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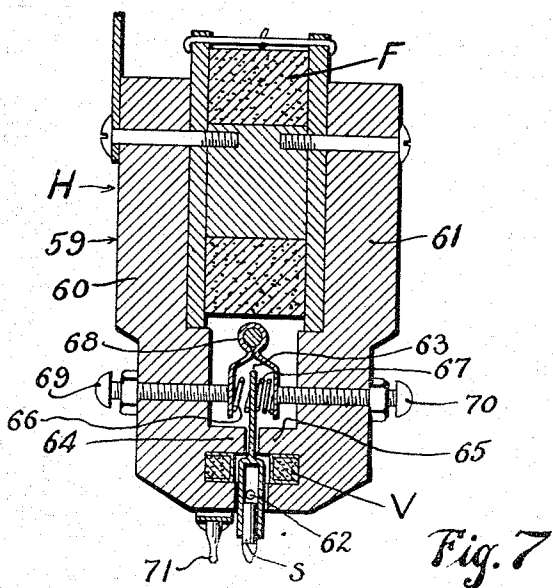
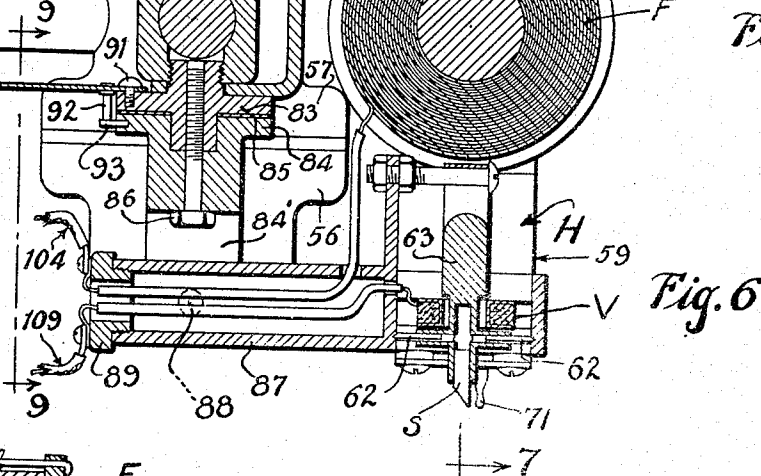
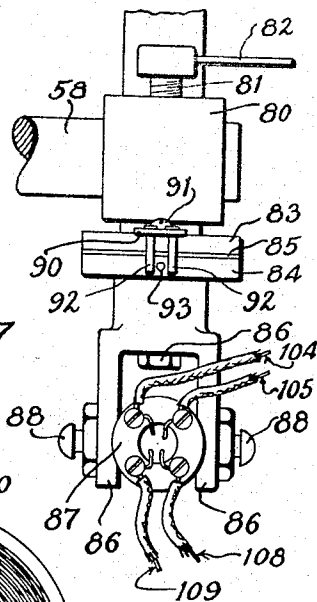
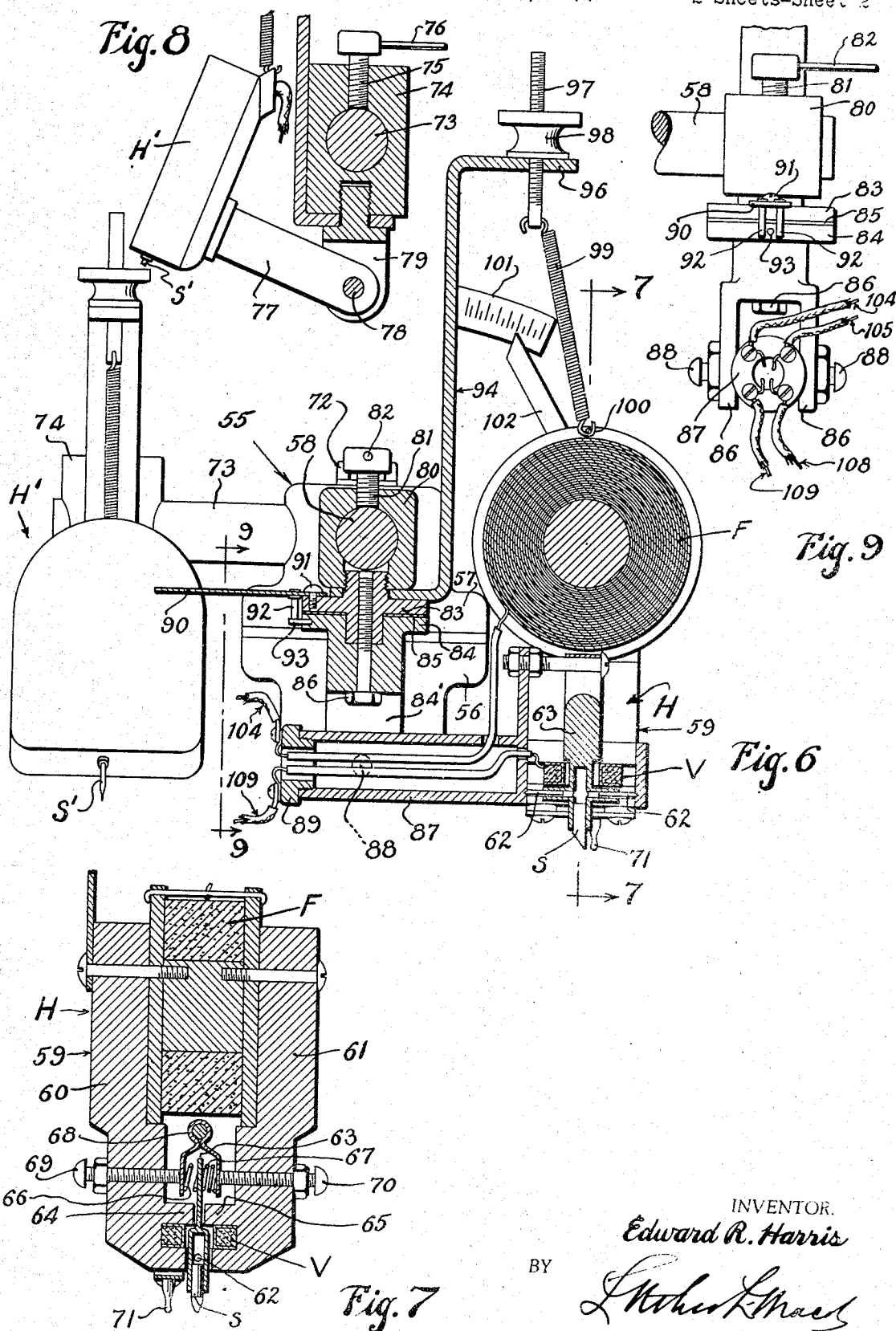
E. R. HARRIS

