April 12, 1949. B. W. ROBINS 2,466,782

FREQUENCY STABILIZED BLOCKING OSCILLATOR

Filed Jan. 28, 1943

FIG. 1.

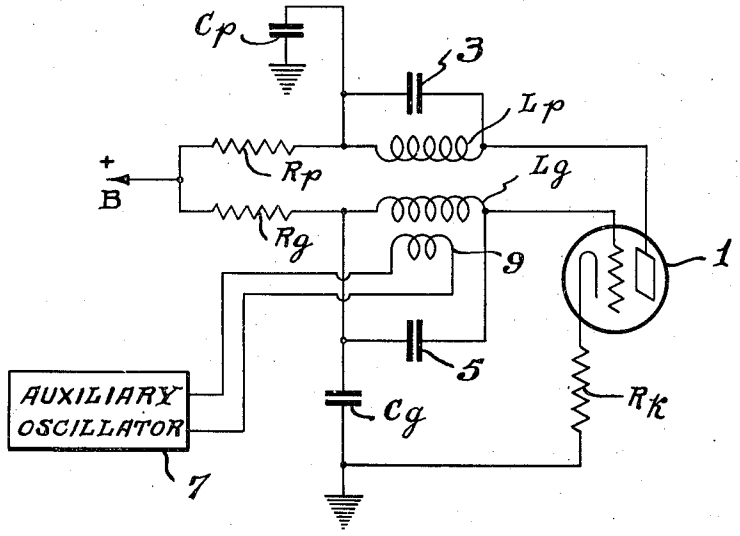
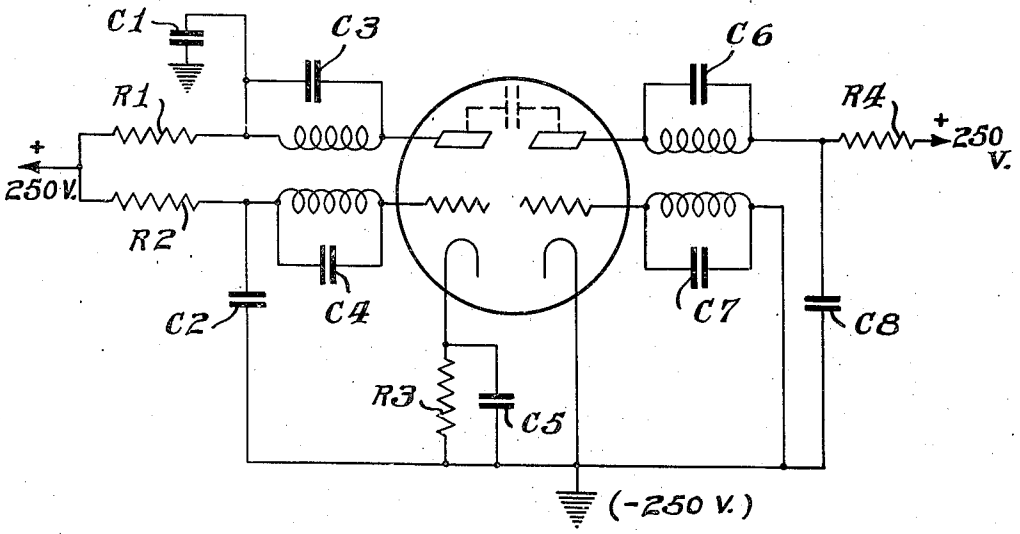


FIG. 2.



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FREQUENCY STABILIZED BLOCKING OSCILLATOR

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8 Claims. (Cl. 250—36)

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This invention relates to blocking oscillators and especially to a blocking oscillator in which the repetition frequency is controlled.

It is well known that blocking oscillators inherently have very poor frequency stability. For example, a blocking oscillator designed to have a nominal frequency of 1,000 cycles per second may have a characteristic such that the successive cycles occupy 990, 1020, 995, 970, 1035 and 990 microseconds. Briefly, the repetition rate is very irregular.

According to the present invention, a blocking oscillator is provided with a frequency stabilizing means which may consist of any suitable source of low level radio frequency signals. These signals of radio frequency are applied to the oscillator whereby an extremely stable form of intermittent oscillation is obtained. For example, an oscillator built according to the instant invention and designed for a mean frequency of 1,000 cycles per second may not vary more than plus or minus $^1/_{1000}$ of a microsecond per cycle.

One of the objects of the present invention is to provide a blocking oscillator in which the intermittent oscillations are truly repetitive. Another object is to provide an auxiliary oscillator generating radio frequency oscillations which are applied to a blocking oscillator whereby the repetition rate is made substantially uniform. Another object is to provide a pair of oscillators in which radio frequency currents and intermittent audio currents, and radio frequency oscillations are generated in the respective oscillators and are combined to produce audio frequency currents having uniform cyclic characteristics.

In the accompanying drawing, Fig. 1 is a circuit diagram in which one form of stabilized blocking oscillator is disclosed, and Fig. 2 is a circuit diagram of a modification of the stabilized blocking oscillator of the invention.

Referring to the drawing, a thermionic tube 1 having anode, grid and cathode elements is connected to a source of +B as follows: The anode is connected through an inductor L*p* and a resistor R*p* to the +B terminal. The grid is connected through an inductor L*g* and a resistor R*g* to the +B terminal. The negative terminal of the B supply is connected to ground. Each of the inductors L*p*, L*g* are shunted by capacitors 3, 5, respectively. The junction of the resistors R*p* and inductor L*p* is connected through a capacitor C*p* to ground. The junction of the resistor R*g* and the inductor L*g* is connected to ground through a capacitor C*g*. The cathode is connected through a self-biasing resistor R*k* to ground. The auxiliary radio frequency oscillator 7 is coupled to the blocking oscillator through any suitable means, such as the coupling inductor 9.

