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DEVICE COMPRISING A CATHODE-RAY OSCILLOGRAPH ADAPTED TO MAKE AT LEAST TWO MEASURING VOLTAGES SIMULTANEOUSLY PERCEPTIBLE

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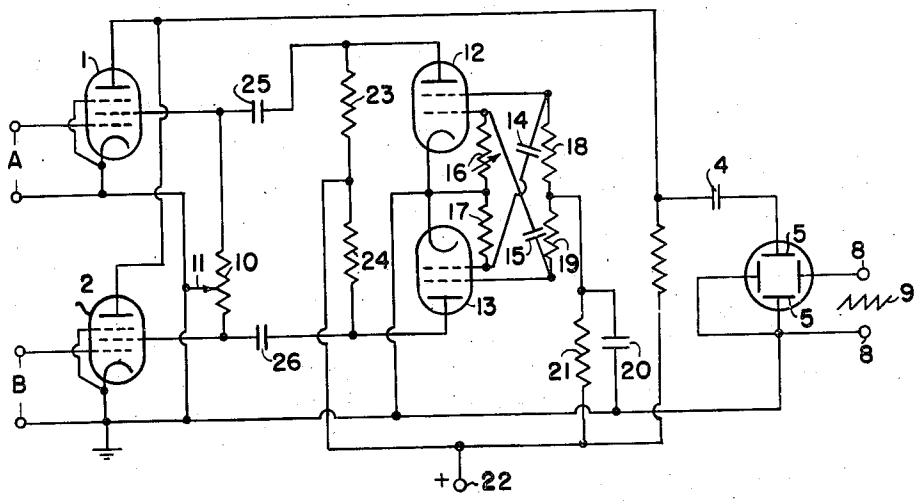


FIG. 1

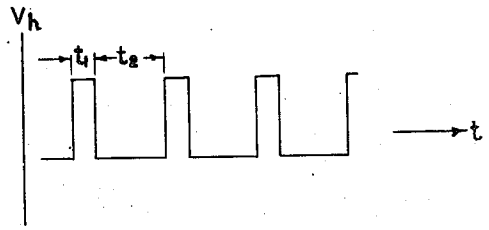


FIG. 2

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DEVICE COMPRISING A CATHODE-RAY OSCILLOGRAPH ADAPTED TO MAKE AT LEAST TWO MEASURING VOLTAGES SIMULTANEOUSLY PERCEPTIBLE

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5 Claims. (Cl. 315—26)

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This invention relates to a device adapted to make two or more non-recurring or recurring phenomena simultaneously perceptible, measuring voltages corresponding to these phenomena alternately controlling in rapid sequence the deflection in one and the same direction of the cathode-ray beam of a cathode-ray oscillograph.

The measuring voltages may then alternately be supplied, for example with the aid of a rotary mechanic switch (cf. for example British patent specification No. 403,060), to a deflection system of the cathode-ray oscillograph, whereas the other deflection system has supplied to it, for example, a time-base voltage which in the case of recurring phenomena varies preferably in synchronism with one of these phenomena or a harmonic thereof.

For the purpose of alternately supplying the phenomena to the oscillograph, discharge paths serving as inertialess switches are preferably used instead of mechanic switches. Diodes or blocking-layer rectifiers may be used, for example, which are blocked periodically with the aid of an auxiliary alternating voltage of preferably sinusoidal or rectangular form (cf. British patent specification 476,224). It is also possible to utilise gaseous discharge tubes as substantially inertialess switches (cf. for example the article by R. Sewig in "Zeitschrift für technische Physik" 1933, vol. 14, pages 152, 153). Further, the ordinary grid-controlled high-vacuum tubes may be used as switching tubes (cf. for example the last-mentioned article and also French patent specification 654,354 and British patent specification 357,968).

The auxiliary voltage required when discharge paths are used as switches, which voltage preferably varies rectangularly with time, may be generated, for example, with the aid of a cathode-ray tube in which a certain number of collecting electrodes are arranged beside each other and successively struck by the cathode-ray beam (cf. for example the above-mentioned French patent specification No. 654,354), or it may be derived from a multivibrator circuit.

The frequency of switching, i. e. the frequency of the auxiliary voltage, for non-recurring phenomena is chosen in such manner that it is considerably higher than the fundamental frequency of the phenomena to be observed; in the

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case of recurring phenomena the frequency of switching, in addition to being considerably higher than the fundamental frequency, may be chosen such that it corresponds to the fundamental frequency or a subharmonic thereof (cf. for example the above-stated British patent specification No. 403,060). In the former case the screen of the cathode-ray tube has formed on it curves produced in points, in the latter case not interrupted curves.

