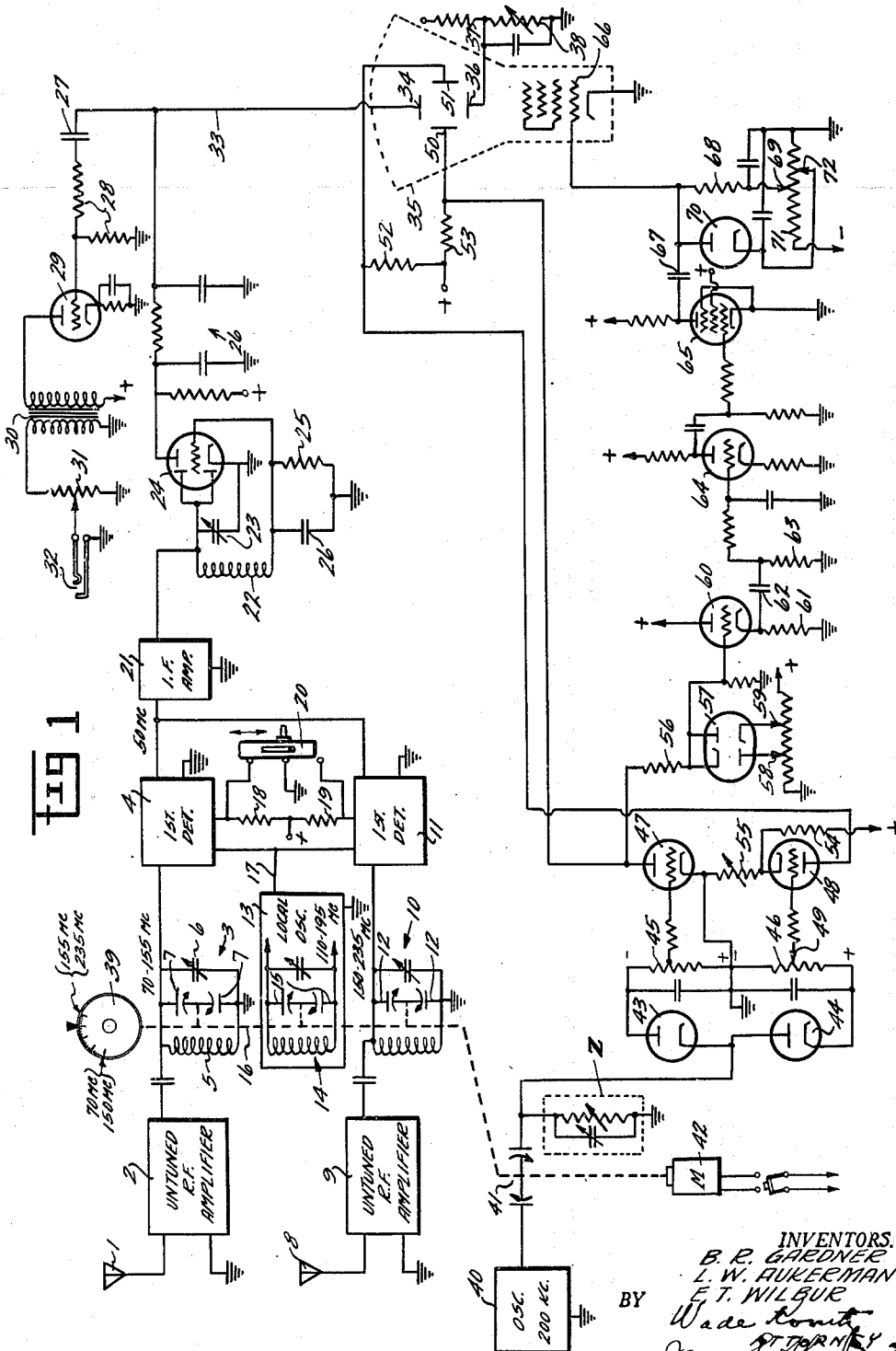


B. R. GARDNER ET AL
BLANKING SYSTEM FOR LOCKED SWEEPS
IN PANORAMIC SYSTEMS

3 Sheets-Sheet 1

3 Sheets-Sheet 1



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2,490,045

Filed June 11, 1948

