

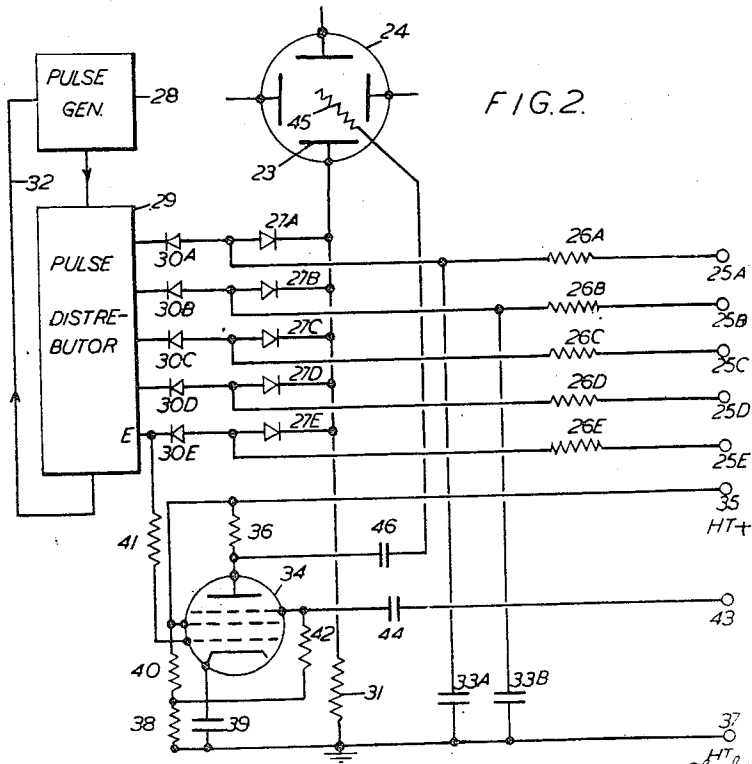
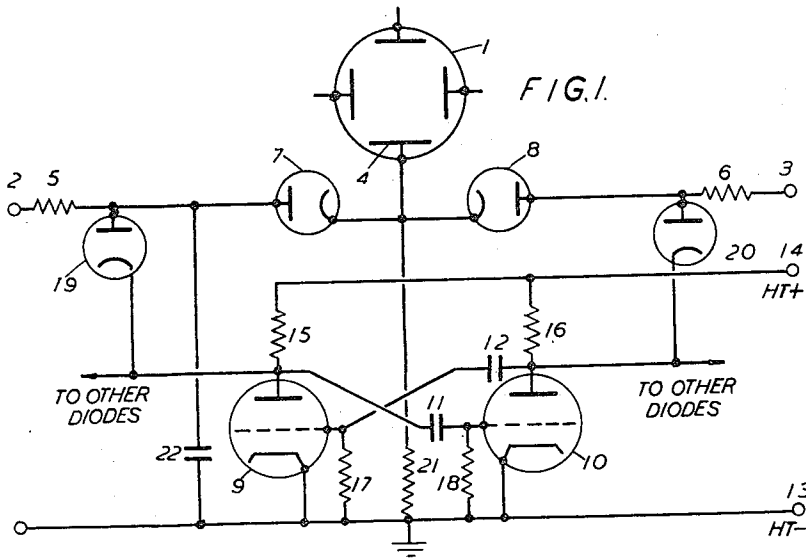
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DISPLAY ARRANGEMENT FOR ELECTRIC OSCILLOGRAPHS

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DISPLAY ARRANGEMENT FOR ELECTRIC
OSCILLOGRAPHS

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The present invention relates to arrangements for simultaneously displaying several phenomena on the screen of a cathode ray oscillograph.

In radio direction indicating systems it is convenient, for example, to be able to display simultaneously on the screen of a single cathode ray tube a trace indicating the direction to some object, a graduated scale on which the direction may be read, and an adjustable cursor trace for facilitating the reading. In other systems employing cathode ray oscillographs it may be desired to display simultaneously two or more traces signifying other types of phenomena.

It is the principal object of the present invention, therefore, to provide a convenient means whereby such simultaneous displays may be made.

