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TUNING APPARATUS

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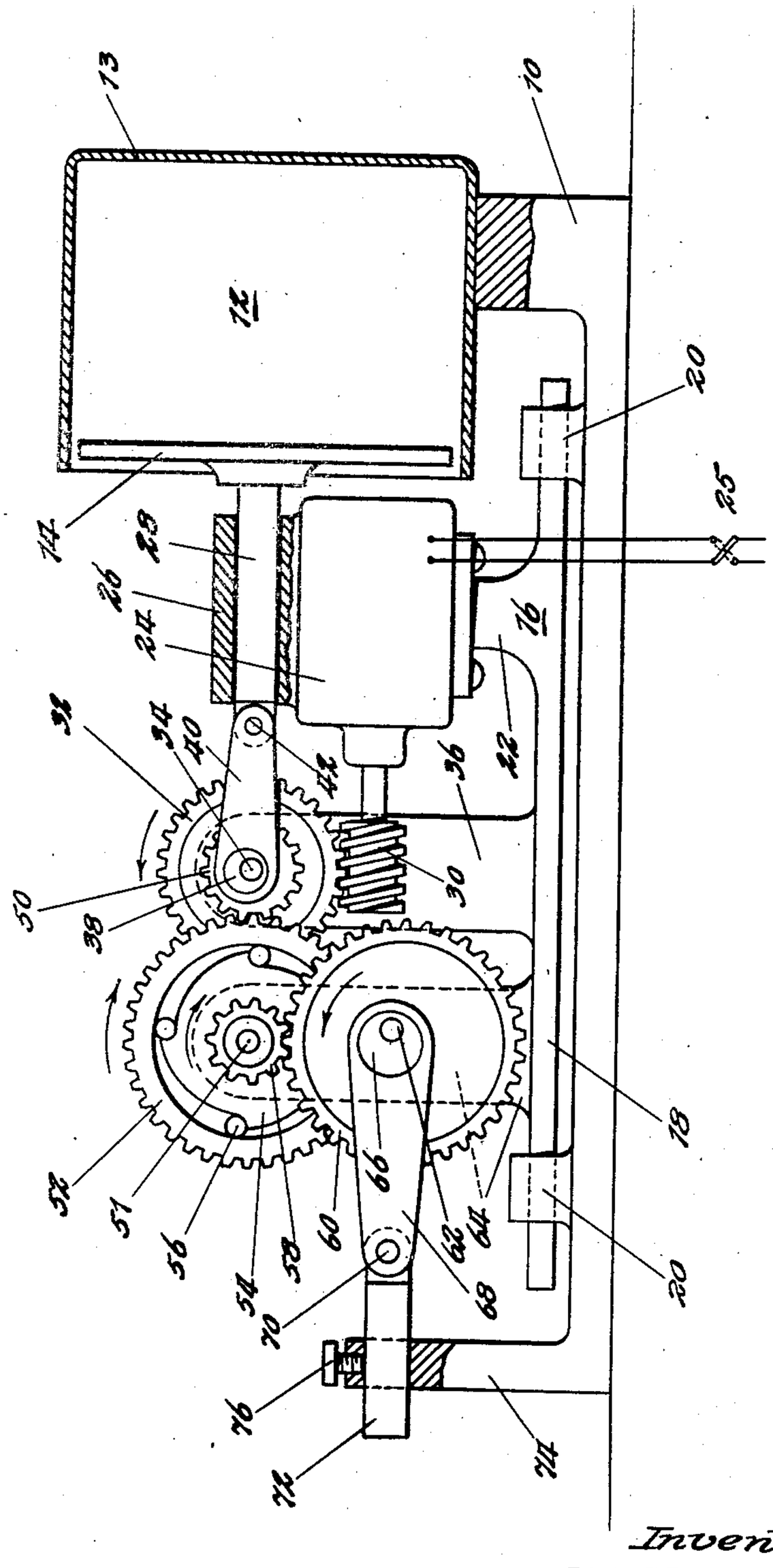

Inventor

ELMER O. THOMPSON

by his attorneys

Howson and Howson

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TUNING APPARATUS

Elmer O. Thompson, Grasmere, N. Y., assignor to Philco Radio and Television Corporation, Philadelphia, Pa., a corporation of Delaware

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This invention relates to a novel mechanism for effecting periodic variation of an electric circuit element, particularly for use in tuning high frequency signaling apparatus. It is sometimes desirable to effect periodic variation of an electric circuit element, e. g. a resistor, inductor, tuning condenser, tuning cavity, or the like. One such instance is the tuning of high frequency signaling apparatus employing a cavity resonator. When it is desired to tune a cavity resonator, sometimes referred to as an "echo box," to a certain wave length or frequency of a signal from a distant station, the process of covering a given range of wave lengths or frequencies requires careful manipulation of the adjustable element or diaphragm to avoid passing by the station, particularly when sharp tuning or close adjustment is required. In order to cover the whole range within a reasonable and practical time, the sweep over the range must be at a regulated rate calculated to cover the range in the predetermined interval. Furthermore, to avoid passing a given frequency or wave length at a time when no signal is coming in, some repetition of the movement of the adjustable element or diaphragm by vibratory or limited reciprocatory movement is desirable while the main sweep is continuing.

