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SUPERAUDIBLE PHONOGRAPH RECORDING SYSTEM

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Fig. 1

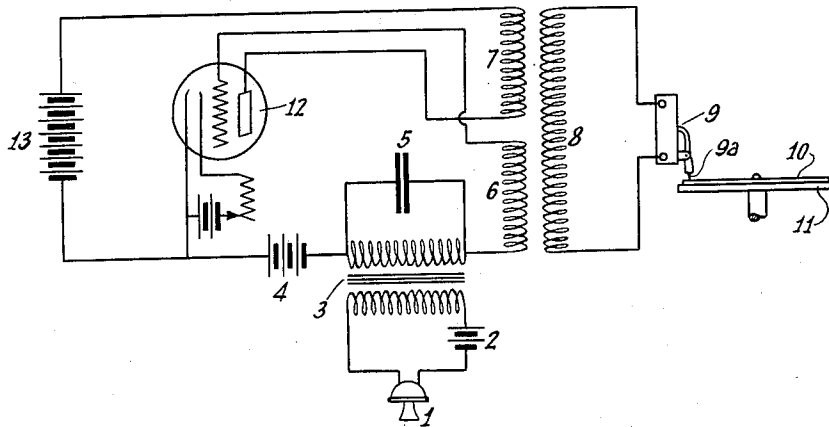


Fig. 2

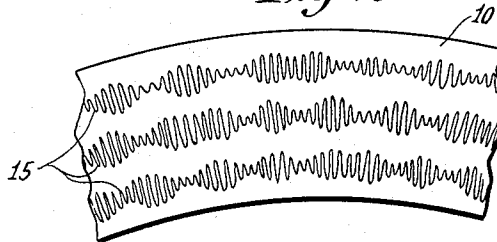
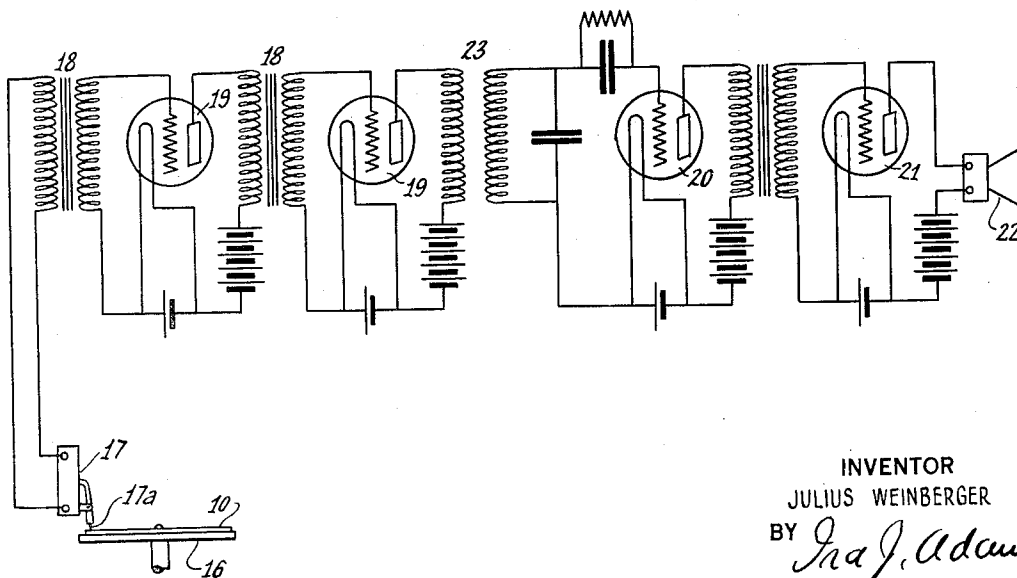


Fig. 3



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SUPERAUDIBLE PHONOGRAPH RECORDING SYSTEM

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23 Claims. (Cl. 179—100.4)

The invention concerns phonograph records and methods of making the same and has for its principal object the provision of a record having unique and improved characteristics.