The invention accordingly provides a cathode ray oscillograph, a plurality of sources of deflecting potentials, a plurality of series blocking devices respectively connecting all the said sources to the same one of the deflecting plates of the oscillograph, each series blocking device having a shunt blocking device corresponding thereto, means for periodically unblocking the said blocking devices in turn, one at a time, and means for unblocking each shunt blocking device when the corresponding series blocking device is blocked.

British Patent No. 567,711 described one arrangement for obtaining simultaneous displays on a cathode ray oscillograph, employing only series blocking valves. As just stated, however, the present invention employs shunt blocking devices in addition, in order more completely to prevent interference between the various display voltages.

The invention will be described with reference to the accompanying drawing, of which Figs. 1 and 2 show respectively schematic circuit diagrams of two embodiments of the invention.

In Fig. 1, a cathode ray oscillograph with the usual four deflecting plates is shown diagrammatically at 1. The other parts of the oscillograph are not shown and may be of any conventional form. Corresponding outlets of two sources of reflecting potentials of any type (not shown) are intended to be connected respectively to the input terminals 2 and 3. Such sources should preferably each have a common terminal connected to ground. The terminals 2 and 3 are respectively connected to one of the plates 4 of the oscillograph through resistances 5 and 6, and through blocking devices consisting of diodes 7 and 8. The diodes have their cathodes connected to the plate 4, and are arranged to be alternately unblocked by pulses from a multi-

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vibrator of conventional pattern consisting of two similar valves 9 and 10 arranged so that the anode of each is cross-connected to the control grid of the other through respective condensers 11 and 12.

The cathodes are directly connected to the ground terminal 13 (which is also the negative terminal of the high tension source for the valves), and the anodes are connected to the positive high tension terminal 14 through resistances 15 and 16. The control grids of the valves 9 and 10 are grounded through resistances 17 and 18. This is a well known arrangement and may be made to generate rectangular pulses whose repetition frequency and duration depend upon the time constants of the two condenser charging circuits.

The anode of the valve 9 is connected to the cathode of another blocking device consisting of a diode 19, the anode of which is connected to the anode of the diode 7. Likewise the anode of the valve 10 is connected to the cathode of a blocking diode 20, the anode of which is connected to the anode of the diode 8. The plate 4 of the oscillograph 1 is connected to ground through a resistance 21.

Since the unblocking periods of the diodes 7 and 8 should preferably be equal, the elements associated with the two valves 9 and 10 should preferably be respectively equal, so that the condenser charging circuits will have equal time constants.

In order to explain the action of the circuit of Fig. 1, it will be assumed that the multivibrator has been so designed that the potential of the anodes of the valves 9 and 10 with respect to ground alternates between the two values +100 volts and +600 volts at a frequency of 100 cycles per second, for example, and that the potentials applied to the terminals 2 and 3 do not vary outside the limits +100 volts and +500 volts. When the potential of the anode of valve 9 is +600 volts, the diode 19 will be blocked and the positive potential at terminal 2 will be applied through the diode 7 to the plate 4, since this diode will be unblocked in this condition. If the resistance 21 is large compared with the resistance 5, there will be a negligible potential drop in the resistance 5. Under these conditions the diode 20 will have a potential of +100 volts on its cathode from the anode of the valve 10, and this will hold the potential of the anode of the diode 20 substantially at +100 volts, so that the diode 8 will be blocked, thus effectively disconnecting terminal 3 from the plate 4. It will be evident

that when the multivibrator switches over, the diodes 7 and 20 will be blocked and the diodes 8 and 19 will be unblocked, thus applying the potential at terminal 3 to the plate 4 instead of that at terminal 2. It will be clear, therefore, that the potentials at terminals 2 and 3 will be alternately applied to the plate 4 for equal periods of time at a frequency of, say, 100 cycles per second.