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Fig 2

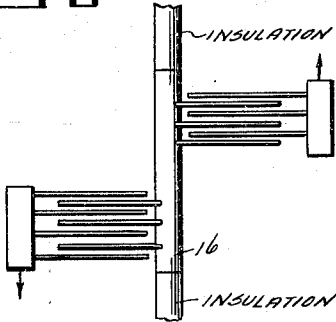


Fig 3

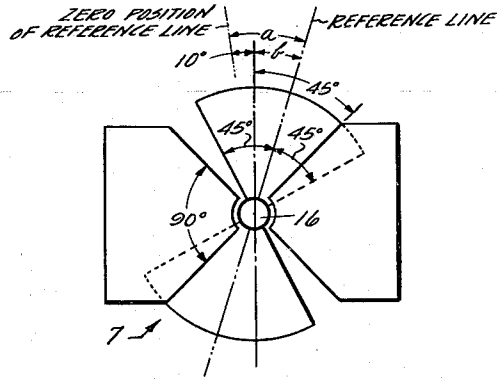


Fig 4

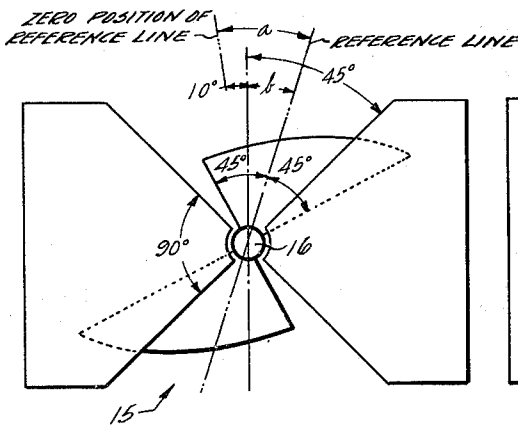
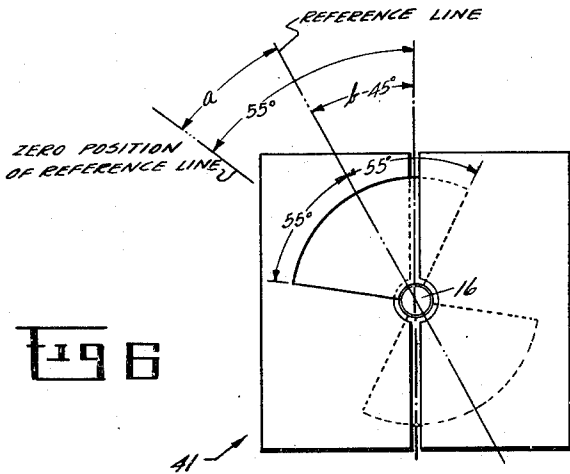
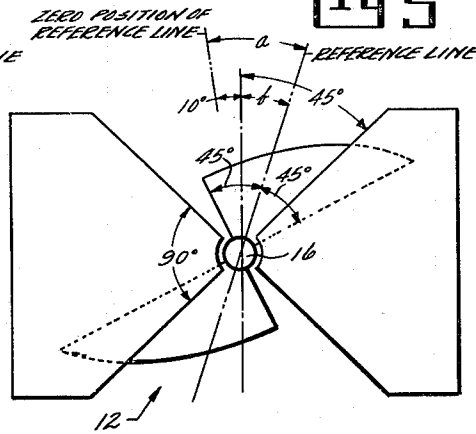


