

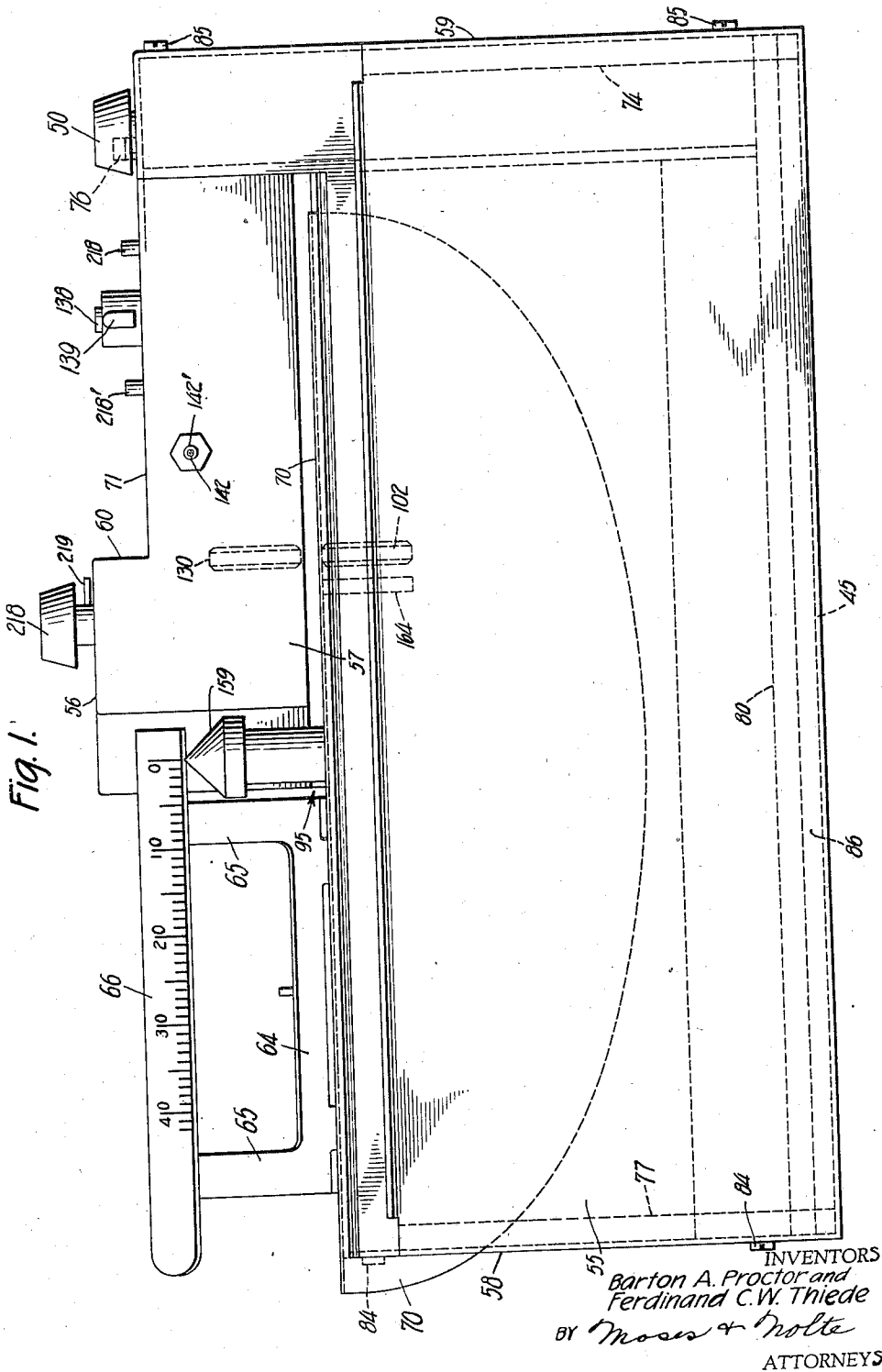
Sept. 29, 1942.

