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METHOD OF AND MEANS FOR CONTROLLING HIGH FREQUENCY VOLTAGE IN MAGNETIC RECORDER HEADS

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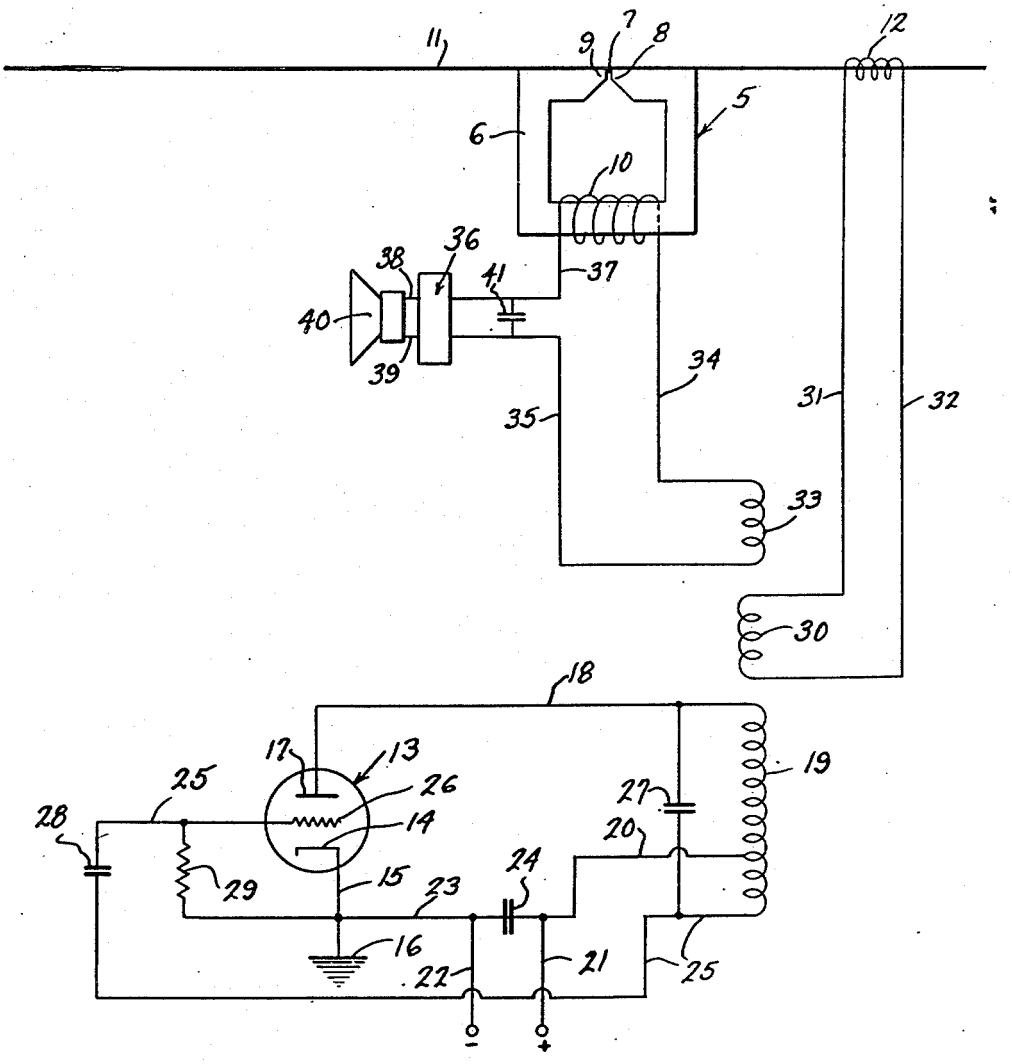

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METHOD OF AND MEANS FOR CONTROLLING HIGH FREQUENCY VOLTAGE IN MAGNETIC RECORDER HEADS

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This invention relates to improvements in a method of and means for controlling the high frequency voltage in a magnetic recorder head, and the invention being highly desirable for use in connection with the electrical circuit of a magnetic recording device, although the invention may have other uses and purposes as will be apparent to one skilled in the art.