Fig 5



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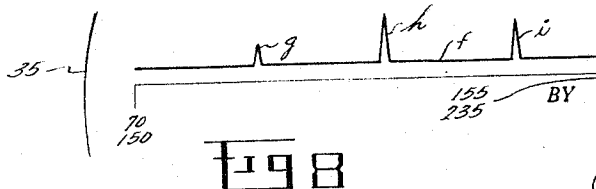
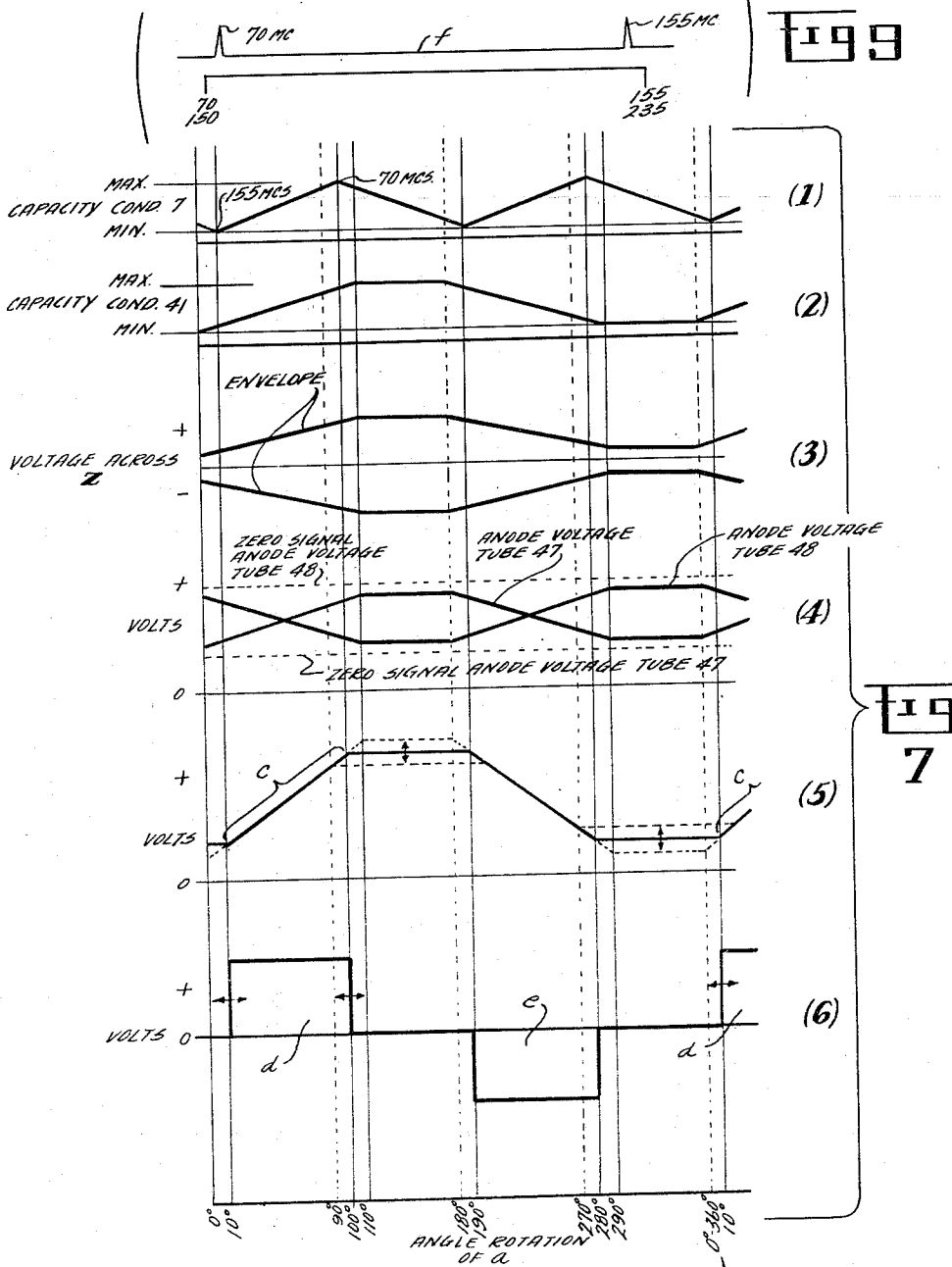
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3 Sheets-Sheet 3



