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V. SUBRIZI

2,132,225

TIMING APPARATUS

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FIG. 1

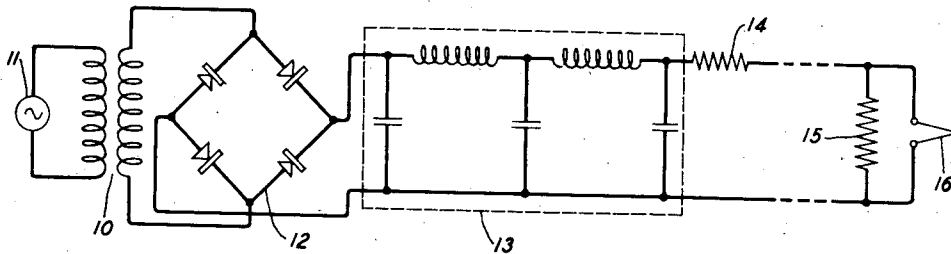


FIG. 2

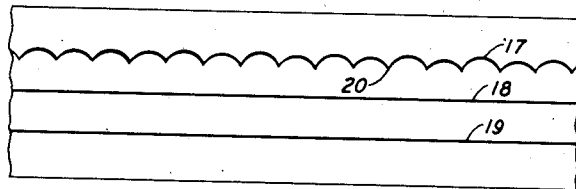


FIG. 3

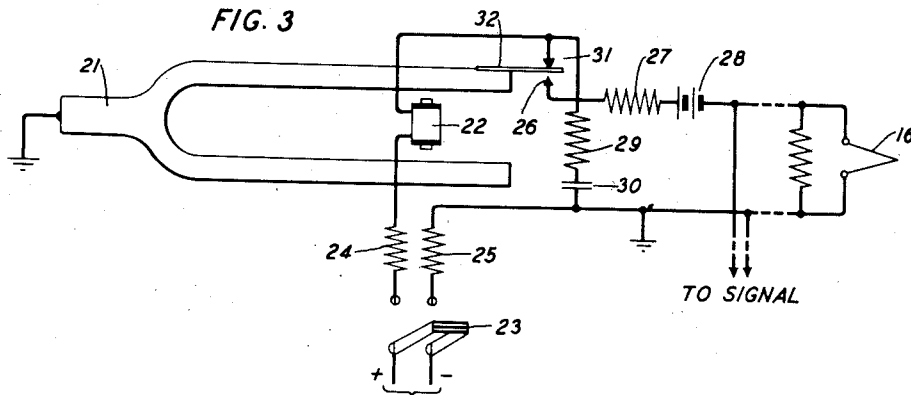
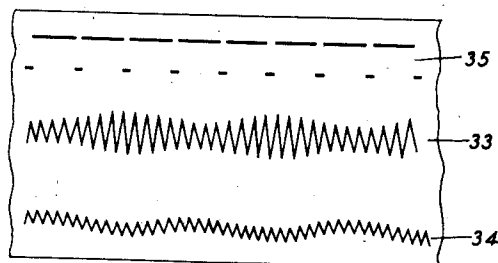


FIG. 4



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## UNITED STATES PATENT OFFICE

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## TIMING APPARATUS

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3 Claims. (Cl. 171-95)

This invention relates to oscillograph records and particularly to apparatus for timing such records.

In the process of making oscillograms one method followed consists in causing a string of a galvanometer to vibrate in accordance with variations in an electric current and projecting the shadow of the vibrating string upon a rapidly moving light sensitive paper. In order to ascertain the rate at which the string vibrates some reference mark occurring at known time intervals must be made on the paper.

The object of this invention is an apparatus for obtaining electrically sharply defined reference points on an oscillograph, the reference points occurring at known time intervals.

In its preferred form this invention contemplates taking an electric current oscillating at either known or unknown frequency, changing its form to one wherein sharply defined reference points occurring at known frequency appear and recording the vibrations of the string through which the current is sent simultaneously with the vibrations of the string actuated by the current under investigation. In one form the current under investigation is utilized as a vehicle for the timing mark, but the marks are of such short duration that the general shape of the current wave is substantially unchanged by the superposition of the timing pulses.

In the drawing which accompanies this specification and forms a part thereof:

Fig. 1 is a wiring diagram of one form of the invention;

Fig. 2 is a facsimile of an oscillogram timed by the method of Fig. 1;

Fig. 3 is a wiring diagram of an interrupter for timing an oscillogram; and

Fig. 4 is a facsimile of an oscillogram timed by the method of Fig. 3.