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SOUND RECORDING MECHANISM

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2 Sheets-Sheet 2



## UNITED STATES PATENT OFFICE

2,110,223

## SOUND RECORDING MECHANISM

Edward R. Harris, Los Angeles, Calif.

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2 Claims. (Cl. 274-13)

This invention relates to and has for a primary object the provision of an improved type of sound recording and reproducing apparatus by means of which the production and reproduction of records of substantially greater length is possible as compared with records of usual length now available for commercial use.

To this end my invention contemplates the provision of means for substantially increasing the number of groove convolutions per radial inch of a record by limiting the lateral thrust of the stylus so as to provide a regular contour of the groove throughout its length and thereby breaking up the sound impulses into groups of relatively short vibrations which are uniformly spaced apart throughout the length of the record groove.

It will be understood that in the production of disc sound records the record groove is formed on a side of a circular disc with a succession of convolutions as closely spaced apart as has been heretofore possible, and the record is rotated at a constant axial speed thereby providing a variable groove speed. Hence, in the production or reproduction of the record the sound impressions in the record groove are gradually spaced farther apart as the stylus is moved from an inner point to an outer point on the record, and frequently results in distortion, inaccuracy and loss of faithfulness of reproduction.

It is therefore, an object of my invention to provide means for rotating the record at a constantly variable speed as the stylus is moved from one extreme of the groove to the other, so as to uniformly space the sound impressions in the groove, as by means of a driving element applicable to the record supporting table at a point opposite the stylus and automatically adjustable with the stylus during a recording or reproducing operation.

A further object is to provide an improved type of combination recording and reproducing unit commonly mounted for adjustment relative to the record so that either of said elements may be used at will, and independently adjustable to operating position.

Other important objects of invention will appear as the description of my invention progresses.