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2,490,045

BLANKING SYSTEM FOR LOCKED SWEEPS
IN PANORAMIC SYSTEMSBenjamin R. Gardner, Dayton, Ohio, Everett T.
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Application June 11, 1948, Serial No. 32,518

4 Claims. (Cl. 250-20)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment to us of any royalty thereon.

This invention relates to cathode-ray tube circuits and particularly to a means for producing correlated sweep and unblanking voltages for a cathode-ray tube.

It is the object of the invention to provide an unblanking pulse for a cathode-ray tube that is coordinated with the sweep voltage and the leading and trailing edges of which may be precisely adjusted with respect to time. This is accomplished in accordance with the invention by applying to the beam deflecting means of the cathode-ray tube a sweep voltage of greater duration than required and also applying this sweep voltage to a branch circuit having adjustable means for limiting the maximum and minimum amplitudes thereof and means for differentiating the resulting limited sweep voltage to produce the unblanking pulse. The times of occurrence of the leading and trailing edges of this pulse may be precisely controlled by adjusting the maximum and minimum amplitudes of the limited sweep voltage.

The circuit is particularly useful in connection with panoramic receivers in which case the cathode-ray tube sweep voltage is locked to the means for sweeping the receiver tuning over a band of frequencies. By adjusting the leading and trailing edges of the unblanking pulse as provided for in the invention the beam of the cathode-ray tube may be unblanked precisely for that period of time during which the receiver tuning is sweeping over the frequency band.

A specific embodiment of the invention is shown in connection with the accompanying drawings in which

Fig. 1 shows a panoramic receiver embodying the invention,

Figs. 2, 3, 4, 5 and 6 show structural features of variable condensers used in Fig. 1,

Fig. 7 is a series of graphs explaining the operation of Fig. 1, and

Figs. 8 and 9 are views of indications produced on the cathode-ray tube screen in Fig. 1.

Referring to Fig. 1, the invention is shown embodied in a panoramic receiver. The particular receiver shown has two radio frequency sections, one tunable over the normal band of receivable frequencies and the other tunable over a band of frequencies having an image relationship to the normal band, so as to double the usable fre-

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quency range of the receiver. The first or normal radio frequency section comprises antenna 1, an untuned radio frequency isolating stage 2, a resonant circuit 3 and a first detector 4. The resonant circuit 3 is composed of inductance 5, adjustable trimmer condenser 6 and a rotatable variable condenser 7 that serves to tune the circuit over the normal frequency band which in this case is 70-155 megacycles. The second or image radio frequency section comprises antenna 8, untuned radio frequency isolating stage 9, resonant circuit 10 and first detector 11. This section is similar to the first section except that the rotating condenser 12 of circuit 10 is designed to tune the circuit over the image band which in this case is 150-235 megacycles. The local oscillator 13 has its frequency controlled by resonant circuit 14 the resonant frequency of which is made to vary by rotating condenser 15 over a frequency band midway between the normal and image frequency bands, or in this case, 110-195 megacycles. The condensers 7, 12 and 15 are caused to rotate together by a common shaft 16 as in the usual superheterodyne receiver. The output of oscillator 13 is applied to the two first detectors 4 and 11 by means of connection 17 where it beats with the frequencies of the normal and image sections to produce the intermediate frequency of 50 megacycles. Provision is made for applying a positive voltage through resistors 18 and 19 to first detectors 4 and 11 respectively. This voltage is applied to the cathodes of the detector tubes and is sufficient in magnitude to bias these tubes beyond the cut-off point and to thereby render them inoperative. A switch 20 is provided for grounding the low potential ends of either or both of resistors 18 and 19 so as to remove the high potential from the cathodes of either or both of detectors 4 and 11 thereby rendering them operative. Thus when switch 20 is in its upper position detector 4 is operative and detector 11 is inoperative so that signals in the normal band of frequencies are received, whereas in the lower position conditions are reversed and frequencies in the image band are received, and in the central position both detectors are operative and signals in both bands may be received.

