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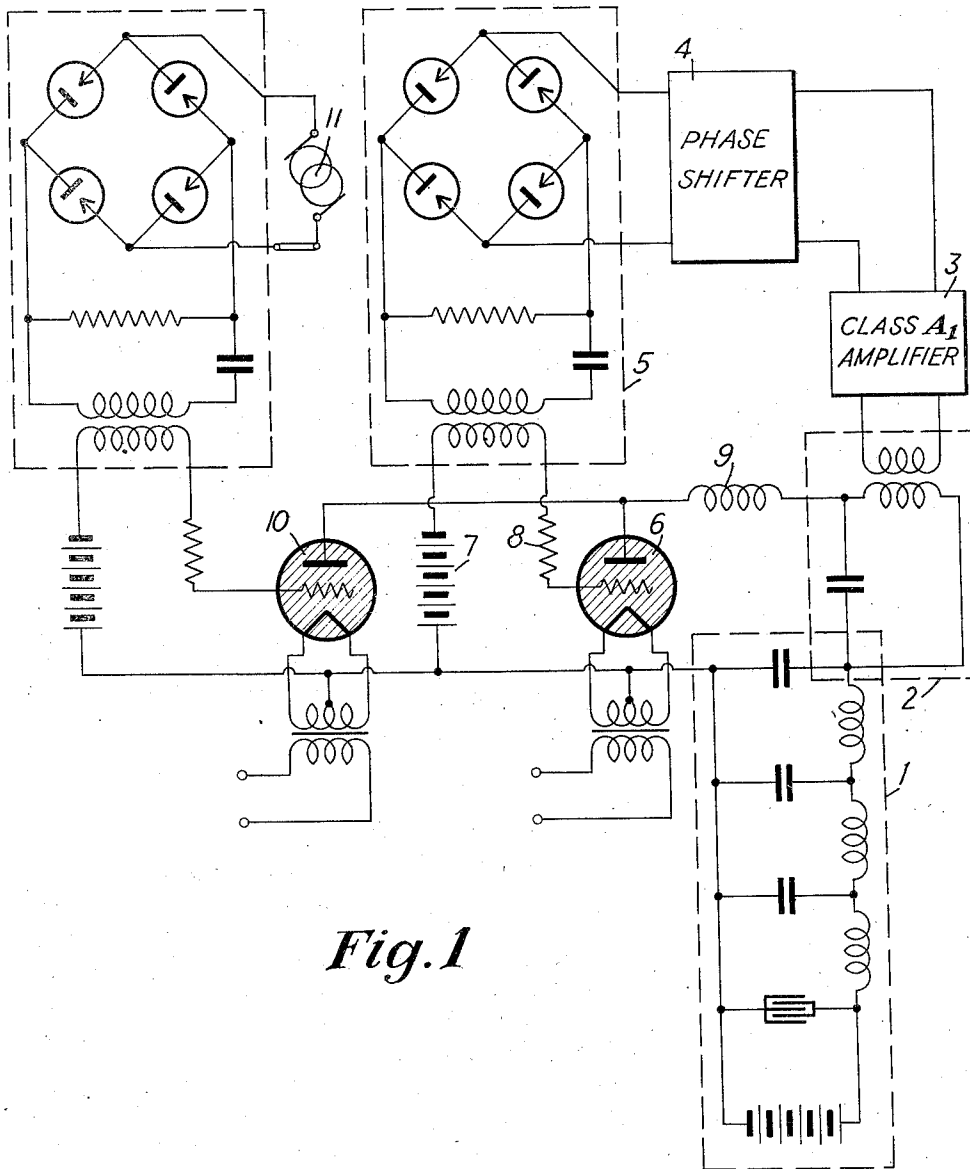
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FREQUENCY AND PHASE CORRECTION IN OSCILLATORS

