 is a motor device for generating control frequencies.

Figures 4 and 5 are end views of the disks shown in Figure 3 for generating the control or frame frequency.

Figures 6 and 7 are simplified diagrams showing the circuit figure numbers used in generating the sweep frequencies.

Figures 8, 9, 10, and 11 show circuits used in my invention.

Figure 12 shows a circuit for identifying certain line scanning pulses.

Figure 13 shows a motor and control circuit.

Figure 14 shows an end view of disk used in Figure 13.

Figure 15 shows picture control character, reproduced at the receiver.

Figure 16 shows my improved cathode-ray pick up tube with circuit connections.

Figure 17 is a top view of the mosaic used in tube shown in Figure 12.

Figure 18 shows my improved cathode-ray viewing tube with circuit connections.

In Figure 1, the numeral 1 designates a cathode-ray pick up tube of the conventional type and is known as an "Iconoscope." It is to be understood that other tubes such as the "Orthiconoscope" developed for perpendicular scanning of all points on the mosaic, or the tube known as the image dissector may be used instead of the one illustrated. As shown, the tube comprises a mosaic, photo-electric screen on which a light image of the object is projected and produced, having two metallic plates on the opposite side, and an electron gun 1 generating a ray of electrons directed at the screen, and two sets of deflecting plates for deflecting the electron ray at the line and field frequencies, so that it is caused to scan the screen. The picture and certain other control characters are thereby developed and fed from one of the metallic plates by an output connector 2 to a modulating amplifier 3. The other connector 4 leads to a blanking pulse circuit 5 to be further described in connection with Figure 12.

A carrier wave is provided by an oscillator 6 in the power amplifier 7. This carrier now is modulated by the frequency band video or picture signals through the modulation amplifier 3. The signals from the amplifier 7 are supplied by a connection 8 to the mixing circuit 9. Certain control signals are also transmitted as video signals.

The numeral 10 designates a generator for producing pulsating voltage waves or waves of sine form for controlling the sweep frequencies at the desired frame frequency. The low frequency sweep control voltage waves or signals through the medium of amplifier 11, modulates another carrier produced by oscillator 12 in its amplifier stage 13.

The audio or sound signals from the microphone 14 are passed through an amplifier 15.

The sweep control signals and the audio signals are applied through a mixer circuit 16 to modulate a second main carrier wave in the

power amplifier stage 17 produced by the oscillator 18. The signals from the amplifier 17 are fed to the mixer circuit 9 through the conductor 19.

The two carrier waves, one modulated by sweep frequency control signals and audio signals, the other modulated by video signals are mixed in the mixer circuit 9 and fed to the common antenna 20 for transmission by radio.

The sweep control signals are transmitted in the form of sine waves, which are used to synchronize or control the scanning action with the transmitter. The antenna 21 receives the combined carrier signals from the transmitter antenna 20 to a radio frequency amplifier 22, an oscillator 23 reacts with these signals in the first stage 24 on the superheterodyne principle, to produce two intermediate-frequency signals which are fed to the two stages 25 and 26.

After suitable amplification, the video signals are detected at 27 and fed by a connection 28 to a reproducing device 29. The device 29 is represented as being in the form of a cathode-ray tube of well known construction, and comprises a fluorescent screen, an electron gun for developing a ray of electrons directed toward the screen, and two sets of electrostatic plates for deflecting the electron ray at the line and field frequencies to cause it to scan the screen. It is to be understood that electromagnetic means may be used for deflecting the electron ray. The video signals are applied to a control electrode of the electron gun to change the intensity of the electron-ray in accordance with picture or video signals.

In this cathode-ray tube I also provide two narrow metallic plates separated by an insulator and placed on the right side of the tube facing the reproduced picture. These metallic plates are for producing blanking pulses at the receiver, which will be further explained in connection with Figure 18.

Referring to the intermediate frequency stage 26 which contains the sweep signals and the audio signals and through the action of the second detector 30 the output of which goes to two selective filters 31 and 32. The low frequency sweep control signals after leaving the filter 31, still in modulated form on a carrier, are demodulated at 33 and fed to the frequency generator 34 where the signals may be amplified and operate a signal generator to redevelop control signals, or the signals may be used after suitable amplification to directly control the scanning action at the receiver which will be explained in more detail later.