The output of first detectors 4 and 11 is amplified by intermediate frequency amplifier 21 and applied to the second detector which comprises a resonant circuit tuned to the intermediate frequency and made up of inductance 22 and condenser 23, the diode section of tube

24, load resistor 25 and high frequency by-pass condenser 26. The resulting audio and direct voltages developed across resistor 25 are applied to the grid of the triode section of tube 24 which has an additional high frequency filter 26 in its output circuit. The audio components at the output of filter 26 are applied through condenser 27 and potential divider 28 to the grid of power amplifier 29 and thence through transformer 30 and volume control 31 to phone jack 32. The direct and audio components in the output of filter 26 are applied by means of connection 33 to the vertical deflecting plate 34 of cathode-ray tube 35. The other vertical deflecting plate 36 of this tube is connected to a point of positive potential on the potential divider made up of resistors 37 and 38. Resistor 38 is variable so that the potential of plate 36 may be varied for adjusting the rest position of the beam along the vertical axis.

Referring again to condensers 7, 12 and 15, these condensers are of the type having an isolated rotor, as shown in Fig. 2, and are actually two equally varying condensers connected in series. However the exact design of these three condensers is not a part of the invention and any suitable type performing the same function may be used. Condenser 7 has its plates shaped as shown in Fig. 3 which gives a linear relationship between capacity and angle of rotation. The plates are so designed that 90° of rotation changes the capacity from its minimum to its maximum value and varies the resonant frequency of circuit 3 from its highest value, 155 megacycles, to its lowest value, 70 megacycles. Likewise, for the same 90° of rotation, condenser 15 changes the resonant frequency of circuit 14 from its highest to its lowest value, namely 195 to 110 megacycles, and condenser 12 changes the resonant frequency of circuit 10 from its highest to its lowest value, namely 235 to 150 megacycles. The general configurations of the plates of condensers 15 and 12 are shown in Figs. 4 and 5 respectively and are such that the resonant frequency of circuit 14 is always 50 megacycles above that of circuit 3, and the resonant frequency of circuit 10 is always 50 megacycles above that of circuit 14. The design of condensers to produce tracking between the local oscillator and radio frequency circuits of a superheterodyne receiver is well known in the art and therefore discussion in greater detail than that given above is unnecessary in this disclosure.

When circuits 3 and 10 are tuned over the band of receivable frequencies by condensers 7 and 12 any signals present in these bands will cause positive voltages to be applied to vertical deflecting plate 34 of cathode-ray tube 35 as the circuits are tuned through these frequencies. This voltage is made up of the rectified carrier with the carrier modulation, if any, superimposed therein, and acts to cause a vertical deflection of the electron beam. In order to spread the frequency band along the horizontal axis of the cathode-ray tube screen a sweep voltage synchronized with condensers 7 and 12 is required. The circuit for generating the required sweep voltage has its origin in oscillator 40 which generates an alternating voltage of relatively high frequency, 200 kilocycles per second being the value used in this case. The output of this oscillator is applied to a potential divider made up of rotating condenser 41 connected in series with impedance Z. The condenser 41 is also of the type shown in Fig. 2 and is rotated along with condensers

7, 12 and 15 by shaft 16. This shaft is driven by motor 42 at a constant speed of 1200 revolutions per minute, although the speed is not critical.