I have shown a preferred form of apparatus embodying my improvements in the accompanying drawings, subject to modification within the scope of the appended claims without departing from my invention. In said drawings:

Fig. 1 is a top plan view of a sound recording unit embodying my improvements;

Fig. 2 is a sectional elevation of the same on line 2-2 of Fig. 1;

Fig. 3 is a transverse section of the same on line 3-3 of Fig. 1;

Fig. 4 is a fragmentary section on line 4-4 of Fig. 2;

Fig. 5 is a circuit diagram showing the electrical connections between the sound record and other related units of a system;

Fig. 6 is an enlarged elevation, partly in section of a combination sound recording and reproducing unit forming a part of my invention; on line 6-6 of Fig. 1;

Fig. 7 is a section of the same on line 7-7 of Fig. 6;

Fig. 8 is a detached elevation of the reproducer on line 8-8 of Fig. 1; and

Fig. 9 is an elevation of the recorder as seen from line 9-9 of Fig. 6.

My mechanism is generally mounted upon a suitable base 1 at one extremity of which is rotatably mounted a turntable 2 suitably fixed to a vertical shaft 3 which is supported in spaced bearings 4 and 5 formed on or attached to base 1, as shown in Fig. 2. A record blank 6 is adapted to be frictionally held on the upper surface of table 2 and is centered thereon in the usual manner as by means of a pintle 7 extended upwardly from shaft 3 through a suitable aperture in the blank or record 6.

A driving spindle 8 is journaled at opposite ends of base 1 in rocking bearings 9 and 10 which are respectively supported on the upper extremities of standards 11 and 12 attached to or formed on the frame. An end of spindle 8 is connected with a speed reduction unit 13 which, in turn, is connected by means of a shaft 14 with a motor 15, whereby the spindle is rotated at a constant speed.

A driving pulley or wheel 16 having a frictional driving surface adapted to engage the lower surface of the turntable 2 is slidably mounted on spindle 8, as shown in Fig. 2. Said pulley is fixed to a sleeve 18 which has a key 19 slidably engaging an elongated keyway 20 in a portion of spindle 8 beneath the turntable 2. Said sleeve carries a collar 21 with an annular groove 22 on its periphery adapted to be engaged by a bifurcated voke 23 formed on or attached to an end of a bar 24 which is secured at its opposite end to a crosshead 25. Bar 24 is yieldably connected with said crosshead so as not to restrict the movement of pulley 16, as by means of a split connection 26 the parts of which are secured together by means of a bolt or screw 27, and rubber gaskets 28, 28

may be positioned on the upper and lower sides of bar 24 and held in place by said bolt.

It is the function of the pulley 18 to drive the turntable 2 at a variable speed to correspond to the gradual change of position of the stylus S of a recorder H as it cuts a sound record groove on the record 6. Accordingly, I provide a screw feed for said pulley embodying an elongated screw 29 which is externally threaded to correspond to the number of groove convolutions cut or formed on the record 6. Said screw is horizontally positioned on base 1 and is held at opposite ends by means of pivot screws 30 and 31 adjustably held in base member 12 and a relatively spaced base member 32. (See Fig. 2.)

Obviously, as the gradual adjustment of pulley 18 must be effected with relation to the rotation of record 6, screw 29 is driven by means of connections with turntable 2. Said connections include a shaft 33 journaled in base members 11 and 32, bevel gears 34 and 35 operatively connecting shafts 3 and 33, and spur gears connecting shaft 33 with screw 29, in the manner shown in Fig. 2, or otherwise. The gear ratio between shaft 3 and screw 29 is predetermined to correspond to the rotative speed of turntable 2. For instance: If the recording head is adapted to cut 100 groove convolutions per inch, a ratio of four to one between shaft 3 and screw 29 will require forty threads per inch on screw 29, whereby pulley 18 will be constantly held on table 2 opposite head H.

Crosshead 25 is slidably supported on base 1 by means of a pair of longitudinal rods 34 and 35 secured at their ends to frame members 12 and 32 which are held in a pair of oppositely extended arms 36, and 37, respectively, formed on the crosshead. A yoke 38 is formed on or attached to the crosshead 25 and depends therefrom for supporting a travelling nut 39 arranged for detachable engagement with screw 29, as shown in Figs. 2 and 3. Nut 39 but partially embraces the screw 29 and has a depending stem 40 slidably held in the bottom portion of yoke 38 and carries a spring 41 adapted to compress between the nut and the bottom of portion 38, thereby tending to hold the nut yieldably in engagement with screw 29. The extended portion of stem 40 is pivotally attached to a friction lever 42 at a point 43 which is so arranged that the turning of the lever will disengage the nut from screw 29, or engage the nut with said screw, as may be desired.

