

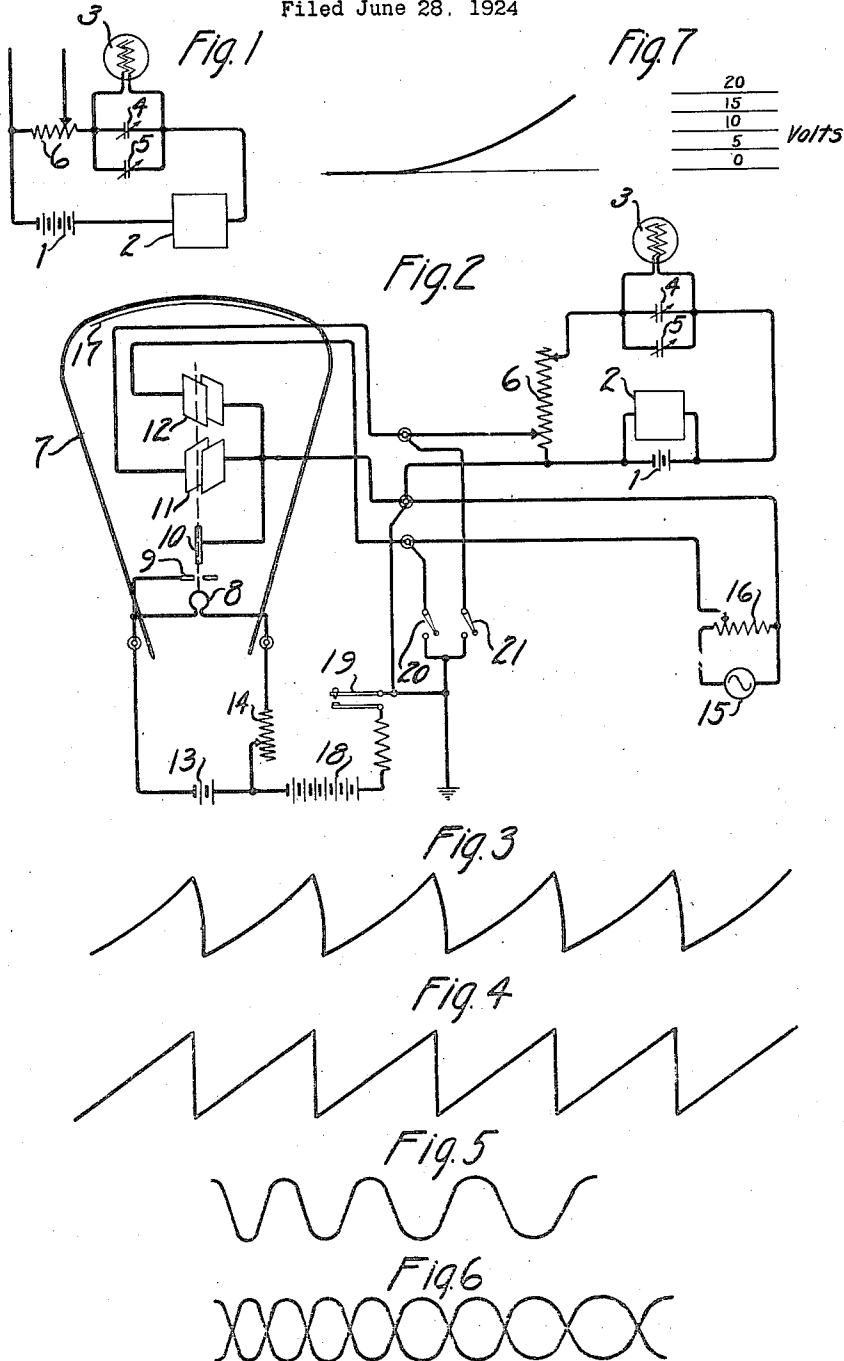
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EMPLOYMENT OF CATHODE RAY OSCILLOGRAPHS

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UNITED STATES PATENT OFFICE.

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EMPLOYMENT OF CATHODE RAY OSCILLOGRAPHS.

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This invention relates to methods and means for studying the wave form of oscillating currents through the use of a cathode ray oscillograph.

5 An object of the invention is to obtain an accurate representation of the wave form of an oscillating current on a cathode ray oscillograph.

10 A related object of the invention is to improve the operating characteristics of systems of the above character.

Normally, only a straight line deflection is produced when an alternating current supply is applied across one pair of oscillograph 15 deflector plates, and it has been necessary to employ some external device for the provision of a second deflection at right angles to that due to the alternating current, which should be proportional to time.

20 Heretofore, the methods employed for accomplishing this purpose have been both costly and cumbersome. According to this invention, however, a simple and inexpensive arrangement is provided by which an 25 accurate representation of the wave form of an oscillating current can be obtained on a cathode ray oscillograph.

