March 30, 1937. K. SCHLESINGER 2,075,140

# TILTING OSCILLATOR AND MODULATOR

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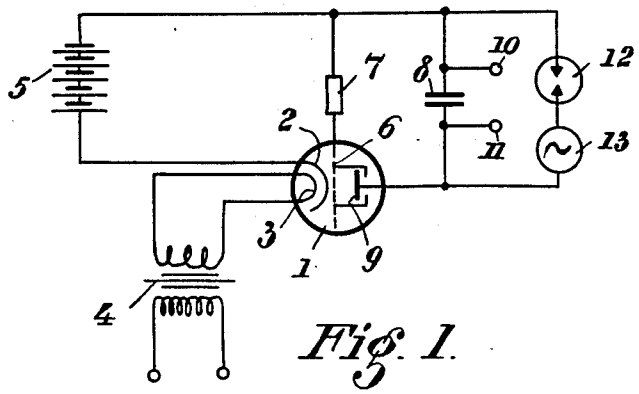



Fig. 1.

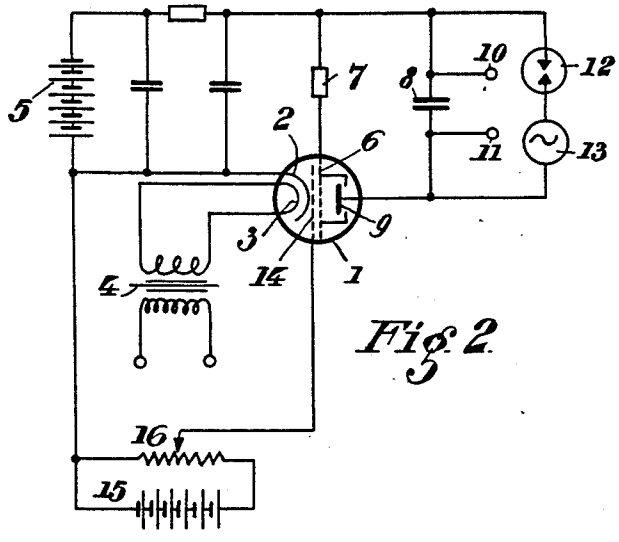
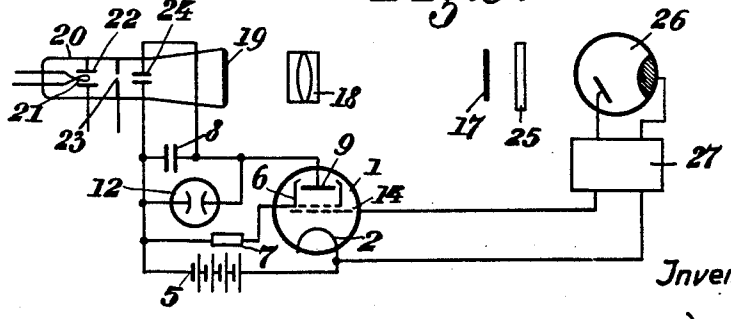



Fig. 2.

Fig. 3.

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# UNITED STATES PATENT OFFICE

2,075,140

## TILTING OSCILLATOR AND MODULATOR

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13 Claims. (Cl. 179—171)

For numerous purposes it is necessary to produce a saw-tooth potential, i. e., a so-called tilting potential, in which either the rise in potential or the drop in potential requires to be as linear as possible. Thus, for example, tilting apparatus of this nature are necessary for the purpose of time deflection in connection with cathode ray oscillographs. The same have also been found to be necessary in various television processes operating with Braun tubes.