B. A. PROCTOR ET AL
SOUND RECORDING AND REPRODUCING

2,296,870

Filed July 8, 1938

15 Sheets-Sheet 1



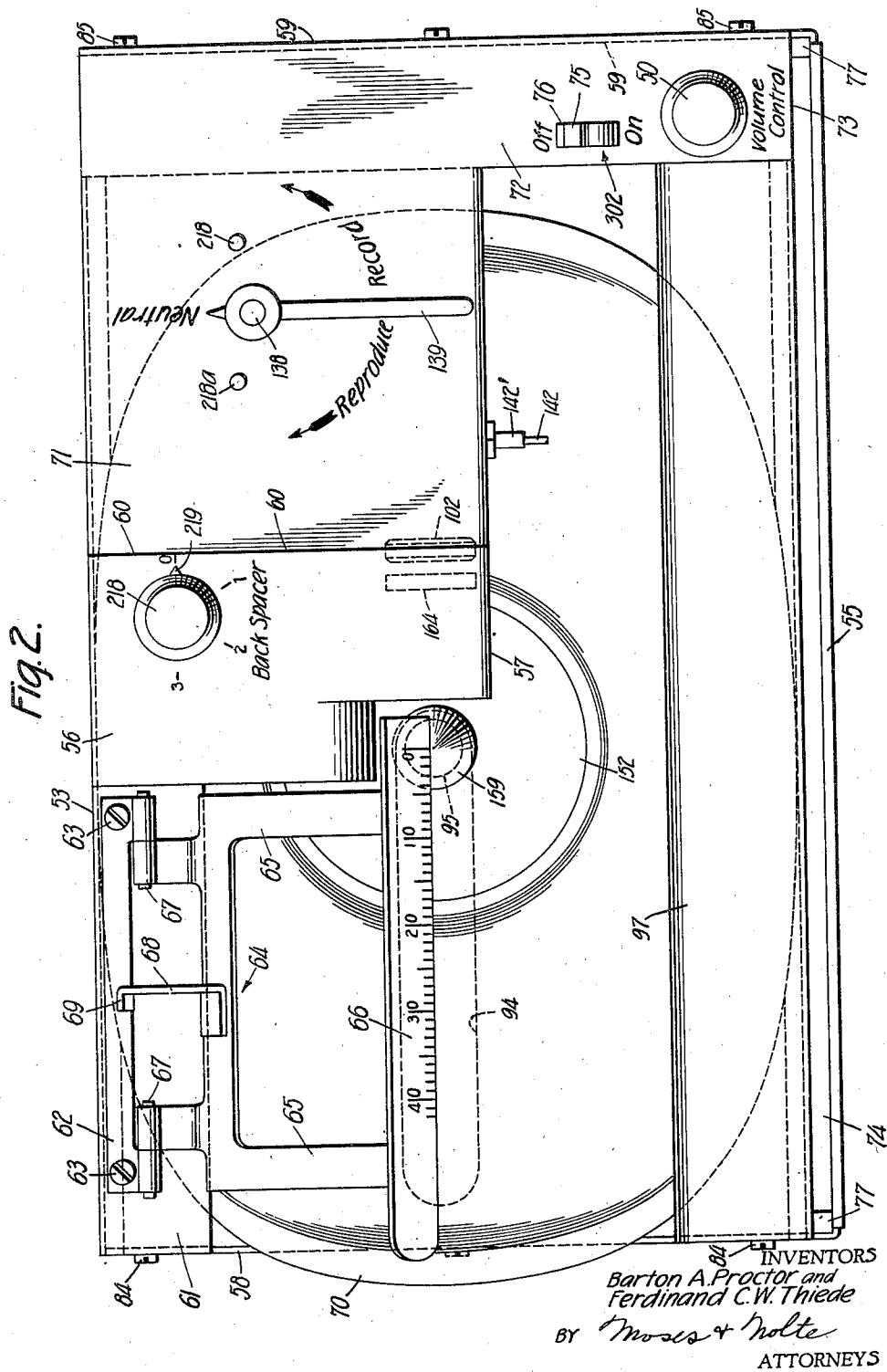
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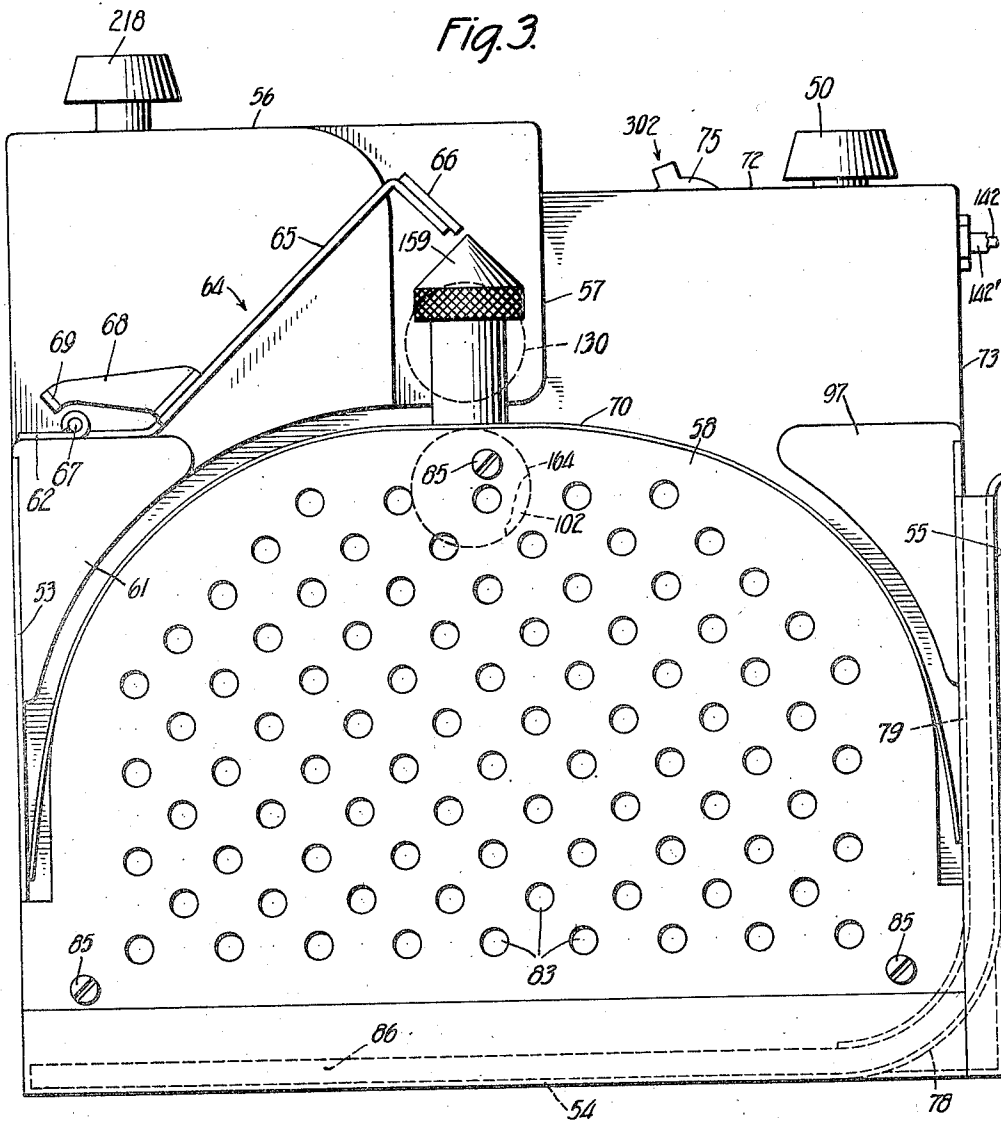
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SOUND RECORDING AND REPRODUCING