It will be understood that each of the deflecting plates of the oscillograph 1 may be provided with elements similar to the elements 2, 3, 5, 6, 7, 8, 19, 20 and 21, arranged in a similar manner, all of which are operated from the one single multivibrator which is preferably not duplicated. These extra elements have not been shown in order to avoid complicating the figure. In such a case all the diodes corresponding to 19 will be connected to the anode of the valve 9 and all the diodes corresponding to 20 will be connected to the anode of the valve 10. Then the trace corresponding to the potentials applied to all the terminals similar to 2 from the corresponding outlets of one deflecting source will be produced alternately with the trace corresponding to the potentials applied to all the terminals similar to 3 from the corresponding outlets of the other deflecting source, and if the switching rate is high enough (e. g. 100 cycles per second) the two traces will appear to exist simultaneously on the oscillograph screen.

The potentials applied to all the terminals such as 2 and 3 may be produced in the corresponding deflecting potential sources in any manner, and may vary in any way so long as they lie within the limits defined by the two potentials generated by the multivibrator. In the case where the potentials applied to the terminals 2 are constant (or only vary very slowly), the spot on the cathode ray tube will be at a fixed point or will move very slowly. In this case it may be desirable to join the spot to the centre of the screen by a straight line trace. This may be done by connecting a condenser 22 between the anodes of the diodes 7 and 19 and ground, and a similar condenser (not shown) for each of the other plates of the oscillograph. The relatively slow charging of the condenser 22 through the resistance 5 will cause the spot to describe a radial straight line, in the manner explained in the specification of co-pending application No. 667,259, filed May 4, 1946, and issued April 4, 1950 as Patent No. 2,502,428, the condenser 22 being discharged when the diode 19 conducts. It will be understood that the condenser 22 will often not be required.

In a slightly modified form of Fig. 1, the diodes may all be reversed and the resistance 21 may be connected to the positive high tension terminal 14 instead of to ground. In this case it is the negative changes of the anode potentials of the valves 9 and 10 which perform the switching, instead of the positive changes. The arrangement has an advantage when the indication of the oscillograph 1 has to be transmitted over a line for repetition on a distant oscillograph by the use of cathode follower amplifying circuits in the manner described in the specification of co-pending application No. 667,260, filed May 4, 1946 and issued October 25, 1949 as Patent No. 2,485,568. The advantage is associated with the fact that the sudden potential changes caused by the short circuiting of the condenser 22 by the diode 19 are positive changes, which are preferable for the most efficient operation of the cathode follower amplifiers.

It will be clear that, if desired, any other suitable type of one-way blocking devices capable of being unblocked by applied potentials may be used instead of the diodes 7, 8, 19 and 20, such for example as dry plate rectifiers, or triodes or like devices with grid electrodes which may be controlled by the pulses from the multivibrator.

Fig. 2 shows a more general arrangement according to the invention by which any number of simultaneous traces may be exhibited on the oscillograph screen. As before, the apparatus for only one of the deflecting plates is shown, but may be duplicated for the other plates. Fig. 2 is arranged for five simultaneous traces, but it will be understood that a similar arrangement may be used for two, or any other number of traces.

The deflecting potentials for the plate 23 of the oscillograph 24 are applied at terminals 25A to 25E from the corresponding outlets of five preferably grounded deflecting sources (not shown) through resistances 26A to 26E and diodes or other one-way devices 27A to 27E which correspond to the diodes 7 and 8. Positive rectangular unblocking pulses are obtained from a pulse generator 28 which supplies pulses to a pulse distributor 29. This distributor may be of any known type, and should produce pulses in regular succession in turn from five outlets which are respectively connected through diodes or one-way devices 30A to 30E to the diodes 27A to 27E as shown. The plate 23 is connected to ground through a resistance 31.

The pulse distributor 29 may, for example, be a delay network or transmission line consisting of a number of low-pass filter sections, having outlet tapplings at equal intervals. Pulses at the output of the distributor may be returned over conductor 32 to synchronize the pulse generator 28 according to well known practice. The distributor should preferably be so designed that the pulses from successive outlets do not overlap in time, and there should preferably also be a very short interval between the leading edge of each pulse and the trailing edge of the immediately preceding pulse. This will provide brief periods when no deflecting potentials will be applied to any of the oscillograph plates, and this will cause the spot to return to the centre each time and mark a dot there.

