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CATHODE RAY TUBE SECTOR SELECTOR

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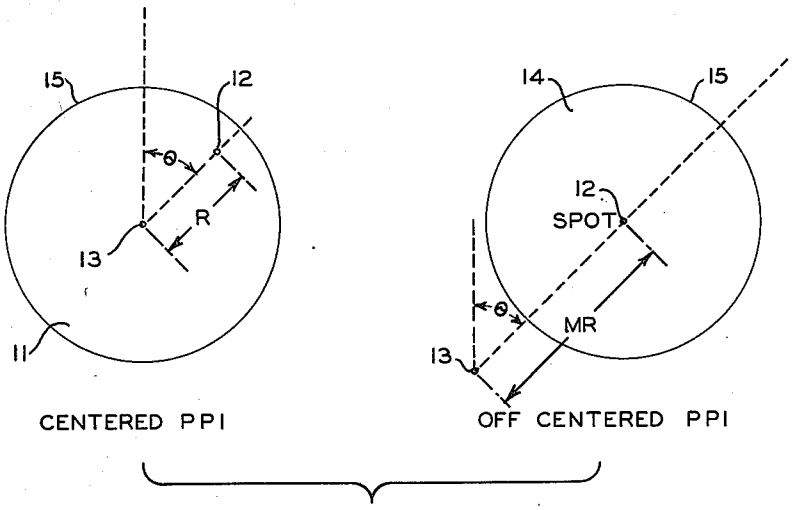


FIG. 1

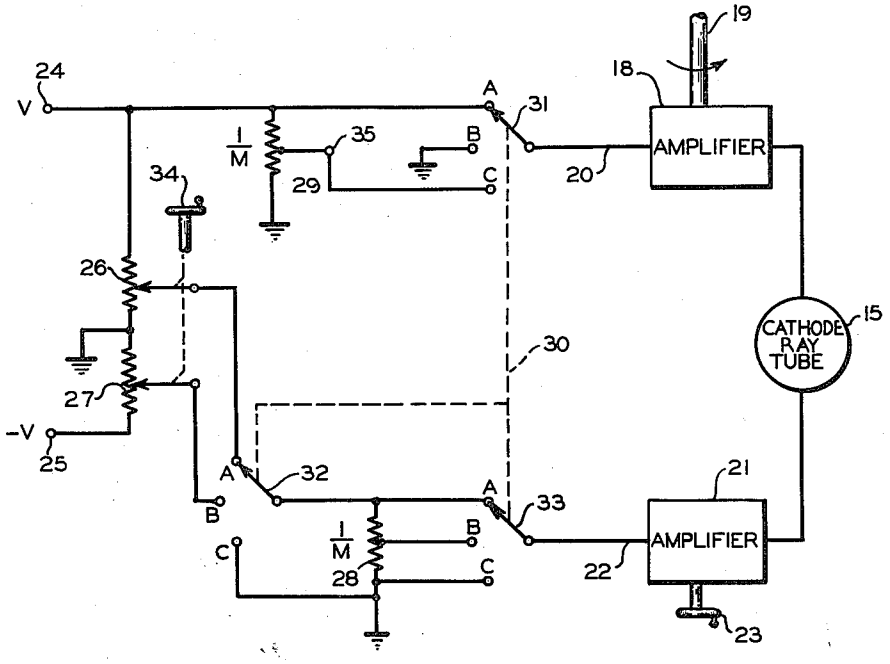


FIG. 2

INVENTOR
RALPH E. MEAGHER
CHALMERS W. SHERWIN

BY M. A. Hayes

ATTORNEY

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CATHODE RAY TUBE SECTOR SELECTOR

Ralph E. Meagher, Champaign, Ill., and Chalmers W. Sherwin, Belmont, Mass., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

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The present invention relates to P. P. I. (plan position indicator) cathode ray tube presentations, and more particularly to the selection of a sector for off-center P. P. I. presentations.

In the past off-center P. P. I. presentations have been limited in their usefulness by a lack of knowledge as to the exact region which was being presented. Since the electrical center of the P. P. I. was off the screen, and since rotational periods were from 10 to 30 seconds, movement to a desired sector was a series of approximations made after each successive sweep of the sector presented. This coupled with the confusion resulting from magnification of the range scale resulted in a generally unsatisfactory system. One attempted solution of these difficulties provided a method which outlined the selected sector on the centered P. P. I. The disadvantage of this method, however, is the amount and complexity of circuit structures which have to be added to existing controls on off-center P. P. I. systems.