According to a feature of the invention, this is achieved by employing a circuit for 30 the production of an ancillary alternating voltage of definite frequency, which depends for its action on a neon lamp, or other gas filled tube having two electrodes and with similar electrical characteristics, namely that 35 the discharge between the electrodes strikes when the difference of potential between them has been increased to some fixed limiting value, but when once it has struck the 40 discharge does not fail until the difference of potential has been reduced to another and lower limiting voltage.

This circuit for producing an ancillary alternating voltage of definite frequency is connected to one pair of deflector plates, 45 while the source of current whose wave form is to be studied is connected across the other pair of deflector plates of the cathode ray oscillograph.

50 Other features and advantages of the invention will appear from the following description, taken in connection with the accompanying drawing, in which

Fig. 1 represents a method of obtaining 55 by means of a neon lamp.

Fig. 2 is a diagrammatic illustration showing a complete arrangement of the cathode ray oscillograph and the time deflection device arranged to examine an alternating current wave form.

60 Figs. 3 to 7, inclusive, show curves illustrating the operation of the systems of Figs. 1 and 2.

In the following description, the words "neon lamp" are to be taken to mean any 65 suitable two-electrode gas filled glow discharge tube of the type described in the "Wireless World", December 5, 1923, page 310.

Referring now to Fig. 1 in which 1 is 70 a battery, 2 is a voltage regulator which may be inserted if necessary, 3 is a neon lamp, 4 a coarse adjustable condenser, and 5 a fine adjustable air condenser, the circuit is arranged in such a manner that the 75 discharge in the lamp "strikes" and "fails" alternately, thus causing the lamp to "blink".

The potential difference across the lamp 80 gradually builds up to the critical "striking" value of the lamp and then falls below this value so that the lamp alternately "strikes" and "fails".

Assuming that the lamp is designated to 85 light ordinarily at 220 volts, 1 would be a battery of 220 volts, and 6 a resistance of say 100,000 ohms, and 4 and 5 variable condensers covering a capacity from 0.0001 to 1 m. f. By this means, with 6 at 100,000 90 ohms, frequency variations from about half a cycle to 10,000 cycles per second can be obtained.

Referring now to Fig. 2, 7 represents a cathode ray oscillograph having a filament 8, 95 a screen 9, an anode 10, and pairs of deflecting plates, 11 and 12.

The filament is caused to glow by current obtained from the battery 13 through the adjustable filament resistance 14. Current is supplied to the anode 10 from the 100 battery 18 when the key 19 is closed.

Upon current passing through the filament, electrons are emitted and those not 105 impeded by either the screen 9 or the anode 10, form a ray which can be deflected by the deflector plates 11 or 12, these pairs of plates being arranged at right angles with one another.

Assuming that it is desired to study the 110 wave form of the generator 15, the voltage

across a potentiometer 16 is applied to one of the pairs of deflector plates 12, and variations in this voltage will cause the cathode ray to be deflected correspondingly.

In order to give the cathode ray a further definite periodic deflection at right angles to that caused by the alternator 15, a voltage across a portion of the potentiometer 6, in the time deflection circuit is placed across the deflector plates 11. By this means the cathode ray acted upon by these two forces describes, on the sensitized surface 17, a clear representation of the wave form of the alternator 15 in the usual sinusoidal form, provided that the time deflection device has been suitably tuned.

The bottom deflector plates 11, are employed to govern horizontal deflection of the ray.

The potential difference across the resistance 6 is proportional to the current in the variable condensers 4, 5 and the neon lamp 3, so that the ray will be horizontally deflected at a frequency equal to that of the flashes of the lamp 3.

The output of the generator 15, under examination, is connected through the potentiometer 16, or otherwise, to the plates 12, governing vertical deflection.

The frequency of the lamp flashes is adjusted by means of the variable condensers 4, 5 or if desired, by altering the series resistance 6, or by both, until an integral multiple of that frequency is equal to the frequency of the A. C. supply under examination. This is easily achieved as the traced wave can be observed to stop momentarily as the condenser is swung across from say 0.001 m. f. to 0.1 m. f., and the tuning can quickly be narrowed down to nearly the correct value, and completed with the air condenser 5.

The A. C. wave is traced out in the sinusoidal form, and variations from the true sine wave are easily seen.

It is important that the battery supply 1, for the neon lamp 3, shall be constant, as variations in voltage means variations in the potential difference across the condensers, and in the frequency of the flash.

A voltage regulator of any known design may be incorporated in the arrangement if no constant source of supply is available for the neon lamp.

Irregularities in D. C. supplies may be examined in the same manner as the wave form of alternator 15, flickerings in the straight line obtained with a steady D. C. supply giving an indication of irregularities of voltage.

Other similar effects may be examined in the same way, wireless "atmospherics" and similar transient effects as well as any voltages, currents, etc., which vary with time may be charted by means of this device.

Calculations show that the oscillations in the series resistance being dependent upon the charge and discharge of a condenser, follow a characteristic similar to that shown in Fig. 3.