The pulse generator 28 may be of any known type, but could, for example, be a multivibrator similar to that shown in Fig. 1, the pulses being taken from one of the valve anodes. In this case the time constants should be chosen so that the pulse duration is an appropriate fraction of the repetition period.

It will be evident that by this arrangement the diodes 27A to 27E will be unblocked in turn by the pulses from the distributor 29, so that the deflecting potentials from each of the terminals 25A to 25E will be applied in turn to the plate 23, producing five superposed traces.

The other plates of the oscillograph 24 will be provided with elements (not shown) similar to 25, 26, 27, 30 and 31 arranged in the same way, but only one pulse generator 28 and distributor 29 will be required to supply unblocking pulses for all of them.

In a radio direction indicating system, circuit A may be used to produce the radial trace indicating the direction. In this case a condenser 33A, corresponding to 22 in Fig. 1, may be provided for each of the oscillograph plates. Like-

wise circuit B may be used for providing an adjustable cursor line in the manner described in the specification of co-pending application No. 747,943, filed May 14, 1947, and issued June 6, 1950 as Patent No. 2,510,074. Similar condensers 33B are then provided for circuit B. It will be supposed that circuits C and D will be used for some other indication not requiring condensers to produce a line trace.

Circuit E is however provided with an arrangement for producing a graduated circle on which the direction indicated by the trace obtained from circuit A may be read. This arrangement includes a pentode valve 34 the anode of which is connected to the positive high tension terminal 35 through a resistance 36. The cathode is connected to the grounded negative high tension terminal 37 through a conventional bias resistance 38 shunted by a condenser 39. The screen grid is connected directly to terminal 35 and through a resistance 40 to the cathode. The control grid is connected through a resistance 41 to the outlet E of the pulse distributor 29. The suppressor grid is connected to the cathode through a resistance 42 and to an input terminal 43 through a blocking condenser 44. The anode of the valve 34 is also connected to a beam control electrode 45 of the oscillograph 24 through a blocking condenser 46.

The valve 34 should be biased so that when no potential is applied to either the control grid or the suppressor grid, the anode current is small and the anode potential relatively high. When the positive unblocking pulse arrives from outlet E, a negative output pulse will be applied to the electrode 45 and should be arranged to suppress the cathode beam for the period of the pulse. Deflecting potentials are also applied to the four plates of the oscillograph through terminal 25E and the other corresponding terminals (not shown) from any suitable means (also not shown) which would normally cause the cathode ray to produce a circular trace on the screen, were the beam not suppressed.

Short negative graduating pulses are applied to the terminal 43 which periodically counteract the effect of the pulse applied to the control grid and release the beam, so that a number of dots corresponding to the graduating pulses will appear around the circular trace. It will be understood, of course, that the repetition period of the graduating pulses should be small compared with the duration of the unblocking pulses, so that a large number of them will occur during the period of each unblocking pulse. A similar method of producing a graduated circle on the screen of an oscillograph is described in the specification of co-pending application No. 679,942, filed June 28, 1946 now abandoned.

It will be evident that as in the case of Fig. 1, resistance 31 may be connected to terminal 35 instead of to ground, all the rectifiers or diodes being reversed. The pulses from the pulse distributor should in this case be negative pulses instead of positive pulses; and those from outlet E will then need to be inverted by a preceding amplifying stage (not shown), for example, before being applied to the control grid of the valve 34.

What is claimed is:

1. An arrangement for producing a plurality of successive traces on the screen of a cathode ray oscillograph corresponding respectively to a plurality of sources of deflecting potentials, comprising a plurality of series blocking devices respectively connecting all the said sources to the same

one of the deflecting plates of the oscillograph, a plurality of blocking devices corresponding respectively to the said series blocking devices and connected in shunt with the connections between the sources and said deflecting plate, means for periodically unblocking the said series blocking devices in turn, one at a time, and means for unblocking each of the said shunt blocking devices during each period when the corresponding series blocking device is blocked.