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

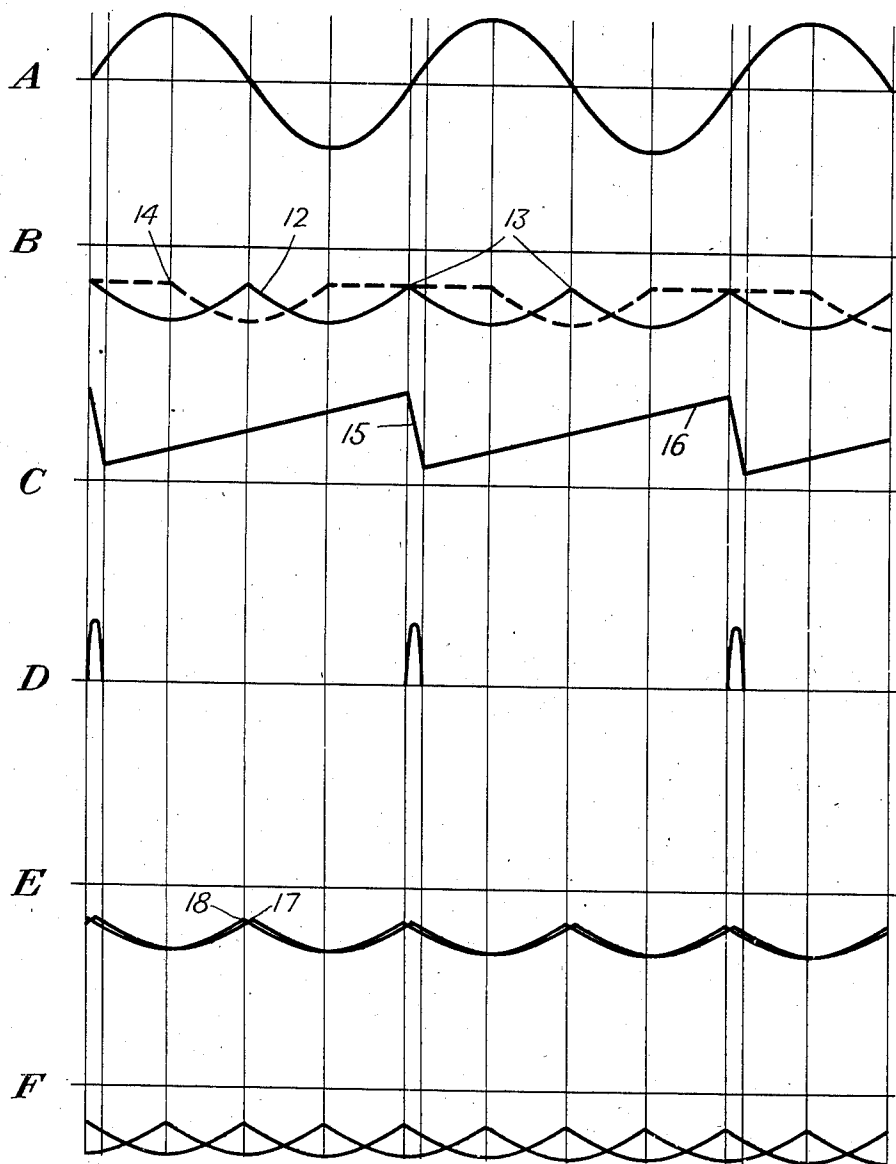


Fig. 2

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FREQUENCY AND PHASE CORRECTION
IN OSCILLATORS

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5 Claims. (Cl. 250—36)

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The present invention relates to electrical circuits comprising elements employed for synchronizing one electronic oscillator with another source of alternating current, and has particular relation to circuits employing a stabilized source of local oscillations to be kept in synchronism with a remotely disposed source of alternations, and more particularly when the remote source is not continuously available locally for synchronizing purposes, as for instance in certain types of synchronous telegraph circuits.

Among the objects of the invention are; to provide a more definite phase instant of introducing energy into certain types of self-excited oscillating circuits; to provide a more definite phase instant of introducing energy into certain types of oscillating circuits when excited from external sources and to provide more accurate phase and frequency correction for self-excited oscillators.

In certain types of telegraphic signaling, a local source of stabilized oscillations is required in the receiving terminal equipment and this local oscillator is required to operate not only in synchronism with a source of alternating current in the transmitting terminal equipment, but the two sources of alternating, and in some cases otherwise periodic, current, must be maintained with a high degree of constancy in a predetermined relative phase position between the two.

In the prior art, simple sine waves have been used as a means of synchronizing one source of alternating current with an oscillator, but this method has the disadvantage of lack of definiteness with respect to the exact phase position at which the synchronization takes place. In all prior art cases the point of synchronization employed is during a rising part of the voltage wave and in the case of the sine wave the steepness of this rising voltage is different for different parts of the wave as well as it is different for different amplitudes of voltage values, which results in a distinctly indefinite position of synchronization.

To overcome this lack of definiteness in the point of synchronization, attempts have been made in the prior art to synchronize telegraph terminal equipment by means of impulses which are really, in effect, forms of lobes of sine waves of a considerably higher frequency than the cycles synchronized and while this so-called impulse synchronization has certain advantages over the lower frequency sine wave method of synchronization, other difficulties are met with in its employment. It is much more difficult to transmit over communication circuits and requires a high quality of transmission characteristic in

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order to preserve its shape sufficiently, in order to serve its purpose well at the receiving end.

