Aug. 16, 1955 R. F. RYCHLIK 2,715,726

DUAL INDICATOR CATHODE RAY TUBE

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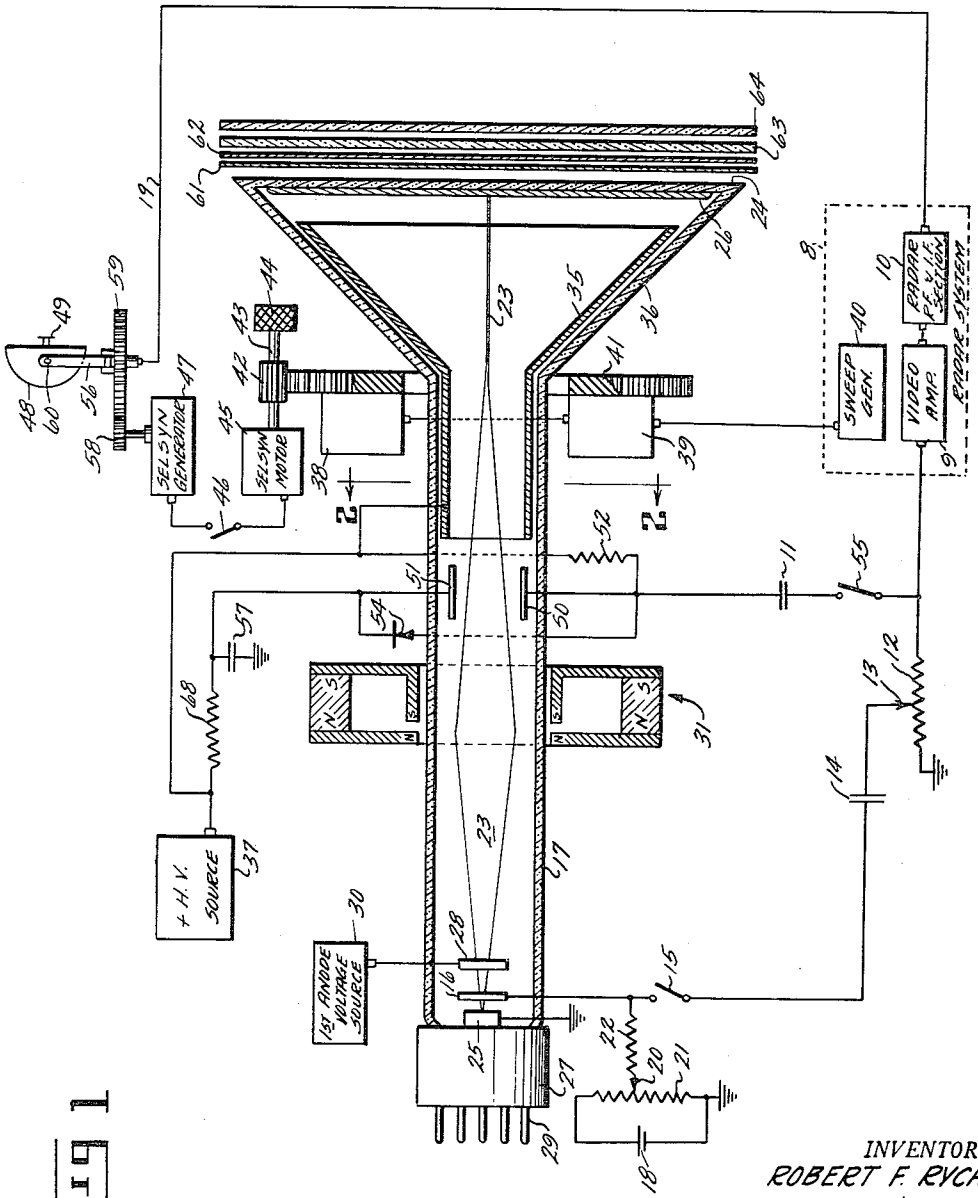


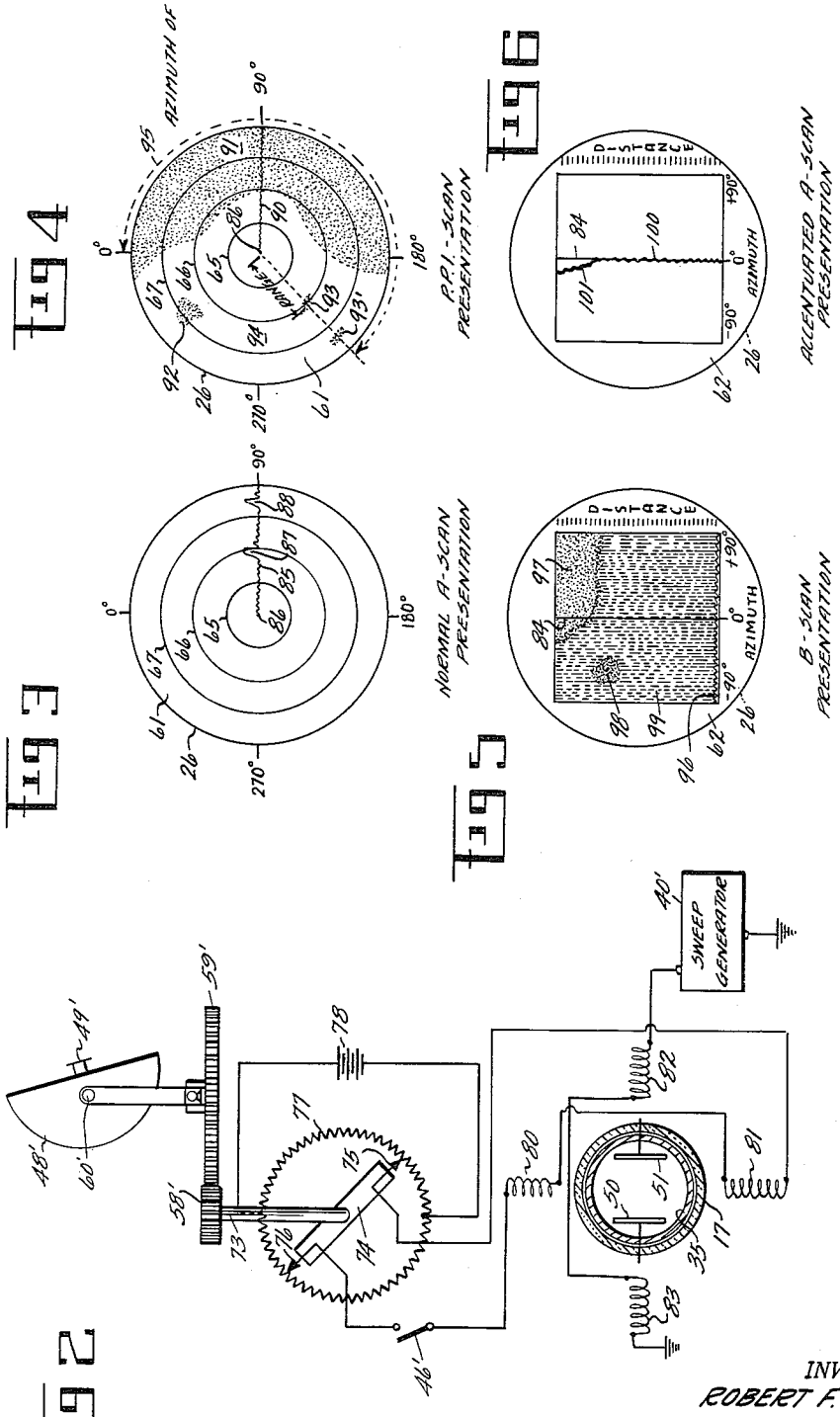
Fig 1

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DUAL INDICATOR CATHODE RAY TUBE

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United States Patent Office 2,715,726 Patented Aug. 16, 1955

2,715,726

DUAL INDICATOR CATHODE RAY TUBE

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Application December 27, 1946, Serial No. 718,723

7 Claims. (Cl. 343—11)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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

This invention relates to signal presentation devices for use in electronics and more particularly to an improved multiple indicator cathode ray tube and to improved circuit arrangements with the tube that are adapted for providing improved multiple indications of radar targets and the like, so that from the single tube mounted in two closely related circuits, A-scan and P. P. I.-scan presentations can be obtained from one circuit and A-scan and B-scan presentations can be obtained from the other circuit.