Accordingly, it is an object of this invention to provide a simple and reliable method for setting an off-center P. P. I. to a desired sector.

Another object of this invention is to accomplish sector selection with a minimum of additional circuit structure.

These and further objects will be more readily apparent upon consideration of the following description together with the accompanying drawings of which.

Fig. 1 illustrates the two conditions of observation, and

Fig. 2 is a schematic illustration of one embodiment of the present invention.

One method of accompanying the foregoing objects incorporates the use of a substitute synchro for that which usually gives azimuth information. Whenever a target of interest is observed on any sweep speed, a switch is thrown which does the following things: (1) Substitutes a hand-operated synchro for the antenna-operated synchro, (2) removes the video signals, and (3) impresses an adjustable range mark in place of the video signals. Then the hand-operated synchro is rotated until the sweep goes through the target of interest, which is still visible due to screen persistence. The next step is to adjust the range of the pip until it coincides with the target of interest. This operation takes only a few seconds with a fixed coil P. P. I. Now an electronic marker, which for all practical purposes is continuously present, appears at the exact range and bearing of the target in question. It is now possible to expand or shift the P. P. I. pattern in any way one desires, using the continuous sweep with the range pip on it to identify the location of the designated target. Then, when one switches back to the antenna synchro and returns the video signals to the indicator circuit, the selected target appears exactly at the point last occupied by the marker pip.

An alternative and better method which uses only potentiometers and a switch in its circuit structure is that disclosed in Figs. 1 and 2. The principle employed in effecting exact location of the expanded sector is to position a spot as seen on the centered P. P. I. to the desired center of the sector to be expanded which will still be

visible due to screen persistence. The positioning of this spot is effected by the controls normally used to off-center the expanded sector. In Fig. 1 centered P. P. I. 11 defines spot 12 in terms of polar coordinates R and θ in relation to electrical center 13 which is located at the geometric center of tube 15 in this case. Off-center P. P. I. 14 presents an expanded sector upon which spot 12 appears at the geometric center of tube 15 and is related to P. P. I. electrical center 13, now off the surface of tube 15, by polar coordinates θ and MR. These new coordinates differ from the previous set only by the magnification factor M which has been introduced in the range sweep circuit.

In Fig. 2 the deflecting circuits for tube 15 are shown together with auxiliary switching means which make possible the procedure of the present embodiment. Off-center P. P. I.'s conventionally have four basic inputs which are used in this invention: a voltage input varied by a radial sweep speed control, a shaft input dependent upon the azimuth of the antenna, and two other voltage inputs which are controlled by off-centering controls R and θ, which could, of course, be Cartesian coordinates X and Y if desired. Amplifier 18, whose output provides a radial sweep for tube 15, responds to azimuth shaft 19 and voltage input 20 which controls the sweep speed. Amplifier 21, whose output is also connected to tube 15, effectively determines the off-center location of electrical center 13 of off-center P. P. I. 14 by its response to off-center distance voltage input 22 and off-center direction input 23. The auxiliary switching means include a positive source of voltage V connected between terminal 24 and ground, a negative source of voltage connected between terminal 25 and ground, which is always equal in magnitude to the positive source V, suitable off-centering potentiometers 26 and 27 which are connected between ground and terminals 24 and 25 respectively, attenuators 28 and 29, and triple-pole triple-throw switch 30 with three sections 31, 32, and 33, in each of which contact A is off-center P. P. I., contact B is Spot, and contact C is Centered P. P. I., attenuators 28 and 29 and switch 30 being connected as follows: the selector of section 31 to input 20 of amplifier 18, the selector of section 32 to contact A of section 33 and also to the top of atenuator 28, the selector of section 33 to input 22 of amplifier 21, contact A of section 31 to the top of attenuator 29 and to the positive source of voltage connected at terminal 24, contact B of section 31 to ground, contact C of section 31 to the tap on attenuator 29, contact A of section 32 to the sliding contact of potentiometer 26, contact B of section 32 to the sliding contact of potentiometer 27, contacts C of sections 32 and 33 to ground, contact B of section 33 to the tap on attenuator 28, and the bottoms of attenuators 28 and 29 to ground.

