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CALIBRATING DEVICE FOR THERMIONIC AMPLIFIERS

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FIG. 1.

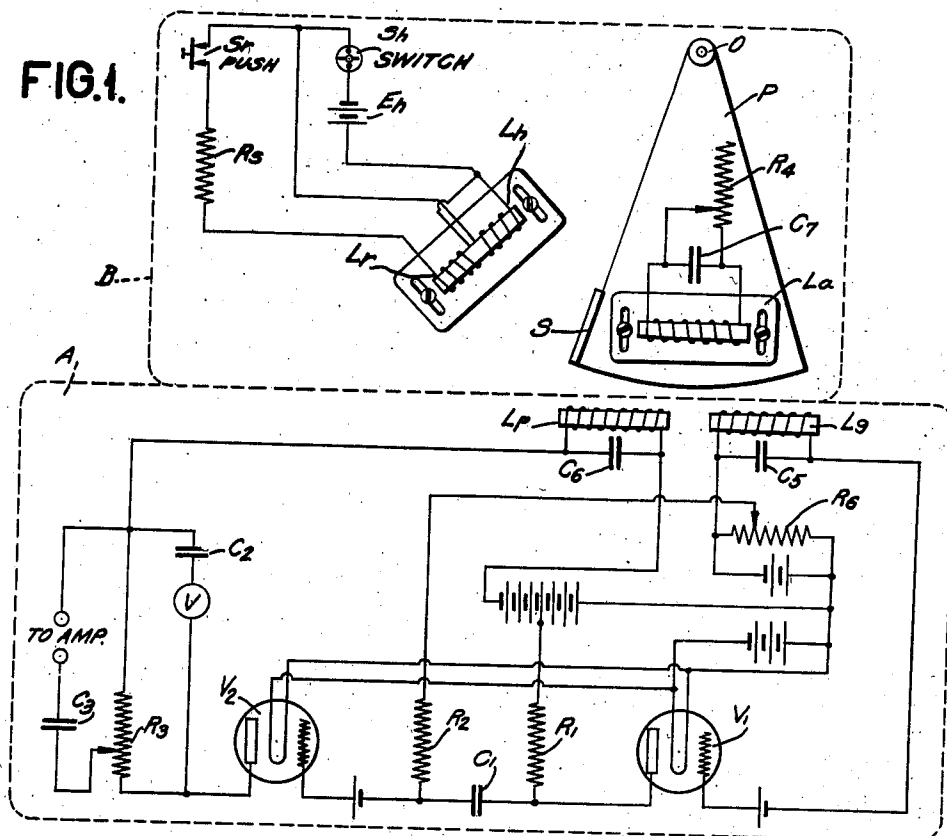
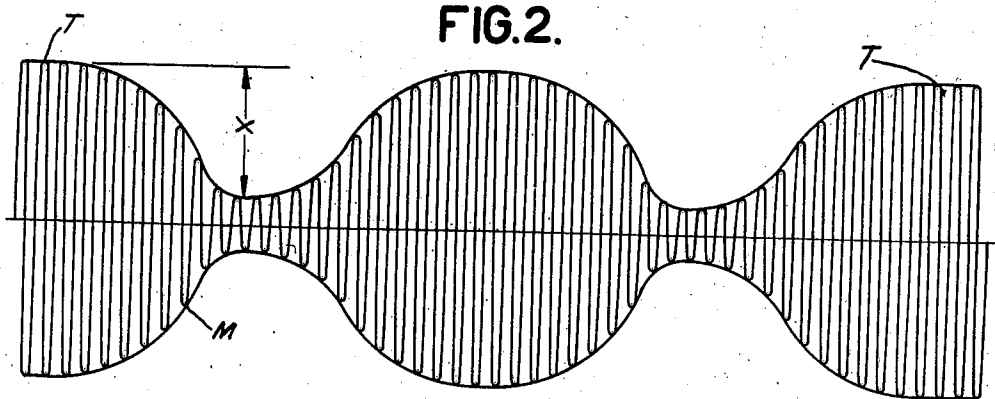


FIG. 2.