For purposes of definition herein, radar presentations appear as rapidly transient light traces upon the unlighted screen of a cathode-ray tube in different types of scan. An A scan presentation appears as a linear trace along the screen base line on which impressed signal amplitudes appear as deflections from and at right angles to the base line and wherein the cathode-ray beam within the cathode-ray tube returns to the base line upon cessation of signal. An accentuated A scan presentation is an A scan presentation wherein, with increase in signal amplitude, the light intensity on the screen increases in proportion to the amount of departure of the cathode-ray beam from the screen base line caused by the signal and hence a strong signal causes not only a departure from the base line but also the presentation will be brighter at the deflection peaks. In a B scan presentation the base line is moved back and forth across the screen with vertical sweeps rising therefrom and the presence of signals is indicated by variations in the degree of brightness of the trace. A plan position indicator of P. P. I. scan is a mode of presentation wherein the sweep moves from the center of the screen radially outwardly and the sweep line is rotated radially about the center point of the screen and the presence of signals is indicated by varying intensities in the brightness of the radially sweeping trace.

In the past the majority of cathode ray tubes have been divided into two classes: electromagnetic tubes using magnetic fields for both focusing and deflection; and electrostatic tubes using electric fields for both focusing and deflection. Both classes of tubes have comprised evacuated envelopes and had disposed therewithin an electron gun for producing a narrow beam of rapidly moving electrons, commonly termed an electron beam or cathode ray, that is adapted for moving from the electron gun axially of the stem portion of the tube until it strikes a tube screen where it appears as a bright spot.

In the electromagnetic type of tube, the electron gun comprises a cathode and heater, a control grid, a first anode or screen grid, and an accelerating or second anode which is commonly an aquadag coating upon the inside of the glass envelope. The electron gun of the electrostatic type of tube consists of a cathode and heater, a control grid, a first or focusing anode and a second or accelerating anode. Control over the focusing and accelerating of the cathode ray is exercised for the purpose of causing

it to be concentrated into a narrow beam and so that both its size and velocity at the time it strikes the luminous screen remote from the electron gun and within the evacuated envelope is such as to cause it to produce a small luminous spot thereupon of controlled intensity.

The cathode ray tubes are also provided with means for causing the deflection both horizontally and vertically of the cathode ray so that it sweeps the tube screen in predetermined orderly fashion. The beam deflecting means commonly consists of separately energized pairs of horizontal and vertical deflecting coils or plates with an electromagnetic field maintained between the members of each pair of coils or plates. The magnitude and direction of the electromagnetic field so maintained determine the disposition at any instant of the electron beam upon the tube screen. In some forms of data presentation a long persistence screen is preferred and for other forms of presentation, a short persistence screen is preferred. Long persistence tube screen coatings require high current densities, whereas low current densities are sufficient for short persistence tube screen coatings.

One type of indication that is commonly produced upon the tube screen of an electrostatic tube is a type A-scan presentation, wherein the cathode ray is caused to describe a linear sweep defining a time base upon the tube screen under the influence of a pair of horizontal ray deflecting plates or coils. The time base appears as a substantially horizontal disposed line across part or all of the tube screen and may be disposed at any desired level and commonly extends across the center of the tube. In this type A-scan presentation the video output signal voltage of the receiver part of the radar set has its output connected to the cathode ray tube, where it is applied to the pair of vertical deflecting plates or coils to cause a vertical deflection of the horizontally extending time base upon the tube screen with the return of each echo signal. In a type A-scan presentation, the sweep is timed in a linear fashion so that a direct range reading may be taken from a scale associated with the tube screen.

Radar energy beamed from an antenna is highly directive and an echo pulse that is received back from the target is of maximum strength when the antenna is pointly directly toward the target. By this invention, searching is done with a P. P. I.-scan presentation and a located target is analyzed with an A-scan presentation. The radar antenna may be caused to rotate and to nod until a position is located where an echo pulse produces the maximum deflection of the trace upon the screen of the cathode ray tube that is connected with the radar. The position of the sweep line including the target with respect to peripheral calibrations upon the screen during the P. P. I.-presentation indicates the position in azimuth of the target. The range or distance of the target from the radar position upon the A scale is taken with respect to the zero position upon the time scale. For a normal A-scan presentation, returned echo pulses are not impressed upon the intensity grid of the cathode ray tube. For an accentuated A-scan presentation, returned echo pulses are impressed upon the tube intensity grid. An indication of the elevation of the target is obtained from the nod or tilt position of the antenna dish as indicated upon the scale part of a control box, which is also connected with the antenna. Tactically, the usual procedure would be to operate the present system as a P. P. I.-scan to search for targets, then to switch to an A-scan for better resolution in the presence of jamming or other radar deception methods.

For a type B-scan presentation, an electromagnetic type of cathode ray tube is commonly used. The B-scan presentation is in rectangular coordinates covering 180° in azimuth with the azimuth or bearing of a target presented as the abscissa and the elevation or range of the

target presented as the ordinate. The antenna system or spinner assembly is rotated about a vertical axis and hence radiated signal lobe patterns are rotated to cover a horizontal plane. The angular motion of the antenna system is synchronized with and is transformed within the cathode ray tube into a linear motion of the cathode ray. In the absence of other deflection, the presentation appears as a horizontal line across the lower portion of the tube screen. A uniform vertical motion from the bottom to the top of the tube screen and of considerably greater rapidity is also imparted to the cathode ray. Each vertical line on the tube screen is synchronized with the pulse transmitted from the radar set as presented in the horizontal base line. The returned echo pulses are impressed upon the intensity grid of the cathode ray tube to thereby increase the intensity of the presentation of a target. The position of the target vertically of the tube screen indicates the elevation of the target with respect to the radar position and its position in azimuth is read from an azimuth scale extending along the bottom of the tube screen.

In the electromagnetic type of tube from which B-scan presentations are obtained, a sweep current is caused to flow through a pair of vertical deflecting coils and a positioning current that is controlled by the position of the antenna in azimuth is caused to flow through a pair of horizontal deflecting coils. By these deflection coils, the position of the vertical sweep of the cathode ray is aligned with the position in azimuth of the antenna. One form of antenna is designed to scan a region up to 90° on either side of its normal forward position or dead ahead in the type B-scan presentation. The position dead ahead is indicated by a hair line extending vertically midway between the lateral extremities of the tube screen. In the type B presentation, echo signals returning from the target normally appear above the time base line and to the right or to the left of the vertical hair line. From the position of the echo signals returned from a target, both the azimuth and the range positions of the target with respect to the radar position are obtained.

In the obtaining of a P. P. I.-scan or a plan position indicator presentation, an electromagnetic type of tube is used. In the obtaining of this type of presentation, the radar antenna is caused to rotate about a vertical axis through the full 360° of azimuth. The signal lobes beamed from the antenna are narrow in azimuth to provide sharp readings and are broad in elevation so that all angles in the horizontal plane are searched with each rotation of the antenna. The presentation is in polar coordinates and has the general apearance of a map of the area swept by the radar antenna. The form of presentation provides information in terms of the range and bearing of targets but does not provide information concerning their elevation.

