

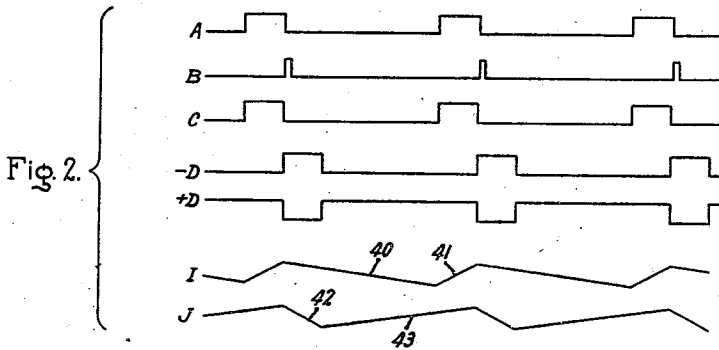
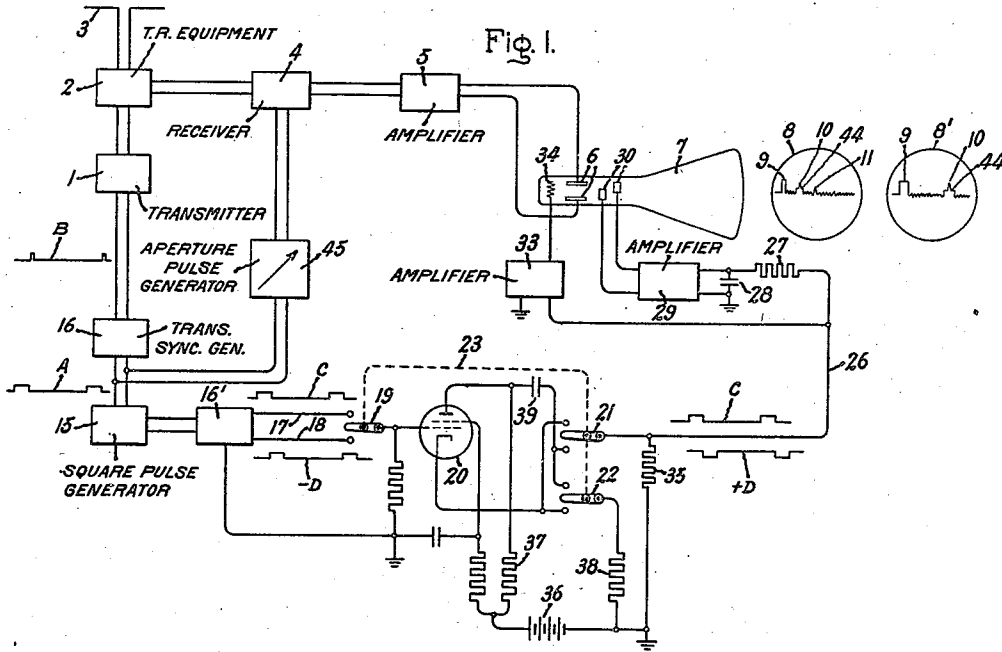
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CATHODE RAY APPARATUS

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CATHODE-RAY APPARATUS

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446,231. Divided and this application February
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7 Claims. (Cl. 315—22)

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My present application is a division of my co-
pending application Serial No. 446,231, filed June
8, 1942, entitled Cathode ray apparatus, and
which is assigned to the same assignee as this
present application.

My present invention relates to cathode ray
apparatus and more particularly to means for
controlling the deflection of the ray in such
devices.

An object of my present invention is to pro-
vide improved means for changing the time inter-
val in which the ray of a cathode ray device is
deflected across the screen thereof.

It frequently happens in the use of cathode
ray apparatus, as, for example, in radio echo
range finding apparatus, that means are re-
quired for quickly and readily varying the time
in which the ray is deflected across the screen.
In radio echo range finding apparatus the range
of the equipment may be varied in this way.
That is, in such equipment, periodic pulses are
radiated and echoes thereof are received in the
equipment during an interval following each
pulse. The cathode ray is deflected across the
screen once for each radiated pulse, the interval
of the deflection beginning just before this
radiated pulse and continuing thereafter for an
interval during which echoes are received. The
length of this interval determines the range of
the equipment since the longer the interval the
greater the distance from which echoes are re-
ceived and indicated on the screen.

An object of my invention is to provide im-
proved means for varying this interval. Of
course, if the interval be long, the echoes received
are indicated in close space sequence on the
screen whereas if the interval be short the echoes
are indicated in more widely spaced sequence on
the screen.