It is an object of this invention to provide novel mechanical means to effect periodic variation of an electric circuit element, and more particularly to provide a mechanism to move the adjustable element of a tuning device, such as a cavity resonator, over the full range of frequencies within the capacity of the tuning device and to repeat the movement through adjacent frequencies several times while the device is being tuned from one end of its range to the other.

Another object is to provide mechanical means of the foregoing type which employs only one motor.

Another object is to provide mechanical means of the foregoing type in which it is possible to partially disable or deactivate the apparatus when the signal frequency or wave length is reached so as to stop the over-all movement but maintain the subsidiary or vibratory movement at the tuning-in position.

Other objects and advantages will appear as the invention is described in connection with the drawing.

In the drawing, the single figure is a side view, partly in elevation and partly in section, of apparatus embodying the invention.

Referring to the drawing, a base or frame 10

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of flat rectangular or any other suitable form and construction supports a cavity resonator 12, which is representative of an electric circuit element to be varied. This resonator comprises a box-like enclosure 13 and a movable diaphragm 14, the movement of which varies the length and volume of the enclosure or cavity.

In accordance with the present invention, a novel mechanism is provided to impart two motions to the diaphragm, one a relatively slow reciprocatory motion of predetermined amplitude and the other a rapid reciprocatory motion of smaller amplitude. This mechanism is mounted upon a slidable structure or sub-base 16, whose exact form may vary as requirements of service dictate. Conveniently, it may comprise a wide bar or plate member 18 slidable within guides 20 conveniently formed or mounted upon and extending upward from the main base 10. Extending upward from the sub-base is a pedestal 22 supporting a reversible direct current motor 24 which may be of the permanent field type. The motor may be controlled by a reversing switch shown schematically at 25. On top of the motor casing or, if preferred, as an extension of the pedestal 22, is a guide block 26 having a guideway or passage for a slidable bar 28 on the end of which the diaphragm 14 of the cavity resonator is mounted.

For the purpose of vibrating the diaphragm rapidly, say at the rate of 200 oscillations per minute, within a short travel, for example 1/64", a train of gears and an eccentric arrangement are provided as follows: On the shaft of the motor is mounted a worm gear 30 driving a spur gear 32 keyed to a shaft 34 whose ends are supported in bearings in parallel standards, such as 36, rising from the slide or sub-base 18. Also keyed to the shaft 34 is an eccentric 38 engaging in one end of a link or connecting rod 40, the opposite end of which is pivotally connected by a pin 42 to the sliding bar 28. It will thus be seen that as the motor rotates, its worm gear 30 will rotate the spur gear 32 and shaft 34 with eccentric 38 to cause reciprocation of the link 40 and sliding bar 28 and thereby vibrate the diaphragm 14 within a limited range or space, for example 1/64". This vibratory action will continue so long as the motor runs and will take place whether the motor runs forward or in reverse direction.

In order to move the sub-base or slide 18 and thus to cause movement of the diaphragm throughout its entire tuning range in the cavity resonator, a small spur gear 50 is mounted upon and keyed to the shaft 34 and meshes with a

large gear 52. Gear 52 is loosely mounted on a shaft 51 journalled in supporting arms 64 rising from the slide or sub-base 18. A circular recess is provided in the face of the large gear 52 to accommodate an over-running clutch mechanism comprising a conventional ratchet-shaped clutch member 54, into whose peripheral recesses are located clutch balls 56, so that as the gear 52 runs in the direction of the arrow (clockwise), clutching will take place by reason of the movement of the balls 56 in well-known fashion to cause the clutching member 54 to rotate clockwise. The clutch parts may be enclosed by a plate (removed) attached over the face of clutch gear 52. The clutching member 54 is fixedly mounted upon the shaft 51 to rotate it and a small gear 58, which is also mounted upon and keyed to the shaft 51. Meshing with the small gear 58 is a large gear 60, keyed to a shaft 62 which is or may be journalled in the mid-portion of the supports 64.

In order that the rotation of the shaft 62 shall cause movement of the slide or sub-base 18, an eccentric 66 is keyed to and rotates with the shaft and engages in one end of a connecting link 68 whose other end is pivotally connected by a pivot pin 70 to a fixed adjustment bar 72. The adjustment bar 72 passes through an aperture formed in an extension 74 of the main base or frame 10 and is adjustably secured by a set screw 76, in order that the travel range of the slide or sub-base may be shifted relatively to the main base and thereby shift the tuning range of the cavity resonator.

