

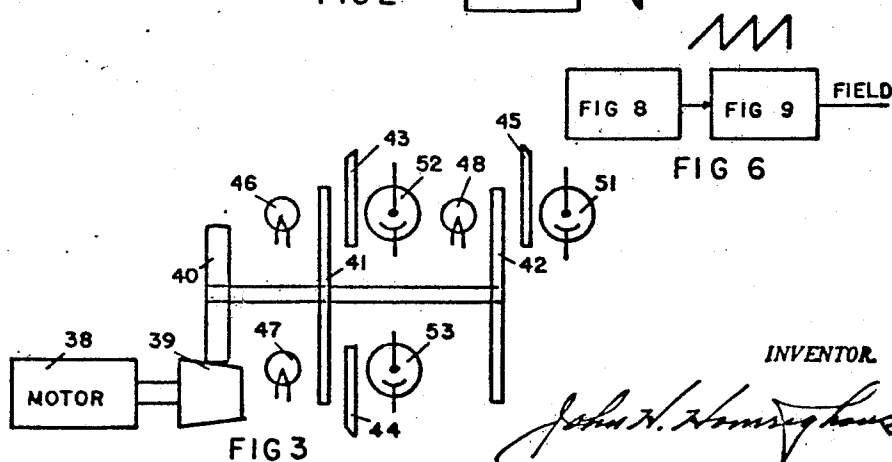
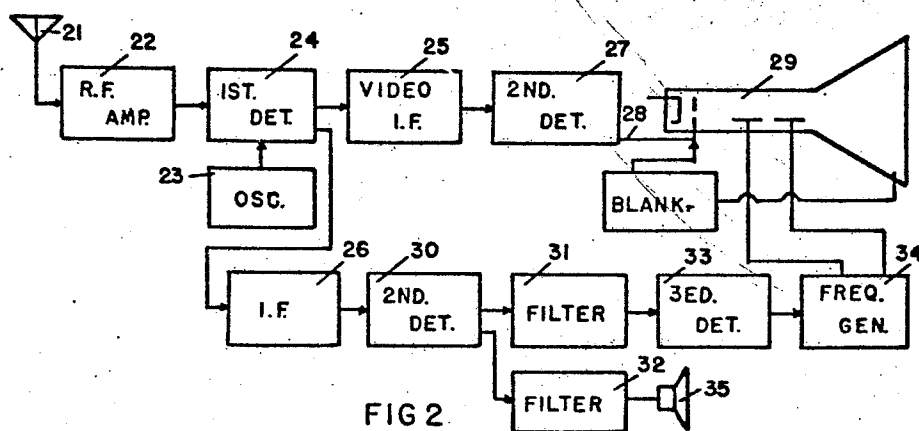
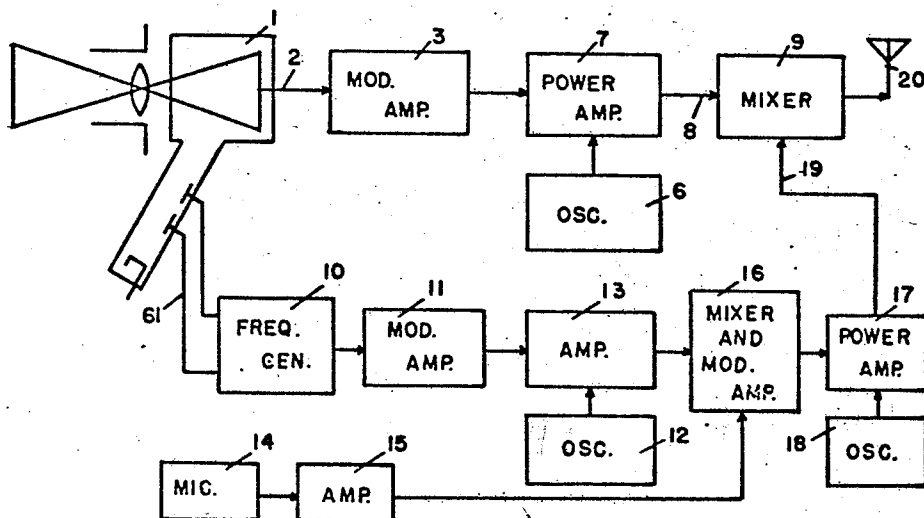
April 13, 1948.

J. H. HOMRIGHOUS

2,439,735

ELECTRICAL CONTROL SYSTEM

Original Filed Sept. 17, 1942 3 Sheets-Sheet 1



INVENTOR.