In magnetic recording devices wherein a sound recording is made upon an elongated paramagnetic recording medium, such as a metallic tape or wire, a recording head is frequently used to apply successive magnetizations varying in intensity in keeping with the sound being recorded to a traveling recording medium such as a tape or wire. There are variations in characteristics in recording heads, so that if one recording head is substituted for another in a particular device, an adjustment is desirable to vary the high frequency voltage applied to the substitute recording head in order to acquire optimum efficiency by compensating for the variations in characteristics of that head in comparison with the one previously used. Likewise, similar adjustments of the applied voltage are desirable in the event a recording medium of a different paramagnetic alloy or metal is substituted for that previously used. Further, if the speed of the device is changed, that is, the speed of travel of the recording medium during a recording operation, a similar adjustment to acquire optimum efficiency is desirable. It is further desirable, in most cases, to effect a variation of the high frequency voltage to the recording head when a magnetic recording device is first manufactured so as to compensate for the relative effect of the recording head, medium and speed characteristics.

With the foregoing in mind, it is an important object of this invention to provide a method of and means for adjusting the high frequency voltage applied to the recording head of a magnetic recording device in order to acquire optimum efficiency.

It is also an object of this invention to provide a method of and means for adjusting the high frequency voltage applied to a recording head in a magnetic recording device, as compared to the maximum amplitude of the sound waves being recorded.

Also a feature of the invention resides in the provision of a method of and means for adjusting the voltage applied to a recording head in a magnetic recording device in a manner to compensate for variations in characteristics of the recording head, or characteristic variations caused by change in speed, or all of them, to acquire optimum efficiency in operation.

A further object of the invention resides in the provision of a simple method of and simple means for adjusting or varying the voltage applied to a recording head in a magnetic recording device over a considerably wide range to select the voltage for optimum operation and efficiency.

Frequently a magnetic recording device also includes what may be termed an erasing head so that the device may record satisfactorily upon a recording medium carrying a previous recording, and as the medium passes through the device the previous recording is removed by demagnetization of the recording medium prior to the magnetizing of the medium in accordance with the new recording.

This invention also has for an object the provision of a combination erasing head and control for the voltage applied to the recording head.

The invention also embodies the feature of providing a method of and means for adjusting the voltage applied to a recording head of a magnetic recording device and utilizing the adjustment means to perform an additional function.

Still a further object of the invention is the provision of a new and novel electrical circuit for inclusion in a magnetic recording device, the circuit involving both a recording head and an erasing head, and being so arranged that a simple variation in the impedance of the erasing head effects a control over the applied voltage to the recording head.

It is also a feature of the invention to provide a novel circuit arrangement for a magnetic recording device, in which the recording head is inductively coupled to a source of high frequency voltage, and the variation in a number of turns of a salient part of the circuit results in a control over the voltage applied to the recording head.

While some of the more salient features, characteristics and advantages of the instant invention have been above pointed out, others will become apparent from the following disclosures, taken in conjunction with the accompanying drawing, in which:

The single figure is a simplified schematic diagram showing salient parts of the electrical circuit embodied in the magnetic recording device, including means embodying principles of the present invention, and means by which the method embodied in the instant invention may be practiced.

As shown on the drawing:

In the illustrated embodiment of this invention there is shown a very simplified circuit and apparatus arrangement for a magnetic recording device. Many parts of the recording device and various other circuit connections which may be included in the device as commercially manufactured are omitted, because the instant invention particularly centers itself in the recording circuit and immediately associated apparatus.

It will be appreciated that in a diagrammatic showing of this character certain of the parts are illustrated in both diagrammatic and exploded fashion for the purpose of clarity, although these parts will present a different appearance in actual manufacture.