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2,296,870

15 Sheets-Sheet 3



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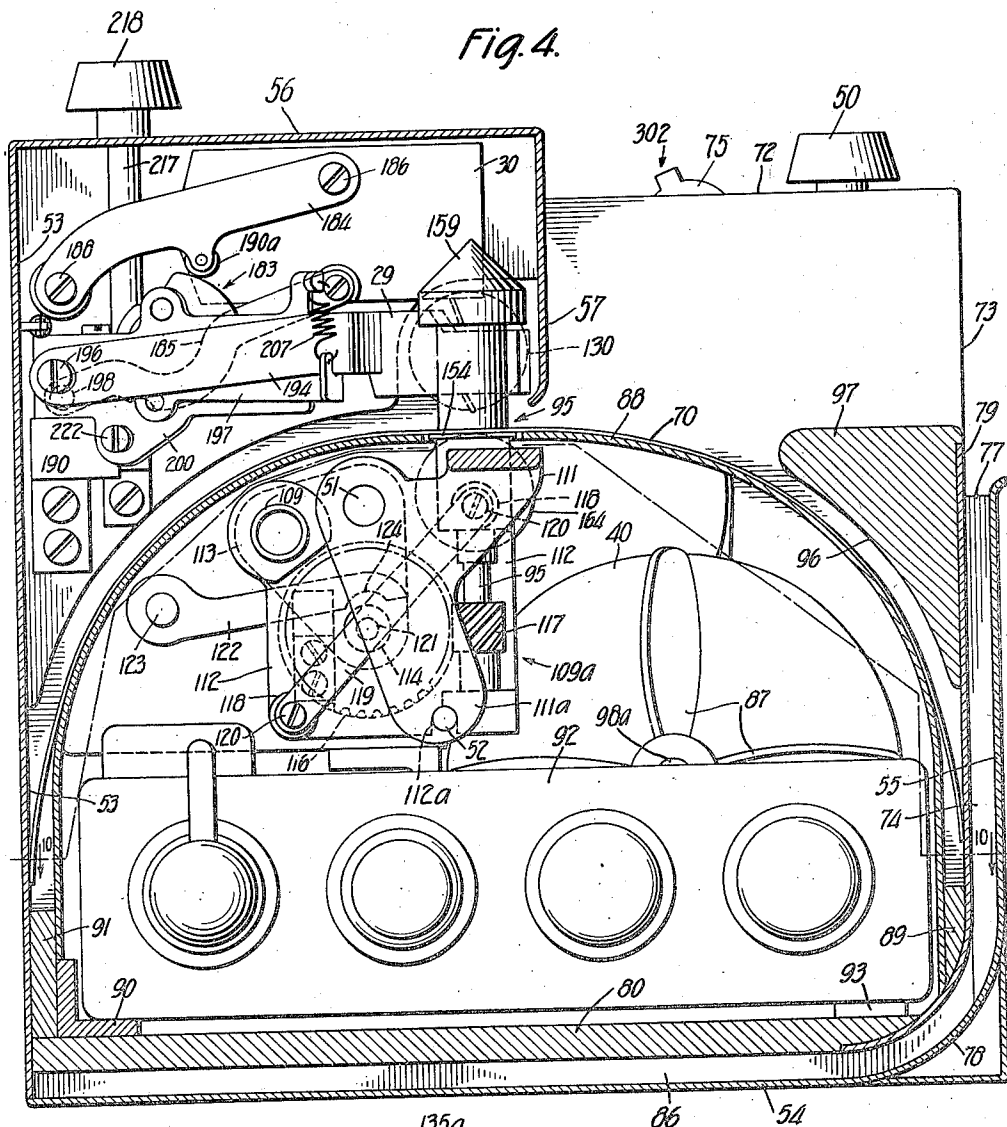
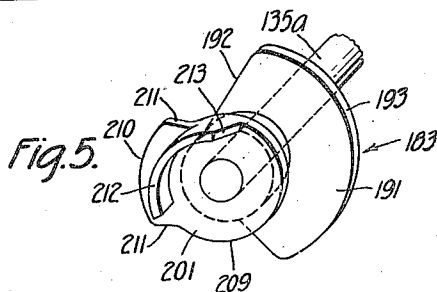
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Fig. 4.



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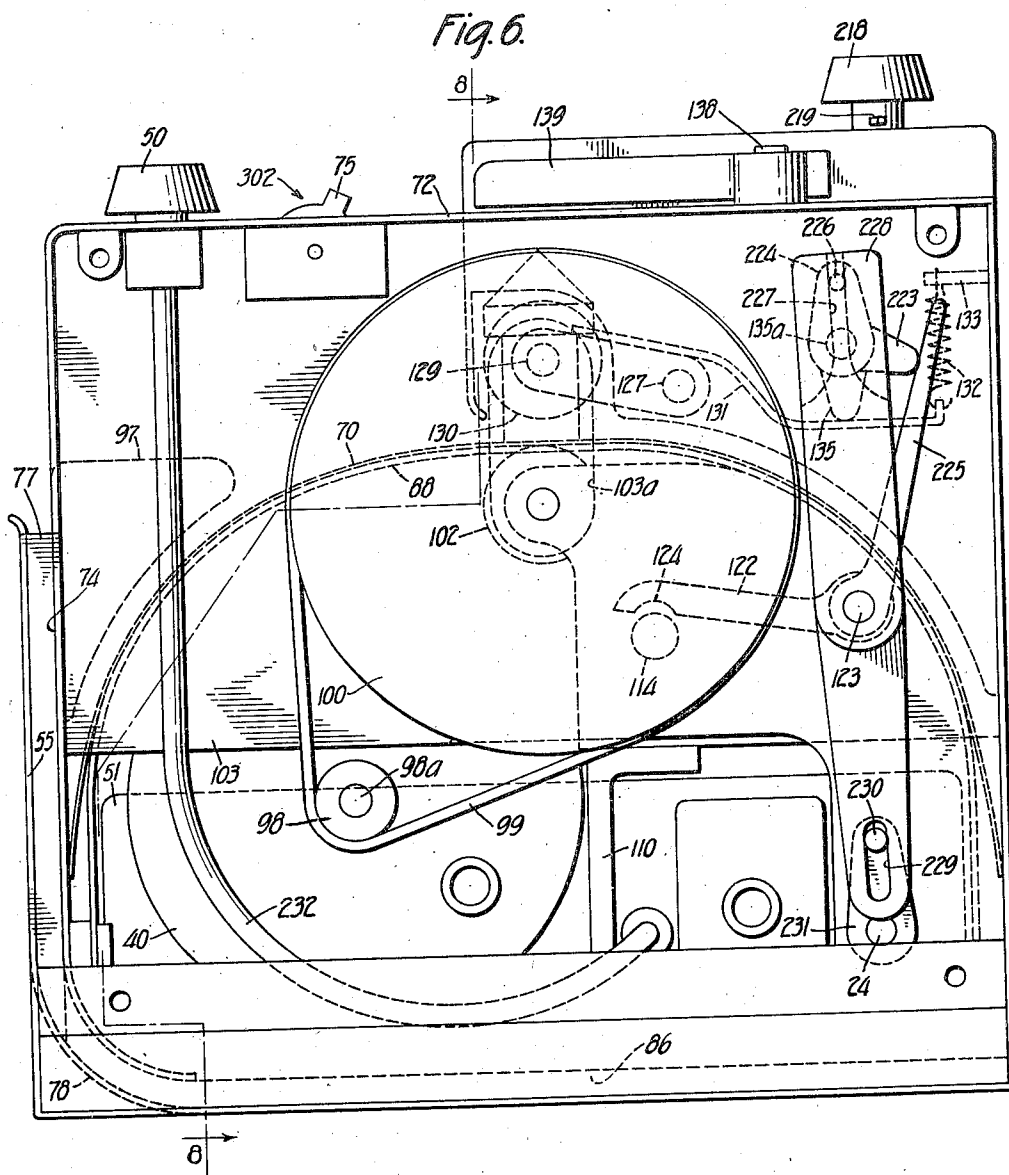
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SOUND RECORDING AND REPRODUCING