In apparatus of this nature hitherto proposed a condenser is charged through the medium of a saturated ionic valve, i. e., a tungsten cathode tube. The increase in potential at this condenser accordingly takes place in linear fashion with the time, and—so far as the operating potential selected is sufficiently high—is independent of the particular potential prevailing at the condenser. In these apparatus there is situated in parallel with the condenser a discharge tube, usually a glow tube, which lights when a certain potential (ignition potential) is reached, and discharges the condenser up to the extent of a certain remnant charge, which corresponds with the so-called extinguishing potential. These arrangements are accompanied by various disadvantages of a weighty kind. In the first place, owing to the necessity for a decided saturation effect it is essential, as stated above, to employ only tubes having a tungsten cathode. These cathodes, however, provide only very slight emission, so that merely very small charging condensers may be employed for producing rapid tilting oscillations. It is obvious from this that the tilting apparatus may be loaded only very weakly if disturbing fluctuations in frequency are to be avoided.

An additional disadvantage of these arrangements resides in the fact that regulation of the frequency of the tilting oscillations in the case of a fixed charging circuit is only possible by varying the heating. Since, however, together with the heating there is very considerable variation in the emission, this method of regulation is an extremely rough one, and on account of the high heating currents which are necessary in the case of tungsten cathodes is not simple to perform as the inevitable inconstancy in the contact resistances of the regulating contacts will result in inconstant heating currents owing to the low value of the total heating circuit resistance.

There is also the fact that the production of tungsten cathodes with very decided saturation meets with difficulties insofar as even traces of impurities by reason of oxides or imprisoned thorium destroy the saturation character of the cathode. Apparatus of this nature moreover naturally also disclose every additional disadvantage of the tungsten cathode, more particularly the requisite high temperature, which results in relatively short life of the tubes.

All of these disadvantages are avoided by the arrangement according to the invention. In accordance with the invention, the condenser is charged through the medium of a discharge tube, preferably a high-vacuum tube, the charge carriers of which, preferably, therefore, electrons, are imparted by special means a particular preacceleration. To accomplish this there is preferably employed a preliminary grid, which is situated in front of the anode and screens the same and conveniently is so dimensioned that the anode potential is able to pass only to little extent through the same (very small reciprocal of the amplification factor), and which is connected with a sufficiently high positive d-c potential, so that the anode current passing through the grid is not affected, or only to very small extent, by the potential of the anode. Since fluctuations in the cathode emission have now also become insignificant, it is possible on the one hand to employ a highly emissive cathode, for example a barium cathode, which does not reveal a decided saturation effect. Furthermore this cathode does not require to be heated by a constant direct current, but in exactly the same manner as the charging potential may be produced by a main-line connection apparatus, and may, for example, be a pure a-c potential.

Fig. 1 shows a simple relaxation oscillation generator including a charging tube furnished with an auxiliary grid according to the invention. Fig. 2 shows a relaxation oscillation generator including a charging tube in which, according to an additional subject matter of the invention, there is provided a further grid, which allows frequency adjustment within a wide range. Furthermore, Fig. 2 shows how filter elements may be arranged in a device according to the invention. Fig. 3 shows an arrangement for modulating, in accordance with light intensities to be reproduced, the scanning rate of a light spot on the luminous screen of a Braun tube, including a charging tube devised and connected according to the invention.

The invention is illustrated in the drawing in several possible forms of embodiment. In Fig. 1, 1 is the discharge tube having the cathode 2, which accordingly may be a modern efficient cathode, for example a highly emissive cathode produced according to the barium vapour proc-

ess, and which is heated indirectly by the filament 3, which receives the necessary heating current from an a-c main through the medium of a transformer 4. A battery 5, which may also be replaced by a main-line connection apparatus, applies a very powerful electronic current to the grid 6, which preferably is constructed in the form of a screening grid, said potential being possibly approximately 1000 volts. A resistance 7 of approximately 1 megohm in the screening grid line prevents an excessive increase of this current (for instance, a maximum of 1 milliampere is permitted).