In the P. P. I.-scan presentation, the radar antenna position occupies the center of the screen. Each signal pulse that is beamed from the antenna would appear in the presentation at the center of the tube screen if it were not blanked out to avoid burning a hole in the screen and the sweep trace starts at the center of the screen and travels radially outwardly to the peripheral edge thereof. Consecutive sweep traces move circumferentially of the tube screen in conformity with the rotation of the radar antenna.

The cathode ray tube used in P. P. I. presentations is intensity modulated so that the presentations of its sweep traces are just at the threshold of visibility until amplified by the arrival of echo pulses that increase their intensity into the range of visibility. The top of the cathode ray screen represents a directly forward position or dead ahead. When the antenna is pointing dead ahead, the sweep of the electron beam moves from the center of the screen to the top thereof. The sweep of the electron beam is synchronized in both direction and in degree with the motion of the antenna and hence as the antenna moves from directly ahead toward the right, the presentation upon the tube screen moves from directly ahead toward the right in conformity with the motion of the antenna. A polar map is developed thereby upon the tube screen with range plotted radially against positions in azimuth plotted along the periphery of the screen.

In the application of the present invention, A-scan and P. P. I.-scan presentations are available from the tube and circuit that are shown in Fig. 1 and A-scan and B-scan presentations are available from the same tube rotated 90° in the modified circuit shown in Fig. 2. The disclosed device with minor adjustments makes it possible to obtain accurate analysis of radar echoes in situations wherein a usual form of radar set providing a single presentation would be entirely inadequate. The multiple presentation provided by the present invention is particularly of advantage where there is inadequate differentiation between a target and its environs. Illustrative situations in which the multiple presentations provided by the present device are useful are in the presence of enemy jamming, or where dense clouds or chaff obscure targets, or where a radar set is being used over open water that is so turbulent that waves reflect the radar pulses and the echo pulses that are returned from the waves are of sufficient strength so that it is difficult for the operator of the radar set to distinguish a target from the waves around it. The multiple presentation that is provided by the present invention has important use in the military field where it is capable of operating successfully in the presence of enemy jamming that would render useless a usual radar set provided with a single type of presentation, particularly since it renders effective such anti-jamming measures as beat note reception through enemy electronic jamming. There has been no single cathode ray tube for use in radar available heretofore capable of presenting the multiple forms of scan presentation that are provided by the present invention with a simple modification of the equipment. The present invention provides improved performance from a single radar set with a minimum weight and occupied space that would require a greater plurality of radar oscilloscopes as previously available which is particularly of importance in the use of radar in airborne equipment.

An object of the present invention is to provide a single cathode ray tube that is adapted for being interchangeably inserted in either of two circuits for providing multiple presentations therefrom with a minimum of adjustment and equipment.

Another object is to provide an improved cathode ray tube in circuit arrangements with which it is possible to obtain easier and more dependable readings through jamming and clutter than is possible with any previously known radar equipment.

Another object is to provide an improved cathode ray tube that is adapted for being removably inserted in either of two improved circuits from which single tube either electromagnetic or electrostatic performance may be obtained.

A further object is to provide a cathode ray tube and associated circuits that are adapted for providing a wider and more dependable range of performance through the impressing of a greater range of beam current density through the tube than has been practical in previously known tubes of the electrostatic deflection type.

A further object is to provide improved radar equipment of minimum weight and occupied space for use in airborne equipment.

Another object is to provide a multiple presentation cathode ray tube and associated circuits for improved target study and analysis.

Additional objects will be apparent to those who are informed in the electronics field from the following description of illustrative embodiments of the present in-

vention that are shown in the accompanying drawings wherein:

Fig. 1 is a fragmentary wiring diagram and an axially sectioned cathode ray tube shown in side elevation that together provide horizontally extending sweep traces and normal and accentuated A-scans, together with P. P. I.-scan presentations upon the tube screen and that incorporate parts of the novel features of the present invention;

Fig. 2 is a fragmentary transverse sectional view of the tube taken substantially along the line 2—2 of Fig. 1 with the background and some connections deleted for simplicity of presentation and with the tube rotated 90° from the position in which it is shown in Fig. 1, together with a modification in the cathode ray deflecting means part of the circuit there shown for the display of vertically extending sweep traces in normal and accentuated A-scan presentations and for the provision of B-scan presentations upon the tube screen;

Fig. 3 is an elevational view of the screen of the cathode ray tube shown in Fig. 1 with a concentric circle distance indicating screen removably interposed between the tube screen and an observer and showing an illustrative horizontally extending A-scan presentation;

Fig. 4 is an elevational view of the screen of the cathode ray tube shown in Fig. 1 with a concentric circle distance indicating screen removably disposed therebefore and with a P. P. I.-scan presentation appearing thereupon;

Fig. 5 is an elevational view of the screen of the cathode ray tube in the modified circuit shown in Fig. 2, with a B-scan presentation appearing inwardly of the frame of a masking screen that carries azimuth and distance scales along two of its intersecting edges with the masking screen removably interposed between the tube screen and an observer; and

Fig. 6 is an elevational view of the screen of the cathode ray tube in the circuit shown in Fig. 2, bearing an A-scan presentation comprising a vertically extending sweep trace appearing inwardly of the frame of a masking screen that bears azimuth and distance indicating scales along a pair of its intersecting edges with the masking screen removably disposed in front of the tube screen.

In Fig. 1 of the accompanying drawings is shown a cathode ray tube in a circuit in which the tube is adapted for providing normal A-scan, accentuated A-scan and P. P. I.-scan presentations as parts of the present invention and as accessory to a usual radar system **8**. The radar system **8**, from which components not essential to the description of the present invention have been deleted for reasons of simplicity, emits transmitted pulses from its antenna **49** and receives back echo pulses from metallic targets in the path of its emitted pulses. The radar system **8** contains radio frequency and intermediate frequency or R. F. and I. F. sections **10** to which returned echo pulses intercepted by an antenna dish **48** are applied. The returned echo pulses are passed from the R. F. and I. F. sections **10** to a video amplifier **9** where they are amplified and fed into a presentation circuit that forms a part of the present invention.

The video amplifier **9** amplifies received echo pulses and applies them to a potentiometer resistor **12** connected at one end to ground and at its opposite end to the movable arm of a switch **55**. A presentation accentuating or contrast controlling potentiometer tap **13** is applied adjustably along the potentiometer resistor **12**. The potentiometer tap **13** is connected through a capacitor **14** to the movable arm of a switch **15**. The switch **15**, when closed, applies the returned echo signals from the video amplifier **9** directly to an intensity grid **16** part of an electron gun that is mounted within a neck or stem portion **17** of an evacuated envelope part of the cathode ray tube that is shown in Fig. 1 for causing the accentuation of the returned echo pulses in their presentation upon the tube screen.

In general, for all types of presentations that are contemplated hereby, when the accentuation switch **15** is open, normal presentations appear upon the tube screen and when the switch **15** is closed, amplified echo pulses are applied to the intensity grid **16** that results in the presentation of accentuated signals. In other words, the switch **15** serves to connect the intensity grid **16** to a portion of the output from the video amplifier **9**, thereby accentuating the tops of echo pulses above ambient noise.

The setting of the signal accentuating potentiometer tap **13** upon the potentiometer resistor **12** varies the amount of video voltage that is applied to the intensity grid **16** of the cathode ray tube. A bias battery **18** applies direct current through a fixed resistor **22** at all times to the tube intensity grid **16**. The amount of direct current voltage that is applied to the intensity grid **16** from the bias battery **18** may be further diminished by the increased setting of an intensity controlling potentiometer tap **20** along the potentiometer resistor **21** across which the potential of the battery **18** is applied. The potentiometer resistor **21** is grounded at its junction with the negative terminal of the battery **18**. The adjustment of the intensity controlling tap **20** upon the potentiometer resistor **21** preferably is such as to apply just sufficient potential to the tube intensity grid **16** so that the presentation upon the coating or screen **26** of the cathode ray tube is but slightly in excess of the threshold of visibility under no signal conditions. The settings of the contrast controlling potentiometer tap **13** and of the intensity controlling potentiometer tap **20** should be such as to provide presentations of optimum signal visibility upon the tube screen **26**.