5 A further object of the invention is to provide a phonograph record on which sounds are recorded in the form of an inaudible frequency modulated by audible frequencies.

10 Still another object of the invention is to provide a phonograph record on which sounds are recorded in the form of superaudible frequencies modulated at audible frequencies.

Up to the present time phonograph records have been made using audible frequencies only 15 for the recording. This has been more or less satisfactory for the mechanical types of phonographs but with the recent development of electrical phonographs the use of this type of apparatus has been increased enormously and this development further permits of greatly improved reproduction of original sounds. It is proposed according to the present invention to record sounds on a record by subjecting the recording instrument to superaudible vibrations and modulating 25 the vibrations in conformity with the frequency of the sound which it is desired to record. The recording instrument may be vibrated mechanically, electrically, electromagnetically or in any other desired way but I prefer to use some sort 30 of an electrical system as this can readily be adapted to the recording process according to the invention.

A record made according to this invention could only be reproduced, of course, on a special 35 reproducing machine provided with suitable means to convert the modulated superaudible frequencies into audible sounds. Many different systems could be used for this purpose although I prefer an electrical system on account of the 40 simplicity of operation and adaptability to this purpose.

The so called scratch on such a record would be much less than on the present records. Scratch seems to consist mainly of audible frequency, 45 regular impulses given to the reproducer needle by the groove of the record. This disturbance would be reduced on records made according to the present invention because in the present case the reproducing stylus is always 50 ways subjected to a steady vibration of high frequency. The difference between reproducing records made according to the former methods and those made according to the present invention resides in the fact that in the former 55 case the reproducing stylus is subjected to un-

controlled irregularities in the record groove while in the latter case the stylus is always subjected to a predetermined vibration at superaudible frequency. In the former records then an undesired vibration of audible frequency is present which is avoided to a large extent by 60 subjecting the stylus to regular superaudible frequency vibrations.

A further advantage of records made according to the present invention resides in the fact 65 that they lend themselves readily and practically to amplification of the reproduced sounds to any desired degree. There is, of course, a definite and rather low limit to the amplification of sounds obtained from the present day 70 phonograph records by mechanical reproducing means. The possible amplification may be increased in electrical reproducing systems by the use of a suitable number of audio frequency amplifiers in the shape of vacuum tubes. Amplifi- 75 cation by this method is superior to that in the mechanical systems but is still limited, as the maximum practical amplification obtainable when vacuum tubes are used as audio frequency amplifiers represents a voltage amplification of 80 about 1000. With a record formed according to the present invention, however, amplification can be obtained to any desired degree as both radio and audio frequencies can be amplified and the combined amplification is only limited by the 85 ability to keep down the distortion in the amplification system. Moreover the superaudible frequency can be suitably chosen to adapt it readily to amplification. The record groove therefore could be made with very small amplitudes 90 and with electrical reproduction can be readily amplified to obtain any required volume of sound.

The invention is illustrated by way of example in the accompanying drawing in which, 95

Fig. 1 shows an electrical system for engraving records according to the invention,

Fig. 2 shows in plan view a section of a record, greatly enlarged, made according to the present invention, and

Fig. 3 shows an electrical reproducing system 100 for playing records made according to the present invention.

Referring to Fig. 1 a record to be engraved is shown at 10 carried by a suitable rotating carriage 11. A recorder 9 of any desired type is 105 mounted in proximity to the record carrier and may be arranged to feed in a radial direction as the record rotates. The recorder is provided with a stylus 9a which bears against the record and cuts a spiral groove in the latter as the rec- 110

ord rotates. The sounds to be recorded on the record are impressed on the diaphragm of the microphone 1 which is connected in series with the primary coil of a transformer 3 and battery 2. A self excited vacuum tube oscillator 12 includes in its plate circuit a coil 7 and a battery 12. Its grid circuit includes the coil 6, the secondary of the transformer 3 and the biasing battery 4 for biasing the grid potential to its proper value. The secondary coil of the transformer 3 is shunted by condenser 5 for by-passing high frequencies around this coil. The coils 6 and 7 are in proper inductive relationship to each other to cause the tube 12 to operate as a self excited oscillator of high frequency oscillations.