An additional part of the electronic current charges the condenser 8, which is situated between the anode 9 and the positive pole of the current source 5. By reason of the high positive potential of the grid 6 the electrons reaching the anode 9 are imparted a preliminary acceleration of such nature that fluctuations in the anode potential are unable to have any appreciable effect thereon. The condenser 8, from a practical standpoint, will accordingly receive, independently of the particular potential connected therewith, a constant charging current, which enables the potential of the same to rise in linear fashion. This may be extracted at the terminals 10 and 11. In parallel with the condenser 8 there is located the series connection for the glow discharge tube 12 and the synchronising potential 13. The latter has the object of compensating any fluctuations in the tilting frequency by synchronously occurring voltage impulses, which cause the ignition potential of the valve 12 to be reached at a certain time. Immediately the ignition potential of the tube 12 has been reached, the ignition occurs in a leaking off of the charge of the condenser 8 to the extent of its extinguishing potential. The charging operation then commences anew.

According to the additional subject matter of the invention, the tilting operation is influenced by the inclusion of an additional electrode, for instance, a grid. Owing to the high amplifying effect of the screening grid tube the emission may be controlled throughout within the range of a few volts of the grid potential of this grid. It is accordingly possible, by regulation of the grid potential, to vary the frequency of the generated tilting oscillations within very wide limits.

A connection of this nature is illustrated in Fig. 2. In the latter the same designations have been employed as in Fig. 1 in respect of similar elements. In addition thereto 14 is a special control grid, which receives a regulable d-c bias from a battery 15 through the medium of a potentiometer arrangement 16, this bias permitting of regulation of the tilting frequency.

For particular purposes it is necessary to modulate the tilting frequency in a manner dependent on some other operation. For this purpose it is also convenient to employ a special auxiliary electrode 14. For example in the case of a new television method the rate of scanning is varied, viz., dependent on certain properties of the image element to be transmitted, for example its intensity. In this connection it is necessary, both in the case of line-by-line scanning of the image, to vary the speed of the deflecting tilting potential dependent on the particular image element to be recorded as well as to obtain in similar fashion modulation of the tilting potential causing the vertical deflection.

An arrangement in which a modulation of the line frequency is required is shown in Fig. 3. In this case 17 is a film, which is assumed to be capable of being advanced line-by-line in a direction vertical to the plane of the drawing. On this film there is reproduced through the medium of a lens 18 the fluorescent spot moving over the screen 19 of a cathode ray tube 20. This cathode ray tube possesses a cathode 21, a Wehnelt cylinder 22, an anode 23 and a pair of deflecting plates 24. Behind the film 17 there may be provided a matte screen 25, so that the ray of light passing diffusely through the same is controlled by a light-responsive cell 26. The cell current is amplified by an amplifier 27, and controls the grid 14 of the charging tube of the tilting apparatus, through the medium of which there is charged the condenser 8 situated in parallel with the pair of deflecting plates 24. In parallel with the condenser 8 there is situated, as in the case of Figs. 1 and 2, a glow tube 12, possibly in series connection with the synchronising potential 13. When the ignition potential of the glow lamp has been reached there occurs the discharge of the condenser down to the extent of reaching the extinguishing potential, whereby the scanning of the lines commences anew. On the screen 19 of the tube 20 there accordingly appears the same image as scanned on the film 17, viz., as a positive or a negative in accordance with the polarity. The remaining parts of the arrangement illustrated in Fig. 3 have been furnished with the same reference characters as the corresponding parts in Figs. 1 and 2.

As disclosed by the above, it is possible, in contradistinction to the tilting arrangements heretofore known, in which an extremely constant heating d-c potential has been required, to employ a-c heating for the cathode, as the latter is no longer subject to saturation, and accordingly small fluctuations in the operating temperature are of no importance. This advantage is all the greater since in itself, owing to the high d-c potential of 1500 volts necessary for the screening grid and the anodes, it is essential to employ a special main-line connection apparatus for creating the high potential.

The difficulties associated with regulation of the frequency are accordingly eliminated by the arrangement according to the invention, as it is only possible to perform frequency regulation in a circuit not consuming output by variation of the grid bias of a special auxiliary grid within the limits of, say −4 and +5 volts as compared with the cathode, which regulation may also be performed by control amplifiers.