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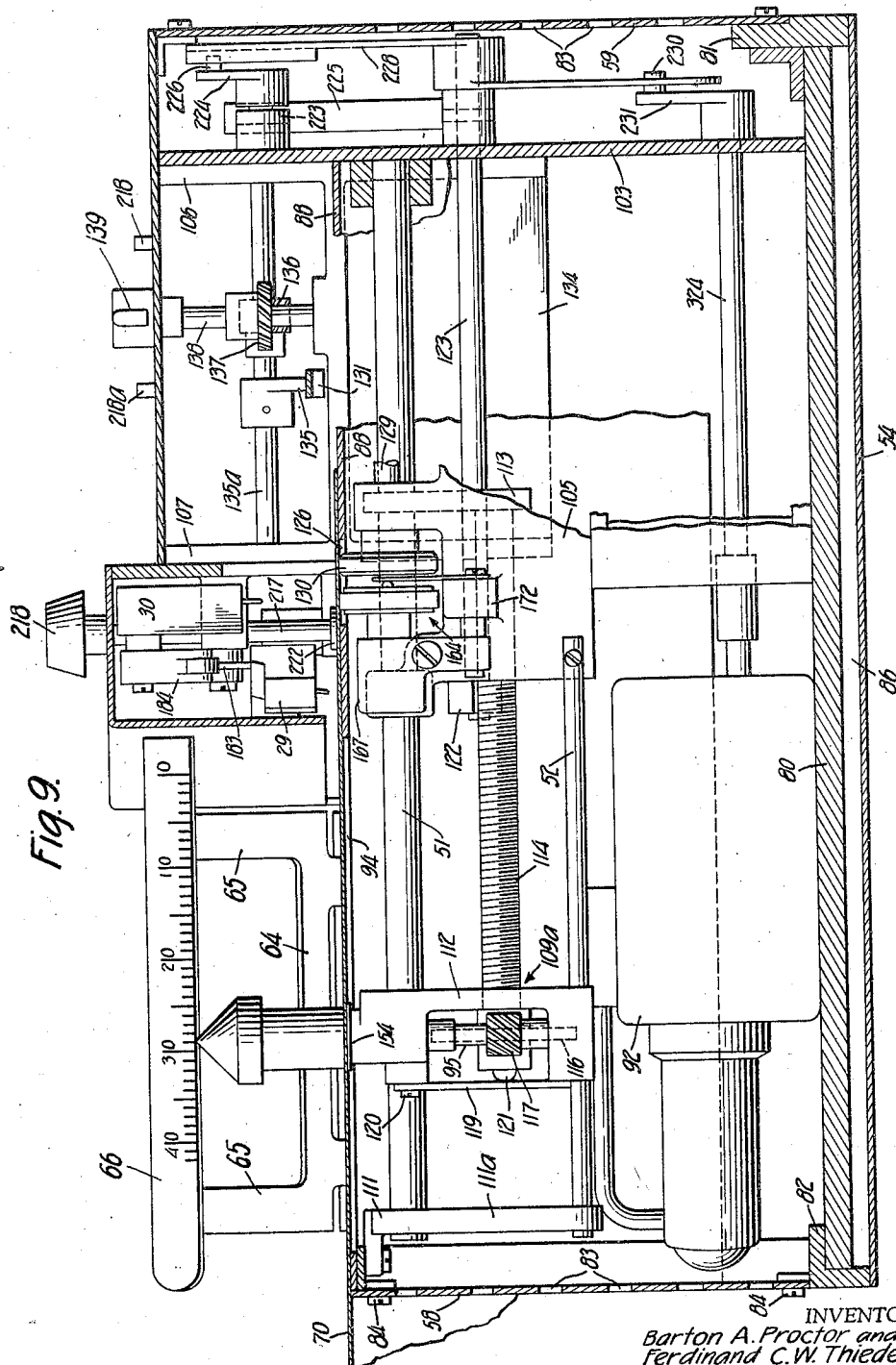
B. A. PROCTOR ET AL

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SOUND RECORDING AND REPRODUCING