John N. Hamsey

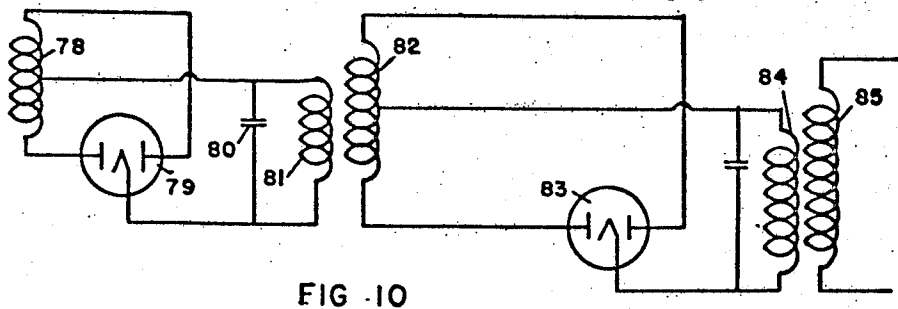
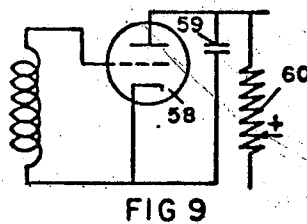
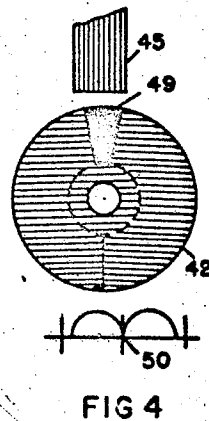
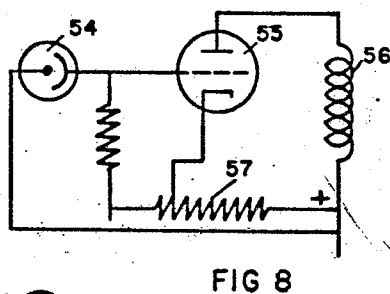
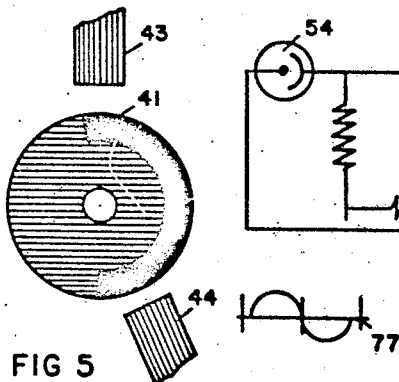
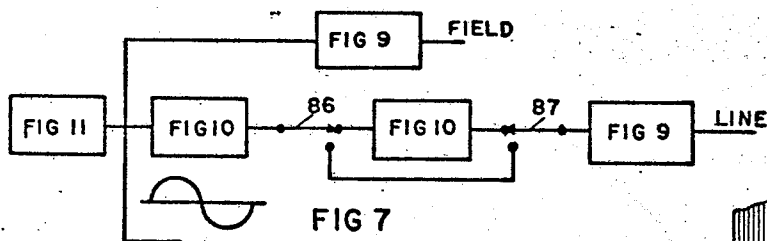
April 13, 1948.