To view the centered P. P. I., switch 30 is thrown to Centered P. P. I., position C; off-centering distance voltage input 22 is reduced to zero by the ground now connected through contact C, section 33; and the sweep speed is reduced to 1/M times its final value by virtue of the connection to tap 35 of attenuator 29 through contact C, section 31. To produce the spot, switch 30 is thrown to Spot, position B; sweep speed is reduced to zero by virtue of the ground connection through contact B, section 31, and video signals are removed by means not shown. The resultant spot can be moved at will by off-centering control R and θ, here identified as 34 and 23 respectively. θ is a direct input and will now have a meaning since R, the radial deflection voltage, is no longer zero. The radial deflection voltage is varied by potentiometer 27 and is attenuated to a value

$$V \times \frac{1}{M}$$

by attenuator 28 to keep spot movement in the same distance units of the centered P. P. I. The spot is moved to the point, still visible due to screen persistence, in the region of which magnification is desired. To view the off-centered P. P. I., switch 30 is thrown to position A. Input 20 to radial sweep amplifier is now connected to the full voltage V and a consequent magnification of the sweep on tube 15 results. In addition, the off-center distance voltage, R, is reversed in sign by reason of switch section 32 which has changed input 22 from potentiometer 27 to potentiometer 26. This, coupled with the magnification of this off-center distance voltage resulting from the application of the full voltage across attenuator 28, causes the appearance of spot 12, the spot selected as the center of the region to be examined, in the geometric center of the screen tube 15. The total length of radial sweep may be controlled by variation in the voltage V which will allow the relative magnification between centered and off-centered P. P. I.'s to remain unaltered. The above-disclosed embodiment has thus presented a simple, reliable means for accurately selecting the sector of a P. P. I. which one desires to examine.

The foregoing description has presented an explanation of this invention in the particular application of sector selection for off-centered P. P. I. presentations, but the principles of the invention are broader in ways which will be apparent to those skilled in the art. It will be understood that the above-disclosed embodiment is primarily illustrative and that the invention includes such other embodiments as fairly come within the spirit and scope of the appended claims.

What is claimed is:

1. An electrical circuit comprising, a cathode ray tube; a radial sweep amplifier for said cathode ray tube having a first and second input wherein the sweep speed is controlled by the amplitude of an applied voltage, said first input being adapted to receive azimuth information; an off-center amplifier for said cathode ray tube having a first and second input, said first input being adapted to receive off-center direction information; a source of balanced voltage having first and second terminals; a first potentiometer connected between said first terminal and ground; a second potentiometer connected between said second terminal and ground; two tapped attenuators; a triple-pole triple-throw switch of positions A, B, and C where A is Off-center P. P. I., B is Spot and C is Centered P. P. I.; said elements being connected as follows; said second input of said radial sweep amplifier to the selector of the first section of said switch, contact A of said first section to the top of the first of said attenuators and to said first terminal of said source of balanced voltage, contact C of said first section to the tap of said first attenuator, said second input of said off-center amplifier to the selector of the second section of said switch, contact A of said second section to the top of the second of said attenuators and to the selector of the third section of said switch, contact B of said second section to the tap of said second attenuator, contact B of said first section, contacts C of said second and third sections, and the bottom of each of said attenuators being connected together and to ground, contact A of said third section to the sliding contact of said potentiometer connected to said first terminal of said source of balanced voltage, and contact B of said third section to the sliding contact of said potentiometer connected to said second terminal of said source of balanced voltage, wherein said circuit enables switching to either of two cathode ray tube presentations, the second one of which will be magnified relative to the first by the ratio of said attenuators and displaced relative to the first to bring to the center of the second of said cathode ray tube presentations, the spot selected from said first presentation by adjustment of said first input to said off-center amplifier and said first and second potentiometers.