The salient portion of the apparatus of a magnetic recording device which I have selected for illustration includes a recording head generally indicated by numeral 5. This recording head may include a core 6, preferably laminated, which is of substantially rectangular shape with the exception of a rather minute air gap 7, and immediately adjacent this air gap 7 the core is shaped to provide confronting pole faces 8 and 9 of opposite polarity, the shaping being such as to reduce the size of the pole faces and concentrate the magnetic flux within a rather small area. Around a leg of the core 6 a coil 10 is wound to energize the core, and this coil, which itself is energized by the output of an oscillatory circuit, sets up a magnetic field within the core 6 which varies in intensity in accordance with variations in the sounds being recorded.

The recording medium, in the illustrated instance, is shown as a fine round wire 11, such a wire being approximately the size of a human hair, .004 to .005 inch in diameter being a satisfactory size. The recording medium is usually wound from one reel or spool to the other, and during the course of its travel it passes over or through a groove in the upper face of the recording head. Small increments of the traveling wire become successively magnetized in the region of the air gap 7 as the wire travels along, and these successive magnetizations will vary in accordance with variations in the sound being recorded.

Frequently, a previously made recording is no longer needed or wanted, and so it is desirable to re-use the medium containing that recording and place a new recording upon the medium. To expedite matters and save labor, the recording device may be equipped with a demagnetizing head 12 which is in the form of a coil through which or adjacent to which the medium 11 travels. This coil effectively demagnetizes the medium prior to the medium reaching the recording head 5 for magnetization in accordance with the new recording. Thus, an extra and separate operation of demagnetizing the recording medium is unnecessary, but a magnetized medium may be placed into the recording device and used as though it were not ever magnetized, because the erasing head 12 removes the magnetization from the medium before the new recording is made upon it.

In the case of the instant invention, as will more fully later appear herein, it is that coil or erasing head 12 which controls the applied voltage to the magnetizing coil 10 and by which that supplied voltage may be varied or adjusted until optimum operating conditions are reached.

Both the magnetizing coil 10 and the erasing head 12 are energized inductively from an oscillatory circuit which is illustrated in very simplified form in the lower portion of the drawing. This oscillatory circuit includes an oscillator tube 13, shown in the form of a triode, which has its cathode 14 connected through a conductor 15 to a ground 16. The plate 17 of the tube 13 is connected through a conductor 18 to one end of an inductance 19 in the form of a high frequency oscillating coil. An intermediate tap is taken from the inductance 19 by way of a conductor 20 which is connected to a positive line wire 21. A negative line wire 22 may be connected through a conductor 23 to the grounded conductor 15 from the cathode of the tube. The two line wires 21 and 22 may be associated with any suitable source of current, such, for example, as a battery, and a condenser 24 is preferably connected across the line wires to bypass alternating current.

The opposite end of the inductance 19 is connected through a feed-back conductor 25 to the grid 26 of the tube 13. A condenser 27 is connected between the conductors 18 and 25 in parallel with the inductance 19 to provide a tuned circuit for the oscillator arrangement.

As will be apparent to one skilled in the art, the alternating component of the plate current passing through the inductance 19 will set up an oscillating current of high frequency in the oscillating circuit, and a grid blocking condenser 28 is included in the conductor 25 to keep the high positive voltage off the grid of the tube. A grid biasing resistance 29 is connected across the grid between the conductors 23 and 25.

A coil 30 is inductively coupled with the oscillating coil 19, and opposite ends of the coil 30 are connected with opposite ends of the erasing head coil 12 by conductors 31 and 32. This coil 30 is so oriented in respect to the oscillating coil 19 that the induced field in coil 30 will buck the field set up in the oscillating coil 19. By virtue of the inductive coupling of the coil 30 with the oscillating coil, alternating current will pass through the erasing head coil 12 and thus cause this coil to demagnetize the recording medium passing therethrough or thereadjacent.