A further object of my invention is to provide
means whereby this time interval may be varied
widely and which may be provided without unde-
sired complication or increased cost of the equip-
ment.

The novel features which I believe to be char-
acteristic of my invention are set forth with par-
ticularity in the appended claims. My invention
itself, however, both as to its organization and
method of operation, together with further objects
and advantages thereof, may best be understood
by reference to the following description taken in
connection with the accompanying drawing in
which Fig. 1 represents an embodiment of my
invention, and Fig. 2 represents certain char-
acteristics of its operation.

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Referring to Fig. 1 of the drawing, I have indi-
cated therein a radio echo apparatus in which
pulses produced by a transmitter 1 are supplied
through equipment 2 to an antenna 3 whereby
they are radiated into space. These pulses may
be reflected from remote objects, such as aircraft,
and again received on the antenna 3, or they may
be relayed by equipment carried by such remote
objects and the relayed pulses received in the
antenna 3. The received pulses are then supplied
through the equipment 2 to a receiver 4, whereby
they are translated into unidirectional pulses
which are amplified by the amplifier 5 and sup-
plied between the vertical deflection plates 6 of a
cathode ray oscillograph 7 where they are indi-
cated upon the viewing screen. The indication
produced upon the viewing screen may be either
that represented in the circle 8 or that indicated
in the circle 8' in which the radiated pulse
is indicated at 9 and echoes thereof are indi-
cated at 10 and 11. The indication in circle 8
is produced when the equipment is adjusted for
long range operation and that in circle 8' when
adjusted for short range operation. The echo
11 shown in the circle 8 does not appear in the
circle 8' since it is produced by an object beyond
the range of the equipment when adjusted for
short range operation.

The equipment 2 comprises suitable equipment
which prevents the intense pulses produced by
the transmitter from injuring the receiver 4 and
also prevents undesired attenuation of the weaker
received pulses in the output circuit of the trans-
mitter 1. Such equipment is commonly referred
to as TR equipment (transmit-receive equipment)
and is so designated on the drawing.

The pulses produced by the transmitter 1 occur
at fixed intervals apart, these intervals being
determined by a square pulse generator 15, the
square wave of which is indicated at A in Fig. 1.
This wave A is supplied to a transmitter syn-
chronizing generator 16 which produces syn-
chronizing pulses B of relatively short duration
which synchronize the pulses produced by the
transmitter 1.

Of course, to produce the indications repre-
sented in the circles 8 and 8' it is necessary to
deflect the beam of the cathode ray device 7
horizontally across the screen in synchronism
with the radiated pulses. This is effected by sup-
plying the square wave A produced by the gener-
ator 15 through equipment 16', which reproduces
these pulses on conductor 17 in the form indicated
at C in Fig. 1 and on conductor 18 in the form
indicated at -D in Fig. 1. These two pulse

waves C and -D are identical but the positive pulse of the wave -D begins at termination of the positive pulse of wave C. In other words, the wave -D is delayed in time, or in phase, with respect to the wave C by an amount equal to the length of the positive pulse of the wave C.

One or the other of these pulse waves C or -D may be selected by a switch 19 and supplied to the input of an electron discharge device 20 having in its output circuit switches 21 and 22, which are arranged for unicontrol with switch 19 by suitable mechanical means indicated by the dotted line 23. If the switches 19, 21 and 22 be in their upper position, then the wave C is supplied to the input of the discharge device and is reproduced with the same form between the conductor 25 and ground. If these switches be in their lower position, then the wave -D is supplied to the input of the discharge device and is reproduced on the conductor 25 with its polarity reversed as indicated at +D in Fig. 1.

These waves C and +D are supplied through a resistance 27 to a condenser 28 whereby they are integrated to produce a sawtooth wave which is amplified by amplifier 29 and supplied between the horizontal deflection electrodes 30 of the cathode ray oscillograph to produce the horizontal deflection. They are also supplied through an amplifier 33 to the control electrode 34 of the cathode ray device to turn the ray of that device on during the negative portion of the wave and off during the positive portion thereof, the polarity of the wave being reversed in amplifier 23.

This operation may now be understood by reference to Fig. 2. In this figure I have represented the waves A, B, C, -D and +D spaced in accordance with their time relation in the equipment. The wave A is the wave produced by the generator 15. The wave B represents the synchronizing pulses produced by equipment 16, the positive pulses of this wave substantially agreeing in time with the radiated radio pulses.