In the present invention a low frequency sine wave is transmitted for synchronization purposes and absolutely definite instants of synchronization are provided by rectifying the sine wave and employ the cusps thereby formed at the zero instants of the rectified current, and which are caused to determine the proper phase position of synchronization as well as to synchronize the two frequencies.

Further and other features and objects will be pointed out and obvious upon reading the following description in connection with the drawings, in which Fig. 1 is a simplified diagrammatic circuit embodying the present invention and Fig. 2 is a series of graphs useful in understanding its operation.

Referring to Fig. 1, the circuit circumscribed by the dotted area 1 is a relaxation circuit employing a low-pass filter instead of the conventional resistance structure, the circuit contained in the area circumscribed by 2 is a high Q closed oscillating circuit, the output of which is fed into a class A₁ amplifier 3, the output of which said amplifier is fed through phase-shifter 4, the output of which is fed through a circuit circumscribed by dotted line 5, which comprises a full wave rectifier, the output of which is delivered to the grid circuit of a gaseous triode 6, through a parallel-fed coupling transformer, as is well understood in the art. The grid circuit of gaseous triode 6, is provided with a conventional bias battery 7 and a current limiting resistor 8. Gaseous triode 6 serves as the trigger tube for the relaxation circuit 1 through the closed oscillating circuit 2 and the reactor 9.

The purpose of the low-pass filter in circuit 1 is to limit the peak value of the plate current in gaseous triode 6 and at the same time provide a higher electrical efficiency in the relaxation circuit. The reactor 9 assists in extinguishing the discharge in the gaseous triode 6.

Relaxation circuit 1, together with the closed oscillating circuit 2 and its other related circuits, is also subject to operation by a gaseous triode 10, connected in parallel with gaseous triode 6, and having an exactly similar input grid circuit with the exception of the source of alternating current utilized in the grid circuit which is derived from generator 11.

With reference to the operation of the present invention, it will be convenient to assume that oscillator 2 is in operation and generating a sine

wave voltage as illustrated along abscissa A, Fig. 2.

When the output voltage of oscillator 2 has been amplified by amplifier 3, Fig. 1, and shifted to a suitable phase position by phase shifter 4, it is rectified and appears at the output terminals of circuit 5 as an alternating current following the shape of the rectified wave form.

From the output terminals of the circuit illustrated in 5, this rectified wave form of current is biased by battery 7 sufficiently to take the form of curve 12, abscissa B, Fig. 2.

It will be appreciated by those skilled in the art that the output voltage form circuit 5 is purely alternating, the zero position automatically assumed being such that if the areas of the positive and negative lobes of the wave be integrated mathematically, this operation will equate the positive and negative current flowing during a complete cycle. In other words, the voltage across the output terminals of circuit 5, as read on a d'Arsonval volt meter, will always be zero.

This output voltage of circuit 5 being biased by battery 7, is caused to assume the position with reference to the zero line shown along abscissa B, by curve 12, Fig. 2.

With such a curve as illustrated by 12 the bias of gaseous triode 6 is always greater than that required for break-down with the maximum plate voltage employed, except at the cusps 13. These cusps are very sharp and occur, of course, at the zero instants of the alternating current wave.

By the addition of a half-wave rectified current such as shown at 14, abscissa B, Fig. 2, every other cusp may be removed if and when desired, though this addition is unnecessary in the present embodiment.

Referring to Fig. 1, the phase shifter 4 is adjusted such that the cusps 13, abscissa B, Fig. 2, are properly timed in order to trigger the relaxation circuit 1, which supplies the impulse energy to the closed oscillator 2, the illustrated circuits functioning as a self-excited electronic oscillator, as hereinbefore described.

The voltage across the output of the relaxation circuit 1, follows the general form shown along abscissa C, Fig. 2, and when the gaseous triode 6 is triggered by one of the cusps 13, this voltage drops off very rapidly, as shown at 15, abscissa C, and in such a manner that no subsequent triggering by the parallel connected gaseous triode 10, will have any effect upon the relaxation circuit until the voltage has risen to substantially its normal value shown at 16. In this way it is obvious that the relaxation circuit is triggered by whichever gaseous triode operates to trigger it first, and only after the relaxation voltage has risen substantially to its maximum value. The impulses along abscissa D, Fig. 2, represent the form of plate current in gaseous triode 6. The duration of these impulses may be adjusted to any predetermined value, though the shorter the period of the impulse the more nearly the oscillator circuit 2 follows its natural period of oscillation, for as long as the oscillator circuit is under power absorption it tends to follow a forced form of oscillation, whereas during the period in which it receives no energy it follows its own natural period of oscillation, as is understood from the fundamental theory of oscillatory systems.