Referring now to Fig. 1, 10 is a step-down transformer, the primary of which is connected to a source of alternating current 11 of constant frequency. Such a source may be the commercial 60-cycle mains now generally available over the entire country. The secondary of transformer 10 is connected to a rectifier 12, preferably of the copper-oxide type because of the ruggedness and simplicity of such a rectifier. The output of rectifier 12, that is, the rectified current, is sent through a filter 13 which is adapted to suppress all frequencies above about a thousand cycles to prevent the recordation of disturbing frequencies which would affect the accuracy of the timing curve. A series resist-

ance 14 and a shunt resistance 15 are used to still further decrease the strength of the current so that the oscillograph string operated thereby will not be vibrated beyond its maximum allowable amplitude. The oscillograph string is shown diagrammatically at 16. The remainder of the oscillograph, such as the magnet, additional strings, light system and camera, is not shown since this portion of the oscillograph may take the usual form such as is disclosed in United States Patent 1,871,361, to A. M. Curtis dated August 9, 1932.

To operate the timing device it is necessary that one string of the oscillograph be available for that purpose. The available string is connected to the timing circuit as shown in Fig. 1. The remaining strings of the oscillograph are connected to the circuit the currents of which are to be investigated.

The record obtainable by this method is shown in Fig. 2. The rectified timing current curve is shown at 17 and to show it more clearly, the strings 18 and 19 available for recording the signal current or currents are shown inactive. The points of reference 20 are very sharply defined and therefore easily located. Since the curve crosses the zero axis twice during each cycle, the number of reference points per unit time is equal to twice the frequency of the timing current, and the time interval between reference points is consequently one-half the time of one cycle. It is understood that the other strings 18, 19 of the oscillograph may be used simultaneously with the recordation of the timing curve and that it is not necessary to record the timing curve by a separate and previous operation.

In the form shown in Fig. 3 one of the strings used to record variations in the signal current to be investigated is also used for timing purposes. The current is interrupted at known time intervals and for a very brief period by a tuning fork 21. The fork is operated from any suitable source of current, such as a 110-volt direct current main, by means of actuating electromagnet 22. A switch 23 is used in the line to control the operation of the tuning fork. The circuit is completed through the prongs of tuning fork 21 and ground, the negative side of the main being grounded. A resistance 24 is inserted in the positive lead to cut down the current to a degree just sufficient to operate the tuning fork. A similar resistance 25 may be used in the negative lead to prevent any damage to the apparatus which might result from in-

advertently reversing the positive and negative connections. At the end of tuning fork 21 is a contact 26 to which one side of oscillograph string 16 is connected through a resistance 27 and a small battery 28. The purpose of resistance 27 and battery 28 is to provide a definite displacement of string 16 when the timing mark is to be made so that should contact 26 become clogged and dirty and thereby only partially short-circuit the string, the displacement would still be sufficient for timing purposes. In situations where the contact can readily be kept clean, battery 28 and resistance 27 can be omitted. The signal current is connected across the string as shown. A resistance 29 and a condenser 30 are connected in series between contact 31 and ground to reduce sparking.

When it is desired to time an oscillograph, current from the line is turned on through switch 23. The circuit through electromagnet 22 is completed through prong 32 and contact 31 against which prong 32 normally rests. The completion of the circuit causes electromagnet 22 to attract prong 32, and thereby break the circuit through itself and also to put ground on contact 26 which prong 32 touches in the course of its vibration toward electromagnet 22. This short-circuits string 16, if battery 28 and resistance 27 are not used and if the latter are used, it puts a potential across the string and causes the string to move a definite distance away from its position at that instant. The displacement of the string is of just sufficient duration to cause a dot to be formed on the oscillogram.

The form of timing curve which results from the above apparatus is shown in Fig. 4. The curves of the phenomena under observation are shown at 33, 34 and 35. Curve 35 is the curve of a rectified wave which is chosen simply for the purpose of illustration and it may be of any form whatever without affecting in any way the operation of the timing device. At regular intervals string 16 is displaced to the position of zero amplitude by the short-circuiting of its ter-

minals. The time interval between the displacement is known since the frequency of the tuning fork is known, that is, the time is the reciprocal of the frequency.

What is claimed is:

1. In combination with an oscillograph having means for producing an oscillogram, means cooperating therewith for timing said oscillogram comprising a source of electric current, means connected to said current source adapted to produce therefrom a series of sharply defined non-sinusoidal current peaks of predetermined frequency, a string-type galvanometer responsive to said current peaks and adapted to record their traces adjacent to and simultaneously with the recording of the oscillogram to be timed.

2. In combination with an oscillograph having means for producing an oscillogram, means cooperating therewith for timing said oscillogram comprising a source of alternating current of known frequency, rectifier means connected to said source to produce therefrom a series of sharply defined non-sinusoidal current peaks, a string-type galvanometer responsive to said current peaks and adapted to record their traces adjacent to and simultaneously with the recording of the oscillogram to be timed.

3. In combination with an oscillograph having means for producing an oscillogram, means cooperating therewith for timing said oscillogram comprising a source of electric current, a vibrating tuning fork of known frequency having electric contacts associated with one prong thereof and adapted to intermittently and momentarily close in synchronism therewith, circuits connecting said contacts to said source, a string-type galvanometer also connected to said source, said galvanometer being responsive to the abrupt changes in potential produced by the intermittent closing of said contacts and adapted to record their traces adjacent to and simultaneously with the recording of the oscillogram to be timed.

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