2. An electrical circuit comprising, a cathode ray tube; a radial sweep amplifier for said cathode ray tube having a first and second input wherein the sweep speed is controlled by the amplitude of an applied voltage, said first input being adapted to receive azimuth information; an off-center amplifier for said cathode ray tube having a first and second input, said first input being adapted to receive off-center direction information; a source of balanced voltage having positive and negative terminals; a first potentiometer conected between said positive terminal and ground; a second potentiometer connected between said negative terminal and ground; two tapper attenuators; a triple-pole triple-throw switch of positions A, B, and C where A is Off-Center P. P. I., B is Spot, and C is Centered P. P. I.; said elements being connected as follows: said second input of said radial sweep amplifier to the selector of the first section of said switch, contact A of said first section to the top of the first of said attenuators and to said positive terminal of said source of balanced voltage, contact C of said first section to the tap of said first attenuator, said second input of said off-center amplifier to the selector of the second section of said switch, contact A of said second section to the top of the second of said attenuators and to the selector of the third section of said switch, contact B of said second section to the tap of said second attenuator, contact B of said first section, contacts C of said second and third sections, and the bottom of each of said attenuators being connected together and to ground, contact A of said third section to the sliding contact of said potentiometer connected to said positive terminal of said source of balanced voltage, and contact B of said third section to the sliding contact of said potentiometer connected to said negaive terminal of said source of balanced voltage, wherein said circuit enables switching to either of two cathods ray tube presentations, the second one of which will be magnified relative to the first by the ratio of said attenuators and displaced relative to the first to bring to the center of the second of said cathode ray tube presentation the spot selected from said first presentation by adjustment of said first input to said off-center amplifier and said first and second potentiometers.

3. In a deflection system for a cathode ray indicator wherein the cathode ray beam is deflected radially and angularly from an origin at center of the indicator screen to present signals in a polar coordinate display, apparatus for displacing the origin of the beam deflection to display an expanded portion centered about a selected point comprising, a source of potentials, means for applying signals and voltages derived from said source to said indicator to sweep said beam radially at a first speed and deflect said beam angularly to present a centered polar display of said signals, a first switch adapted to remove said signals from said indicator and reducing the radial sweep speed to zero to provide a stationary beam spot at the center of said indicator screen, means for adjusting auxiliary deflection voltages derived from said potential source to displace said beam spot by the radial distance and angle to said selected point on said unexpanded display, means for increasing the speed of said radial sweep to provide a second sweep speed, and a second switch adapted to apply said signals and said adjusted deflection voltages in reversed polarity to said indicator to displace the origin of said expanded radial sweep by an amount and in a direction to shift said selected point to the center of said screen.

4. In a deflection system for a cathode ray indicator wherein the cathode ray beam is deflected radially and angularly from an origin at the center of the indicator screen to present signals in a polar coordinate display, the method of obtaining an expanded display of a portion centered about a selected point, comprising the steps of, first removing signals from the indicator and reducing the radial sweep to zero to produce a stationary beam spot at the center of the indicator screen, secondly adjusting auxiliary deflection voltages to displace said beam spot in distance and direction in accordance with

the position of said selected point, thirdly increasing the radial sweep speed to a maximum value to provide an expanded scale, and finally restoring signals to said indicator while applying said auxiliary deflection voltages with reverse polarity to displace the origin of said expanded radial sweep to bring said selected point to the center of said indicator screen.

5. In a radio pulse echo object detection system having a cathode ray indicator wherein the radial distance of the echo signal from the center of the indicator screen indicates range and the polar angle of the radial line on which the echo signal appears indicates direction of the reflecting object, apparatus for changing the origin of the cathode ray beam deflection to obtain an expanded display of a sector centered about the signal from a selected object comprising, a source of potentials, means applying attenuated voltages from said source to said indicator to deflect said ray radially and angularly from the center of said screen, means to derive auxiliary deflection voltages from said source adjusted to displace said beam spot to the unexpanded position of said selected echo signal, means to increase the speed of radial deflection of said ray to secure an expanded range scale, and switching means for removing said attenuated voltages from said indicator and for applying said adjusted voltages as auxiliary deflection potentials with reversed polarity to said cathode ray indicator to deflect said ray at increased speed from an origin displaced from the center of said screen, whereby said selected object echo signal appears at the center of said indicator screen.