The positive pulses of the wave C occur simultaneously with the positive pulses of wave A but are slightly shorter than the positive pulses of wave A and terminate before the positive pulses of wave B begin and hence before the radiated pulses occur. Thus the radiated pulses occur just after the negative portions of wave C begin. This negative portion of wave C has a duration equal to the longest interval over which echoes are to be received. This interval may be the interval required for an echo to be received from an object one hundred miles away, for example.

This wave C is reproduced on conductor 26 when switches 19, 21 and 22 are in their upper positions, and is supplied through resistance 27 to condenser 28. The elements 26 and 27 integrate the wave C and produce across condenser 28 a wave of the form indicated at I. That is, condenser 28 charges during the positive portions of impressed wave C and discharges during the negative portion thereof. This wave I is supplied through the amplifier 29 between electrode 30 where it deflects the ray of the cathode ray device horizontally across the screen during the long portion 40 of the wave I. The wave C is also supplied through amplifier 33 to the control electrode 34 of the cathode ray device with reverse polarity so that it turns the ray of the cathode ray device on during the long portion 40 of the wave I and off during the short portion. Thus, the ray is deflected from its initial starting position at the left side of the screen

represented by the circle 8 horizontally across the screen and then is extinguished and deflected back to its initial position during the short portion 41 of the wave I. Since the long portion 40 of the wave I corresponds to the greatest range of the equipment, which may be one hundred miles, the indication is that indicated in the circle 8 in which echoes from varying distances within the range of one hundred miles are indicated upon the screen in relatively close space relation and, of course, in space sequence corresponding to the time sequence in which the echoes are received.

If it be desired that these echoes be more widely spaced on the screen, then the deflection across the whole width of the screen may be produced in a shorter time interval corresponding to shorter range of the equipment. This is effected by operating the switches 19, 21 and 22 to their lower position. When these switches are in their lower position, the wave -D is selected and supplied to the discharge device 20 and is reproduced with reverse polarity on the conductor 26 where it is designated as +D. Thus the waves -D and +D are indicated in Fig. 2 as of exactly the same form but of opposite polarity. This wave +D is supplied through the resistance 27 to the condenser 28 and produces thereon a wave which is indicated at J in Fig. 1. The condenser discharges during the negative portion of the wave D and charges during the positive portion of the wave D. Thus the cathode ray of the device 7 is now deflected across the whole width of the screen during the short portion 42 of the wave J and is then extinguished and returned to its initial position during the long portion 43 of the wave J. Of course, the wave +D is supplied through the amplifier 33 and to the grid 34 with reverse polarity turning the cathode ray on during the portion 42 of the wave J. The indication produced on the cathode ray screen now is that indicated in the circle 8' and may correspond to a range of 25 miles.

The radiated pulses occur substantially simultaneously with the positive pulses of wave B and they, therefore, occur just after the beginning of the two portions 40 and 42 of the waves I and J, respectively. These radiated pulses are indicated at 9 at the left side of the screen represented by the circles 8 and 8'.

The echo indicated at 10 in the circle 8 is also indicated at 10 in the circle 8' where it is more widely spaced from the pulse 9. It will also be observed that the pulse 9 is wider as indicated in the circle 8' than it is as indicated in the circle 8.

It will be observed that the echoes 10 as indicated in the circles 8 and 8' appear at the top of square-shouldered pedestals 44 in each of these circles. This square-shouldered pedestal is produced by a pulse generated by the equipment 45 designated on the drawing by the legend "Aperture pulse generator." This equipment produces a pulse wave having square positive pulses of very short duration relative to the total time over which pulses are received and which is synchronized with the square wave A produced by the generator 15. This wave may be variable in phase, as indicated by the arrow shown within the rectangle 45, so that its positive pulses may occur at any desired time within the interval over which echoes are received. These pulses are supplied to the receiver 4 where they are mixed with the received echo to produce the deflection 75 44 indicated on the cathode ray oscillograph. In

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this way a particular echo, such as that indicated at 10, may be marked, or identified, and caused to stand out on the screen among the other indications shown thereon. Since the aperture pulse produced by the equipment 45 is variable in phase, this deflection 44 may be moved across the screen to agree with and to bracket any particular echo which it may be desired particularly to observe.

The particular circuits of the discharge device 20 to produce the waves C and +D upon conductor 26 will now be described. Let us assume that the switches 19, 21 and 22 are in their upper position. Then the anode circuit of the discharge device 20 extends from the cathode thereof through the upper switch 21, resistance 35, anode source of potential 36, resistance 37, back to the anode of the discharge device. Thus an increase in current in the discharge device 20 which occurs during the positive pulses of the wave C produces an increase in current in resistance 35 making the upper terminal of this resistance more positive than the lower terminal. Thus the wave C is reproduced between the conductor 26 and ground.