If the oscillator circuit 2 has a normal self-excited frequency, of a value slightly less than

that of the source 11, Fig. 1, the cusps of the two waves in the grid circuits of the two gaseous triodes 10 and 6 may be represented by the curves along abscissa E, Fig. 2, in which 17 represents the grid circuit voltage of triode 6 and 18 represents the grid circuit voltage of triode 10.

It will be appreciated if the source of alternating current 11 is of a highly standardized order and that the frequency of oscillator 2 is slightly less than that of generator 11 and such that the frequency of oscillator 2 will at no time be faster than that of generator 11, oscillator 2 may be expected to run for considerable periods of time self-oscillated without drifting away greatly from its standardized frequency and if and when generator 11 is thrown into the circuit because of sequence of events illustrated along abscissa E, Fig. 2, oscillator 2 will promptly be brought into exact frequency of and to exact phase position with generator 11 because of gaseous triode 6 losing control of the relaxation circuit due to being behind that in phase of gaseous triode 10, as has been pointed out.

It will be appreciated that oscillator 2 may drift considerably out of phase and even as much as shown along abscissa F, Fig. 2, without the standardized frequency generator being unable to correct the frequency in phase position of oscillator 2.

It will be appreciated by those skilled in the art that in the present embodiment, the practical application of this invention to the many uses to which it may be put has been omitted for the sake of clearness in teaching the spirit of the invention, and those skilled in the various arts to which the invention appertains will appreciate the obvious applications thereto.

The scope of the invention is set forth in the claims hereunder.

What I claim is:

1. In a relaxation oscillator of alternating currents having power currents initiated by electrical breakdown in gaseous discharge tubes; a relaxation generator of oscillations including a source of power, a feed-back circuit supplying control current to maintain said oscillations and a gaseous discharge tube receiving control current from said feed-back circuit to initiate power currents; a second gaseous discharge tube connected in parallel with first said tube to also initiate power currents in said oscillator, and an independent source of control current for second said tubes.

2. In a relaxation oscillator of alternating currents having power currents initiated by electrical breakdown in gaseous discharge tubes; a relaxation generator of oscillations including a source of power, a feed-back circuit supplying control current to maintain said oscillations and a gaseous discharge tube receiving control current from said feed-back circuit to initiate power currents; a second gaseous discharge tube connected in parallel with first said tube to also initiate power currents in said oscillator, an independent source of control current for second said tube, and electrical circuit means to cause one and only one of said tubes to initiate power currents in said oscillator during any one oscillation period.

3. In a relaxation oscillator of alternating currents having power currents initiated by electrical breakdown in gaseous discharge tubes; a relaxation generator of oscillations having a predetermined timing and a source of power, a feed-back circuit supplying control current to maintain said oscillations and a gaseous discharge tube receiving control current from said feed-back cir-

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cuit to initiate power currents; a second gaseous discharge tube connected in parallel with first said tube to also initiate power currents in said oscillator, an independent source of alternating control current for second said tube having independent timing, and electrical circuit means to cause one and only one of said tubes to initiate power currents in said oscillator during any one oscillation period, whereby the timing of the power currents generated is fixed by the one tube initiating said currents.

4. In a relaxation oscillator of alternating currents having power currents initiated by electrical breakdown in gaseous discharge tubes; a relaxation generator of oscillations having inherent timing and a source of power, a feed-back circuit supplying control current to maintain said oscillations and a gaseous discharge tube receiving control current from said feed-back circuit to initiate power currents; a second gaseous discharge tube connected in parallel with first said tube to also initiate power currents in said oscillator, an independent source of alternating control current for second said tube having predetermined timing, and electrical circuit means to cause the second said tube to initiate power currents in said oscillator when said inherent timing is different from said predetermined timing.

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5. In an oscillator system for alternating currents; a local relaxation generator of oscillations having inherent timing, a source of power and two gaseous discharge tubes to initiate power currents; a control current feed-back circuit to one of said tubes to provide initiated power currents under local timing, a remotely disposed source of alternating control current connected to the other of said tubes, and electrical circuit means to cause the second of said tubes to initiate power currents in said generator in the absence of initiation thereof by first of said tubes.

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