The presentation upon the tube coating or screen **26** is accomplished by causing it to be swept by a cathode ray **23** that is emitted by a cathode **25** of the tube and that passes through the intensity grid **16** thereof. For all signal presentations that are contemplated hereby, the intensity grid **16** operates to increase the intensity of the presentation upon the tube screen **26** with increase in the potential that is applied thereto. The tube screen **26** is disposed upon the inner surface of a flat or curved end **24** of the tube envelope and remote from a tube base **27** that carries a desired plurality of pin contacts **29** in usual manner. A cathode ray or electron beam **23** is concentrated sufficiently by its passage through the intensity grid **16** so that it is sufficiently narrow to also pass through an aperture in a first anode **28** that is disposed forwardly of the intensity grid **16** in the cathode end or stem **17** of the tube.

The tube first anode **28** is maintained at a positive potential from a suitable first anode voltage source **30** so that it accelerates to a degree directly proportional to the magnitude of the potential applied to the first anode **28**, the velocity of the electrons in the electron beam **23**. The first anode **28** operates in all types of scan that are available in the exercise of the present invention, to attract and to focus the electron beam **23** so that it passes substantially along the axis of the tube stem **17**.

Further magnetic focusing the the electron beam **23** is accomplished in all types of disclosed scan by a focusing magnet **31** that is disposed forwardly of or upon the screen side of the first anode **28** and outwardly of the tube stem **17**. The focusing magnet **31** preferably is a permanent magnet of centrally apertured ring or do-nut shape and is mounted upon the tube stem **17** so that its disposition with respect to the axis of the tube stem is adjustable both axially and radially thereof. When so adjustable, the focusing magnet **31** can be made to assist in both the focusing of the electron beam **23** and in causing it to be centered to flow substantially along the axis of the tube stem **17**. The electron beam focusing magnet **31** sets up and maintains a magnetic field through which the electron beam **23** is caused to pass. The portion of the magnetic field so established through which the electron beam **23** passes comprises lines of force that are substantially tangential to the direction of travel of the

electrons in the electron beam 23. The electron beam focusing magnet 31 serves to concentrate, to narrow and to center the electron beam on the axis of the tube stem 17 so that it may appear as a small dot upon the fluorescent screen 26 of the tube.

A pair of electrostatic sweep deflecting plates 50 and 51 are disposed substantially parallel with respect to each other within the tube stem 17 and substantially equi-distant from the axis thereof. In the circuit of the electrostatic plates 50 and 51, the plate 50 is connected through the coupling capacitor 11 to the fixed arm of the switch 55, to the movable arm of which returned echo pulses amplified by the video amplifier 9 are applied. A rectifier 54 is connected across the plates 50 and 51. The plates 51 and 50 through resistors 68 and 52, respectively, are connected with a high voltage source 37 of positive potential. Plate 51 is connected through capacitor 57 to ground. The capacitor 11 and 57 protect the high voltage source 37 from ground. Video voltage is impressed upon plate 50 through capacitor 11 when switch 55 is closed. In this circuit the rectifier 54 serves the purpose of direct current restoration between the plates 50 and 51. The rectifier 54 minimizes the tendency for sweep deflections of the electron beam 23 to appear both above and below the sweep trace in a presentation upon the tube screen 26. Rectifier 54 acts as a low resistance to returned echo pulses of one polarity amplified by the video amplifier 9 when the switch 55 is closed and acts as a high resistance to pulses of the opposite polarity. The rectifier 54 may be a rectifying crystal or a series of crystals, a suitable vacuum tube device or the like.

The plates 50 and 51 maintain electrostatic lines of force that extend normal to the axis of the tube stem 17. These lines of force produce a beam deflection that is parallel to the magnetic lines of force that are maintained by the sweep deflection coils 38 and 39 and deflect the electron beam 23 by means of lines of force that extend perpendicular to the faces of the electrostatic plates 50 and 51. The electron beam 23 is deflected by these electrostatic lines of force in direct proportion to their strength. The plates 50 and 51 impart electrostatic characteristics to an otherwise electromagnetic type of tube.

An electrically conducting second anode 35 imparts magnetic characteristics to the tube for all types of presentation that are contemplated hereby. The second anode 35 preferably comprises a coating of conducting material disposed inwardly and axially of both the tube cylindrical stem 17 and a frusto-conical frontal portion 36 of the tube envelope from their junction. The tube frontal portion 36 terminates remotely from its junction with the tube stem 17 in the transparent tube end 24 upon the inner surface of which the tube screen 26 is positioned.

The second anode 35 has a high positive voltage applied to it, as by being connected with the high voltage source 37 that also supplies the plates 50 and 51, or the like. The positive charge upon the second anode 35 maintains a field free space within the frusto-conical frontal portion 36 of the tube and serves to attract secondary electrons that are emitted by the tube screen 26, upon being impacted by the electron beam 23 for all of the contemplated types of scan presentation.

The electron beam 23 in its sweep is deflected from its normal course axially of the tube stem 17 and from the center of the screen 26 by suitable means, such as by a pair of sweep deflection coils 38 and 39 or the like, shown in Fig. 1, for A-scan and for P. P. I.-scan presentations. The electron beam 23, under the influence of the pair of deflection coils 38 and 39, is caused to sweep across or between the center and the edge of the screen 26 along predetermined paths under the influence of electromagnetic lines of force established by the sweep deflection coils 38 and 39.

The sweep deflection coils 38 and 39 are connected with and are energized from a sweep generator 40, part of a sweep system of the radar system 8. The sweep generator 40 generates a saw-tooth current that is passed through the deflection coils 38 and 39 in usual manner. The saw-tooth current builds up the energization of the coils 38 and 39 to a maximum value for each sweep of the cathode ray 23 across the tube screen 26, then drops the coil energization to a minimum value for the return sweep, in timing the energization of the coils 38 and 39. The position upon the tube screen 26 of the electron beam 23 in its radial sweep at any instant depends upon the polarity direction of the electromagnetic field that is determined by the physical disposition at that time of the deflection coils 38 and 39 circumferentially of the tube stem 17.

The pair of sweep deflection coils 38 and 39 preferably are disposed coaxially with respect to each other and are mounted for rotary motion circumferentially of the tube stem 17 by being mounted upon a plane driven gear 41 of a large diameter and with teeth disposed along its periphery as shown in the accompanying drawings. The peripheral teeth of the driven gear 41 are engaged by peripheral teeth upon a smaller driving gear 42. The driving gear 42 is mounted upon a shaft 43 so that it may be rotated mechanically by a receiver selsyn or selsyn motor 45, part of a selsyn system, or, upon the interruption of the selsyn system, manually by operation of a deflection coil knob 44.

The receiver selsyn motor 45 is connected by the switch 46 to a transmitter selsyn or selsyn generator 47. The selsyn generator 47 is actuated from an antenna or spinner assembly comprising, for example, a paraboloid reflector or dish 48 and the antenna 49. The selsyn generator 47 is geared through gears 58 and 59 to a yoke 56 that supports the antenna dish 48. The dish 48 is journalled in the yoke 56 by a pair of bearings 60 that are positioned upon the opposite ends of a common diameter through the dish 48 so that the dish may be caused to tilt or nod under the control of an operator of the radar set. In the selsyn system, the selsyn motor 45 falls into step with any movement of the selsyn generator 47 when the selsyn connecting switch 46 is closed. A wave guide designated by the lead 19 connects the antenna or spinner assembly with the radio frequency and intermediate frequency sections 10 of the radar system 8.