If the switches 19, 21 and 22 be in their lower position, then the anode circuit of the discharge device extends from the cathode thereof through switch 22, resistance 33, anode source of potential 36, resistance 37, back to the anode of the discharge device. The increase in current which occurs during the positive pulses of the wave -D produces a drop in potential on resistance 37. This drop in potential is transferred through condenser 33 to resistance 35. Thus the voltage wave on resistance 35 is of the same form as the wave -D but reversed in polarity and is, therefore, designated +D on the drawing. The waves C and +D when integrated by the resistance 27 and condenser 28 produce the sawtooth waves I and J, respectively, represented in Fig. 2.

This equipment, including switches 19, 21 and 22 and discharge device 20, comprises means whereby both the blanking voltage for the control electrode 34 of the cathode ray device and the ray deflection voltage may be transmitted over the single conductor 26 and whereby the intervals of the forward deflection of the ray and the intervals of its greater intensity may be varied synchronously and in agreement simply by varying the relation between the durations of the intervals of unlike sign of the square wave generated by this equipment on conductor 26.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since different modifications may be made, and I contemplate by the appended claims to cover any modifications which fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a cathode ray device having a viewing screen, means to deflect said ray across said screen in either of two different desired time intervals, said means comprising means to generate either of two square waves in accord with the time interval of deflection desired, one of said waves comprising periodic positive pulses and the other periodic negative pulses, said pulses being short relative to the period between said pulses and occurring substantially end to end in time, means to integrate said pulses, and means to control said deflection in accord with the wave produced by said integration.

2. In combination, a cathode ray device having

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a viewing screen, means to deflect said ray across said screen in either of two different desired time intervals, said means comprising means to generate either of two square waves in accord with the time interval of deflection desired, one of said waves comprising periodic positive pulses and the other periodic negative pulses, said pulses being short relative to the period of the pulses and occurring substantially end to end in time, a resistance and a condenser, means to supply either one of said waves or the other, as desired, through said resistance to said condenser, and means to control the deflection of said ray in accord with the potential on said condenser.

3. In combination, a cathode ray device having a viewing screen, means to deflect said ray across said screen in either of two different desired time intervals, said means comprising means to generate either of two square waves in accord with the time interval of deflection desired, one of said waves comprising periodic positive pulses and the other periodic negative pulses, said pulses being short relative to the period of the pulses and occurring substantially end to end in time, a resistance and a condenser, means to supply either one of said waves or the other, as desired, through said resistance to said condenser, means to control the deflection of said ray in accord with the potential on said condenser, and means responsive to said square wave supplied to said resistance to interrupt said ray during the retrace periods thereof.

4. In combination, a cathode ray device having a viewing screen, means to deflect the ray of said device over a predetermined path on said screen in either of two different time intervals, said means comprising means to select either one of two square waves in accord with the time interval desired, means to integrate the square wave selected by said last means, and means to deflect said ray in accord with the integral produced by said last means, each of said square waves having positive and negative portions related in duration to deflect said ray over said path in the respective time interval.

5. In combination, a cathode ray device, a condenser, means to deflect the ray of said device in accord with the voltage on said condenser, a resistance, means to supply a square wave across said condenser through said resistance, and means to change the relative durations of the positive and negative portions of said square wave in accord with the interval in which said ray is to be deflected across said screen.

6. In combination, a cathode ray device having ray intensity control means and ray deflecting means, a source of square wave pulses, a square wave integrating circuit, said ray deflecting means being connected across the output of said integrating circuit, means to supply said square wave pulses from said source to said ray intensity control means and to said integrating circuit, whereby the intensity of said ray is alternately increased and decreased in accord with said square ray and said ray is deflected over a predetermined path when said ray is more intense and is returned to starting position during the intervening intervals, and means to change the relation between the intervals of said square wave of unlike sign thereby to vary together the duration of the intervals when said ray is more intense and when said deflections over said path occur.

7. In combination, a cathode ray device having ray intensity control means, ray deflecting

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means and a viewing screen, a circuit having a square wave impressed thereon, means to supply said square wave to said ray intensity control means to turn said ray on during intervals of said wave of like polarity and off during intervening intervals, means to integrate said wave to produce a sawtooth wave agreeing in phase with said square wave and to supply said sawtooth wave to said deflecting means, where-

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by said ray is deflected over a predetermined path on said screen during its on intervals and is restored to starting position during its off intervals, and means to change the time relation between the intervals of said square wave of unlike sign thereby to change the duration of the on intervals of said ray.

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