The audio signal from the filter 32 is fed to the loud speaker 35.

In Figure 2, the numeral 36 represents what may be called an automatic brightness control circuit and derives its energy from the changes in brightness of a spot or mark 37 televised from the transmitting tube and directed into a photo-cell circuit. The output from this circuit is used to adjust the bias on previous stages to aid in maintaining the brightness of the reproduced picture substantially constant.

Referring to Figure 3, the numeral 38 represents a motor which is operated from the local supply current and formally runs at approximately 1800 R. P. M. Operated from the motor through the action of a cone shaped pulley 39 and the contacting pulley 40 are two disks of light polarizing material 41 and 42, revolving normally at approximately 1800 R. P. M. and re-

volving past stationary pieces of polarizing material 43, 44, and 45 and also separate sources of light 46, 47, and 48 respectively.

The revolving and stationary members are better shown in Figures 4 and 5. In Figure 4 the disk 42 is made up of two halves of polarizing material; each half may be rotated through a very small angle and as shown on the drawings the planes of polarization are not parallel. This angle depending upon the desired size of the dark portion 49 or the period of the gap between pairs of pulses as illustrated at 50.

From the above it will be seen that when the disk 42 is rotated past the stationary member 45 and between its source of light 48 and photo-electric cell 51, that the intensity of the light reaching the photo-cell will vary from zero to maximum value and back to zero when rotated through approximately 180 degrees.

Referring to Figure 5 the numeral 41 represents a disk of light polarizing material having a certain part painted or blacked out so that rotating it in a clockwise direction past its stationary polarized members 43 and 44 and between its sources of light 46 and 47 and their respective photo-cells 52 and 53 the intensity of light reaching each photo-cell will vary from zero value to maximum value and back to zero during one half of a revolution and during the other half of the revolution there will be no light change.

A system for producing the proper sweep voltages and control signals is shown in Figures 8 to 12 inclusive. In Figure 6 I have shown a photo-cell 54 which may be the photo-cell 51 in Figure 3. This cell is responsive to the variations of light intensity caused by the rotation of disk 42 previously explained to cause grid excitation of amplifier 55. The anode of tube 55 is connected through the primary winding 56 of a transformer, to the positive terminal of the voltage divider 57 to thereby produce pulsating voltages for controlling the discharge tube.

To produce the desired output wave of saw tooth form for field scanning I employ a grid controlled discharge tube circuit shown in Figure 9, where the pulsating voltages from transformer winding 56 are induced into the transformer secondary winding to drive the grid of tube 58 positive, discharging the condenser 59 through the tube 58. Thus by alternately charging the condenser 59 through the resistance 60 and discharging it through the tube 58 a saw tooth voltage is generated. The vertical sweep pulses generated by the disk 42 in the wave forming circuits Figure 9 is fed to conductor 61 at the transmitting tube Figure 1 and as diagrammatically shown in Figure 6. The circuit of Fig. 9 is also used to produce the line sweep voltages.

From the above description it will be seen that each revolution of the disk 42 will produce two similar impulses in the transformer winding 56 to trigger the discharge tube 58. The tube 58 may be biased so that only the positive pulses applied to the grid will operate the tube. Since there is a gap 49 in the disk 42 successive impulses will occur at differently spaced intervals. Changing the speed of the disk by the adjustment of the cone pulley 39 will change the picture rate without changing the number of lines per picture.

The control voltages produced in Figure 8 may be transmitted to the receiving station to govern the scanning thereat.

The pulses generated by the disk 42 can be used to produce the line scanning control pulses by interposing frequency multipliers between the

circuits of Figures 8 and 9. I may also use disk 41 having associated with it two sources of light 46 and 47 and their respective photo-cells 52 and 53. These cells are responsive to the variation of light intensity caused by the rotation of the disk 41 as previously explained.