The recorder 9 is connected in circuit with a coil 8 also in inductive relationship with the coil 7. With this arrangement, if no sound waves are impressed on the microphone 1, the high frequency oscillations generated by the tube 12 will be transferred to the coil 8 and operate the recorder 9 causing the stylus 9a to vibrate at the frequency of the oscillating tube 12. If sound waves are impressed on the microphone they will cause a change in current through the primary of the transformer 3 thereby causing changing voltages across the secondary of this coil. As the secondary of the transformer is in the grid circuit of the oscillator 12, it will modulate the output of the oscillator in accordance with the sound waves impressed on the microphone. In this case, the stylus 9a will vibrate at the frequency of the oscillator but its vibrations will be modulated in accordance with the sound waves impressed on the microphone.

A record formed by this method will have the appearance shown in Fig. 2 in which the record and the grooves cut by the vibrating stylus are shown to a greatly enlarged scale. The vibrating stylus cuts grooves in the shape of the curves 15 consisting of high frequency curves of varying amplitude representing the motion of the stylus. The envelopes of these curves represent the audible frequencies with which the high frequency output of the oscillator is modulated. The envelopes therefore represent the frequencies of the sound waves impressed on the microphone 1.

As the record represents a modulated high frequency vibration it is clear that some rectifying means must be used to reproduce the sounds recorded on the record. Such a system is shown in Fig. 3 in which 10 represents the record, 16 its rotating carrier, 17 a reproducer of any desired form provided with a stylus 17a, 19 high frequency vacuum tube amplifiers, 20 a detector, 21 an audio frequency amplifier and 22 a loud speaker. The reproducer 17 is connected to the radio frequency amplifiers and the latter are connected to each other in cascade to the radio frequency transformers 18. The plate circuit of the last high frequency amplifier is connected to the input of the detector 20 by means of the transformer 23. The amplified high frequencies are rectified by the detector and impressed on the audio frequency amplifier 21 in whose output circuit is connected the loud speaker 22. This arrangement provides for amplifying the superaudible frequencies to any desired extent, then detecting them and amplifying the resulting audio frequencies. The reproducer 17 may be of any desired form such as the electro-magnetic, electro-static, and piezo-electric crystal type but it is desirable that it have a resonant frequency the same as that of the carrier frequency on the record. The details of

several approved forms of the reproducer 17 and recorder 9 are shown in my copending application Serial No. 65,135 filed October 27th, 1925. This will increase the amplitude of the currents supplied to the first high frequency transformer 18 and improve considerably the operation of the circuit.

While I have shown my invention as applied to certain specific examples, it is obvious that many modifications will readily occur to those skilled in the art, for example, the electrical systems can be replaced by suitable mechanical ones if desired.

I intend to be limited therefore only as indicated by the scope of the following claims:

1. The method of recording sound waves on phonograph records which consists in engraving superaudible frequencies modulated with audible frequencies thereon.

2. The method of recording sound waves on phonograph records which consists in modulating waves of superaudible frequency at the frequencies of the sound waves and engraving the modulated waves on the record.

3. The method of engraving phonograph records which consists in vibrating the recording stylus at super-audible frequency and modulating the vibrations at audible frequencies.

4. A phonograph record having sound waves engraved thereon in the form of a modulated super audible frequency.

5. A phonograph record having sound waves engraved thereon in the form of a super-audible frequency modulated at audible frequencies.

6. In combination, an electrical circuit adapted to generate electrical oscillations at a super-audible frequency, means to modulate said electrical oscillations at an audio frequency, and means for engraving said superaudible oscillations of varying amplitude upon a phonographic record.

7. In combination, a thermionic valve, a super-audible frequency oscillatory circuit coupled thereto, means for modulating at audio frequencies the current in said circuit, and an electrically actuated recorder for engraving the superaudible oscillations of varying amplitude on a phonograph record.

