April 5, 1949. N. I. DANIEL 2,466,306

VIBRATO SYSTEM FOR AMPLIFIERS

Filed Oct. 29, 1947

FIG. 1.

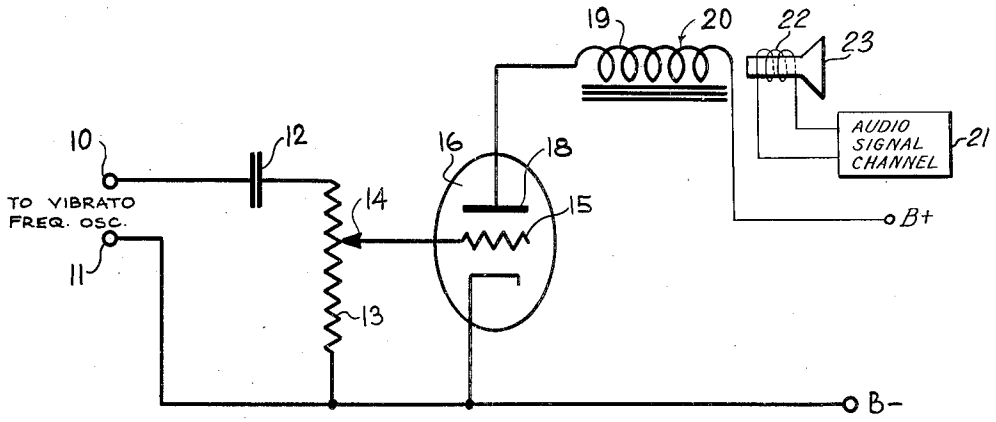
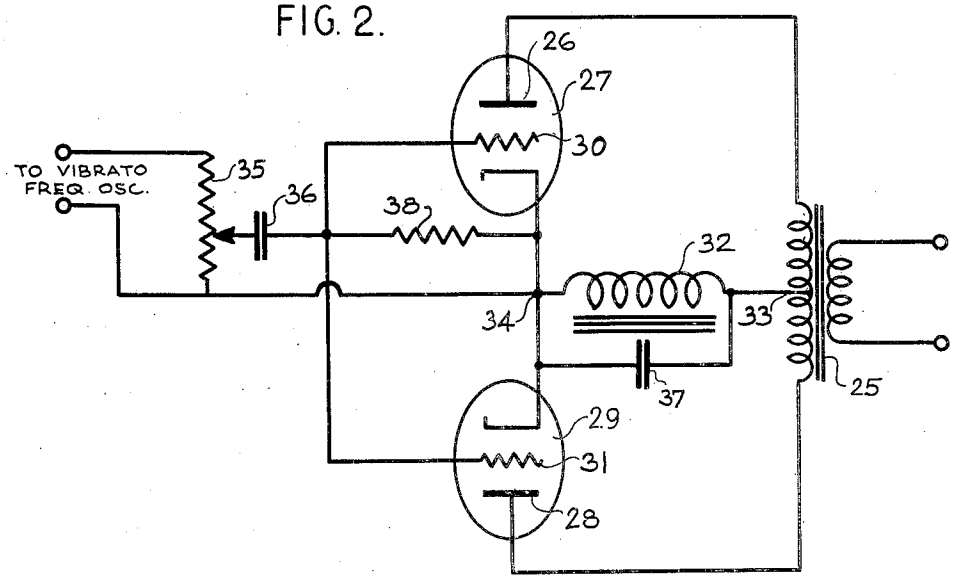



FIG. 2.




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## VIBRATO SYSTEM FOR AMPLIFIERS

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Application October 29, 1947, Serial No. 782,838

3 Claims. (Cl. 179—1)

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This invention relates to audio frequency amplifier devices and more particularly to an amplifier for a musical instrument or the like wherein the output is automatically provided with a tremolo or vibrato effect.

This application is a continuation in part of my previous application filed August 29, 1947, and bearing Serial No. 771,259.

As was disclosed in said prior application, it is well recognized that a vibrato improves the quality of music and it is employed by accomplished musicians through supplementary manipulation of the strings or other sound producing elements of an instrument. However, not only must the musician be accomplished at his task, but it requires particular effort and attention while the human element involved often causes notes or passages to be deprived of vibrato or to be insufficiently provided therewith.