Referring to Figure 11, I have shown a circuit for producing an alternating current from the variation of light occurring in the photo-cells 62 and 63 which may be the photo-cells 52 and 53 shown in Figure 3. These photo-cells control the grid excitation of grids 64 and 65, of amplifier tubes 66 and 67; the anodes 68 are connected in parallel through the primary winding of transformer 69 to the positive side of voltage divider 70. The cathodes 71 are connected in parallel to an intermediate point of the voltage divider 70. The cathode 73 of photo-cell 62 is connected to the grid 64 of amplifier 66 and through resistance 74 to negative potential at the voltage divider, thereby maintaining the grid 64 at a negative potential with respect to cathode 71 and plate 68; the circuit is so arranged that an increase in the intensity of light on the photo-cell 62 will increase the photo-current of tube 66. The photo-cell 63 has its anode 75 connected to the grid 65 of amplifier tube 67, and it is maintained at a positive potential with respect to its cathode 76. This causes a decrease in the current of tube 67 upon increasing the intensity of light directed toward the photo-cell 63. Other amplifier tubes may be connected in parallel to increase the amplification.

Therefore, since the plates of tubes 66 and 67 are in parallel the rotation of the disk 41 will alternately operate the photo-cells 62 and 63 to produce a continuous rising and falling current in the transformer primary winding 69, whereby, alternating voltages are induced in the secondary winding. These control voltages from winding 69 may be induced into the transformer winding of Figure 9 to control the vertical deflection, and by changing the speed of rotation of the disk 41 the duration of the time per field is changed so that any desired number of frames per second may be produced.

One method or system for producing interlace scanning uses the disk 41, Figure 5, with Figure 11, to develop impulses to trigger the sweep generator, Figure 9, to thereby control the vertical reciprocating movement of the electron ray at different time intervals whereby one field period will be of a greater duration than the next succeeding field since the dark portion on disk 41 extends through more than an 180 degree arc. Therefore, the return trace time in alternate fields will be greater than in the intervening fields, causing a fractional part of a line to be included in each field, which will have the effect of placing the lines of alternate fields between those of intervening fields.

From the above it will be seen that I have devised a novel method of producing unequal field periods of time to effect interlace scanning.

In the preferred embodiment of my invention I use the disk 100, Figure 14, instead of the disk 41, with Figure 11, to develop trigger impulses at equal spaced periods of time. This circuit is to be used as diagrammatically illustrated in Figure 7 to develop line and field trigger or control signals and a sine form wave to modulate a carrier as previously explained. The circuit figure members shown in Figure 7, plus Figure 3, constitute the frequency generator shown at 10, Figure 1.

It is proposed to use frequency multiplying cir-

cuits for the purpose of producing the high frequency required for horizontal line scanning. The field frequency is obtained as described above and from these frequencies the higher line frequencies are produced.

Referring to Figure 10, two stages of frequency multiplication are shown. The secondary winding 78 is connected to the transformer winding 69 in Figure 11 which supplies alternating pulses to the tapped secondary and in turn to the full wave rectifier tube 79 which delivers twice the number of pulses or cycles to the tuned filter comprising the condenser 80 and the next transformer primary winding 81. This double cycle signal is supplied by the taped secondary 82 to the full wave rectifier 83 where it is again doubled and fed to the next succeeding transformer primary 84. The tapped secondary 85 delivers alternating current to the next stage and so on until the desired high frequency for line scanning is obtained. While I have shown a circuit to double or to multiply the frequencies, other frequency multiplying circuits may be used.

In my invention I prefer to use the doublers and obtain 128 or 256 lines per field, where each field will have exactly the same number of pulses, therefore, the same number of lines for each field and to avoid interference with local power, all that is necessary to do is to slightly change the field rate, which will of course change the line frequency but will not change the number of lines per field.

With further reference to Figure 7, I have provided two switches 86 and 87 for shorting out one or more stages of doublers; for instance, certain stations could be operating on 256 lines per field and other stations on 128 lines per field.

