

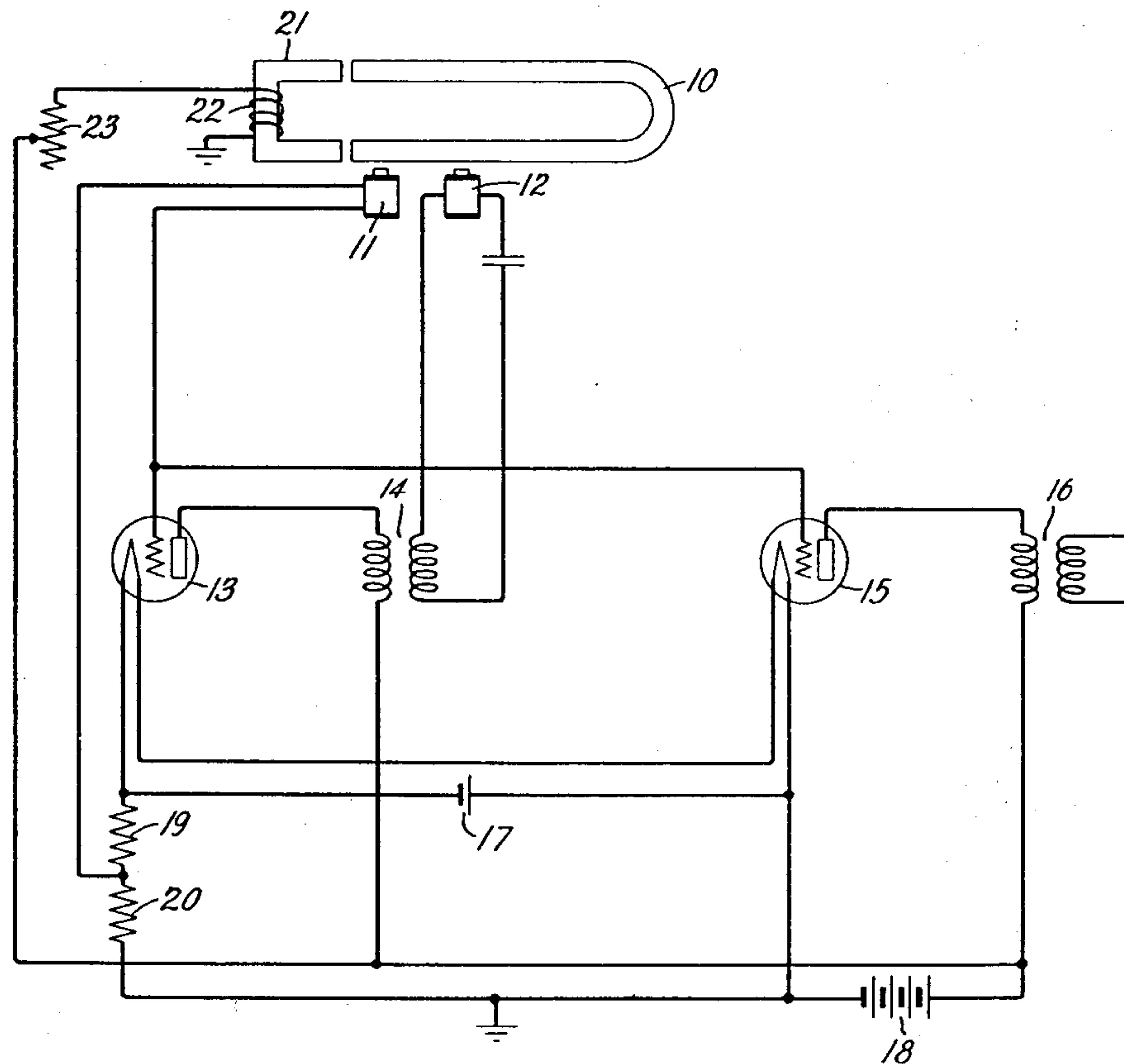
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CONSTANT FREQUENCY WAVE SOURCE

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CONSTANT FREQUENCY WAVE SOURCE

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This invention relates to constant frequency wave sources and more particularly to oscillators and generators including mechanical vibratory systems.

5 An object of the invention is to compensate for the effect of circuit variations which tend to vary the amplitude of vibration of the mechanical system.

As is well recognized, the frequency of a tuning fork or other mechanical vibrating system is to some extent dependent upon the amplitude of vibration so that when such a device is sustained in vibration by the use of some well-known arrangement, for example, an amplifier coupled with the driving and controlling magnets of a fork, the frequency of vibration will be dependent upon the amplitude of the wave supplied to the driving element.

20 In a specific preferred embodiment this invention comprises a tuning fork oscillator of the type employing an electric discharge amplifier coupling the control and driving magnets of the fork in which there is provided an electromagnet having a U-shaped core member mounted with its pole faces in close proximity to the tine ends of the fork and having a winding connected in the plate circuit of the amplifier. The action of the magnet is to effectively stiffen the tines of the fork and produce an increase in the rate of vibration so that the frequency of the fork is controlled by the magnitude of the magnetic field. Therefore, since the energizing current is proportional to the amplitude of the wave supplied to the driving magnet, by properly adjusting the constants of the circuit, the fork can be made to vibrate with a substantially constant amplitude independent of the driving force, thus preventing any variation in frequency from that effect.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing which shows one embodiment thereof in a tuning fork oscillator.

