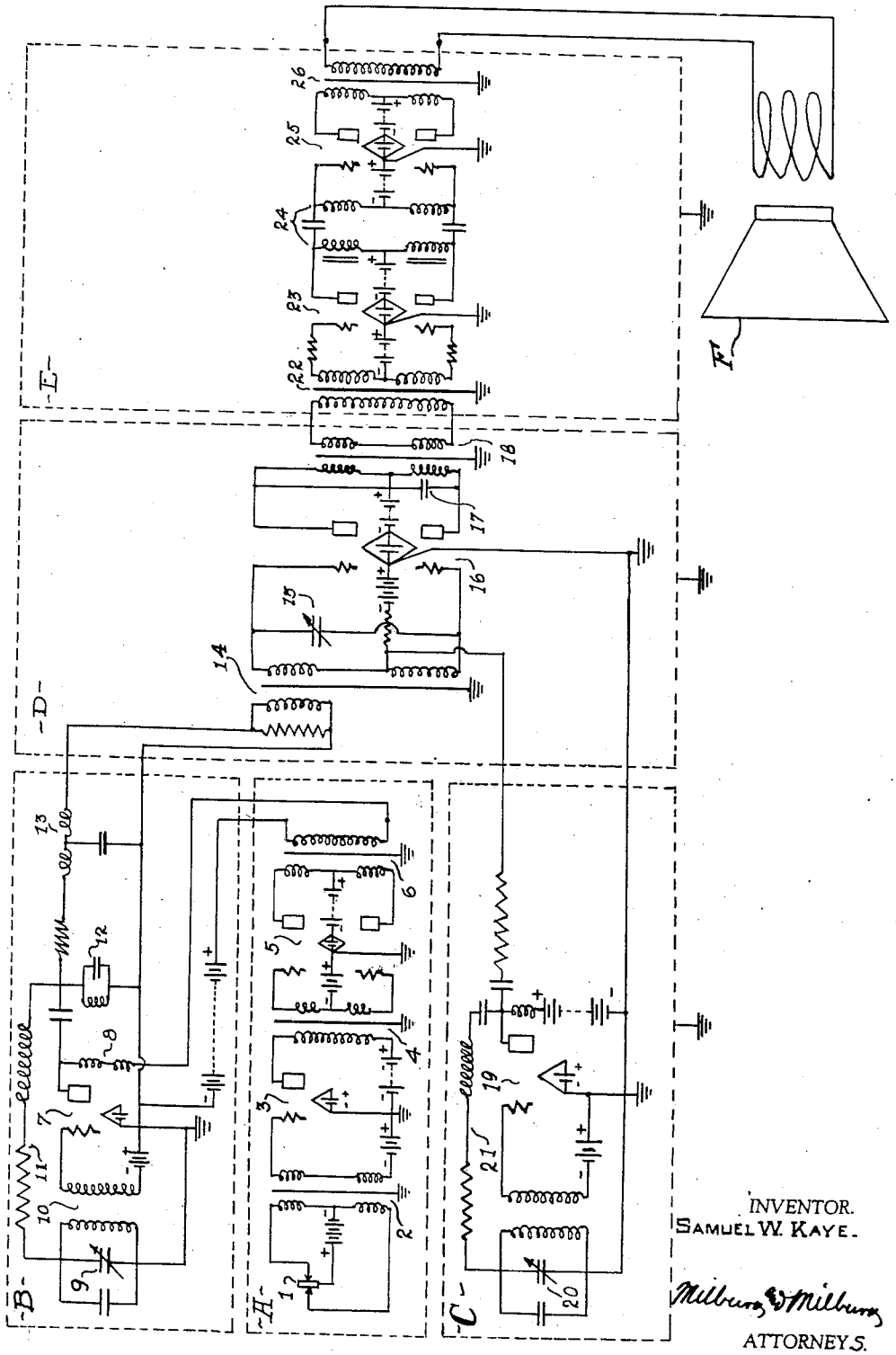
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DEVICE FOR PRODUCING VIBRATO

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## DEVICE FOR PRODUCING VIBRATO

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8 Claims. (Cl. 179—1)

This invention relates to the production of vibrato in musical and other sounds, the idea being to enhance the quality and pleasing effect thereof.