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15 Sheets--Sheet 8



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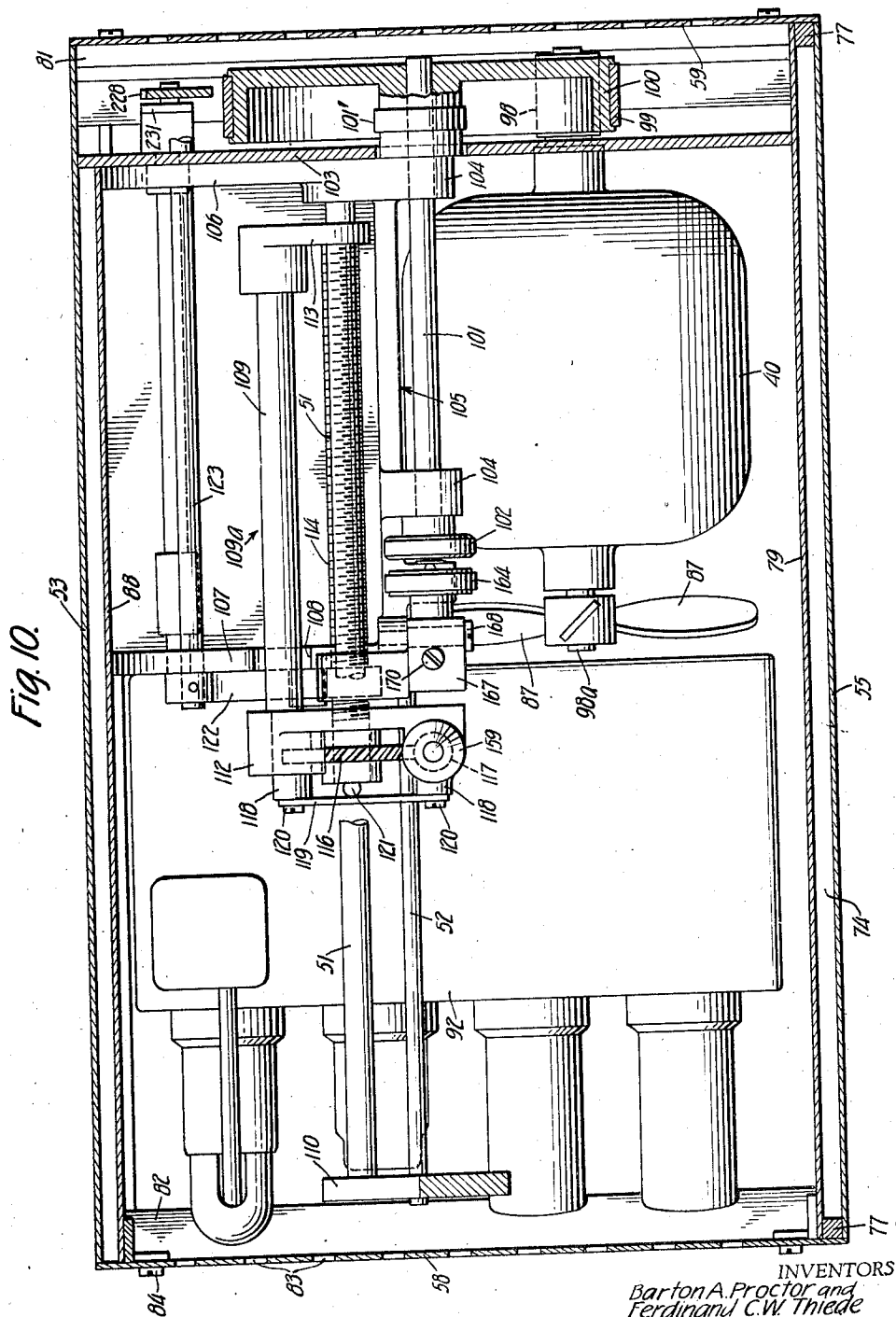
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Fig. 11.

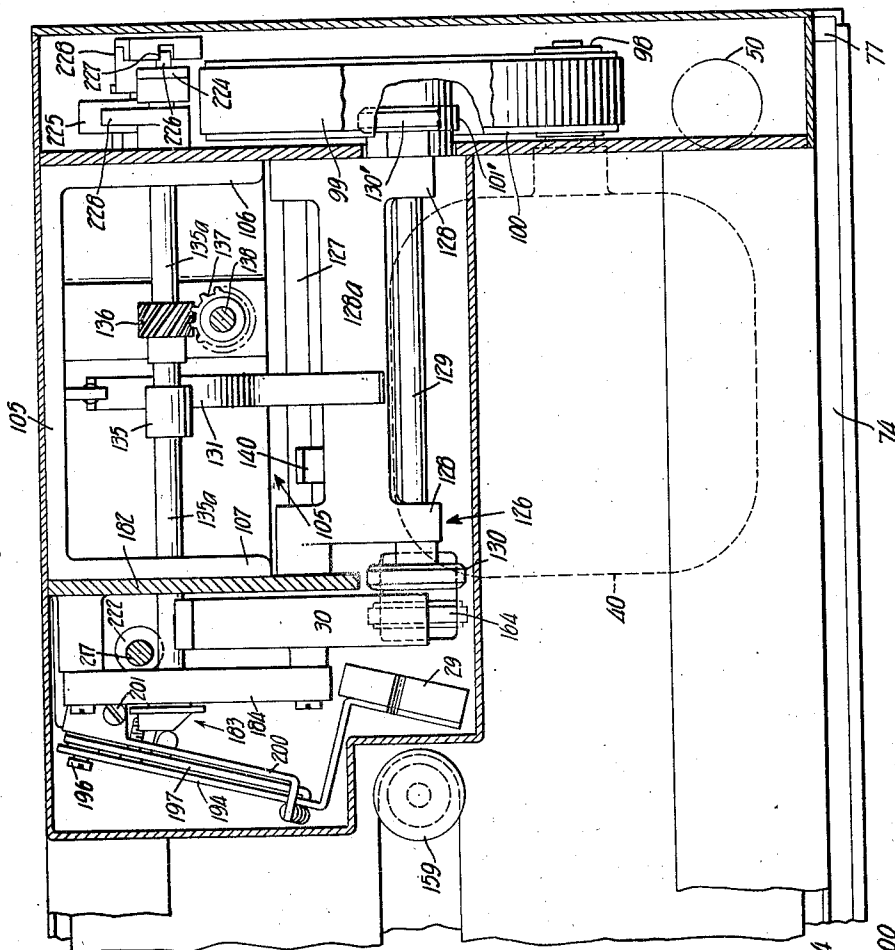
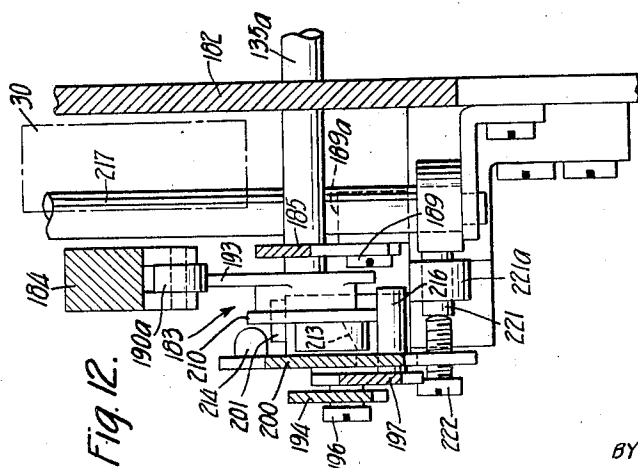


Fig. 14.