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2,439,735

ELECTRICAL CONTROL SYSTEM

Original Filed Sept. 17, 1942 3 Sheets-Sheet 2



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ELECTRICAL CONTROL SYSTEM

Original Filed Sept. 17, 1942 3 Sheets-Sheet 3

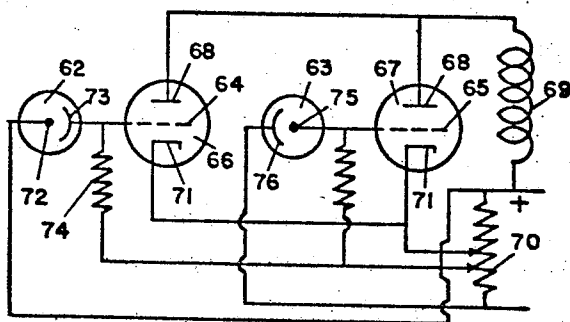


FIG. 11

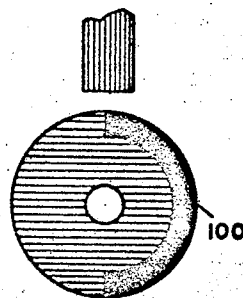


FIG 13

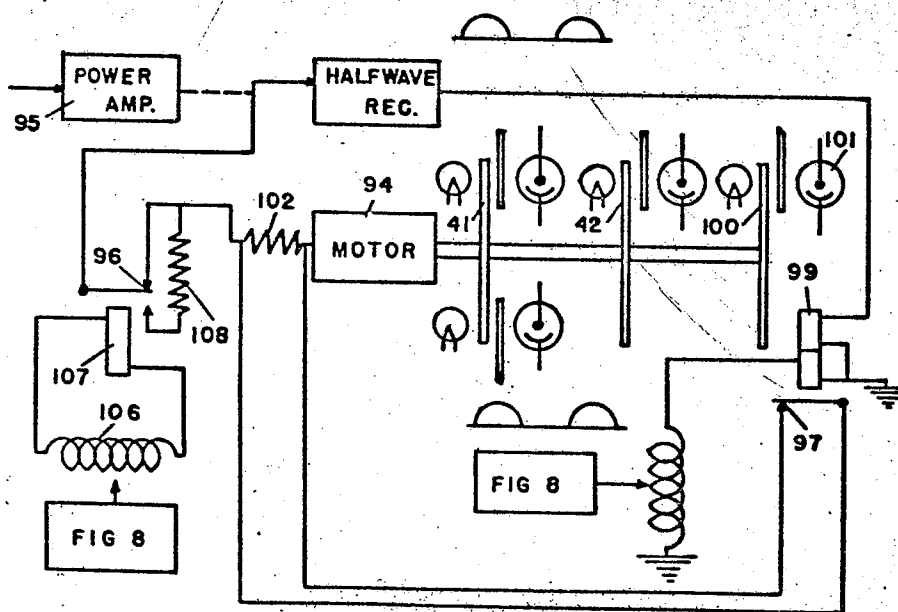


FIG. 12

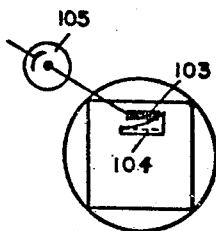


FIG 14

INVENTOR,

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UNITED STATES PATENT OFFICE

2,439,735

ELECTRICAL CONTROL SYSTEM

John H. Homrighous, Oak Park, Ill.

Original application September 17, 1942, Serial No. 458,612. Divided and this application October 16, 1944, Serial No. 558,932

9 Claims. (Cl. 250-41.5)

1 My invention relates to improvements in electrical control and distribution, more particularly to a system for controlling the phase relationship of motors or motor driven mechanism with the alternating current supply.

One of the objects of my invention is automatic control and maintenance of two or more mechanisms in step with each other located in different places.

Various motor control systems have been devised, but in none of these systems has automatic means been provided for maintaining phase relation with the supply current.

This invention will be described in connection with a television system, but it is to be understood that it is not limited to such uses.

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 views of a television transmitting station and a television receiving station, respectively, illustrating the principles applied in this invention.

Figure 3 is a motor driven 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 motor and control circuit.

Figure 13 shows an end view of disk used in Figure 12.

Figure 14 shows picture control character, reproduced at the receiver.

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 "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, and an electron gun for 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 the metallic plate by an output connector 2 to a modulating amplifier 3.

A carrier wave is provided by an oscillator 4 in the power amplifier 7. This carrier wave is

2 modulated by the frequency band video or picture signals through the modulation amplifier 5. 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, modulate another carrier produced by oscillator 12 in its amplifier stage 13.

15 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.

25 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.

30 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.

35 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 heterodyne principle, to produce two intermediate-frequency signals which are fed to the two stages 25 and 26.

40 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.

50 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 demodu-

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lated 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 signals from the filter 32 may be fed to the loud speaker 35.

Referring to Figure 3, the numeral 38 represents a motor which is operated from the local supply current and normally 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 revolving 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 drawing 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 member 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 11 inclusive. In Figure 8 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 as 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 saw tooth voltages may be produced. The vertical sweep pulses generated by the wave forming circuits Figure 9 are fed to conductor 61 at the transmitting tube Figure 1 and as diagrammatically shown in Figure 6. The circuits of Figure 9 are also used to produce the line sweep voltages.

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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 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 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 a 180 degree arc. Therefore, the return trace time in alternate fields will be greater than in the intervening fields,

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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.

In the preferred embodiment of my invention I use the disk 100, Figure 13, 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 circuits 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 inductively connected to the transformer winding 69 in Figure 11 which supplies alternating pulses to the taped 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 taped 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.

With 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.

The circuit figure number 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 pickup tube, whenever the receiving station is tuned to the proper carrier wave.