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CALIBRATING DEVICE FOR THERMIONIC AMPLIFIERS

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2 Claims. (Cl. 179-171)

Thermionic amplifiers are now widely employed for the general purpose of amplifying electric impulses and frequently are designed for the particular task which they are required to perform. Thus, in the Sperry flaw detector mechanism wherein flaws in rails, tubes and the like are detected, an impulse is generated which is amplified by a thermionic amplifier having specially designed properties so that said amplifier shall be particularly responsive to the wave form which is generated by the detector mechanism acting upon defects in these materials. Where a thermionic amplifier has been designed with certain predetermined properties to respond to particular wave forms, it is important to know at all times whether said amplifier is in operative condition and adjusted to required sensitivity. For this purpose, it is highly desirable to be able to generate at will an impulse of the type to which the amplifier is specially designed to respond. It is the principal object of this invention, therefore, to provide a calibrating device which is capable of generating at will an impulse having a wave form substantially similar to the type of wave form to which the amplifier is particularly designed to respond.

This invention, however, is not limited to a calibrator which is designed to generate a wave form similar to that generated when a detector mechanism detects a defect in metal, but broadly is adapted for calibrating any amplifier by generating a predetermined type of wave form.

For the above purpose, I employ a calibrator which has means for setting up an oscillatory circuit for establishing an oscillation of predetermined frequency and amplitude, and then modulating this oscillation by abstracting energy from the oscillatory circuit at a predetermined rate and to a predetermined degree. By this means, an impulse of modulation of predetermined amplitude and duration may be obtained. This impulse is impressed upon the input of the amplifier, and since the input is known, the output of the amplifier will give an indication as to whether the amplifier is in proper working order or not.

Further objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawing:

Fig. 1 is a wiring diagram illustrating the principles embodied in this invention.

Fig. 2 is an oscillogram illustrating the operation of the Fig. 1 device.

Referring to Fig. 1 of the drawing, it will be

seen that this invention comprises an oscillatory circuit, the mechanism for which is included in the dotted rectangle indicated at A. This circuit may comprise an oscillator tube V₂ designed to operate at a predetermined frequency. The vacuum tube V₁ serves as an amplifier to increase the energy input to the grid of tube V₂. The inductance L_p in the plate circuit of the oscillator tube V₂ is magnetically coupled to inductance L_g in the grid circuit of the amplifier tube V₁. The system is tuned by condensers C₅ and C₆ so that the system oscillates at the required frequency, developing a continuous wave voltage of that frequency across plate resistance R₃. The amplitude of the oscillatory voltage across R₃ is adjusted by means of bias control R₆. The other constants of the circuit are chosen so that the form of the oscillatory wave is an approximate sine as indicated by the unmodulated portions T of Fig. 2. The amplitude of the oscillatory voltage developed across R₃ is indicated by voltmeter V which is connected across R₃ through condenser C₂, so that only the A. C. voltage across the resistance is indicated on the meter. The system is thus a source of constant amplitude, constant frequency, alternating current, which can be observed on voltmeter V and readjusted as necessary by resistance R₆ or by adjusting plate voltages to the amplifier tube V₁ or the oscillator tube V₂.

The oscillatory voltage across R₃, or some portion of it, is obtained at the output terminals marked "To amp," through a low reactance condenser C₃ which blocks direct current and passes alternating current and is made large enough to pass the A. C. without appreciable loss. A portion of the constant amplitude, constant frequency A. C. is fed to the amplifier to be calibrated. The amplitude of that portion is controlled by adjustment of R₃.

Thus by the above described mechanism a carrier wave of predetermined constant amplitude and frequency may be delivered to the amplifier merely by connecting the input plugs from the amplifier to the plugs marked "To amp" in Fig. 1. The object of this invention is to provide means whereby the above carrier wave may be modulated to generate a desired impulse of the type to which the amplifier is designed to respond for the purpose of determining whether or not the amplifier in fact responds to this impulse and therefore to determine whether or not the amplifier is in proper operating condition. For this purpose, there may be provided a periodically-acting mechanism which is designed to ab-