6. In a radio pulse echo object detection system having a cathode ray beam indicator wherein the radial distance of the echo signal from the center of the indicator screen indicates range and the polar angle of the radial line on which the echo signal appears indicates direction respectively of the reflecting object, the method of obtaining an expanded display of a sector centered about a selected object echo signal comprising the steps of, first applying deflection voltages and echo signals to deflect and intensify the beam of said indicator from the center of said screen to display the range and bearing of reflecting objects in polar coordinate form; secondly, removing echo signals and reducing the radial sweep speed to zero to display a stationary beam spot at the center of the indicator screen; thirdly, adjusting auxiliary deflection voltages to displace said beam spot angularly and radially to the unexpanded range and bearing of the selected object echo signal; and finally, applying said deflection voltages at maximum radial sweep speed with said auxiliary deflection voltages and said echo signals to said indicator, whereby said beam is deflected at increased speed from an origin displaced from the center of the indicator screen an amount and direction to display the selected echo signal at the center of said indicator screen on an expanded scale.

7. In a radio pulse echo object detection system having a cathode ray indicator wherein the ray is deflected radially from an origin at the center of the indicator screen at a speed determined by range and in a radial direction in accordance with the position of a directional scanning antenna and wherein the ray is intensified in response to echo signals to present a polar display of the range and bearing of reflecting objects, apparatus for obtaining an expanded display of a sector centered about a selected echo signal comprising, a source of potentials, a first attenuator for supplying a voltage in fixed predetermined ratio to the amplitude of potential applied from said source, means for generating a radial sweep voltage having a speed adjustable in accordance with the amplitude of an applied voltage, means for applying said sweep voltage to said indicator to deflect said ray in a radial direction in accordance with the directivity of said scanning antenna, a second attenuator for supplying a second voltage in said predetermined ratio to its applied voltage, a potentiometer for adjusting the amplitude of the potential applied to said second attenuator from said source, means for applying deflection voltages to said indicator to control the location of the origin of the radial sweep of said ray, and a three position switch mechanism disposed between said indicator and said potential source, said switch being operable in the first of said three positions to apply voltage from said first attenuator to said radial sweep generator to provide a first sweep speed and to apply echo signals and zero deflection voltages to said indicator, said switch being operable in the second of said three positions to disconnect said echo signals and to apply zero voltage to said sweep generator thereby reducing said sweep speed to zero to produce a stationary spot at said sweep origin and to apply deflection voltages to said indicator from said second attenuator to displace said spot angularly and radially to the unexpanded range and bearing of said selected echo signal, and said switch being operable in the third of said three positions to disconnect said first and second attenuators to provide an expanded range scale by applying maximum potential from said source of said sweep generator and to apply said deflection voltages and said echo signals whereby said indicator beam is deflected at increased speed from an origin displaced from the center of said indicator screen by an amount and in a direction to display the signal of the selected object at the center of said indicator screen.

8. In a cathode ray deflection system wherein the radial distance of the indicated signals from the center of the indicator screen and the angle of the radial line on which the signals appear produce a display in polar coordinates, apparatus for changing the origin of the cathode ray beam deflection to obtain an expanded display of a sector centered about a selected signal position comprising, switching means to cause said beam to produce a stationary spot at the center of said indicator screen, a source of potentials, means to adjust auxiliary deflection potentials from said source to deflect said spot to the unexpanded position of said selected signal, means to increase the speed of radial deflection of said beam to secure an expanded range scale, and switching means for restoring the display of said signals and for applying said adjusted voltages with reversed polarity as auxiliary deflection potentials to deflect said cathode ray beam at increased speed from an origin displaced from the center of said screen to display said selected signal position at the center of said indicator screen.

9. In a deflection system for a cathode ray indicator wherein the cathode ray beam is deflected radially and angularly from an origin at the center of the indicator screen to present signals in a polar coordinate display, apparatus for displacing the origin of the beam deflection to display an expanded portion centered about a selected point comprising, a source of potentials, a first switch operable for removing said signals from the indicator and reducing the radial deflection voltage to zero to provide a stationary beam spot at the center of the indicator screen, means for adjusting auxiliary deflection voltages derived from said source to deflect said beam spot by the radial distance and angle to said selected point on said unexpanded display, means for increasing the speed of said radial sweep to provide an expanded scale, and a second switch operable for restoring said signals and applying said auxiliary deflection voltages in reverse polarity to said indicator to displace the origin of said expanded radial sweep by an amount and in a direction to shift said selected point to the center of said indicator screen.

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