When the switch 46 is open so that the connection between the selsyn motor 45 and selsyn generator 47 is broken, the pulsed energization of the pair of coils 38 and 39 from the sweep generator 40 in an A-scan presentation commonly causes the cathode ray beam 23 to swing laterally of the tube screen 26 with sufficient rapidity so that the presentation is substantially that of a straight line. When the switch 46 is closed, the rotation of the antenna spinner assembly causes the rotation of the pair of deflection coils 38 and 39 around the tube stem 17 in a manner that is synchronized with the rotation of the spinner assembly and thereby causes a P. P. I. presentation upon the tube screen 26.

The presentation produced when the electron beam 23 strikes the tube coating or screen 26 is viewed normally through the transparent tube end 24. Screens 61 or 62 are permanently mounted in the cathode ray tube housing, 61 being used for P.P.I./A scan and 62 being used for B/A scan applications. Movable screens 63 and 64 are preferably so mounted as to be removably moved into or out of registration before the tube coating or screen 26. For example: screen 61 may bear a plurality of distance indicating concentric circles to be used for P. P. I. viewing; alternatively, screen 62 may bear a square or rectangular mat for framing the B type presentation upon the tube screen 26; screen 63 may be a blue light filter; and screen 64 may be an orange light filter. An orange light filter having a blue strip for viewing an A-scan presentation may be used if preferred.

The tube coating **26** preferably is a multiple or dual purpose screen composed of a plurality of layers of commonly available phosphors or materials that provide for the single screen both short and long persistence performance. The use of the screens **61** to **64**, respectively, are in conformity with usual practice in that when screen **61** is positioned in front of the tube screen **26**, an observer sees the plurality of concentric circles indicating upon the presentation the distance of the target from the location of the radar set depending upon the nearness of the image of the target to one of the concentric circles. The concentric circles may be calibrated to indicate yards, miles or 5 or 10 miles distances between each pair of concentric circles, in usual manner. Alternatively, for type B presentation, the disposition of the mat screen **62** before the tube screen **26** causes the presentation to be framed within the limits of a square or rectangular mat. A pair of adjacent edges of the mat screen **62** bear respectively, scales in azimuth and in distance, as commonly used.

The disposition of the blue color filter **63** before the tube screen **26** permits the conduction of light waves in the blue portion of the spectrum to pass through the screen or color filter and to be apparent to an observer who thereby selectively views blue flash short persistence presentations upon the tube screen **26**. The orange color filter screen **64** may in a similar manner be positioned before the tube screen **26** for the conduction or transmission of light rays within the yellow, amber to orange region of the spectrum so that an observer may thereby selectively view long persistence presentations upon the tube screen **26**.

It will be apparent that desired combinations among the screens **61** to **64** may be used, such as combinations of the distance indicating concentric circle screen **61** and the mat screen **62** with either of the color filter screens **63** and **64** and the like. An A-scan presentation is commonly viewed through a blue filter, because of its transient characteristic. Mapping presentations, such as B and P. P. I.-scan presentations, are normally viewed through deep orange filters.

In an A-scan presentation, echo signal deflections appear in the presentation upon the tube screen **26** substantially normally to the horizontal sweep trace. This provision adapts the tube shown in Fig. 1 for providing an A-scan presentation when the switch **46** is open. Opening the switch **46** disconnects the selsyn motor **45** from the selsyn generator **47** that is operated from the spinner assembly that carries the antenna **49**. Opening of the switch **46** leaves the cathode ray deflecting coils **38** and **39** in their last established position with respect to the tube stem **17** and presumably with the antenna **49** pointing directly toward the target for the return of echo pulses of optimum strength. For A-scan presentations the switch **55** is closed, and knob **44** is rotated to produce the horizontal sweep position required for this type of application. In these A-scan presentations, the switch **15** may be either open or closed depending respectively upon whether a usual A or an accentuated A-scan presentation is desired. This switching provision adapts the tube also for P. P. I.-scan presentations upon the tube screen **26** with the tube positioned as shown in the circuit in Fig. 1.

The type of presentation desired from the tube in the circuit shown in Fig. 1 is obtained by operation of the switches **15**, **55** and **46**, which can be ganged together to simplify switching operations where P. P. I. and A-scan are used in the absence of accentuated A-scan. Operatively, when switches **15** and **55** are open, amplified echo pulses coming from the video amplifier **9** are passed through the resistor **12** to ground. When the switch **15** is closed and switch **55** is open, these amplified echo pulses are passed through the coupling capacitor **14** to the intensity grid **16** against the resistance of the potentiometer resistor **12**. When switch **15** is opened and switch **55** is closed, the amplified echo pulses applied to the coupling capacitor **11** are impressed across the capacitor coupling plates **50** and **51** against the resistance of the potentiometer resistor **12**. When the switch **46** is opened, the disposition of the cathode ray deflecting coils **38** and **39** with respect to the tube stem **17** is established by operation of the deflection coil knob **44**. When the switch **46** is closed, the selsyn system thereby connected causes the pair of cathode ray deflecting coils **38** and **39** to follow in direction and degree any rotation of the spinner assembly of which the antenna **49** is a part.

In the operation of the tube and circuit arrangement shown in Fig. 1, pulsed signals originate within the radar system **8** and are conducted through the wave guide indicated by the lead **19** to the radar antenna **49** from which they are beamed into space in a lobe pattern. The signals so radiated are reflected in diminished energy content as an echo pulse by a metallic object such as an airplane, battleship or the like within the lobe pattern. The echo pulse is intercepted by the antenna dish **48** and is fed into the wave guide lead **19** which conducts the echo pulse and applies it to the IF and RF sections **10** of the receiver part of the radar system **8**.

The azimuth position of the antenna **49** at the instant the echo is received controls the disposition of the cathode ray deflecting coils **38** and **39** when the switch **46** is closed to connect the selsyn system, comprising the selsyn generator **47** and selsyn motor **45**. When a target is located in this manner, the switch **46** may then be opened and the switch **55** closed and an optimum presentation of the target be made upon the tube screen **26** by drawing an angular presentation at the azimuth position of the target to the horizontal position by operation of the cathode ray deflection coil knob **44**. With these minor adjustments, a normal A-scan target presentation appears as a vertical pip upon a horizontally extending sweep trace upon the tube screen **26** when the switch **15** is open and an accentuated A-scan presentation appears upon the tube screen **26** when the switch **15** is closed.

In using the invention for A-scan presentation, the antenna **49** is at rest and beams radar energy directly toward the target for maximum strength of echo pulse presentation. With the switch **15** open and switch **55** closed, the amplified echo pulse from the video amplifier **9** is deflected by the resistor **12** through the closed switch **55** and is impressed through coupling capacitor **11** upon resistor **52**, the electrostatic sweep deflecting plate **50** and the direct current restoration rectifier **54**. The complete video wave is applied to the plate **50** and a rectified component of the wave is applied to the plate **51**. This application of the amplified echo pulse to the pair of plates **50** and **51** causes a pip or deflection normal to the direction of the sweep trace upon the tube screen **26** from which a reading may be taken indicating the distance of the target from the radar position. When the cathode ray tube is mounted as shown in Fig. 1 of the drawings, the deflecting coils **38** and **39** provide the horizontal sweep and the electrostatic plates **50** and **51** provide vertical deflections of the sweep when echo signals are impressed thereupon and when switch **46** is open, switch **55** is closed and switch **15** either open or closed, depending upon whether plain or accentuated A-scan is desired, respectively.

For an accentuated A-scan presentation, switch **15** is closed, switch **55** is closed and switch **46** is open. With switch **15** closed, the power carried by the amplified echo pulse impressed upon the coupling capacitor **14** and conducted through the switch **15** to the tube intensity grid **16** augments the potential normally supplied from the battery **18** to the intensity grid **16** to draw an increased quantity of electrons from the tube cathode **25** and thereby accentuate the A-scan presentation upon the tube screen **26**.