2. An arrangement for producing a plurality of successive traces on the screen of a cathode ray oscillograph, comprising a plurality of sources of deflecting voltages, each source having a number of outlets equal to the number of deflecting plates of the oscillograph, means for connecting each outlet of each source to the corresponding plate through an individual series blocking device having a shunt blocking device associated therewith in shunt with said connecting means, means for periodically unblocking simultaneously all the series blocking devices corresponding to each source in turn, only those series blocking devices corresponding to one source being unblocked at one time, and means for unblocking each of the said shunt blocking devices when the associated series blocking device is blocked.

3. An arrangement according to claim 2 comprising a pulse generator having a number of outlets equal to the number of sources, and adapted to produce repeated unblocking pulses at different times from the said outlets, and means for applying the pulses from each of the said outlets to unblock all the series blocking devices corresponding to one of the said sources.

4. An arrangement according to claim 3 in which the pulses are applied to unblock each series blocking device through the corresponding shunt blocking device.

5. An arrangement according to claim 2 in which each series and shunt blocking device comprises a rectifier with unlike electrodes, one electrode of the series rectifier being connected to the electrode of the same kind of the corresponding shunt rectifier, the common point being connected to the corresponding outlet of the deflecting source through a resistance.

6. An arrangement according to claim 5 in which the common points of all the series and shunt rectifiers corresponding to given number of the sources are connected to ground through individual condensers, each of the said one or more sources having a common terminal connected to ground.

7. An arrangement for producing a plurality of successive traces on the screen of a cathode ray oscillograph, said oscillograph comprising means for deflecting said cathode ray, comprising a plurality of sources of deflecting potentials, a plurality of means for coupling said sources to said deflecting means, each of said coupling means comprising a series path and a shunt path and each path including a substantially unidirectional conducting device, and means for varying the conductivity of said devices comprising means for generating a switching voltage and for applying said voltage to said devices in such phase and polarity that only one coupling means is effective to transfer energy at one time and one device in each coupling means is substantially non-conducting when the other is conducting.

8. An arrangement for producing a plurality of successive traces on the screen of a cathode ray oscillograph, said oscillograph comprising

means for deflecting said cathode ray, comprising a plurality of sources of deflecting potentials, and a plurality of means for coupling said sources to said deflecting means, each of said coupling means having a set of input terminals 5 connected to a source and a set of output terminals connected to said deflecting means and comprising a first substantially unidirectional conducting device poled in a first direction with respect to one of said input terminals and connected between said one input terminal and an output terminal, a second substantially unidirectional conducting device poled in said first direction with respect to said one input terminal and connected across a set of said terminals, means for generating a succession of switching voltages and means for coupling a predetermined one of said voltages to said second device for controlling the conductivity of said devices.

9. An arrangement according to claim 8 wherein said devices are rectifiers.

10. An arrangement according to claim 8 further comprising a reactive impedance connected across at least one set of input terminals. 25

11. An arrangement according to claim 10 wherein said reactive impedance is a condenser.

12. An arrangement for producing a plurality of successive traces on the screen of a cathode ray oscillograph, said oscillograph comprising a plurality of means for deflecting said cathode ray and means for varying the intensity thereof, comprising a plurality of sources of deflecting voltages including a circular deflecting voltage source, and means for coupling each of said sources to one of said deflecting means, each coupling means comprising a first and a second rectifier each having unlike electrodes, means for connecting like electrodes of said rectifiers together, means for connecting said connected electrodes to one of said sources and means for

connecting another electrode of said first rectifier to said one deflecting means, and means for connecting the other electrode of said second rectifier to another point in said one source, and said arrangement further comprising means for generating a plurality of switching voltages, means for applying a predetermined one of said switching voltages to the other electrode of said second rectifier, a source of pulses having a short duration with respect to the duration of said predetermined switching voltage, a translating device having means for preventing the transfer of energy and means for permitting the transfer of energy, one of said two last mentioned means having greater control than the other and one being connected to said generating means and being under control of said predetermined switching voltage and the other being connected to said pulse source, and means for 20 connecting said translating means to said intensity varying means for controlling the intensity of said cathode ray during the existence of said predetermined switching voltage.

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