The recording circuit also includes a coil 33 which is inductively coupled with both the aforesaid coil 30 and the oscillating coil 19. One end of the coil 33 is connected through a conductor 34 to one end of the magnetizing coil 10 associated with the recording head 5. The other end of the coil 33 is connected through a conductor 35 to an amplifying arrangement generally indicated by numeral 36 and shown only diagrammatically. The other end of the magnetizing coil 10 is also connected to the amplifying arrangement 36 through a conductor 37. The amplifying arrangement 36 is connected by way of conductors 38 and 39 to a microphone or other equivalent pick-up device 40 which functions as a pick-up for the sound to be recorded on the wire 11.

In view of the fact that high frequency current will be passing through the recording circuit, a condenser 41 is connected across the conductors 35 and 37 leading to the amplifying arrangement, which condenser is of such capacity as to pass high frequency current but act as an insulator for low frequency current in order to keep the high frequency current out of the amplifying arrangement 36.

While the three inductively coupled coils 33, 30 and the oscillating coil 19 are illustrated in

aligned spaced relationship for the purpose of clarity, it will be appreciated that in actual manufacture these three coils would be wound in superposed relationship about the same axis, or assembled in that relationship in most cases for the purpose of convenience and conservation of space. The coils would, of course, be insulated one from the other, and the coil 30 would be disposed between the oscillating coil 19 and the coil 33 in the recording circuit.

With the circuit arrangement above described, it will be appreciated that the energization of the magnetizing coil 10 is controlled by the inductively coupled coil 33. The voltage induced in the coil 33 will result from a summation of the fields in the opposing coils 30 and 19, the coil 33 not being oriented with respect to the oscillating coil 19.

The voltage induced in the coil 33 will cause a high frequency alternating current to pass through the magnetizing coil 10 and thus energize the recording head 5 so that it will successively magnetize increments of the recording medium 11. The low frequency current from the microphone hook-up will add to the high frequency current and cause variations in the magnetic fields set up by the magnetizing coil 10 in the recording head 5 in accordance with variations of sound picked up by the microphone or equivalent device 40, and thus whatever sound is picked up by the microphone 40 will be recorded with fidelity on the wire 11.

Now, to illustrate the operation of the instant invention, let it be assumed that the magnetic recording device has just been manufactured, or let it be assumed that some change has been made in a recording device previously used. Such change, by way of illustrative example, could be made by increasing the speed of travel of the recording medium, by the substitution of a new recording head for the one already in use, or by the use of a recording medium of a different paramagnetic metal or paramagnetic alloy than the medium previously used. Any such change would set up a variation in characteristics which might tend to detract from the optimum performance of the recording device.

The recording device may be brought back into optimum operation, or if it is a newly manufactured device may be placed into condition for optimum operation, by varying the high frequency voltage on the magnetizing coil 10. This voltage may be varied by increasing or decreasing the number of turns in the erasing head coil 12. From the circuit above set forth, it will be apparent that if the number of turns in the erasing head coil 12 is reduced, there will be more current flow in the coil 30, and consequently since this coil is in opposition to the oscillating coil 19, there will be less voltage induced and less current flow in the coil 33 and likewise in the magnetizing coil 10. If the number of turns in the erasing head coil 12 is increased, an opposite result will follow. Thus, it will be seen that a simple, economical and facile adjustment of the erasing head coil, or of the coil 12 in some other location in the event it is not used as an erasing head, will expeditiously place the recording device in condition for optimum operation when the device is newly built, or when some change has been made in the device causing a variation in characteristics of some component part of the magnetizing circuit. It will be noted that changing the number of turns in the coil 12 will vary the high frequency voltage on the magnetizing coil 10 over a considerably wide range.