For a plan position indicator or a P. P. I.-scan presen-

tation upon the tube screen **26** in the circuit that is shown in Fig. 1, switch **15** is closed, switch **55** is opened and switch **46** is closed. The power of an amplified echo signal impressed upon the coupling capacitor **14** and of a magnitude depending upon the setting of the tap **13** upon the potentiometer winding **12** and augmented by the potential of the battery **18**, depending upon the setting of the tap **20** upon the resistor **21**, is impressed upon the intensity grid **16** for intensifying the image of a target appearing in the presentation upon the tube screen **26**.

In the P. P. I.-scan presentation, switch **46** is closed so that movement of the spinner assembly under the control of the radar operator actuates the selsyn generator **47** followed by the selsyn motor **45**. The selsyn motor **45** causes the cathode ray deflection coils **38** and **39** to be rotated about the tube stem **17** through the gear train comprising the gears **42** and **41**. In this usual operation of the deflection coils **38** and **39**, the sweep of the cathode ray **23** upon the tube screen **26** is synchronized accurately with the rotation of the spinner assembly with the usual arrangement of selsyn phasing switches. When the antenna spinner assembly is rotated through 360°, the cathode ray deflecting coils **38** and **39** undergo a complete rotation through 360° around the tube stem **17**. This rotation of the deflection coils **38** and **39** together with the operation of the sweep generator **40** deflects the sweep trace of the cathode ray **23** upon the center of the tube screw **26** through 360° around the tube screen **26**. In this manner the deflection coils **38** and **39** are displaced circumferentially of the cathode ray tube stem **17** in conformity with the rotation in azimuth of the antenna **49**.

The circumferential movement of the deflection coils **38** and **39** around the tube stem **17** causes the cathode ray **23** to sweep the screen **26** from the center to the peripheral edge thereof continuously and to follow or to move circumferentially of the screen **26** in conformity with the motion in azimuth of the antenna **49** in usual manner for a P. P. I-scan presentation, such as that shown in Fig. 4 of the accompanying drawings. When using the P. P. I.-scan presentation, an investigation is being made of the direction in which the antenna **49** is pointing when a target is located with the antenna **49** continuously rotating and with the switch **46** closed so that the defletcion coils **38** and **39** rotate in both direction and degree along with the rotation of the antenna **49**.

In the above described manner, the present invention makes available to a radar operator with the cathode ray tube positioned within the circuit shown in Fig. 1, both normal and accentuated A-scan presentations with the switch **55** closed and the switch **46** open and with the switch **15** open or closed respectively, and also a P. P. I. scan presentation with switch **46** closed and with switch **55** open and with switch **15** closed to obtain optimum visibility of the presentation upon the tube screen **26**.

In Fig. 2 of the accompanying drawings is shown in fragmentary form a combined A and B-scan application of the present invention to a system that is modified to the extent of using an azimuth potentiometer and stationary cathode ray deflecting coils through which polyphase currents are passed, which assembly is to replace the selsyn system and mechanically rotated deflection coils **38** and **39** that are shown in Fig. 1. The same cathode ray tube that is shown with its electrostatic sweep deflecting plates **50** and **51** disposed horizontally in Fig. 1, is used in the circuit illustrated in Fig. 2 rotated 90° from its position in Fig. 1, so that the plates **50** and **51** are disposed vertically in the modified circuit shown in Fig. 2. The same cathode ray tube and its previously recited connections apply to the circuit in both Figs. 1 and 2. Components in Fig. 2 that correspond to components in Fig. 1 bear the same or corresponding numerals primed. The vertical disposition of the electrostatic plates **50** and **51** within the tube stem **17** results in a sweep trace presentation upon the tube screen **26** that extends vertically thereof and that is deflected in horizontally extending pips by each echo pulse that is returned to the radar set from a metallic object.

In Fig. 2, the antenna or spinner assembly of which the antenna **49'** is a part is mounted and rotated in azimuth along with the rotation of the gears **59'** and **58'**. The gear **58'** is connected by a shaft **73** to the mid point of an insulating bar **74** that is adapted for rotary motion along with the rotation of the gear **58'**. The insulating bar **74** carries a pair of contacts **75** and **76** at its opposite ends. The pair of contacts **75** and **76** make continuously wiping engagement with a stationary resistor winding **77** of a rheostat or circular azimuth potentiometer. A battery **78** is connected to apply its potential to two fixed taps 180° apart across the potentiometer winding **77**. The potentiometer moving arm comprising the insulation bar **74** and pair of contacts **75** and **76**, is adapted to rotate completely around the potentiometer stationary winding **77** in both direction and in degree with the rotation of the antenna spinner assembly. The potentiometer contacts **75** and **76** through a switch **46'** are connected in series to a pair of coaxial stationary windings **80** and **81** upon diametrically opposite sides of the tube stem **17**. In this circuit upon the closing of switch **46'**, potential from battery **78** is passed through the coaxial windings **80** and **81** for controlling the disposition of the cathode ray **23** upon the tube screen **26** in conformity with the disposition of the contacts **75** and **76** upon the potentiometer winding **77**.

In the operation of the azimuth potentiometer to which current from battery **78** is applied to vertically fixed taps, if the spinner assembly is turned so that the potentiometer moving arm is horizontally disposed for a position dead ahead, then no current flows into deflection coils **80** and **81** and the cathode ray **23** is disposed at the center of the tube screen **26**. If the spinner assembly is turned so that the antenna **49'** is directed 90° to the right of the dead ahead position, then the cathode ray **23** is deflected a maximum amount to one side of the tube screen **26**. If the antenna **49'** is directed 90° to the left of its dead ahead position, then the potentiometer contacts **75** and **76** reverse their polarity in their engagement of the fixed taps from the battery **78** upon the potentiometer winding **77** and the electron beam **23** is deflected a maximum amount in the opposite direction upon the tube screen **26**. A sweep trace is maintained continuously upon the tube screen **26** by a pair of coaxially disposed sweep deflecting coils **82** and **83** that are connected in series between the sweep generator **40'** and ground on dimetrically opposite sides of the tube stem **17** and having their common axis normal to the axis that is common to the sweep deflection coils **80** and **81**. In other circuit details, the circuit arrangements shown in Figs. 1 and 2 are the same.

A presentation upon the tube screen **26**, using the circuit shown in Fig. 2, may be either a normal or an accentuated A-scan with the switch **46'** open to deenergize the pair of coils **80** and **81** and the switch **55** closed, or it may be a B-scan presentation with the switch **46'** closed and the switch **55** open. As in the description of the circuit shown in Fig. 1, a normal A-scan is provided with the switch **15** open and an accentuated A-scan is provided with the switch **15** closed. In the presentation from the circuit shown in Fig. 1, the A-scan sweep trace when adjusted by knob **44** is disposed horizontally upon the tube screen **26**. In the presentation from the circuit shown in Fig. 2, the A-scan sweep trace upon the tube screen **26** extends vertically.

In the B-scan presentation, the azimuth potentiometer provides the azimuth position of the vertical sweep and may be disconnected from the circuit and replaced by a fixed resistor combination adjusted to produce a vertical

trace in the center of the tube corresponding to azimuth zero or dead ahead. Plates 50 and 51 would then be used in a manner similar to their function when used for an A-scan or a P. P. I.-scan presentation excepting that in the A-scan, the echo deflections would now extend horizontally from a vertically extending trace.

In Figs. 3 and 4 of the accompanying drawings, presentations that are available to the radar operator from the circuit that is shown in Fig. 1 and with the cathode ray tube disposed in the circuit as shown therein are illustrated. The presentation in Fig. 3 illustrates a representative A-scan presentation. The presentation shown in Fig. 4 represents a P. P. I.-scan presentation.