abstract energy from the oscillatory circuit previously described for an interval which is predetermined. The interval of energy abstraction may be, by design, controlled and made small relative to the period of the actuating mechanism so that an isolated impulse is produced. One such arrangement is disclosed in Fig. 1 and comprises a pendulum P pivoted at point O and carrying a tuned magnetic circuit comprising an inductance L_a , resistance R_4 and condenser C_7 . This magnetic circuit is positioned so that as the pendulum P swings through a cycle, the inductance L_a swings past the inductances L_g and L_p to vary the coupling between the last two named inductances and abstract energy from the oscillatory circuit, thus varying said circuit. Inductance L_a is tuned to the required frequency by condenser C_7 so that when L_a is coupled to the oscillator circuit $L_g L_p$, maximum voltage may be developed to permit dissipation of maximum energy in resistance R_4 . This resistance may then be adjusted to absorb any portions of that energy so as to result in any desired reduction of amplitude of the current wave in L_p . Therefore, as the pendulum swings back and forth through the position of maximum coupling between L_a and $L_g L_p$, the amplitude of the oscillatory voltage across R_3 varies in accordance with the degree of coupling between L_a and $L_g L_p$. In the uncoupled position, that is, with the pendulum P and L_a at the extreme end of its cycle, the continuous wave amplitude across R_3 is maintained constant. The amplitude of the impulse modulation of this wave is controlled by adjustment of R_4 . This impulse modulation of the continuous wave amplitude occurs each time L_a passes the $L_g L_p$ assembly.

If the pendulum P were free to swing, then once displaced from its central position it would continue to oscillate and provide continuous cycles generating repeated impulses. It is, however, desired in the process of calibration to provide for but a single complete cycle or oscillation of pendulum P, so that only two modulated impulses M of the continuous carrier wave T will be obtained.

For this purpose, there may be provided two coils L_h and L_r , wound in the single magnetic circuit and mounted in such position that the armature S carried by pendulum P will cooperate with said coils at the extreme end of the oscillatory movement of pendulum P. The coil L_h is a holding coil supplied with sufficient power from a battery E through an on and off toggle switch S_h to hold the pendulum in a deflected position, ready for release. L_r is a release coil wound on the same core as L_h and provided with a momentary push type switch S_r . Momentary operation of switch S_r sets up a momentary magnetomotive force in the common core, cancelling the magnetomotive force of L_h and releasing the pendulum. R_5 is a current limiting resistor. In operation, the pendulum is deflected by a manual trip with the coil L_h energized. The coil L_h attracts armature S and holds the pendulum in its extreme position. When a pair of impulses is to be generated the switch S_r is pressed for an interval less than the time of one complete pendulum vibration. The pendulum in making one complete vibration loses a small part of its initial starting angle but coil L_h supplies the required pull to make up this loss of angle and retain the

pendulum in its initial starting position ready for the next release by push button S_r .

By adjusting the various elements of the mechanism described hereinbefore, it is possible to obtain a wave form having predetermined characteristics. This is desirable, particularly in the case where an amplifier is specially designed to respond to wave forms of certain predetermined characteristics. Thus, for example, in the Sperry fissure detector mechanisms the amplifiers are designed to be particularly sensitive and responsive to the type of wave form which is generated when the detector unit consisting of detector coils passes over a region of flaw within the material through which current is passing.

Thus it will be apparent that if the angle through which the pendulum P swings is adjustable, it will be possible to adjust the period of the modulated wave shown in Fig. 2 since it is apparent that if the pendulum swings through a large angle the velocity of the pendulum past the coils L_g and L_p will be faster and have a shorter duration, and therefore the period of the modulated wave will be shorter. Furthermore, the depth of the wave, that is, the amount X by which the amplitude of the carrier wave is modulated, may be controlled by adjusting the position of coil L_a closer to or farther from coils L_g and L_p . This would vary the amount of energy abstracted from the oscillatory circuit. A somewhat similar result can be obtained by varying the number of turns comprising coil L_a with corresponding correction of capacity C_7 to maintain the system resonant. By these means a desired wave form of predetermined type for testing the particular amplifier may be generated.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other equivalent means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. A calibrator for thermionic amplifiers comprising an oscillatory circuit for generating a wave of normally constant frequency, said circuit including an inductive coupling, means for abstracting energy from said circuit by varying said coupling, a pendulum for supporting said energy-abstracting means and adapted to swing past said coupling to generate an impulse of predetermined wave form, and means whereby said impulse may be impressed on said amplifier.

2. A calibrator for thermionic amplifiers comprising an oscillatory circuit for generating a wave of normally constant frequency, said circuit including an inductive coupling, a tuned magnetic circuit for abstracting energy from said circuit by varying said coupling, a pendulum for supporting said tuned circuit and adapted to swing past said coupling to generate an impulse of predetermined wave form, and means whereby said impulse may be impressed on said amplifier.

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