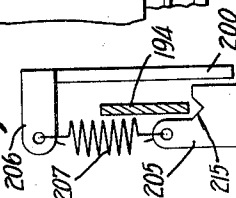
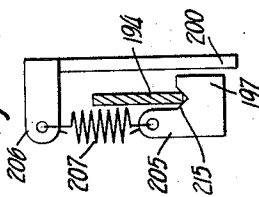


Fig. 13.



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Fig. 15.

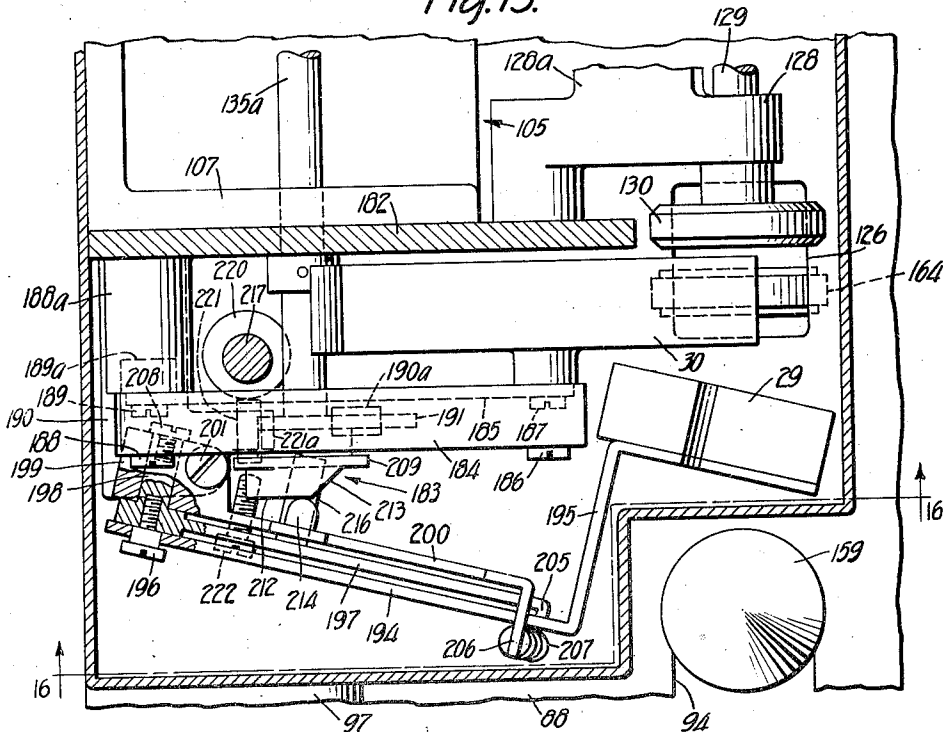
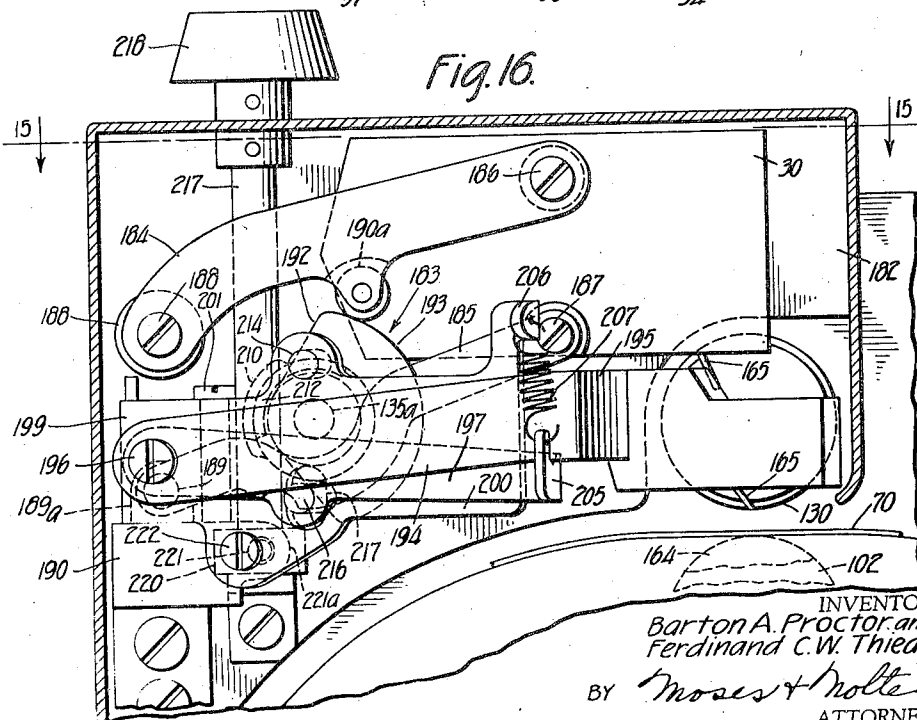


Fig. 16.