From the foregoing, it may be observed that upon rotation of the motor in a direction to cause counterclockwise rotation of the gear 32 the shaft 34 and small gear 59 will also rotate counterclockwise to cause clockwise rotation of the gear 52 and engagement of the overrunning clutch. Thus, the shaft 51 and gear 58 will rotate clockwise, causing counterclockwise rotation of the gear 60 and eccentric 66. The movement of the eccentric will, of course, cause movement of the slide or sub-base 18 within a range equal to the throw of the eccentric 66.

Assuming that the cavity resonator forms part of a signal receiver, the movement of the slide or sub-base and the corresponding movement of the diaphragm 14 will cause the tuning of the cavity resonator to be varied over a predetermined range; and when an incoming signal is detected, the motor may be stopped at the desired position. However, when sharp tuning is required, as is often the case, it is desirable that the diaphragm have a vibratory movement in order to detect signals which might otherwise be missed. Thus as the diaphragm is moved through its tuning range, it is vibrated by the action of the eccentric 38.

The apparatus lends itself to use in connection with automatic tuning arrangements in the respect that when the signal is heard, means (not shown) may be provided for automatically stopping or reversing the motor.

In case of motor reversal (e. g. by operation of switch 25), the vibratory action of the diaphragm will continue while the overall movement will have terminated by reason of the overrunning clutch causing cessation of the movement of the slide or sub-base 18.

Desirably, a brake or friction arrangement (not shown) may be added to or incorporated in the apparatus to act when the motor current is cut off so as to stop the movement of the slide or sub-base immediately. Preferably such brake will act upon the shaft 51 so as to also prevent reverse rotation of that shaft.

Although the operation and structure of a device embodying the principles and functions of the invention may be clearly understood from the foregoing description of the drawing, it will be understood that the invention is not limited to the specific application illustrated, and that many modifications within the scope of the invention will occur to those skilled in the art.

I claim:

1. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a tuning element movable over a predetermined range, motor-driven means for moving said element over its said range, means powered from said motor-driven means for imparting limited subsidiary vibratory movement to said element during its over-all movement by said first means, and means to stop at will the over-all movement of said element while continuing the vibratory action of said element.

2. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a tuning element movable over a predetermined range, motor-driven means for moving said element over its said range, means powered from said motor-driven means for imparting limited subsidiary vibratory movement to said element during its over-all movement by said first means, and means including an overrunning clutch to stop at will the over-all movement of said element and to continue its vibratory action.

3. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a tuning element movable over a predetermined range, a driving motor, means driven by said motor for moving said element over its said range, and means including a unidirectional clutch driven by said motor for imparting limited subsidiary vibratory motion to said element during its over-all movement by said first means, said motor being reversible at will to stop the over-all movement and to continue the subsidiary vibration of said element.

4. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a tuning element movable over a predetermined range, motor-driven means for moving said element over its said range, means powered from said motor-driven means for imparting limited subsidiary vibratory movement to said element during its over-all movement by said first means, common movable supporting means for said element and for the aforesaid means, and means for adjusting the position of said element by moving said common supporting means.

5. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a movable tuning element, means for moving said element over a predetermined range, means for imparting limited subsidiary vibratory movement to said element during its over-all movement, a single motor for driving both of said means, and a clutch between said motor and said first-named means to deactivate the latter and to enable continued activation of said second-named means.

6. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a movable tuning element, means for moving said element over a predetermined range, means for imparting limited subsidiary vibratory movement to said element during its over-all move-

ment, a single reversible motor for driving both of said means, and one-way clutch means between said motor and said first-named means to deactivate the latter when said motor is reversed and to enable continued activation of said second-named means.

7. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a movable tuning element, movable supporting means for said tuning element, means including an eccentric for vibrating said element, means including a second eccentric for moving said supporting means to thereby move said tuning element over a predetermined range, and a single motor supported by said supporting means and driving said eccentrics.

8. A tuning apparatus for high frequency signaling systems, comprising a tuning device having a movable tuning element, movable supporting means for said tuning element, means including an eccentric for vibrating said element, means including a second eccentric for moving said supporting means to thereby move said tuning element over a predetermined range, a reversible motor supported by said supporting means and driving said eccentrics, and one-way clutch means in the driving connection between said motor and said second eccentric, whereby movement of said support is stopped on reversal of the motor.

9. A method of effecting tuning operation of a cavity resonator having an adjustable element which comprises imparting relatively slow movement to said element through a predetermined range, and imparting relatively rapid vibratory movement to said element as it is moved through said range.

10. A tuning apparatus for high frequency signaling systems, comprising a tuning element, a motor, means powered by said motor for continuously moving said element over a predetermined path, and means powered by said motor for continuously imparting to said element oscillatory movements in the direction of said path, the amplitude of said oscillatory movements being very short by comparison with the length of said path, said means being operative concurrently.

ELMER O. THOMPSON.