The recording and reproducing head is supported for universal movement on the crosshead 25, as shown in Figs. 1 and 3, said crosshead having spaced sockets 44 and 45 extended upwardly therefrom in which rods 46 and 47, respectively, are secured. A crosshead 48 has laterally formed bosses 49 and 50 thereon which are slidable on rods 46 and 47, respectively, and said rods are cross connected at their tops by a rigid member 51. Crosshead 48 is vertically adjustable by means of a screw 52 which is threaded through the crosshead and is rotatable in member 51, and a hand wheel 53 is affixed to the upper per end of screw 52 for adjusting the crosshead.

The head H is mounted upon a rod 54 which is secured at one end to crosshead 48 and at its other end carries a swivel fitting 55 composed of two mating members 56 and 57, one of which is secured to rod 54 and the other to a rod 58 on which the head H is pivotally held. Said recording head includes a frame 59 composed of opposed members 60 and 61 as shown in Fig. 7, be-

tween which a field coil F and a voice coil V are held and a stylus S is oscillatably mounted in the bottom of said frame on a pivot 62.

It will be noted by reference to Fig. 7 that the stylus S has a portion above the pivot 62 which extends through the center of the voice coil V and a continuing stem 63 between portions 64 and 65 of members 60 and 61. The frame members 60 and 61 are adapted to be magnetized by the energization of the field coil F and the portions 64 and 65 of said members thus become poles of the magnet while the stem 63 of the stylus is an armature adapted to be vibrated between said poles. Stem 63 extends upwardly and is tensioned between a pair of springs 66 and 67, or other suitable devices carried by a central member 68, and separate adjusting screws 69 and 70 are carried in the frame members 60 and 61 for regulating the tension of said springs, for the purpose hereinafter described. On the bottom of one of the members 60 or 61 a depending pin 71 is attached for providing a pilot by means of which the cutting depth of the record groove is limited, said pilot being adapted to engage the upper surface of a record blank 6 and prevent the stylus S from cutting beyond a predetermined depth therein.

A reproducing head H' of suitable character is provided in connection with head H and is adapted to be swung into and from playing position while the cutting head is swung out of and into cutting position, respectively, about the axis 72 of swivel 55. Said reproducer is mounted at an angle of ninety degrees relative to the head H on an arm 73 fixed to the upper part 57 of said swivel. The unit H' includes a fixture 74 which is adjustably carried on the end of arm 73 and is held in adjusted position by means of a set screw 75 provided with an operating arm 76. The head H' carries the usual needle or stylus S' and has an arm 77 which is pivoted at 78 to a clevis 79 secured to the bottom of fixture 74, as shown in Fig. 8. Thus, the reproducing head H' swings on the axis 78 into and from operating engagement with the record 6.

Arm 56 which carries head H is adjustably secured to a fixture 80 by means of a set screw 81 having an operating arm 82, as shown in Fig. 6. Recording head is directly suspended from fixture 80, as shown in Fig. 6, by a pair of relatively adjustable members 83 and 84 which are flanged and provided with a frictional gasket 85 therebetween. Member 83 is threaded into the bottom of fixture 80 and member 84 is held on member 83 by means of a bolt or screw 86 axially extended through both of said members and secured to the upper member 83. Member 84 has a depending clevis 84' between the furcations of which a tubular extension 87 from frame 59 of head H is pivotally held at 88. The end of extension 87 is closed by a cap 89 through which the wires from the field and voice coils F and V are extended for connection with other elements of a system, as hereinafter described.

Head H is manually adjustable as a unit on the axis of bolt 86, for the purpose hereinafter described, by means of an arm 90 which is pivotally attached to member 83 at 91 and has a pair of depending pins 92, 92 straddling a pin 93 extended from the periphery of member 84. A bracket 94 is attached at its lower extremity 95 to member 83 adjacent the bottom of fixture 80 and is bent outwardly at its upper extremity 96 for supporting an adjusting screw 97 on which a nut 98 is adjustably held. A tension spring 99

resiliently connects the lower end of screw 97 and a point 100 at the top of field coil F or its frame 59. Bracket 94 also has an arcuate graduated arm 101 extended over field coil F and formed concentrically with the axis 88 of frame 59 of head H. Frame 59 has an indicator arm 102 extended upwardly therefrom for adjustment over the graduated arm 101, whereby the adjustment of the head H on its axis 88 may be gauged.