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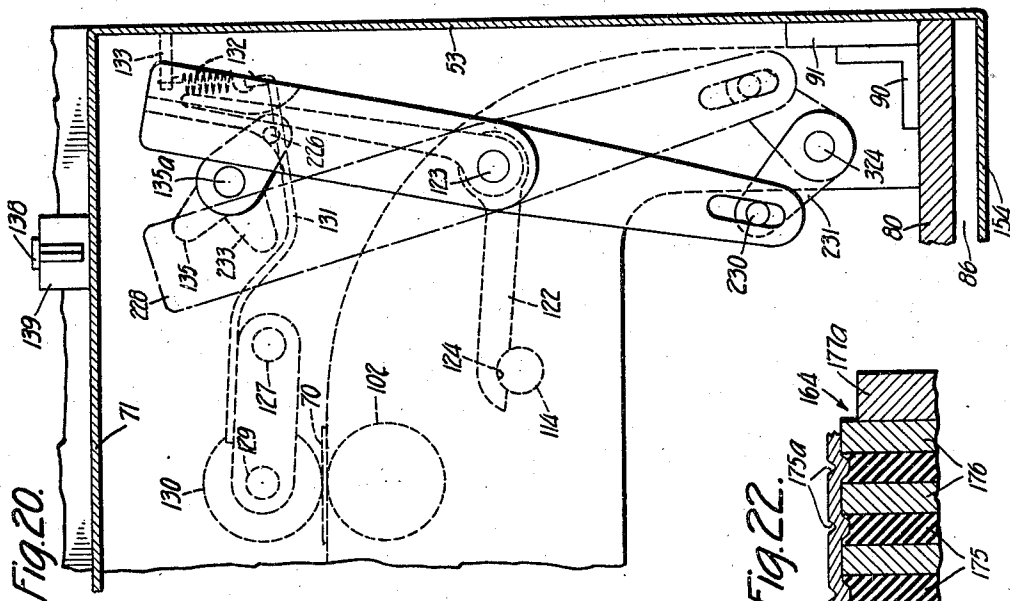
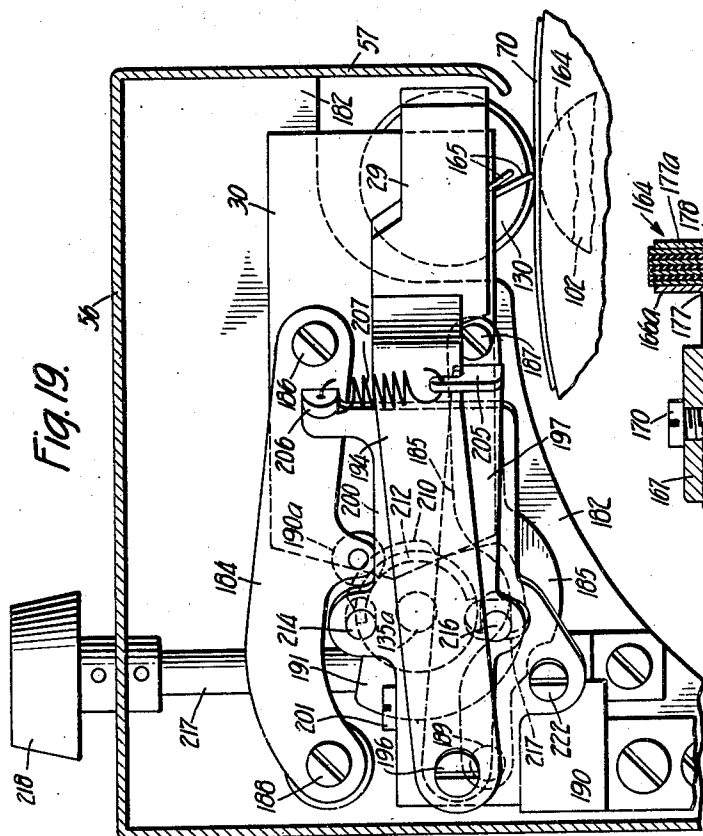
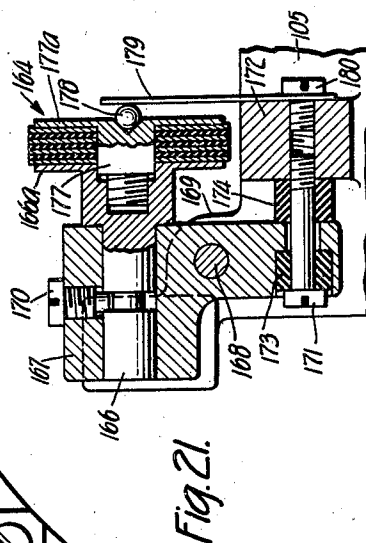
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Fig. 23.

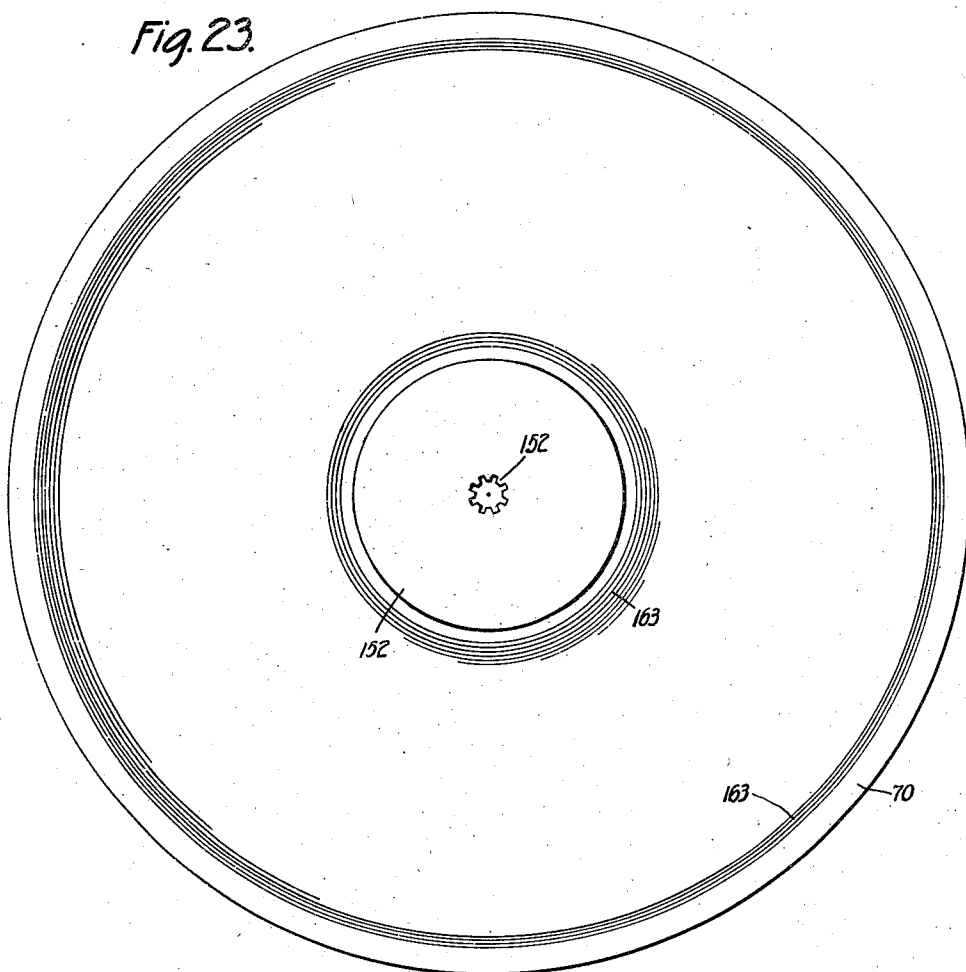
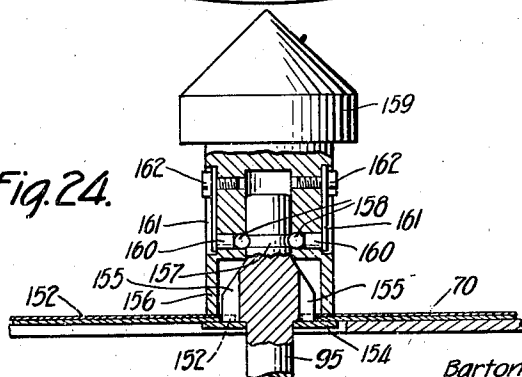


Fig. 24.