8. The method of recording sound waves upon a phonograph record which comprises, vibrating the recording stylus at a constant superaudible frequency and at a constant amplitude when no sound waves are being recorded, moving the record relatively to the stylus in a predetermined manner, and varying the amplitude of vibration of the stylus at audio frequencies corresponding to the sound waves to be re-recorded while maintaining constant the said superaudible frequency of vibration of the stylus.

9. A phonograph record having sound waves recorded thereon comprising a groove of wave form having a superaudible frequency, said wave having variations in amplitude which correspond to the sound to be reproduced.

10. A phonograph record comprising a stylus track having the sounds to be reproduced recorded therein as a superaudible vibration modulated in accordance with sound frequencies.

11. Phonograph apparatus comprising, in combination, a mechanical record having sounds engraved thereon as modulations of a superaudible frequency vibration, and means to be driven by said record for converting the vibrations produced thereby, into electrical oscillations.

12. The method of reproducing sound from a

mechanical record thereof engraved with oscillations of relatively higher frequency modulated in accordance with the sounds to be recorded, which comprises producing from said record electrical oscillations corresponding thereto, and converting said oscillations into sound waves.

13. The method of recording audible sounds which comprises producing electrical oscillations corresponding to the sounds to be recorded, modulating other electrical oscillations of a relatively higher frequency in accordance with the first set of oscillations and recording said modulated oscillations as mechanical modifications of a record.

14. The method of recording audible sounds which comprises producing electrical oscillations corresponding to the sounds to be recorded, modulating other electrical oscillations of a relatively higher frequency in accordance with the first set of oscillations, and engraving a record blank in accordance with such modulated oscillations.

15. The method of recording audible sounds which comprises producing electrical oscillations corresponding to the sounds to be recorded, producing a second group of electrical oscillations of superaudible frequency, modulating said second group of oscillations in accordance with said first group, and recording said modulated oscillations as mechanical modifications of a record.

16. The method of recording audible sounds which comprises producing electrical oscillations corresponding to the sounds to be recorded, producing a second group of electrical oscillations of superaudible frequency, modulating said second group of oscillations in accordance with said first group, and engraving a record blank in accordance with such modulated oscillations.

17. The method of recording audible sounds which comprises producing electrical oscillations corresponding to the sounds to be recorded, producing a second group of electrical oscillations of superaudible frequency sufficiently high to be capable of radiation as electromagnetic waves, modulating said second group of oscillations in accordance with said first group, and engraving a record blank in accordance with such modulated oscillations.

18. The method of reproducing sound from a

record engraved with super-audible frequency vibrations modulated at sound frequencies which comprises producing directly from said record oscillations of super-audible frequency, modulated at sound frequencies, and converting said oscillations into sound waves.

19. Phonographic recording apparatus comprising, in combination, means for generating electrical oscillations of a frequency sufficiently high to be modulated at desired sound frequencies, means for modulating said oscillations in accordance with the sounds to be recorded, and means for engraving a record in accordance with said modulated oscillations.

20. Phonographic recording apparatus comprising, in combination, means for generating electrical oscillations of a frequency sufficiently high to be modulated at desired sound frequencies, means for modulating said oscillations in accordance with the sounds to be recorded, and means for engraving a record in accordance with said modulated oscillations, said means comprising a piezo-electric crystal device.

21. A phonograph record comprising a stylus track having the sounds to be reproduced recorded therein as vibrations of a frequency corresponding to that of radiatable electromagnetic waves modulated in accordance with sound frequencies.

22. Phonograph apparatus for producing from a record electrical oscillations of superaudible frequency modulated at sound frequencies, comprising in combination, a record having sounds engraved on a stylus track as modulations of a superaudible frequency vibration, and means to be driven by said record for converting the vibrations produced thereby into electrical oscillations, said means comprising a piezo-electric device.

23. In a piezo electric sound reproducing system, the combination of a piezo electric transmitter arranged to traverse a movable mechanical member bearing a sound record and a high frequency simple harmonic vibration record, said high frequency vibration record serving to sensitize said piezo electric transmitter.

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