From the foregoing, it is apparent that I have provided a novel method of and means for adjusting the high frequncy voltage impressed on the magnetizing head of a magnetic recording device, in order to make the recording device function at optimum efficiency. It will be noted that the adjustment may be made simply and with great ease and compensate for variances in characteristics of component parts of the circuit connections and apparatus. Further, it will be noted that if an erasing head is utilized in the particular magnetic recorder, that erasing head may be made to govern the voltage impressed upon the magnetizing head and be used to vary that impressed voltage, as well as perform its own function of demagnetizing the recording medium, this providing a compact wiring arrangement, adding to the economy of production and use, and eliminating the need of a separate controlled circuit.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit, each of said circuits embodying a coil, and said coils being inductively coupled with the coil of the bucking circuit between the coils of the oscillatory and magnetizing circuits, the coil of the bucking circuit being oriented to oppose the coil of the oscillatory circuit, and the coil of the magnetizing circuit not being oriented with respect to the oscillatory circuit coil so the magnetizing circuit coil receives an induced voltage which is a result of the summation of the fields of the other two coils.

2. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit, all said circuits being inductively coupled, and means in the bucking circuit by which the impedance of the bucking circuit may be varied to adjust the induced voltage of the magnetizing circuit.

3. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit, including a recording head to magnetize a traveling recording medium, all said circuits being inductively coupled, means in the bucking circuit by which the impedance of that circuit may be varied to control the voltage induced in the magnetizing circuit, and said means being positioned to demagnetize the recording medium before it reaches said magnetizing head.

4. In a magnetic recording device, a magnetizing circuit, including a recording head to magnetize a traveling recording medium, and electrical means associated with said circuit by which the voltage in said circuit may be varied, said means also functioning as an erasing element to demagnetize the recording medium prior to its being acted upon by said recording head.

5. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit, each of said circuits embodying a coil, said coils being inductively coupled so that the bucking and magnetizing circuits receive energization inductively from the oscillating circuit,

and another coil providing an impedance in said bucking circuit and which by varying the number of turns therein may be used to control the voltage induced in said magnetizing circuit.

6. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit, all said circuits being inductively coupled, said bucking circuit being in opposition to said oscillatory circuit, and an impedance in said bucking circuit which may be varied to control the voltage induced in said magnetizing circuit.

7. In a magnetic recording device, an oscillatory circuit, a bucking circuit, a magnetizing circuit including a recording head to magnetize a traveling recording medium, all said circuits being inductively coupled, and a coil providing an impedance in said bucking circuit and which by varying the number of turns therein may be used to control the voltage induced in said magnetizing circuit, said coil being positioned adjacent the path of the recording medium to also function as an erasing element and demagnetize the medium prior to the action of said recording head.

8. The method of adjusting the voltage applied to the recording head of a magnetic recording device wherein a magnetizing circuit, an oscillating circuit, and a bucking circuit are inductively coupled, which consists in varying the impedance in the bucking circuit.

9. The method of controlling the voltage applied to the recording head in a magnetic recording device wherein a magnetizing circuit is inductively coupled with an oscillating circuit, which includes the steps of setting up an opposing field to that of the oscillating circuit in a manner that the magnetizing circuit receives a voltage resulting from a summation of the magnetic field of the oscillating circuit and the opposing field.

10. The method of controlling the voltage applied to the recording head in a magnetic recording device wherein a magnetizing circuit is inductively coupled with an oscillating circuit, which includes the steps of setting up an opposing field to that of the oscillating circuit by inductively coupling an impedance circuit between the couplings of the magnetizing and oscillating circuits, and varying the impedance in the impedance circuit.

11. The method of controlling the voltage applied to the recording head in a magnetic recording device wherein a magnetizing circuit is inductively coupled with an oscillating circuit, which includes the steps of setting up an opposing field to that of the oscillating circuit by inductively coupling a bucking circuit having an impedance coil between the couplings of the magnetizing and oscillating circuits, and changing the number of turns in the impedance coil.

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