According to my prior application, I automatically produced a vibrato effect in the output of the amplifier by employing a low frequency oscillator which was connected to the control grids of the amplifier output tubes. The amplitude of the output was varied according to the low frequency oscillator signals and the music issuing from the speaker of the amplifier was thereby provided with a vibrato or tremolo effect. However, if it were desirable or necessary to achieve a high intensity of vibrato, correspondingly high oscillator signals would have to be fed to the control grids of the output tubes. It is evident that under such conditions the music could be distorted if the tubes were required to operate along a non-linear portion of their characteristic curves. In other words, an oscillator signal of high intensity might bring the plate current of a tube into a flattened portion of its curve so as to produce distortion as is well understood in the art.

Bearing the foregoing in mind, it is an object of this invention to provide an amplifier for musical instruments or any similar sound producing medium wherein the sound output may be automatically provided with a vibrato of practically unlimited intensity. The vibrato in fact may periodically cut off the output completely so that substantially 100% vibrato may be secured. This object also includes the achievement of such vibrato without having any effect on the fidelity of the amplifier output, the foregoing being accomplished by avoiding action on the tubes of the amplifier in modulating the output as required.

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Another object of this invention is to provide a vibrato arrangement which is largely disassociated from an amplifier with which it is connected thereby enabling the arrangement to be separately produced and simply incorporated into an amplifier. Thus, a separate power supply for the vibrato system is produced, such an arrangement offering further advantages as well.

Other objects of my invention will be apparent from the following description, it being understood that the above general statements of the objects of my invention are intended to describe and not limit it in any manner.

Referring to the drawings:

Fig. 1 is a schematic view of the improved vibrato system such as may be incorporated into an audio amplifier.

Fig. 2 is a modified embodiment thereof.

As disclosed in my previous application, the amplifier itself may be conventional including a loud speaker having an exciting field winding. The present invention provides an apparatus for connection to such speaker field so that in effect the speaker efficiency may be caused to vary at the sub-audio frequency rate of the vibrato oscillator. The vibrato frequency oscillator or generator may take any conventional form of audio oscillator such as may be found in any radio handbook and in the instant application I employ the term vibrato frequency oscillator to indicate an oscillator operating approximately over a 3 to 20 cycle frequency range. In my prior application I disclosed an oscillator of the resistance-capacity type which provides good stability and can be easily controlled as to frequency. That oscillator or any other type may be employed in the instant invention. The output of the oscillator is applied to points 10 and 11 which are connected through condenser 12 to a potentiometer 13 constituting the vibrato amplitude control. Condenser 12 may be .5 microfarad so as to present very little impedance to low audio frequencies while potentiometer 13 may be in the order of a half megohm. The arm 14 of potentiometer 13 is connected to the control grid 15 of an electron discharge tube 16. Tube 16 is preferably, but not necessarily, of the so-called

power type tubes such as type 45 or type 6L6. The purpose of preferring power tubes is that more current can be handled so as to adequately energize a speaker field. In fact, two or more such tubes in parallel may be employed as by directly connecting the plates, grids and cathodes together when the total field current requirements cannot be provided by a single tube. For example, one large speaker field may require high currents or more than one speaker may be used in a system. The plate 18 of tube 16 is connected to the winding 19 of the speaker field 20. The other end of the speaker field winding is connected to a suitable source of B+ voltage such as may be supplied through the power supply of the amplifier. In other words, the speaker field and tube 16 will be connected across the power supply of the amplifier.

As the grid 15 is fed the output of the oscillator which generates the required fluctuating voltages of vibrato frequency, the plate current of the tube will vary correspondingly in an amplified manner. This varying plate current flows through the speaker field and varies its excitation function accordingly so that the varying vibrato currents are fed, from the output of the tube, to the voice coil of the speaker, by the conventional electro-magnetic action of such speakers. The speaker efficiency is thus caused to vary in the vibrato frequency and the music produced by the amplifier and speaker is thereby modulated by the vibrato currents. Such music is fed from the audio signal channel 21 which is the source of audio frequency signals, to the voice coil 22, the speaker cone 23 being actuated accordingly. It will be noted that the vibrato action is independent of the amplifier or audio signal channel so as to avoid any tendency to distortion of the audio signals.