There is shown a tuning fork 10 provided with a magnetic pick-up or control element 11 and a magnetic driving element 12. The

winding of the control element is connected to the grid circuit of a three-electrode electric discharge device 13 and the winding of the driving element is connected to the plate circuit thereof through the output transformer 14.

As is well understood in the art, the fork is maintained in vibration by means of the coupling between the two elements through the discharge device 13. The vibration of the fork sets up an electromotive force in the winding of the control element 11, which is impressed on the grid circuit of the device 13 and amplified energy is supplied from its plate circuit to the winding of the driving element 12.

The electromotive force generated in the winding of the control element 11 is also impressed upon the grid circuit of a second three-electrode electric discharge device 15 and amplified energy is transmitted to a load circuit through the output transformer 16.

Heating current is supplied to the cathodes of the device 13 and 15 in series from a battery 17 and space current is supplied to both devices from a battery 18.

Resistances 19 and 20 are employed to provide a biasing potential for the grid of the device 13. They are so proportioned as to maintain the output of the device 13 constant irrespective of normal fluctuations of the cathode heating current.

The fork is provided with a stiffness control element of the type described and claimed in U. S. patent to Clokey 1,717,094, granted June 11, 1929. This element comprises an electromagnet 21 having a winding 22 rigidly mounted with its pole faces in alignment with the ends of the tines of the fork. The magnetic effect, due to the energization of the electromagnet by current flowing in the winding 22, serves to increase the effective stiffness of the fork and thereby provides a means by which the rate of vibration may be controlled as hereinafter explained.

The winding 22 is connected in series with a variable resistance 23 through the space current battery 18. Any fluctuations in the voltage of the battery, which would other-

wise tend to vary the rate of vibration of the fork, would simultaneously produce such a change in the effect of the stiffness control element as to prevent any change in the rate of vibration. This may be explained as follows. A decrease in battery voltage tends to decrease the power supplied to the driving element 12 and consequently to decrease the amplitude of vibration to thereby produce an increase in the rate of vibration of the fork. However, simultaneously therewith, there is produced a decrease in the magnetic effect of the electromagnet 21, which causes a consequent decrease in the effective stiffness of the fork, which tends to decrease the rate of vibration in such manner as to compensate for the effect of the decrease in driving force. A similar compensating effect is produced by increases in the voltage of the battery 18, so that the rate of vibration of the fork and hence the frequency of the oscillations generated is maintained constant irrespective of fluctuations in the voltage.

The electromagnet 21 is so spaced with respect to the ends of the tines of the fork that by an adjustment of the resistance 23 a maximum change in absolute value of frequency can be obtained for a given loss in compensation. This spacing is not very critical and in one embodiment a distance of about 1.5 mm. was found satisfactory.

What is claimed is:

1. A source of constant frequency waves comprising a mechanical vibratory member, means for driving said member, and means responsive to changes in the driving force for controlling the period of vibration of said member so that it is substantially constant during such change.

2. A source of constant frequency waves comprising a mechanical vibratory member, electromagnetic means for driving said member, and electromagnetic means responsive to changes in the driving force for controlling the period of vibration of said member so that it is substantially constant during such changes.

3. A source of constant frequency waves comprising a mechanical vibratory member, electromagnetic means for driving said member, electromagnetic means comprising a core cooperating with said member to constitute a magnetic circuit and a winding on said core, said second mentioned means acting to control the period of vibration of said fork, and an electrical source for supplying current to said driving means and said winding.

4. A source of constant frequency waves comprising a tuning fork, an amplifier, a source of potential for energizing said amplifier, a control element for producing an electromotive force of frequency proportional to the rate of vibration of said fork connected to the input of said amplifier, means for driving said fork connected to the output of

said amplifier, electromagnetic means comprising a core forming with said fork a magnetic circuit and a winding on said core, said electromagnetic means acting to control the effective stiffness of said fork, and connections from said source to said winding to maintain the frequency of vibration of said fork substantially constant irrespective of variations of the potential of said source.

5. A source of constant frequency waves comprising a tuning fork, an electric discharge amplifier, a source of space current for said amplifier, an electromagnetic control element for producing an electromotive force of frequency proportional to the rate of vibration of said fork connected to the input of said amplifier, electromagnetic means for driving said fork connected to the output of said amplifier, electromagnetic means comprising a substantially U-shaped core mounted in alignment with the tines of said fork and a winding mounted on said core, said last mentioned means acting to control the effective stiffness of said fork, and connections from said space current source to said winding to maintain the frequency of vibration of said fork substantially constant irrespective of variations of the potential of said source.

6. The method of maintaining the rate of vibration of a mechanical vibratory member substantially constant irrespective of variations in the driving force which comprises subjecting said member to a magnetic force tending to increase the period of vibration of the member and causing said magnetic force to be proportional to the driving force.

7. The method of maintaining the rate of vibration of an electrically driven tuning fork substantially constant irrespective of variations in the driving force which comprises magnetically damping the vibrations of said fork and thereby increasing the rate of vibration of the fork and automatically controlling the damping effect to make it proportional to the driving force.

In witness whereof, I hereunto subscribe my name this 17th day of October, A. D. 1927.

WARREN A. MARRISON.