As is well known, it is common practice for the player of a musical instrument to produce vibrato by his own effort. But, in an orchestra, with each individual player producing his own vibrato, there would be nothing to keep them at the same number of vibrations per second or in step and there would result an out-of-step assembly of the several vibrato effects, and there would be interference between the beats produced by the players in the tones from their individual instruments.

Accordingly, the object of the present invention is to devise an artificial means for producing vibrato in connection with a sound amplifying system, considered in a generic sense.

A further and more specific object is to produce such a device that can be employed in connection with either a radio broadcasting or receiving system or a public address system.

Another object is to devise a method of artificially producing vibrato in each of a plurality of musical instruments and/or voices and combining the same into an ensemble with the vibrato in proper step and the volume in proper balance, so far as the relation between the instruments and voices is concerned. It is also contemplated that this invention be employed in various other combinations, as hereinafter explained.

Still another object of this invention is to devise a method and apparatus whereby the vibrato effect, as herein referred to, can be obtained electronically.

Other objects will appear from the following description and claims when considered together with the accompanying drawing.

The single figure of the accompanying drawing illustrates one form of electronical means that can be employed for carrying out the present invention.

It is to be understood that the present form of disclosure is merely for purposes of illustration and that there may be devised various other forms and combinations of apparatus without departing from the spirit of the present invention as herein set forth.

Also, it is to be understood that this invention may be embodied in various combinations and arrangements of musical instruments and other sources of sounds, as above suggested and as hereinafter more fully explained.

Briefly stated and in a general way, my present form of device comprises a conventional microphone amplifier A, a modulated oscillator B of constant frequency, a variable unmodulated oscillator C, a modulator-detector D, a low frequency modulated amplifier E and a loud speaker F.

The method, in a general way, consists in first picking up and amplifying the original sound by means of amplifier A, then having the output therefrom to modulate the constant oscillator B by plate linear modulation, this modulated frequency and the unmodulated frequency of the other oscillator C being then mixed together in the modulator-detector D, from which the out-put is the sound or audio frequencies modulated by a certain predetermined beat frequency for the purpose of obtaining vibrato. This is then amplified at E whence it is transmitted to the loud speaker or speakers F. The variable oscillator C is adjusted to beat with the modulated oscillator to very low frequencies, one (1) to ten (10) cycles per second, and this is the predetermined modulated beat frequency above referred to.

The various elements of the several parts of the system herein illustrated will, no doubt, be understood from the accompanying drawing, but they will be briefly described.

The microphone amplifier A comprises the microphone 1, the input transformer 2, the first stage of amplification 3, the coupling transformer 4, the second stage of amplification (push pull) 5, and the out-put transformer 6. This amplifier picks up sound in the conventional manner and amplifies all audio frequencies in the practical range of from thirty (30) to ten thousand (10,000) cycles per second. The out-put of this amplifier is a power out-put such as is created by a class "B" type of audio amplifier and is sufficient for one hundred per cent (100%) modulation of the oscillator indicated by reference letter B.

The oscillator B, as herein indicated, is a constant carrier of one hundred thousand (100,000) cycles per second and comprises the oscillating vacuum tube 7, the retard coil 8, the adjustable and calibrated condenser 9, in-put transformer 10, the feed-back resistance 11, the filters 12, and the inductance 13.

The modulator-detector D comprises the special coupling transformer 14 for all frequencies, the volume control 15 for varying the amplitude of low frequencies, the balanced modulator tubes 16, the by-pass high frequency control 17, and the out-put transformer 18.

The variable unmodulated oscillator 6 comprises the oscillating vacuum tube 19, the variable control 20 for creation of the eventually low frequencies, and the feed-back circuit 21. The oscillator C generates a radio frequency and is manually variable between ninety-nine thousand nine hundred and ninety (99,990) and one hundred thousand (100,000) cycles per second, creating a difference in frequency from a fraction of a cycle to ten (10) cycles per second or higher if required. However, the correct effect seems to be best obtained in the range from two (2) to three (3) cycles per second.