Field coil F is connected at its opposite terminals with a battery 103 by means of wires 104 and 105, as shown in Fig. 5, whereby the field coil may be continuously energized for magnetizing the pole pieces 60 and 61 of frame 59 of the recording head H. Voice coil V is responsive to sound-impulses set up in the recording apparatus and is connected with one side 106 of an output transformer 107 by means of wires 108 and 109. Wires 110 and 111 lead, respectively, from the other side of transformer 107 to power tubes 113 and 114, which, in turn are connected as usual to other elements of a sound recording system, and by means of which the sound impulses from an original source are transmitted to the voice coil.

The circuit of the voice coil being alternating in character the polarity of the armature 63 is changed and the attraction of the opposite poles of the pole pieces 60 and 61 of frame 59 cause the vibration of the stylus S correspondingly under the influence of the limiting springs 66 and 67. Thus, the vibration of stylus S is more rapid and the sound impressions made thereby are more frequent and of shorter length than impressions made by the stylus without limitation of its swing. Hence, instead of a series of long impressions, each series of impressions is broken up into groups of short and closely spaced impressions on the groove of the record which are uniformly spaced throughout the length of the groove.

In operation, when a blank record disc 6 is positioned as shown on the turntable 2 the recording head H is adjusted on the axis of swivel 55 into the position shown in Fig. 1 above the record disc, and further adjusted by turning nut 98 to the proper position for cutting a record. When in such position, the reproducing head H', as shown in Fig. 1, will be out of operative position. Records are usually made by moving the stylus from a position near the periphery of the record inwardly to a position near the axis, and before the adjustment of the stylus to the record the carriage which supports both the driving pulley 16 and the heads H and H' are manually adjusted inwardly until the heads are positioned near the center of record. The adjusting screw 52 serves to elevate both of the heads H and H' and their associated parts out of operative position for the above named purpose.

The adjusting arm 90 is for the purpose of accurately adjusting the position of the stylus S relative to a groove or a groove position on the surface of the record 6. The member 83 being stationary on fixture 80 and the arm 90 being pivoted on member 83, the movement of arm 90 will correspondingly rotate head H and member 84 on the axis of bolt 86 in either direction by reason of the engagement of pin 93 with

one or the other of pins 92, 92 depending from arm 90.

The adjustment of head H vertically relative to a record establishes the cutting depth of the groove and to this end the depth gauge 101 is calibrated in thousandths or tens of thousandths of an inch so that when set for a given depth the depth of a record groove may be uniformly maintained throughout its length.

By limiting the vibration of stylus S the usual waves in a sound groove are almost if not quite completely eliminated and I am enabled to provide a vastly greater number of groove convolutions per inch than is otherwise possible. Moreover, when recording sound on a record operated at a constant axial speed, as is customary, a single tone frequently requires several inches of groove length for recordation, whereas by rotating the record at a gradually decreasing speed from the outer extremity of a record groove to its inner extremity, a single tone requires no more groove length in an outer convolution than in an inner convolution. Thus, I am enabled to obtain in addition to substantially increased groove length, a uniformity of tones which is otherwise impossible, and a still longer and more condensed and accurate sound record on a single unit.

What I claim, is:

1. A sound recording apparatus comprising a rotatable table for operatively supporting a record during a recording operation, a driving spindle, a sleeve splined on said spindle, a frictional wheel secured on said sleeve in frictional engagement with the under side of said turntable, a collar carried by said sleeve and provided with an annular groove in its periphery, a cross head, a bar lying in parallel relation to said spindle and secured to said head and formed with a yoke engaging said collar in said groove, a rotatable feed screw, an arm fixed to said crosshead and lying in superposed parallel relation to said bar, a travelling nut mounted on said cross head for engagement with said feed screw, a bodily movable sound recorder supported by said arm for bodily movement therewith in operative relation to a record supported on said rotatable table, and means whereby said feed screw is driven by said rotatable table.

2. A sound recording apparatus comprising a rotatable table for operatively supporting a record during a recording operation, a driving spindle, a sleeve splined on said spindle, a friction wheel secured on said sleeve in frictional engagement with the under side of said turntable, a collar carried by said sleeve and provided with an annular groove in its periphery, a cross head, a bar substantially parallel with said spindle secured to said head and formed with a yoke engaging said collar in said groove, a rotatable feed screw, an arm fixed to said crosshead and lying in superposed parallel relation to said bar, a travelling nut mounted on said cross head for detachable engagement with said feed screw, a sound recorder, means for mounting said sound recorder on said bar for bodily movement therewith and in operative relation to a record supported on said rotatable table, and means whereby said feed screw is driven by said rotatable table.

EDWARD R. HARRIS.