The known devices of the indicated type, independently of the switching device or the frequency of switching utilized, have the drawback that the multiple oscillograms can difficultly be read if the amplitudes of the simultaneously produced curves are of different size. This is the case, for example, if in recording a phenomenon the screen has at the same time projected on it a sinusoidal voltage of known frequency to enable with the aid of the latter voltage to determine in a simple manner the lapse of time between two arbitrary points in the oscillogram. The amplitude of this sinusoidal reference voltage is preferably given a comparatively small value, in order that over crossings in the multiple oscillogram may be avoided as much as possible.

According to the invention, the said drawback in devices of this kind is obviated by that the times during which at least two of the measuring voltages control the deflection of the cathode-ray beam are made different from each other.

For example, when taking a twofold oscillogram, one thus obtains that the measuring voltage having the larger amplitude is longer active than the other measuring voltage. Since the mean quickness of writing of the cathode-ray beam (i. e. the quickness with which the cathode-ray beam is moved across the screen) increases with the amplitude of the measuring voltage to be recorded, as a result of which the light intensity of the image obtained is smaller according as the amplitude is larger, the effect of the greater quickness of writing upon the light intensity is neutralised by causing the measuring voltage having the larger amplitude to be longer active. It is thus possible with measuring voltages having different amplitudes to obtain curves of at least substantially equal light intensity and consequently equal sharpness.

For the purpose of obtaining an optimum

adaptation of the times during which the different measuring voltages control the oscillograph to the amplitudes of the measuring voltages, the ratio of the said times is preferably adjustable.

In order that the invention may be more clearly understood and readily carried into effect, it will be described more fully by reference to the accompanying drawing.

Fig. 1 represents one advantageous form of construction of a device according to the invention for simultaneously two phenomena.

Fig. 2 shows as a function of time the auxiliary voltage used in the device of Fig. 1 for switching.

In Fig. 1, 1 and 2 are amplifying tubes serving respectively to amplify the measuring voltages A and B supplied to the control grids concerned, the amplified measuring voltages set up at the anode resistance 3 which is common to both tubes being supplied via a condenser 4 to the vertical deflecting electrodes of a cathode-ray oscillograph 6. A sawtooth time-base voltage 9 is supplied to the horizontal deflecting electrodes, for example via terminals 8.

The amplifying tubes 1 and 2 are alternately released and blocked in rapid sequence by means of a rectangular auxiliary alternating voltage which is set up at a resistance 10 interposed between the screen grids of the amplifying tubes 1 and 2 and is derived from a multivibrator circuit of a construction known per se.

For the mutual displacement in the vertical direction of the curves A, B produced on the screen of the cathode-ray tube, the cathodes of the amplifying tubes are connected to an adjustable tapping point of the resistance 10.

The multivibrator circuit comprises two push-pull connected and crosswise feedback-coupled screen-grid tubes 12, 13, the feed-back being effected with the aid of condensers 14, 15 connected between the screen grid of the one tube and the control grid of the other tube. The control grids of the tubes are connected to the earthed cathodes through resistances 16 and 17 respectively, while screen-grid resistances 18, 19 are connected to the positive terminal 22 of a source of direct voltage (not shown) through a resistance 21 shunted by a condenser 20.

The output voltage of the multivibrator circuit is derived from the anode resistances 23, 24 and supplied to the resistance 10 via separating condensers 25, 26. The point of connection of the anode resistances 23, 24 is also connected to the terminal 22 of the source of direct voltage.

In the known devices of the indicated type for producing twofold oscillograms, the multivibrator circuit is constructed entirely symmetrically, so that the times during which the amplifying tubes 1 and 2 were alternately active and hence also the times during which the different measuring voltages controlled the oscillograph were always equally great.

According to the invention, in the device shown the symmetry of the multi-vibrator circuit is intentionally avoided, for example by giving equal values to the condensers 14, 15 but different values to the resistances 16, 17.

The output voltage v_h of the asymmetric multivibrator circuit thus obtained exhibits, for example, the variation shown in Fig. 2 as a function of the time t, the time t_1 during which the tube 12 is traversed by current and consequently the amplifying tube 1 is blocked, being considerably smaller than the time t_2 during which the tube 13 is traversed by current and the amplifying tube 2 is blocked. Consequently, the measuring voltage A will act upon the oscillograph during a longer time than the measuring voltage B, so that with a larger amplitude of the measuring voltage A curves of equal intensity and sharpness are nevertheless obtained.