The configuration of the plates in condenser 41 is shown in Fig. 6. As will be seen the rotor plates extend for 110° and the stator plates for 180° as compared with 90° for both rotor and stator plates in condensers 7, 15 and 12 shown in Figs. 3, 4 and 5 respectively. Each of the condensers in Figs. 3, 4, 5 and 6 has a reference line drawn through the angular center of the rotor plates. The four condensers are mounted on shaft 16 so that the reference lines in Figs. 3, 4 and 5 occupy the same angular position on the shaft and so that the reference line in Fig. 6 lags the other reference lines by 45° as shown in these figures by the angle θ referred to a vertical axis through the center of the shaft. The zero positions of the reference lines are indicated in each of the figures. These positions are determined by the positions of the reference lines when the leading edges of the rotor plates of condenser 41, shown in Fig. 6, coincide with the vertical axis through the center of the shaft 16. In Figs. 3, 4, 5 and 6 the condensers are shown as having been rotated clockwise from the zero positions through an angle α .

Graphs (1) and (2) of Fig. 7 show the variation of capacity in condensers 7 and 41 for values of angle α from 0 to 360°. It will be noted that the capacity of condenser 41 begins to increase from its minimum value 10° before condenser 7 and reaches its maximum value 10° later than condenser 7, the reason for which will be apparent later. Graph (3) shows the 200 kilocycle voltage developed across impedance Z. This voltage may be made to vary linearly with angle A by properly selecting the value of Z or by so shaping the plates of condenser 41 as to achieve this result. The voltage shown in graph (3) is applied to a full wave rectifier comprising diodes 43 and 44 and associated load resistors 45 and 46 so that a direct voltage varying as the negative envelope of the 200 kilocycle voltage is developed across resistor 45 and a direct voltage varying as the positive envelope is developed across resistor 46. These two voltages are of equal amplitude and opposed phase and are applied to the grids of amplifier tubes 47 and 48. The adjustable contact 49 is provided to adjust the relative amplitude of the voltages on these grids. The anode of tube 47 is connected to horizontal deflecting plate 50 of tube 35 and through load resistor 53 to a source of positive potential. Likewise the anode of tube 48 is connected to horizontal deflection plate 51 and through load resistor 52 to the same source of positive potential. The cathode of tube 48 is connected to a source of positive potential through resistor 54 and to ground through variable resistor 55 whereby an adjustable biasing voltage may be applied to this tube. The manner in which the potentials of the anodes of tubes 47 and 48 and deflection plates 50 and 51 vary with the angle A is shown in Fig. 7 (4). At 0° the potential of the anode to tube 48 (plate 51) is higher than that of the anode of tube 47 (plate 50) so that the electron beam has its maximum deflection to the right toward plate 51. As the angle A becomes larger the potential of anode 48 decreases while that of anode 47 increases until at 110° the potential of the anode of tube 47 exceeds that of the anode of tube 48 by the maximum amount so that the beam has its maximum deflection to the left or

toward plate 50. The beam therefor sweeps from right to left as the angle A changes from 0° to 110°. The behavior of these voltages from 110° to 360° is unimportant at this point since the beam is cut off during this period as will be seen later. The amplitude of the sweep and the horizontal position of its starting point may be adjusted by variable contact 49 and variable resistor 55 respectively.

In order to provide a blanking pulse for the cathode-ray tube the anode voltage of tube 47, which is shown in Fig. 7 (4), is utilized. This voltage is applied to a clipper circuit comprising resistor 56 connected in series with each of the two oppositely poled diode sections of tube 57. The two sections are differently biased as determined by the positions of contacts 58 and 59. The clipper imposes adjustable upper and lower limits on the voltage applied to the grid of tube 60 by preventing the voltage from rising above the voltage of adjustable contact 59 or falling below the voltage of the adjustable contact 58. The voltage appearing across the load resistor 61 of the conventional cathode follower stage comprising tube 60 is shown in graph (5) of Fig. 7, somewhat increased in amplitude to aid in illustration. It will be noted that the values of angle A at which part C of this voltage starts and stops may be very accurately adjusted to occur within limits of 10° on either side of A=10° and A=100° by varying the maximum and minimum values of the voltage through adjustment of contacts 58 and 59.