It is to be understood that a crystal may be employed in connection with each of the oscillators B and C as a means of holding the frequency at the point desired.

It will be observed from the accompanying diagram that the oscillator B is connected to the primary of the special coupling transformer 14 which is coupled to the secondary of one of the grids of the balanced modulator tubes 16.

It will also be observed that the oscillator C is connected directly to the grids of the balanced modulator tubes 16.

The amplifier E comprises the in-put transformer 22, the push-pull amplifying tubes 23, the reactance resistance coupling 24, the push-pull power amplifying tubes 25, and the out-put transformer 26 which is connected to one or more loud speakers F.

Other elements, such as batteries, condensers, resistances, and electrical connections are indicated conventionally in the accompanying diagram and will be understood as to their arrangement in the various parts of the system without explanation. There are also indicated ground connections to the individual shields (indicated in dotted lines) for the parts A, B, C, D and E, and each shield is shown as having a ground common terminal.

The operation will now be explained. The sound is picked up by the microphone and microphone amplifier A which amplifies all audio frequencies in the practical range of from thirty (30) to ten thousand (10,000) cycles per second. The out-put of the amplifier A then modulates the radio frequency oscillator B of let us say one hundred thousand (100,000) cycles per second. (This is similar to a broadcast station transmitter.) Thus the out-put of the oscillator B is one hundred thousand cycles (100,000) per second modulated by the sound or audio frequency varying between thirty (30) and ten thousand (10,000) cycles per second, and this out-put is fed to the modulator-detector D, as above explained.

The oscillator C. having been set with respect to the oscillator A, let us say at ninety-nine thousand nine hundred ninety-seven and five tenths (99,997.5) cycles per second, so as to produce a difference of two and one-half cycles per second in frequency between the two oscillators, the out-put of oscillator C is fed directly to the grids of the balanced modulator tubes.

The mixture of the oscillations of the oscillator B and the modulations of from thirty (30) to ten thousand (10,000) cycles per second of musical frequency, creates frequencies ranging from ninety thousand (90,000) to one hundred and ten thousand (110,000) cycles per second. Mixed with this in the modulator-detector is the constant frequency of ninety-nine thousand nine hundred and ninety-seven and five tenths (99,997.5) cycles per second, and the result in the secondary of the out-put transformer 18 is the detected original audio frequencies varying between thirty (30) and ten thousand (10,000) cycles per second shifted two and one-half (2.5) cycles per second above and below its original frequency. Having obtained the audio frequency modulated at two and one half (2.5) cycles per second, I have produced the vibrato effect. This result is then amplified and broadcast from the loud speaker or loud speakers.

It should be noted that with my system, all oscillations are created as relatively high frequencies, which makes it possible to accomplish the result here desired without having to create, handle and amplify a fundamental frequency of two and one-half (2.5) cycles per second, which is a difficult thing to do in practice. In fact, it is difficult to create and amplify frequencies in the range from a fraction of a cycle to ten (10), fifteen (15) or twenty (20) cycles per second. With my device, I am enabled to avoid this problem as all frequencies are here mixed and there is not required the transfer of the extremely low frequency as a fundamental low frequency.

It should be noted also that by this method the creation of the vibrato frequency produces an increased aggregate power in the circuit, creating the correct effect, whereas in many other absorption methods of modulation there is a subtraction of power thereby not creating the desired effect.

Also, with my method, the vibrato is created in the best wave form (sinusoidal), whereas with any other method this would be very difficult if not impossible to accomplish, the reason being that the low frequency here obtained is the result of two relatively high frequencies operating with good wave form and consequently the beat frequency wave form is good and very desirable. The mixing and detecting of all frequencies at a single point is most efficient and desirable and constitutes an important feature of my present invention.

Thus, I have devised a means for artificially producing vibrato in an amplifier of the proper proportions and wave form to give a pleasing effect to the tones of any musical instrument or instruments and/or singer or singers. In fact, this effect may be applied to any tone for the purpose of giving it a more pleasing effect or to create individuality. This invention may also be applied to the sounds produced by other instruments that are not ordinarily considered as musical instruments, as for instance whistles, bells. automobile horns. etc.