In order to produce or develop interlaced scanning from a sine form voltage wave it is necessary to identify every other field pulse and in some manner cause the horizontal lines of one field to fall in between the lines produced in the other field or the lines of one field are even numbered and in the second field they are odd numbered. I accomplish these features by the circuit shown in Figure 12. In this circuit, voltage waves of sine form are supplied from the circuit of Figure 11 to a full wave rectifier 86 of conventional design, which may be one stage of Fig. 10. The output wave form is shown at 87; these pulses are fed through the transformer winding 88 which may be the winding 81 in Fig. 10 to wave forming circuit Figure 9 to drive the grid of tube 58 positive discharging the condenser 59, thereby producing saw tooth form waves for vertical scanning as previously described. Inductively connected with the transformer winding 69 of Fig. 11 is a half wave rectifier 89, the output wave form is shown at 90. The current in the half wave rectifier lead can be adjusted to impress voltage pulses on the grid of tube 91 out of phase with the voltage pulses developed in the full wave rectifier 86. The anode of amplifier 91 is connected through the primary transformer winding 92 to battery. The current pulses in the primary winding 92 will induce in the secondary a voltage which will alter the potential in conductor 93, from that furnished by the battery, for the duration of each pulse and in phase with the vertical sawtooth voltage waves. The conductor 93 supplies potential through a centering resistance to one vertical deflecting plate. The other vertical deflecting plate is supplied with potential from the same source through another centering resistance not shown. The potential

on the plate of amplifier 91 is adjustable, depending upon the space between lines.

The rectifier 89 and amplifier 91 will operate during each positive pulse to increase or decrease the potential on one of the deflecting plates without changing the potential on the opposite plate which will have the effect of raising or lowering the horizontal lines.

From the above description it will be seen that I have provided a novel and very simple means for interlace scanning or for shifting the position of the horizontal lines scanned in a cathode-ray tube, during alternate field pulses and which are controlled by the generator at the transmitting station. Thus eliminating the necessity of transmitting by radio synchronizing pulses other than the one sine form wave.

At the receiver I employ the same means for identifying the positive pulses and at the same time causing the shift in the position of horizontal lines on the viewing tube screen.

The circuit figure numbers shown in Figure 7, omitting Figure 11, may constitute in one receiving station the frequency generator shown at 34, Figure 2.

From the above description it will be seen that the line pulses are definitely locked with the field pulses, or in other words, the same pulse that triggers the vertical deflection also supplies through multiplying circuits the trigger pulses for line scanning.

Furthermore, from the above description, the control of the field and line deflecting circuits at the receiver from the sine form voltage wave transmitted by radio from the transmitting station will cause the cathode-ray or electron ray at the viewing tube to be in exact synchronization with the cathode-ray in the pick up tube, whenever the receiving station is tuned to the proper carrier wave.

In other words, at any time or interval that the receiver is tuned to the proper carrier wave of a transmitting station, the deflecting circuits will automatically be in step. Supposing that at a certain instant the cathode-ray or electron ray in the pick up tube is focused on midpoint of line number 40, then since a single frequency or control voltage wave generated at the transmitter station times the deflection of both the field and the horizontal lines at both the transmitting station and receiving station, the cathode-ray at the viewing tube would automatically be focused at the midpoint of line 40 on the screen of the viewing tube, and furthermore since I have provided through the medium of a half wave rectifier, Figure 12, means for associating the positive pulse in each cycle of the control voltage wave with a certain field, the focused electron ray in each tube would also fall in the proper field. The picture produced from this system will be approximately as high as they are wide, since there is no necessity of reserving space at the bottom of picture for synchronizing pulses.

Another system for controlling the scanning operations at the receiving station may comprise the motor 94, Figure 13, having control circuits for keeping the position of the rotor in step with the alternating current signals. The motor 94 drives disks or mechanisms similar to those explained in connection with Figure 3 to in turn develop line and field trigger potentials, utilizing the circuits shown in Figure 7. The motor and mechanism shown in Figure 13, together with the circuits shown in Figure 7 may

constitute the frequency generator 34, Figure 2, in another receiving station.

The power amplifier 95 may be supplied with signal current from the detector 33, Figure 2. These signals after proper amplification at 95 are fed to the motor 94 through contact 96 and 97. The half wave rectifier 98 will supply the positive pulses to one winding of relay 99. The motor 94 is small and carries a very light load; therefore very little power is required to operate it. Secured to its shaft are three disks of polarizing material, two of which are exactly like those shown in Figures 4 and 5 with their associated stationary polarized members and photo-cells. The disks are designated by the same numbers 41 and 42 and operate the circuits shown in Figure 7, as previously explained, in connection with the transmitting station. In the preferred embodiment of my invention I propose to substitute the disk 100, Figure 14, for the disk 41 to thereby develop a series of trigger impulses having equally spaced periods of time.