Figs. 5 and 6 represent presentations upon the tube screen 26 that are obtainable from the circuit and the tube positioning that is shown in Fig. 2 of the accompanying drawings. In Fig. 5, a B-scan presentation is illustrated and in Fig. 6 an A-scan presentation is shown. In the presentations illustrated in both Figs. 3 and 4 of the drawings, the concentric circle bearing distance indicating screen 61 is disposed in front of the tube screen 26. In Figs. 5 and 6, the presentation is framed by the interposition of the mat screen 62 between the observer of the tube screen 26. As previously indicated, the mat screen 62 bears an azimuth scale along its lower edge and a distance scale along a vertical edge, as shown.

In the normal A-scan presentation that is shown in Fig. 3 of the accompanying drawings, a sweep trace 85 begins at the center 86 of the screen 26 and extends to the peripheral edge thereof. If it is desired that the sweep trace 85 extend completely across the screen 26, the amplitude of the sweep voltage from the sweep generator 40 is increased until that result is accomplished.

When radar pulses are beamed from the radar antenna 49, or the antenna 49', and the respective sweep generators 40, or 40', begin the energization of their pair of coils 38 and 39 or 82 and 83, respectively, if a target is nearby, echo pulses return quickly and if the target is at a greater distance away, a proportionally greater length of time elapses between the sending out of the radar pulse and the receiving of an echo pulse at the radar position. The sweep generators 40 and 40' are synchronized with the sources of the radiated pulses. Consequently, when an echo pulse returns to the radar position, the displacement of the echo pulse upon the sweep trace with respect to the position on the sweep trace of the original pulse, or the start of the sweep, is a function of the distance between the radar position and the target.

With the cathode ray tube mounted in the circuit shown in Fig. 1 of the drawings, the P. P. I. presentation may extend radially of the tube screen 26 in any position of azimuth since the cathode ray deflecting coils 38 and 39 rotate about the tube stem 17 with the rotation of the antenna 49 in azimuth when the switch 46 is closed. For an A-scan presentation, when the radar operator observes an echo signal upon the tube screen 26, he positions the antenna 49 directly toward the target, takes its azimuth position from the presentation, opens the switch 46 and draws the sweep trace to the horizontal position by operation of the deflection coil knob 44. Where trace rotation is secured by field rotation in stationary coils, horizontal sweep can be secured by switching in proper voltages from a multiphase source to produce the horizontal sweep action.

In the illustrative trace shown in Fig. 3, the sweep trace 85 extends horizontally upon the tube screen. In the presentation shown with the screen 61 in front of the tube screen 26, the trace 85 extends from the center of the tube screen 26 to the right hand peripheral edge thereof and shows two target pips 87 and 88 as vertical deflections of the horizontally disposed trace 85 indicating ships 93 and 93' shown in Fig. 4. Signal beamed from the antenna 49 is blanked out of the presentation upon the tube screen to avoid burning a hole in the screen material since each pulse beamed from the antenna 49 would appear in the presentation at the tube screen center 86 and the coating would not continue to function if it were subjected to this continuous bombardment at a single point. The findings from the presentation shown in Fig. 3, assuming the concentric lines 65, 66 and 67 to be spaced in multiples of five miles from the radar position at the screen center 86, the targets illustrated by the pips 87 and 88 are approximately ten and eighteen miles, respectively, from the antenna position. Azimuth position is that which was indicated by the trace during P. P. I. operation.

In the presentation shown in Fig. 4 of the accompanying drawings, the same concentric circle distance indicating screen 61 is interposed in front of the tube screen 26. In this presentation the switch 46 is closed so that the presentation is substantially that of a map since the rotating cathode ray deflecting coils 38 and 39 are caused to continuously rotate with the antenna 49. The rotation of the cathode ray deflecting coils 38 and 39 causes the sweep trace 90 to continuously rotate between the center 86 of the tube screen 26 and the periphery thereof along with the rotation of the radar antenna 49. In this presentation, as before, individual signals beamed from the antenna 49 are blanked out of the presentation upon the tube screen 26 but separately initiate each trace that appears thereupon, to provide the P. P. I.-scan presentation that is shown in Fig. 4. In the presentation shown in Fig. 4, a body of land 91, an island 92 and two ships 93 and 93' appear as radar echo areas in the adjoining water area 94. In this presentation, the position in azimuth of dead ahead is zero degrees and the azimuth of the ship 93, which might be regarded as a possible target, is indicated by the dashed line 95 as being substantially 230°. The range of the ship 93 is as indicated in the drawing and, again assuming the concentric circles 65, 66 and 67 to be spaced five miles from each other, would be ten miles and would be measured radially on the tube screen 26 from the center 86 thereof, which in this presentation is the radar position. The presentation of the ships 93 and 93' in Fig. 4 conforms with the pips 87 and 88 in Fig. 3. As previously stated, the presentations shown in Figs. 3 and 4 of the accompanying drawings are available to a radar operator with the cathode ray tube positioned and connected as shown in Fig. 1 of the accompanying drawings.

With the cathode ray tube rotated 90° and mounted in the circuit shown in Fig. 2, the types of presentation shown in Figs. 5 and 6 of the accompanying drawings are available to the operator of the radar set. An illustrative B-scan presentation is shown in Fig. 5 and a vertically extending accentuated A-scan presentation is shown in Fig. 6 of the drawings. In both of these views the mat screen 62 carrying the hair line 84 is in front of the tube screen 26.

In the B-scan type of presentation shown in Fig. 5, the initial signal trace 96 extends horizontally of the tube screen 26 that preferably has the mat screen 62 positioned in front of it. The mat screen 62 carries a dead ahead position indicating vertically extending hair line 84 at 0° azimuth. In this B-scan presentation the signals beamed from the radar antenna 49 appear in the sweep trace 96 that preferably extends substantially parallel with and slightly above the azimuth scale extending along the horizontal lower edge of the orifice in the mat screen 62 as shown. A distance scale extends vertically along the lateral edge of the orifice in the mat screen 62, as shown, and, with reference to the trace 96, indicates the distance of the target from the antenna position. In this presentation land 97 and an island 98 appear as being radar echo areas distinct from the water area 99. In this respect, the B-scan presentation resembles the P. P. I.-scan presentation shown in Fig. 4. The azimuth position of zero degrees at which the hair line 84 appears illustrates the position dead ahead from the antenna position and the

azimuth scale is limited to a position plus 90° to the right of dead ahead and negative 90° to the left of dead ahead. In this presentation the radar antenna scan is limited to a straight angle or 180° in front of and to either side of the radar position. The position in azimuth and range or distance of a target, such as the island **98**, from the antenna position is readily indicated from the scales appearing upon the mat screen **62**.

The presentation shown in Fig. 6 of the accompanying drawings is also available to the operator of the radar set with the assembly shown in Fig. 2, and here again the mat screen **62** is positioned in front of the tube screen **26**. In this presentation, switch **15** is preferably closed and switch **46** is open. The positioning of the cathode ray tube with the electrostatic plates **50** and **51** disposed vertically results in the vertical trace **100**, as shown. Deflections of the sweep trace **100** such as the deflection **101** indicates the presence of the land **97** shown in Fig. 5 as being dead ahead of the antenna position. Other deflections may be to the right or left of the hair line **84**, as indicated by the position of a target projected upon the azimuth scale extending along the lower edge of the mat screen **62**. The target range would be at a distance from the antenna position that is indicated upon the distance scale that extends vertically along the right hand edge of the orifice in the mat screen **62**. The closing of the switch **15** causes the impression of the returned echo signals upon the intensity grid **16** of the cathode ray tube and provides a presentation of optimum intensity upon the tube screen **26**.