As mentioned above, it is advantageous to regulate the ratio of the times t_1 and t_2. In the device shown, this may be effected by varying the resistance 16 in the multivibrator circuit, as is schematically indicated by an arrow in the figure.

It is evident that the invention may be applied similarly to devices for oscillographing more than two measuring voltages. In recording, for example, non-recurring electrical phenomena of which the variation of voltage and current in a circuit as a function of time, as well as a sinusoidal reference voltage must be recorded simultaneously, it is frequently advantageous that the voltage and the current to be measured are active during approximately equally great times, but that the reference voltage is active only during a considerably shorter time. The auxiliary voltage required therefor may be generated, for example, with the aid of a rotary mechanic switch, the extremity of a switching arm moved with uniform quickness touching successively three different contact surfaces, two of which are of equal width, whereas the third contact surface has a considerably smaller width.

In addition to the stated advantage of equal intensity of all the curves produced, with the use of the invention one also obtains, for example, in the last-mentioned case, a more detailed reproduction of the phenomena to be measured.

It has been found that in particular when the multiple oscillograms obtained, are photographed an appreciable improvement is achieved by the use of the invention.

What I claim is:

1. An oscillographic system adapted to exhibit simultaneously along a common time base the waveforms of a plurality of voltages having different amplitudes, said system comprising a cathode-ray tube having a fluorescent screen and first and second deflection means for displacing the ray in mutually perpendicular directions, means to apply a sawtooth time base wave of a prescribed frequency and amplitude onto one of said deflection means, and means independent of said base wave to apply sequentially onto the other of said deflection means each of said voltages for a period whose duration depends on the amplitude thereof whereby the waveforms displayed on said screen are of substantially like intensity.

2. An oscillographic system adapted to exhibit simultaneously along a common time base the waveforms of first and second voltages having different amplitudes, said system comprising a cathode-ray tube having a fluorescent screen and first and second deflection means for displacing the ray in mutually perpendicular directions, means to apply a sawtooth time base wave of a prescribed frequency and amplitude onto one of said deflection means, means to apply alternately said first and second voltages onto the other of said deflection means, and means independent of said base wave to control the time ratio of the periods during which the respective voltages are applied onto said other deflection means in accordance with the ratio of the amplitude of said voltages.

3. An oscillographic system adapted to exhibit simultaneously along a common time base the waveforms of first and second voltages having

different amplitudes, said system comprising a cathode-ray tube having a fluorescent screen and first and second deflection means for displacing the ray in mutually perpendicular directions, means to apply a sawtooth time base wave of a prescribed frequency and amplitude onto one of said deflection means, a pair of amplifiers each arranged to impress a respective one of said first and second voltages onto the other of said deflection means, and means independent of said base wave for alternately rendering said amplifiers operative for a period whose duration is proportional to the amplitude of the voltage applied as an input thereto.

4. An oscillographic system adapted to exhibit simultaneously along a common time base the waveforms of first and second voltages having different amplitudes, said system comprising a cathode-ray tube having a fluorescent screen and first and second deflection means for displacing the ray in mutually perpendicular directions, means to apply a sawtooth time base wave of a prescribed frequency and amplitude onto one of said deflection means, a pair of amplifiers each arranged to impress a respective one of said first and second voltages onto the other of said deflection means, means independent of said base wave for alternately rendering said amplifiers operative for a period whose duration is proportional to the amplitude of the voltage applied as an input thereto, said last named means including an asymmetrical multivibrator producing alternating rectangular pulses, each of said pulses being applied to said first and second amplifiers to disable one and simultaneously render the other operative.

5. An oscillographic system adapted to exhibit simultaneously along a common time base the

waveforms of first and second voltages having different amplitudes, said system comprising a cathode-ray tube having a fluorescent screen and first and second deflection means for displacing the ray in mutually perpendicular directions, means to apply a sawtooth time base wave of a prescribed frequency and amplitude onto one of said deflection means, a pair of amplifiers each including an electron discharge device having a control grid, a screen grid and an anode, the anodes of the amplifier devices both being coupled to the other of said deflection means, means to apply said first and second voltages to the respective control grids of said amplifier devices, and an asymmetrical multivibrator independent of said base wave for alternately rendering said amplifiers operative, said multivibrator including a pair of electron discharge devices each having a control grid, a screen grid and an anode, said pair of devices being arranged in push-pull relation, the screen grid in each of said pair of devices being feedback coupled to the control grid in the other, the anodes of said pair of devices being coupled respectively to the screen grids of said amplifier devices.

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