My invention is capable of many various combinations in its adaptation to the radio and public address systems. For instance, the vibrato applied to a voice may be transmitted over a public address system and broadcast in combination with the regular music of an orchestra, i. e. without any vibrato. Or, vibrato may be produced individually upon the music of each of a plurality of instruments and/voices, and these individual effects combined into an ensemble. Also, the music of a conventional orchestra may be broadcast and heard in conjunction with other music having vibrato over a public address system. And, an orchestra may play in a conventional manner to an audience while vibrato created at a point remote from the orchestra is transmitted by the public address system to the location of the orchestra, and then the music from both the orchestra and the public address system may be broadcast. Again, the music of a singer without vibrato and the music of an or-

chestra with vibrato might be combined, or vice versa or the vibrato might be applied to both the orchestra and singer. These few instances merely indicate the range of possibility of use of this invention and, as above explained, any of these various combined effects may be transmitted over either a broadcasting or public address system.

My present device may also be employed in connection with the radio receiving set and it is to be understood that this arrangement is comprehended by the present disclosure of invention. It is to be understood also that the term "sound amplifying system", as employed herein, is intended to include both radio and public address systems, this term being adopted as generic.

What I claim is:

1. In the art of the class described, means for generating and modulating a radio frequency wave by means of an audio frequency wave, means for generating and supplying another radio wave different from the first by an extremely low number of cycles per second, and means for mixing said modulated and unmodulated waves and producing therefrom an extremely low frequency modulation of the audio frequency wave, ready to be transformed into sound.

2. In the art of the class described, the method of artificially producing vibrato in musical and other sounds, consisting in amplifying the audio frequency wave, employing the out-put thereof for modulating the oscillations of radio frequency, mixing with said modulated oscillations the unmodulated oscillations of another radio frequency differing from the first by an extremely low number of oscillations so as to create a resultant extremely low frequency modulation of an audio frequency wave, said resultant modulation being of a frequency corresponding to the difference between the frequencies of the two radio oscillations.

3. In the art of the class described, means for amplifying the audio frequency wave, an oscillator of radio frequency, means of operative connection between said amplifier and oscillator for modulating the latter in accordance with the output of the former, a variable unmodulated radio frequency oscillator adjustable with respect to the modulated oscillator, a modulator-detector, and operative means of connection between said modulator-detector and each of said oscillators, whereby the frequencies are all mixed and there is obtained as a result thereof the audio frequency wave modulated at a resultant extremely low frequency, and ready to be transformed into sound.

4. In the art of the class described, the method of artificially producing vibrato, consisting in modulating the audio frequency wave of approximately between thirty (30) and ten thousand (10,000) cycles per second by means of two radio frequencies differing from each other by approximately two and five-tenths (2.5) cycles per second.

5. In the art of the class described, the method of artificially producing vibrato, consisting in modulating the audio frequency wave of approximately between thirty (30) and ten thousand (10,000) cycles per second so as to produce vibrato having variable peak amplitudes at approximately two and five-tenths (2.5) cycles per second.

6. In the art of the class described, means for amplifying the audio frequency wave, an oscillator of radio frequency, means of operative connection between said amplifier and oscillator for modulating the latter in accordance with the output of the former, a variable unmodulated oscillator adjustable with respect to the modulated oscillator, a modulator-detector, operative means of connection between said modulator-detector and each of said oscillators, whereby the frequencies are all mixed and there is obtained as a result thereof the audio frequency wave modulated at an extremely low frequency and ready to be transformed into sound, and means for varying the amplitude of the vibrato component.

7. In the art of the class described, means for generating and modulating a radio frequency wave by means of an audio frequency wave, means for generating and supplying another radio wave different from the first by an extremely low number of cycles per second, and means for mixing said modulated and unmodulated waves and producing therefrom an extremely low frequency modulation of the audio frequency wave.

8. In the art of the class described, means for modulating a radio frequency wave by means of an audio frequency wave, means for supplying another radio wave different from the first by an extremely low number of cycles per second, and means for mixing said modulated and unmodulated waves and producing therefrom an extremely low frequency modulation of the audio frequency wave, ready to be transformed into sound.

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