From the foregoing description, it will be apparent that with a single cathode ray tube when mounted in the circuit shown in Fig. 1, the radar operator has available to him a P. P. I.-scan presentation and his choice of a normal A-scan presentation or an accentuated A-scan presentation beginning at either the center of the cathode ray tube screen or extending diametrically thereof depending upon the nature of the potential that he applies to the cathode ray deflecting coils **38** and **39**. In the presence of enemy jamming through which enemy signals make useless a P. P. I. presentation, the radar operator by a switch manipulation has immediately available to him an A-scan presentation which, depending upon the nature of the enemy jamming, might provide him with the nature and range of an intended target, which data could not possibly be obtained under those circumstances from a P. P. I. presentation. Within the further exercise of the present invention, the radar operator, by simply withdrawing the cathode ray tube from the circuit shown in Fig. 1, rotating it 90° and inserting it in the slightly modified circuit shown in Fig. 2, then has available to him the choice of a B-scan presentation and either a normal or the accentuated A-scan presentation such as those that are shown in Figs. 5 and 6, respectively, of the accompanying drawings.

It will be noted that the particular details of the cathode ray tube that is shown in the accompanying drawings and of the particular circuits with which it is associated have been submitted for the purposes of illustrating and describing suitable operative embodiments of the present invention and that similarly functioning changes or modifications may be made therein without departing from the scope of the present invention.

I claim:

1. A cathode-ray tube multiple presentation system for use with a transmitter-receiver system comprising an antenna spinner system connected by a wave guide to the radio frequency and intermediate frequency sections of the transmitter-receiver system and the antenna spinner system connected through an interruptible selsyn system to a cathode ray deflecting rotatable means mounted to move in synchronization with the antenna spinner assembly around the stem of the cathode ray tube wherein a cathode emits an electron beam toward a screen with the cathode ray deflecting means timed in the sweep of the cathode ray over the tube screen from a sawtooth wave emitted from a sweep generator part of the transmitter-receiver system, the cathode ray tube multiple presentation system comprising in combination with the above designated components an intensity grid mounted forwardly of the tube stem and adjacent the cathode therein, a first anode forwardly of the intensity grid within the tube stem for increasing the velocity of the electron beam, a first magnet adjustable axially and radially of the tube stem and mounted outwardly thereof and forwardly of the first anode for maintaining electromagnetic lines of force extending substantially tangentially to the direction of flow of electrons in the electron beam to thereby narrow the electron beam toward the axis of the tube stem, a pair of electrostatic electron beam deflecting plates disposed forwardly of said first magnet and maintained at a high positive potential and to which beam deflection plates echo signal from the radio frequency and intermediate frequency sections of the transmitter-receiver system may be selectively applied directly or in parallel with echo signal application to the said intensity grid of the cathode ray tube, a rectifier connecting said pair of electrostatic plates, a resistor connecting said pair of electrostatic plates in parallel with said rectifier, a deflection coil knob operating a part of said selsyn system and for manually adjusting said magnetic cathode ray deflecting means upon the interruption of the selsyn system, and switch means for interrupting the selsyn system.

2. A radio signal presentation device for use in a transmitter-receiver system, comprising a radar system initiating signals, an antenna assembly transmitting and receiving said signals, an electromagnetic-electrostatic cathode ray tube containing electrodes and a screen and connected with said radar system and said antenna assembly for providing signal presentations, contrast controlling first variable resistor means connected between said radar system and a signal receiving first electrode in said tube, intensity controlling second variable resistor means connected between said signal receiving first electrode in said tube and ground, a first switch means connected between said first and second resistors, a first electrostatic sweep deflection plate within said tube, a second switch means capacitively connected between said radar system and said first deflection plate, a second electrostatic deflection plate positioned within said tube, a signal focusing permanent magnet positioned between the said first electrode and said pair of plates, a voltage source supplying voltage to both of said plates, rectifier means connected between said plates, sweep deflection coils positioned between said pair of plates and the tube screen, and means adjusting said deflection coils circumferentially of said tube.

3. The device described in claim 2 with a third switch means releasably connecting the means for adjusting said sweep deflection coils circumferentially of said tube in its relation with the operation of said antenna assembly.

4. The device described in claim 2 wherein said deflection coil adjusting means is a selsyn system between said antenna assembly and said sweep deflection coils for positioning said sweep deflection coils circumferentially of said tube in a predetermined relation with the setting of said antenna assembly.

5. A radio system presentation device for use in a transmitter-receiver system, comprising a radar system initiating signals, an antenna assembly transmitting and receiving said signals, an electromagnetic-electrostatic cathode ray tube containing electrodes and a screen and connected with said radar system and said antenna assembly for providing signal presentations, contrast controlling first variable resistor means connected between said radar system and a signal receiving first electrode in said tube, intensity controlling second variable resistor means connected between said signal receiving first electrode in said tube and ground, a first switch means connected between said first and second resistors, a first

electrostatic sweep deflection plate within said tube, a second switch means capacitatively connected between said radar system and said first deflection plate, a second electrostatic sweep deflection plate positioned within said tube, a signal focusing permanent magnet positioned between said first electrode and said pair of plates, a voltage source supplying voltage to both of said plates, rectifier means connected between said plates, sweep deflection coils positioned between said pair of plates and the tube screen, and a sweep deflection coil adjusting knob for altering the position of said switch deflection coils with respect to said tube.

6. A radio system presentation device for use in a transmitter-receiver system, comprising a radar system initiating signals, an antenna assembly transmitting and receiving said signals, an electromagnetic-electrostatic cathode ray tube containing electrodes and a screen and connected with said radar system and said antenna assembly for providing signal presentations, contrast controlling first variable resistor means connected between said radar system and a signal receiving first electrode in said tube, intensity controlling second resistor means connected between said signal receiving first electrode in said tube and ground, a first switch means connected between said first and second resistors, a first electrostatic sweep deflection plate within said tube, a second switch means capacitatively connected between said radar system and said first deflection plate, a second electrostatic sweep deflection plate positioned within said tube, a signal focusing permanent magnet positioned between said first electrode and said pair of plates, a voltage source supplying voltage to both of said plates, a direct current restoration rectifier connected between said plates, resistor means connected between said plates, sweep deflection coils positioned between said pair of plates and the tube screen, and means adjusting said deflection coils circumferentially of said tube with respect to the setting of said antenna assembly.

7. A radio signal presentation device for use in a transmitter-receiver system, comprising a radar system intiating signals, an antenna assembly of a rotatable yoke carried dish and dipole for transmitting and receiving said signals, an electromagnetic-electrostatic cathode ray tube envelope including a stem and containing electrodes and a screen and connected with said radar system and said antenna assembly for providing signal presentations, contrast controlling first variable resistor means connected between said radar system and a signal receiving electrode in said tube, intensity controlling second variable resistor means connected between said signal receiving electrode in said tube and ground, a first switch means connected between said first and second resistors, a first electrostatic sweep deflection plate within said tube, a second switch means capacitatively connected between said radar system and said first deflection plate, a second electrostatic sweep deflection plate positioned within said tube, a signal focusing permanent magnet positioned between said first electrode and said pair of plates, a voltage source supplying voltage to both of said plates, rectifier means connected between said plates, sweep generator means within said radar system, circular azimuth potentiometer means having a circular resistor wiped by a pair of contacts on opposite ends of an insulating bar rotated with the rotation of said antenna, a first pair of coaxial sweep deflection coils with their common axis normal to the axis of the stem of said tube and electrically shunting the potentiometer wiping contacts, a second pair of coaxial deflection coils with their common axis normal to the axis of the stem of said tube and displaced a quadrant around the tube stem from said first pair of coaxial deflection coils and connected between said sweep generator in said radar system and ground, and a potential applied to the potentiometer circular resistor at the opposite ends of a common diameter thereacross.

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