The voltage developed across resistor 61 and shown in graph (5) is applied to a differentiating circuit consisting of condenser 62 and resistor 63. The resulting voltage across resistor 63 is as shown in graph (6) of Fig. 7. It will be seen that part C of the voltage graph (5) which increases at a constant rate produces a positive pulse d, whereas the unvarying portions produce zero voltage and that part which decreases at a uniform rate produces the negative pulse e. It is the d pulse that is of interest and since the leading and trailing edges of this pulse coincide with the starting and stopping points respectively of portion c of graph (5) it is seen that the angular position of these edges may be adjusted to occur at any point within 10° on either side of A=10° and A=100° by adjustments of contacts 58 and 59 (Fig. 1) to alter the maximum and minimum limits in the voltage across resistor 61 shown in graph (5).

The voltage across resistor 63 shown in graph (6) is amplified by conventional amplifier stages employing tubes 64 and 65 and applied to the beam intensity control electrode 66 of tube 35 through condenser 67. Grid 66 is connected through resistor 68 to an adjustable contact 69 on potentiometer 71 whereby a negative bias is placed on the grid which is somewhat in excess of the cut-off bias of the tube. The diode 70 has its anode connected to the upper end of resistor 68 and its cathode to the adjustable contact 72 on potentiometer 71. The anode of diode 70 is therefore negative with respect to its cathode by the amount of the voltage drop between contacts 69 and 72. By adjustment of contact 72 this voltage drop should be made equal to the rise in voltage of grid 66 required to turn the beam on to the proper intensity. The diode will then prevent an increase in grid potential above this point, thus maintaining uniform beam intensity in the presence of variable or "noisy" unblanking pulses applied through condenser 67.

The operation of the system may be understood by again considering Fig. 7. Assuming switch 20 (Fig. 1) in its uppermost position, as motor 42 rotates shaft 16 the tuning of the receiver is varied from 155 megacycles at angle A=10° to 70 megacycles at angle A=100° as shown in graph (1). However the deflection voltages shown in graph (4) start 10° earlier at A=0 and end 10° later at A=100°. This is due to the fact that the angular size of the rotor plates of condenser 41 exceed those of condenser 7 by 20° and insures the presence of a horizontal sweep at all times during the 90° rotation of condenser 7 between A=10° and A=100°. Therefore as the receiver is tuned over the band starting at the high end, the deflection voltage is present to move the electron beam from right to left across the face of the cathode ray tube. The function of that part of the circuit beginning with tube 57 is to generate an unblanking pulse that may be adjusted in length and position to turn the beam of tube 35 on for precisely that period of time during which the tuning of the receiver is changing from 155 to 70 megacycles. This is the pulse d in graph (6). During the presence of this pulse, which is applied to grid 66 after amplification in tubes 64 and 65, the electron beam is on, while during all other periods of the voltage in graph (6) the beam is cut off or blanked, since at these times the voltage applied to grid 66 by the unblanking circuit is either zero or negative and does not overcome the constant negative bias applied to the grid from potentiometer 71. The screen of the cathode-ray tube 35 may be provided with a horizontal scale calibrated in frequency as shown in Figs. 8 and 9. When properly adjusted the zero vertical position of the beam will appear as a horizontal line f and signals present in the band will be indicated by vertical deflections from the zero line, as at g, h and i, at points opposite their frequencies. If it is desired to listen to one of the stations the motor 42 may be de-energized and the station manually tuned to the desired frequency by dial 39. This dial is mounted on shaft 16 and is graduated to read frequencies in the superimposed bands 70-155 megacycles and 150-235 megacycles (as illustrated in Fig. 1.) A reading of 155 or 235 megacycles on the dial corresponds to A=10° in Fig. 7.