The third disk in Figure 13, designated 100, and like the view shown in Figure 14 is secured to the motor shaft in such a manner that when it is rotated one-half of a revolution to alter the light in the photo-cell 101 (which may be substituted for the photo-cell 54, Figure 8) to produce a pulse of current in the transformer winding 56 of Figure 8, which is then fed to a circuit containing the lower winding of relay 99, in the interval between the pulses produced by rectifier 98, the rotor may be considered in step with the positive pulses of the sine form voltage wave supplied to the power amplifier 95.

The relay 99 will not operate by separate pulse from either the rectifier 98 or photo-cell 101. But since the motor is two pole, the rotor may be out of step several degrees; in which case the relay would receive aiding pulses from both the rectifier 98 and the photo-cell 101 and would operate to open its contacts at 97 which would include the resistance 102 in the motor circuit momentarily in order to slow its speed sufficiently after a few revolutions to slip the rotor back in step with the supply current.

From the above description it is shown that the disk secured to the motor shaft will automatically keep in step with the current supply and that the other disk connected to the motor shaft will also generate voltage waves and pulses of current in exact phase relation and in synchronism with the supply.

This motor generator circuit or frequency generating device, Figure 13, may be used to supply the line and frame control frequencies at the receiver in a similar manner to that shown in Figure 3, at the transmitter.

When using this circuit the picture signals developed in one horizontal line may be slightly out of adjustment with the signals developed in the next following line and to overcome this automatically I have provided a horizontal line 103, Figure 15, which is reproduced from the permanent mark 37 at the transmitting tube, Figure 1, and will occur in all picture changes and frames. From a point, just at the left of this horizontal line 103, a ray of light is directed by mirror 104 and suitable lenses to a photo-cell 105. This photo-cell may be used in the circuit of Figure 8 which has been previously described. The transformer winding 56 would be inductively connected to the winding 106, Figure 13, which winding is connected through the control relay 107. The mark will move to the left, should the motor

speed lag the picture speed which will render relay 107 inoperative and give a slightly longer interval for the horizontal lines. However, should the motor speed lead the picture time, the mark would move to the right causing light to enter the photo-cell 105 which would operate relay 107 momentarily to include resistance 108 in the motor circuit, thereby reducing the speed of motor. This feature has been disclosed in my prior application, referred to before.

The mark 103, Figure 15, also serves another purpose, that is, it automatically controls the brightness of the picture reproduced by the reflections of the changes in the intensity of the line or mark 103 into the photo-cell 109 from the mirror. The photo-cell 109 may be substituted for the one shown in Figure 8, whereby this circuit will function to adjust the bias on previous stages as shown in Figure 2 to assist in maintaining practically constant brightness in the reproduced picture.

With reference to Figure 16, I have shown my improved pick up tube 1, which improvement consists in dividing the metallic plate on the back of the mosaic 110 into two parts 111 and 112, better shown in top view, Figure 17, with conductors extending from each metallic plate through the tube, the mosaic may be in two parts also, otherwise this pick up tube is of conventional design. The conductor 113 extending from the smaller of the two plates 111 which is located on the left side of the tube facing the front, controls the grid excitation of grid 114 of amplifier tube 115. The anode of tube 115 is connected through primary winding 116 of a transformer to positive battery.

The operation of this circuit is as follows: As the electron beam moves from right to left across the mosaic 110 when scanning the image it will at the end of each scanning line be focused on a vertical image of full height of the picture caused by a narrow permanent flat bar 117, shown outside the lens system in Figure 1. This mark will appear in all the fields, so that each time the scanning beam reaches this vertical image a small potential change will be produced in the grid 114 of the amplifier 115, which may be further amplified in other stages, to in turn produce a pulse of current in the primary transformer winding 116 which is induced into the secondary transformer winding 118 to change the potential on the control grid 119 to reduce the intensity of the electron ray during the retrace period which is commonly known as blanking. These pulses, before being applied to the control grid, may be slightly delayed by well known pulse delaying methods so that the intensity of the electron beam will be reduced just at the right instant.

With reference to Figure 18, I have shown a very similar arrangement to that shown in Figure 16 for blanking the electron ray in the viewing tube at the receiver.