By reason of the arrangement according to the invention it is also possible to modulate the charge curve in simple fashion, viz., in an extremely sensitive arrangement, so that the necessary operating amplifiers (photo-amplifier in the case of a television process with linear control) do not require to be greatly loaded and good adaptation to the tube is rendered possible.

By the application of an alternating potential taken from some source 28, to the control grid 14 it is possible in accordance with the additional subject matter of the invention to perform a frequency reduction, if the constant bias is so chosen that the charging operation of the condenser is stopped or retarded by a part of the alternating potential applied.

The possibility of employing particularly efficient cathodes with extremely high emissive currents enables tilting apparatus to be constructed, which ensure sufficient constancy of the

tilting oscillation even in the case of strong external loading. This possibility is of importance particularly in those cases in which it is desired to connect up a plurality of television receivers with the same tilting generators. Naturally it requires to be observed that the discharge glow lamp must also be in a position to take over the relatively high discharge currents. The same, therefore, must be constructed with glow electrodes having a particularly large surface area.

A particular advantage of the arrangement according to the invention is to be regarded in the fact that when employing main-line connection apparatus as compared with the previous tilting apparatus operating with saturation tubes high-frequency disturbances of the main line and any main lines receivers connected therewith are avoided. As well known, the tilting curve contains all of the higher harmonics of the fundamental oscillation, viz., in a particularly slowly fading amplitude, so that broadcasting and other receivers are frequently greatly disturbed. The tilting apparatus heretofore employed have accordingly required to be made free of disturbances by the inclusion of impedances in the lines proceeding from the charging apparatus. In the arrangement according to the invention the avoidance of disturbances is effected in positive fashion by the screening effect of the screening grid, the more so if when employing main-line connection apparatus there are provided in the anode line the filter chains which are required in any case.

I claim:

1. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

2. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode, constructed in the form of a screening grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

3. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode constructed in the form of a screening grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, said auxiliary grid screening the electrodes connected to said condenser, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

4. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having a highly emissive barium cathode, anode, and an auxiliary grid electrode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube, and to the other electrode of said discharge tube, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

5. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having a highly emissive barium cathode, anode and an auxiliary grid electrode, means for indirectly heating said cathode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

6. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode and auxiliary grid, and a preliminary grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, and means to apply a direct current bias to said preliminary grid.

7. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, an auxiliary grid, and a preliminary grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, and means for applying a variable direct current bias to said preliminary grid.

8. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, an auxiliary grid, and a preliminary grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other

electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, means to apply a direct current bias to said preliminary grid, and means to apply an alternating control potential to said grid.

9. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, and a filter comprising condenser and resistance elements connected between said source and the two connections to said charging tube.

10. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode constructed in the form of a screening grid, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, said auxiliary grid screening the electrodes connected to said condenser, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, said charging tube having an amplification factor of at least 100.

11. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having a highly emissive barium cathode, anode, and an auxiliary grid electrode, means including an alternating current source of any kind for indirectly heating said cathode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, and a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source.

12. A device for producing relaxation oscillations of straight line wave form comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, and an auxiliary grid electrode, and a discharge tube, the one electrode of said condenser being connected to the one terminal of said source and to the one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, said auxiliary grid being connected to a positive terminal of a source.

13. A device for producing relaxation oscillations of straight line wave form modulated in accordance with light intensities to be reproduced, comprising a direct current source, a condenser, a thermionic charging tube having cathode, anode, an auxiliary grid and a preliminary grid, and a discharge tube having electrodes, the one electrode of said condenser being connected to the one terminal of said source and to one electrode of said discharge tube, the other electrode of said condenser connected to the other terminal of said source through the discharge space of said charging tube and to the other electrode of said discharge tube, a high ohmic resistance connecting said auxiliary grid to the positive terminal of said source, and means to apply to said preliminary grid potentials modulated according to the light intensities to be reproduced.

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