The second embodiment employs a separate power supply from that of the amplifier and discloses a full wave rectifier arrangement which incorporates the speaker field as a load. Transformer type 25 may be of the usual step-up type and the respective ends of its secondary winding are connected to plate 26 of tube 27 and plate 28 of tube 29. Tubes 27 and 29 may be of the power type as above described. The cathodes of the tubes are connected together as are the control grids 30 and 31. The speaker field winding 32 is connected from the mid-point 33 of the power transformer secondary to cathode mid-point 34 which may be a high voltage point relative to point 33. Potentiometer 35 and condenser 36 serve substantially the same function as potentiometer 13 and condenser 12 in the previous embodiment. Resistor 38 is a grid return of conventional high resistance. Condenser 37 is a filter condenser which may have a value of 8 mfd.

The operation of the circuit shown in Fig. 2 is essentially similar to that of the previous embodiment. Briefly, the vibrato voltages are fed to the input circuit or control grids of the tubes 27 and 29 which operate as grid control rectifiers and produce a varying and amplified voltage across the speaker field 32. Corresponding currents will flow through the speaker field in the cathode or output circuit so as to vary the efficiency of the speaker field in the manner above stated. Either the full wave rectifier arrangement shown or a half wave rectifier may be employed as will be self-evident to one skilled in the art. Thus, the supply voltage, with or without a transformer, may be rectified across the plate and cathode electrodes of a tube while the control grid is connected to the vibrato oscillator, the speaker field being in the plate circuit the audio signal channel, voice coil, and speaker cone follow the arrangement shown in Fig. 1.



In the second embodiment, it is recognized that the filter condenser 37 used to smooth out supply frequency ripples in the power supply, will tend to similarly smooth out the vibrato signals. However, the vibrato signals are generally of a frequency of about 3 to 20 times per second while the filter condenser is generally chosen to be effective on currents of 60 cycle frequency. Therefore, if the filter condenser is approximately 8 mfd., it will be satisfactory for filtering the conventional 60 cycle frequency of the power supply output but will be too small to smooth out the very low oscillator frequency. In this arrangement, since a separate power supply is employed, the vibrato system is almost fully independent of the amplifier and can be produced as a separate unit wherein it is only necessary to connect the speaker field in the manner shown in order to provide the amplifier with the desired vibrato.

It will be observed that in both of the above embodiments the amplifier output tubes are not affected since the vibrato is accomplished in the speaker alone substantially independently of normal operation of the amplifier itself.

While there has been shown what at present is considered a preferred embodiment of the invention, it will be evident that many changes and modifications may be made therein without departing from its spirit. It is therefore aimed in the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the invention. Thus, it is unnecessary to employ a cyclicly operating electronic generator as illustrated, but any type of electrical fluctuations in the vibrato frequency range may be applied to the speaker field in the manner and for the purposes described.

What is claimed is:

1. In an audio amplifier including a speaker, an exciting field winding therefor, a voice coil, and an audio signal channel connected to said voice coil, vibrato means for said amplifier, said vibrato means comprising an electronic vibrato frequency oscillator, at least one electron discharge tube having a control grid and an output circuit, said oscillator being connected to said control grid and the output circuit of said tube being directly connected to said field winding whereby the output of said tube flows through said field winding, the connection of said oscillator to said control grid being independent of said audio signal channel, said oscillator being variable in both amplitude and frequency, the frequency variation being over a range of approximately 3 to 20 cycles per second.

2. In an audio amplifier including an audio signal channel, and a speaker having electromagnetic means including an electromagnetically actuated voice coil for driving the speaker cone, vibrato means for said amplifier, said vibrato means comprising an electronic vibrato frequency oscillator, electron discharge tube means having input and output circuits, said oscillator being connected to said input circuit, and the output circuit being electrically connected to said speaker electromagnetic means whereby the currents flowing in said output circuit are fed to said voice coil through electromagnetic action, the connection of said oscillator to said input circuit being independent of said audio signal channel, said oscillator being variable in both amplitude and

frequency, the frequency variation being over a range of approximately 3 to 20 cycles per second.

3. In an audio amplifier including a speaker, an exciting field winding therefor, a voice coil, and an audio signal channel connected to said voice coil, vibrato means for said amplifier, said vibrato means comprising an electronic vibrato frequency oscillator, said oscillator being connected to said field winding so as to feed its vibrato frequency output currents therethrough, the connection of the oscillator to the field winding being independent of said audio signal channel, the operating frequency of said oscillator being less than approximately 20 cycles per second.



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## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,967,125 | Miller | July 17, 1934 |
| 2,169,762 | Kaye | Aug. 15, 1939 |