In order to initially adjust the system, standard frequencies of 155 and 70 megacycles are applied to the antenna input. If adjustment is not correct the frequencies may appear, for example, as shown in Fig. 9. With contacts 58 and 59 adjusted to lengthen the unblanking pulse so that the zero position trace f extends considerably beyond the 70 and 155 megacycle deflections, resistor 55 (Fig. 1) is adjusted until the 155 megacycle deflection aligns with the 155 megacycle mark on the scale and contact 49 is adjusted until the 70 megacycle deflection aligns with the 70 megacycle mark on the scale. Since adjustment of contact 49 has a light effect on the adjustment of resistor 55 it will be necessary to co-ordinate these two adjustments. After the above alignment is accomplished that part of trace f to the left of the 70 megacycle deflection is removed by adjusting contact 58 and the excess to the right of the 155 megacycle deflection is removed by adjustment of contact 59. The system is then adjusted for proper operation.

We claim as our invention:

1. An interlocked sweep voltage and unblanking pulse generating circuit for a cathode-ray

tube of the type having beam deflecting means and beam intensity control means, said circuit comprising means for generating a periodically recurring linear sweep voltage, means for applying said sweep voltage to said beam deflecting means, means for adjustably limiting said sweep voltage as to its maximum and minimum amplitudes, a differentiating circuit, means for applying said limited sweep voltage to said differentiating circuit whereby a pulse is produced having an amplitude proportional to the rate of change of said limited sweep voltage and a time duration equal to that of said limited sweep voltage, means for applying a negative bias to said beam intensity control electrode of sufficient magnitude when acting alone to cut off said electron beam, and means for applying said pulse to said beam intensity control electrode in opposition to said bias to turn on said beam in the presence of said pulse.

2. A panoramic receiver comprising a variable condenser of the rotating type for tuning said receiver over a fixed band of frequencies in n degrees of rotation of said condenser, a cathode-ray tube having vertical and horizontal beam deflecting means and a beam intensity control electrode, means for applying the output of said receiver to said vertical beam deflecting means, a source of relatively high alternating voltage of constant frequency, a potential divider connected across the output of said source, said potential divider comprising a second rotating condenser mounted on a common shaft with said first mentioned rotating condenser and having plates slightly exceeding n degrees in angular size and positioned on said shaft so that the voltage output of said potentiometer increases constantly over a period of time centered with respect to and slightly exceeding the time required for the first condenser to tune said receiver over said band, means for rectifying the output of said potential divider to produce a sweep voltage and means for applying said sweep voltage to said horizontal beam deflecting means, means for adjustably limiting the maximum and minimum values of a voltage applied thereto, means for also applying the output of said rectifying means to said limiting means for producing a limited sweep voltage having maximum and minimum values determined by the settings of said limiting means, means for differentiating the output of said limiting means to produce a voltage pulse of the same time duration as said limited sweep voltage, means for biasing said beam intensity control electrode be-

yond the cut-off point, and means for applying said voltage pulse to said beam intensity control electrode in opposition to said bias.

3. Apparatus as claimed in claim 2 in which means are provided for limiting the maximum value of the voltage pulse applied to said beam intensity control electrode.

4. In a panoramic receiver of the type having tuning means for periodically sweeping the receiver tuning over a fixed frequency band and having a cathode-ray tube indicator of the type in which the receiver output deflects the beam vertically and a sweep voltage coordinated with the receiver tuning deflects the beam horizontally, a sweep voltage and unblanking pulse generating circuit, said circuit comprising means interlocked with said receiver tuning means for generating a sweep voltage extending over a time interval centered with respect to and of slightly greater duration than the time interval required to sweep the tuning of said receiver over said band, means for applying said sweep voltage to the horizontal deflecting means of said cathode-ray tube, adjustable maximum and minimum amplitude limiting means, means for also applying said sweep voltage to said limiting means for producing a limited sweep voltage, means for differentiating said limited sweep voltage to produce a voltage pulse having its length and time position relative to said receiver tuning sweep determined by the maximum and minimum settings of said limiting means, means for applying beam blanking voltage to said cathode-ray tube, and means for applying said voltage pulse to said cathode-ray tube in opposition to said blanking voltage for unblanking said beam during the presence of said pulse.

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