The element 120 on the inside of the viewing tube and near the right edge facing the front, is composed of two metallic plates 121 and 122 separated by insulating material 123. From the plate 121 a lead 124 is brought out from the vacuum tube 29 and extends to the grid 125 of tube 126 which is a similar circuit to that shown and explained in connection with Figure 16, and as the electron ray contacts the plate 122, at the end of each scanning line a potential change is produced on plate 121 for changing the potential of the control grid 127 after proper ampli-

fication and as explained for the pick up tube. Thus at the end of each horizontal line the intensity of the electron ray in the viewing tube is reduced for the retrace interval.

From the above description it will be seen that I have provided a very simple and novel arrangement for blanking the electron ray in pick up and viewing tubes during the vertical and horizontal line retrace.

It will be understood that numerous modifications are possible without departing from the spirit of my invention or the scope of the claims.

Having thus described my invention, I claim:

1. In a television system, a cathode ray camera tube having an image plate and an electron ray directed toward the image plate, a motor, means for moving the said electron ray to scan the said image plate, including mechanism driven at adjustable speeds by the said motor, said mechanism provided with apparatus and suitable circuits to control the movement of said electron ray in vertical directions during spaced periods of time, and provided with other apparatus and suitable circuits to control the movement of said electron ray in horizontal reciprocating directions, said mechanism also provided with a half wave rectifier, and suitable circuits for adjusting the said electron ray vertically, during alternate periods, a distance equal to the space of one horizontal line location on the said image plate, whereby even line locations on the said image plate are scanned during alternate periods, and odd line locations on said image plate are scanned during intervening periods.

2. The system, in accordance with claim 1, in which there is provided means for adjusting the speed of said mechanism to scan all line locations on the said image plate twenty-four to thirty times per second.

3. The system, in accordance with claim 1, in which there is provided means including a part of said image plate to control the intensity of the said electron ray during its backward movement.

4. The system, in accordance with claim 1, in which there is provided switching means to vary the number of line locations that may be scanned on the said image plate in any of the said periods.

5. In a television system, a cathode ray camera tube having an image plate and an electron ray directed toward the image plate, a motor, means for moving the said electron ray to scan the said image plate, including mechanism, driven at adjustable speeds by the said motor, said mechanism having vertical deflecting means to control the movement of said electron ray in vertical directions during spaced periods of time, and horizontal deflecting means to control the movement of said electron ray in horizontal reciprocating directions, said mechanism also having means for applying a different condition to the said vertical deflecting means for alternate peri-

ods, relative to the said vertical deflecting means for the intervening periods, whereby even line locations on said image plate are scanned during alternate periods and odd line locations on said image plate are scanned during the intervening periods.

6. The system, in accordance with claim 5, in which there is provided means for adjusting the speed of said mechanism to scan all line locations on the said image plate twenty-four to thirty times per second.

7. The system, in accordance with claim 5, in which there is provided means including a part of said image plate to control the intensity of the said electron ray during its backward movement.

8. The system, in accordance with claim 5, in which there is provided switching means to vary the number of line locations that may be scanned on the said image plate in any of the said periods.

9. In a television system, a cathode ray viewing tube, provided with an image screen, and an electron ray directed toward the image screen, a motor arranged to be driven by received synchronizing signals, means, including mechanism, driven by the said motor, for moving the said electron ray over the said image screen to produce successive images from received picture signals, said mechanism having vertical deflecting means to control the movement of said electron ray in vertical directions during spaced periods of time, and horizontal deflecting means to control the movement of said electron ray in horizontal reciprocating directions, said mechanism also having means for applying a different electrical condition to the said vertical deflecting means during alternate periods to adjust the said electron ray vertically during alternate periods, a distance equal to the space of one horizontal line location on the said image screen, whereby, even line locations on the said image screen are scanned during alternate periods, and odd line locations on said image screen are scanned during intervening periods.

10. The system, in accordance with claim 9, in which there is provided an electron ray contacting member at one edge of the said image screen, and means including said contacting member for controlling the intensity of the said electron ray during its backward movement.

11. The system, in accordance with claim 9, in which there is provided switching means to vary the number of line locations that may be scanned on said image screen in any of the said periods.

12. The system, in accordance with claim 9, in which there is included a mark in the said image, and means controlled by said mark reproduced in all images for momentarily changing the motor speed to adjust the lines horizontally on said image screen.

JOHN H. HOMRIGHOUS.