Another system for controlling the scanning operations at the receiving station may comprise the motor 94, Figure 12, 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 12, 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

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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 13, for the disk 41 to thereby develop a series of trigger impulses having equally spaced periods of time.

The third disk in Figure 12, designated 100, and like the view shown in Figure 13, 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, which is supplied to the circuit containing the lower winding of relay 99; during 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 over 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 received signals.

This motor generator circuit or frequency generating device, Figure 12, 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 14, 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 mark 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 12, 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.

In the various circuits shown and described I have simplified the drawings by indicating the source of potential by a sign. Also I have omitted the heater filaments for the various tubes, but it is to be understood that such filaments are necessary.

The embodiments of the invention which have been given herein are illustrations of how the various features may be accomplished and the principles involved. It is to be understood that the invention contained herein is capable of embodiment in many other forms and adaptations, without departing from the spirit of the invention and the scope of the appended claims.

This application is a division of application Serial Number 458,612, filed September 17, 1942, now Patent No. 2,398,642, issued April 16, 1946.

Having thus described my invention, I claim:

1. In a motor control system, a source of alternating current supply, a motor driven by alternating current from said source, automatic means under the control of the positive polarity pulses of alternating current from said source to change the speed of said motor for adjusting a point on the rotor relative to the positive polarity pulses of the alternating current supply.

2. In a motor control system, a source of alternating current supply, a motor driven by alternating current from said source, rotary mechanism driven by said motor, means including said mechanism and for utilizing the positive polarity pulse of alternating current from said source to change the speed of said motor for adjusting the position of the said mechanism relative to the positive polarity pulses of the alternating current supply.

3. In a motor control system, a source of alternating current supply, a motor driven by alternating current over a circuit extending from said source, a resistor adapted to be included in said circuit, means including rotary mechanism driven by the said motor to produce spaced impulses of current, a relay energized by the positive polarity pulses of current from said source and from said spaced impulses to include said resistor in said circuit thereby changing the speed of the said motor for adjusting a point on said mechanism relative to the positive polarity pulses of the alternating current supply.

4. In a motor control system, a source of alternating current supply, a motor driven by alternating current from said source, rotary mechanism driven by the said motor, a source of direct current supply, photo electric devices having suitable circuit arrangements controlled by said mechanism to produce impulses of current from said source of direct current supply, a relay momentarily energized by the positive polarity pulses from the said alternating current supply and from the impulses of current developed from the said direct current supply to alter the current supplied to said motor thereby changing the speed of the said motor to regulate a point on the said mechanism relative to the positive polarity pulses of the said alternating current supply.

5. In a motor control system, a motor arranged to be driven by alternating current signals modu-

lated on a carrier wave, a source of light, a rotary light valve driven by said motor to vary the intensity of a beam of light directed from said source toward the light valve, a source of direct current supply, photo electric devices having suitable circuit arrangements actuated by the said variable intensity light beam to produce impulses of current from said source of direct current in synchronism with the positive polarity pulses of the received alternating current signals.

6. In a motor control system, a source of alternating current supply, a motor arranged to be driven by alternating current from said source, automatic means under the control of current from said source for effecting a momentary change in the speed of said motor to adjust the position of its rotor relative to the positive polarity pulses of the alternating current.

7. In a transmission system comprising a number of stations geographically separated by relatively great distances, each of the said stations having movable members, a motor at each of the said stations to drive said members at corresponding speeds of rotation from received alternating current signals, automatic means under the control of said signals for making phase changes in any one of the said movable members comprising means for effecting a momentary change in the speed of its drive motor to adjust the position of its movable member relative to the position of the other movable members.

8. In a remote control system, a motor located at a distant station, rotatable mechanism driven by said motor, a transmitter station, means at said station to produce a carrier wave, means to transmit energy at the operating frequency of said motor modulated on said carrier wave, a receiver at said distant station wherein the modulated energy is developed and supplied to said motor, and automatic means under the control of the modulated energy to facilitate the maintenance of a point on said mechanism rotating through a certain arc relative to the positive polarity pulses of the operating frequency.

9. In a remote control system, a motor located at a distant station, a source of direct current supply, a generator comprising a plurality of electron tubes controlled by mechanism driven by said motor to produce alternating current from said direct current source, a transmitter station having means to produce a carrier wave, a receiver at said distant station wherein the modulated energy is developed and supplied to said motor, and means at said transmitter to change the frequency of said energy to change the speed of said motor, thereby regulating the frequency of alternating current delivered by said generator.

JOHN H. HOMRIGHOUS.

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