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The mode of operation is as follows: The oscillator operates intermittently at a radio frequency rate determined primarily by the capacity and inductance of the anode and grid tank circuits L*p*, L*g* and the two shunt capacitors. The audio repetition rate at which the radio frequency oscillations are repeated is determined primarily by the time constant of the resistor R*g* and capacitor C*g* network but it is normally somewhat random unless the oscillations from the auxiliary oscillator are applied. The theory which explains the stabilization of audio frequencies by the application of radio frequencies is not at present known. However, it has been found that the presence of a continuous radio frequency signal having a frequency close to the oscillation frequency of the blocking oscillator made the audio frequency rate truly repetitive. Insofar as the auxiliary oscillator is concerned, it may be of any conventional type supplying low level signals which may be introduced into the intermittent oscillator by any conventional method.

Referring to Fig. 2, the blocking oscillator is shown in the left hand portion of the diagram and the stabilizing oscillator on the right. The two thermionic tubes are included within a common envelope. The capacity between the anodes is about 0.5 micromicrofarad which provides sufficient coupling between the blocking and stabilizing oscillators. The constants for a blocking oscillator operating at 7.5 megacycles per second and a stabilizing oscillator operating at 3.75 megacycles per second, the latter providing a second harmonic at 7.5 megacycles, are as follows:

R1, R3	2200 ohms
R2	1.25 megohms
R4	270,000 ohms
C1, C5, C8	150 mmfd. (bypass)
C2	3900 mmfd. (timing)
C3, C4	50 mmfd. (tank tuning)
C6, C7	450 mmfd. (tank tuning)

The feed-back transformer coils each include 20 turns of ½'' diameter.

The output currents of the circuit of Fig. 2 were applied to a cathode ray oscillograph which gave indications as follows: (*a*) without the radio frequency stabilizing currents the intermittent output currents were so irregular that the cathode ray traces moved back and forth about ¼'' to ⅜'' and were unsatisfactory for observation; (*b*) with the stabilizing oscillations applied to the

blocking oscillator and without any form of synchronizing signal, the pulse traces were very steady and movements thereof were imperceptible.

Thus the invention has been described as a blocking oscillator in which the repetition rate is stabilized by the application of a continuous radio frequency signal derived from an auxiliary oscillator. The stabilizing radio frequency currents may be of fundamental or harmonic frequency. The nominal repetition rate may be controlled by varying the time constants of the blocking oscillator frequency. Moreover, a conventional low frequency synchronizing signal may be applied so that the output is both synchronized and repetitive.

I claim as my invention:

1. The combination of a first oscillator including radio frequency tank circuits for establishing radio frequency currents and means including at least a portion of said tank circuits for interrupting said radio frequency currents at a desired but irregular rate, a second oscillator for generating continuous radio frequency currents of substantially the frequency of said first currents, and means for applying said generated radio frequency currents to said first oscillator whereby said irregular rate is made substantially uniform.

2. The combination of a first oscillator including radio frequency tank circuits for establishing radio frequency currents and a time constant circuit including at least a portion of said tank circuits for interrupting said radio frequency currents at a desired but irregular rate, a second oscillator for generating continuous radio frequency currents of substantially the frequency of said first currents, and means for applying said generated radio frequency currents to said first oscillator whereby said irregular rate is made substantially uniform.

3. The method of establishing intermittent oscillations which are truly repetitive including generating radio frequency oscillations, interrupting said radio frequency oscillations at a lower and somewhat random rate, applying continuous radio frequency oscillations at substantially the frequency of said first mentioned oscillations to said generated oscillations, and deriving from said application intermittent currents of substantially constant frequency.

4. The method of establishing intermittent oscillations which are truly repetitive including generating radio frequency oscillations, interrupting said radio frequency oscillations at a random audio frequency rate, applying continuous radio frequency oscillations at substantially the frequency of said first mentioned oscillations to said generated oscillations, and deriving from said application intermittent currents of substantially constant frequency.

5. The combination of a first oscillator including means for establishing radio frequency oscillations having a first desired frequency, means for interrupting said oscillations at a second frequency rate, a second oscillator for establishing continuous oscillations having substantially the same frequency as said first frequency, and means for applying said last mentioned oscillations to said first oscillator to control said second frequency rate.

6. The combination of a first oscillator including capacitor and inductors for establishing radio frequency oscillations of a first desired frequency and resistors and capacitors for interrupting said oscillations at a second frequency rate, a second oscillator for establishing continuous radio frequency oscillations having a frequency substantially equal to said first frequency, and means for applying said last mentioned oscillations to said first oscillator to control said second frequency rate.

7. A method of establishing intermittent oscillations which are truly repetitive including generating radio frequency oscillations, interrupting said radio frequency oscillations at a random audio frequency rate, generating a continuous stabilizing radio frequency current including at least one harmonic frequency substantially equal to the frequency of said generated oscillations, applying said harmonic of said stabilizing radio frequency current to said generated oscillations, and deriving from said application intermittent currents of substantially constant frequency.

8. The combination of a first oscillator including means for establishing radio frequency currents and means for interrupting said currents at a random rate, a second oscillator for establishing continuous radio frequency currents including at least one harmonic frequency substantially equal to the frequency of said first mentioned currents, and means for applying said harmonic of the currents from said second oscillator to said first oscillator whereby said random rate is made substantially uniform.

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