The ideal and distortionless characteristic for tracing out wave forms would be as shown in Fig. 4. It is not thought that the cathode ray oscillograph, is or will be, much used for accurate measurements, owing to the difficulties of photographing the figure. The oscillograph is used more for visual examinations, and it is considered doubtful, therefore, if the slight spreading out, as explained later, resulting from the wave form of the time deflection will have serious results on the utility of the device. The neon lamp time deflection device has been tried in conjunction with the outputs of valve oscillators at 150 to 30,000 cycles with ringing generators, hand generators and other sources of alternating current from 16 cycles to about 30,000 cycles. It is found to be easily tuned at all frequencies, giving a clear image of the wave form. Slight irregularities in the outputs of machines due to commutator irregularities etc., are easily observed as well as larger deviations from true sinusoidal form due to the presence of harmonics. The effect of the wave form of the oscillations in the neon lamp circuit as described above is merely to spread out to a greater amplitude the waves at one end of the series from the A. C. supply under examination as shown in Fig. 5.

This, however, only prevents exact numerical measurements from being taken. Visual examination is, if anything, simplified by this effect, as irregularities are accentuated, and the different parts of a wave still remain in their correct proportion.

A curious, and at the same time useful effect, is obtained when the neon lamp oscillator makes two complete vibrations, while the generator supply makes 1, 3, 5 or any odd number of cycles.

This means that the neon lamp oscillator must go through two complete cycles before the same track is retraced by the cathode ray so that two reproductions of the generator wave form are superposed; this results in a curve of the type illustrated in Fig. 6.

A useful means is thus obtained of comparing the top half of the wave with the lower half, making irregularities between the two halves more easily seen.

Similar effects are obtained with 3, 4, etc. superposed waves, 120°, 90°, etc., respectively apart in phase, when the frequencies of the two oscillations bear relations to each other like those occurring in the more complicated Lissajou's figures.

The neon lamp time deflection device has been used as an easy means of observing voltage surges. A horizontal deflection pro-

duced with the lamp is suddenly bent upwards or downwards by a voltage surge. By means of transparent squared paper held over the screen of the tube calibrated for deflection per volt, measurements of the voltage surge were easily obtained. The type of effect observed is shown in Fig. 7.

If desired keys 20 and 21 may be employed for the purpose of separately observing either the horizontal or vertical deflection of the cathode ray. Thus, when the key 20 is closed the deflector plates 12 are short circuited and consequently no vertical deflection takes place. Similarly, by closing the key 21 the plates 11 are short circuited and hence the cathode ray is not deflected horizontally.

What is claimed is:

1. In combination, a cathode ray oscillograph, means for deflecting the beam of cathode rays in one direction, and means including a gas-filled discharge tube for deflecting said beam of rays in another direction.

2. In combination, a cathode ray oscillograph, means for deflecting the beam of cathode rays in one direction in accordance with a source of current whose wave form is to be examined, and means including a neon discharge lamp for deflecting said beam of rays in another direction.

3. In combination, a cathode ray oscillograph, means including a source of current whose wave form is to be examined for deflecting the beam of cathode rays in one direction, and means including a gas-filled discharge tube for deflecting said beam of rays in another direction.

4. In combination, a cathode ray oscillograph, a source of alternating current whose wave form is to be examined and an ancillary source of alternating current generating two complete cycles while said first source generates an odd number of cycles, means controlled by said first source for deflecting the beam of cathode rays in one di-

rection, and means controlled by said ancillary source for deflecting said beam of rays in a direction at right angles to the plane of said first deflection.

5. In combination, a cathode ray oscillograph having two pairs of deflector plates, a source of current whose wave form is to be examined connected across one pair of deflector plates, and a circuit for the production of an ancillary alternating current connected across the other pair of deflector plates, said circuit including a gas-filled discharge tube for determining the frequency of said ancillary current.

6. In combination, a cathode ray oscillograph having two pairs of deflector plates, a source of alternating current connected across one pair of plates, and an ancillary source of alternating current connected across the other pair of deflector plates, said ancillary source generating two complete cycles while the first source generates an odd number of cycles.

7. In combination, a cathode ray oscillograph having two pairs of deflector plates, a source of current connected across one pair of deflector plates, and a circuit for the production of an ancillary alternating current connected across the other pair of deflector plates, said circuit including a constant source of direct current, a resistance, a gas-filled discharge tube and a condenser in shunt of said tube.

8. In combination, a cathode ray oscillograph having two pairs of deflector plates, a source of alternating current connected across one pair of deflector plates, and a circuit for the production of an ancillary alternating current connected across the other pair of deflector plates, such circuit including a constant source of direct current, a resistance, a neon lamp, and coarse and fine adjustable condensers in shunt of said lamp.

In witness whereof, I hereunto subscribe my name this 13th day of June A. D., 1924.

NORMAN KIPPING.