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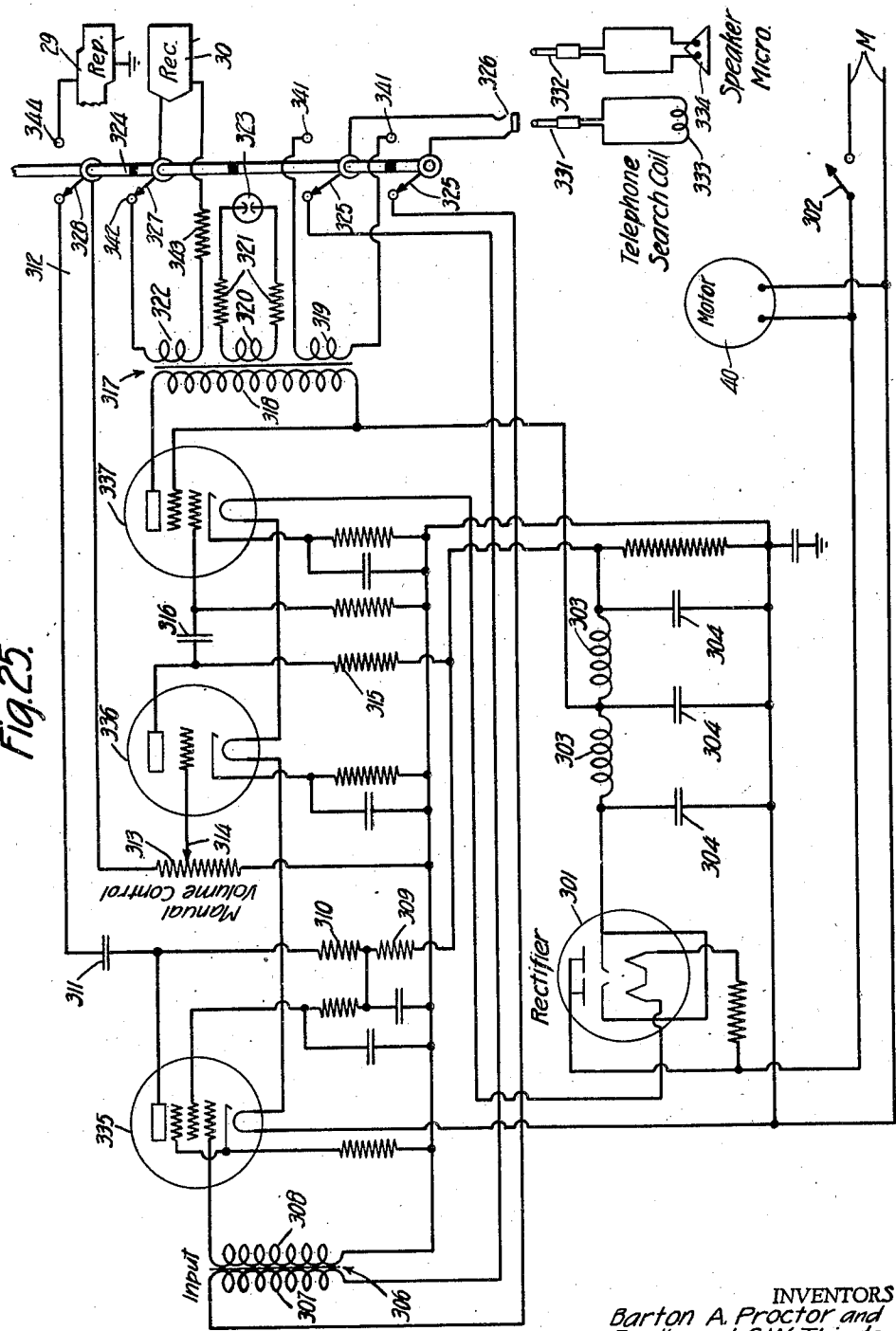
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Fig. 25.



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UNITED STATES PATENT OFFICE

2,296,870

SOUND RECORDING AND REPRODUCING

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Application July 8, 1938, Serial No. 218,082

30 Claims. (Cl. 274-12)

This invention relates broadly to sound recording and reproducing, and more particularly to machines and records adapted to be used in office work for the dictation and transcription of letters, memoranda, etc. The invention involves various features of special utility for dictation purposes, and also many features of more general application.

In accordance with prior commercial practice, dictation machines are designed to be used with cylindrical wax records. These records are expensive, bulky and fragile. Economy demands that the records be re-used, and hence it is necessary to provide a shaving machine for shaving the transcribed records to prepare them for re-use. This involves an added investment for equipment, consumes the time of the operator for performing the shaving operation, and puts an end to any further possibility of reference to the shaved record for verification purposes. Valuable office space is consumed by records waiting to be shaved.

It is not feasible to keep any substantial number of unshaved records on hand for reference, both because that would involve an inordinate investment in records, and because of space requirements for storing the records. The records must be handled very carefully at all times because they are extremely fragile. The dropping of a blank or transcribed record involves destruction of the record, but the dropping of an untranscribed record is likely to be much more serious because of the loss of the material recorded upon it.

Important objects of the present invention have to do with the overcoming of the above mentioned drawbacks by providing an improved record which is small in bulk, infrangible, and so inexpensive that it may be filed away, if desired, after it has been transcribed, and may be eventually discarded without re-use; and by providing a recording and reproducing machine capable of use with the improved record in a highly efficient and satisfactory manner.

The improved record is desirably in the form of a through-deformable disc of tough, flexible material, adapted to have a sound record scribed upon it, and of no greater thickness than an ordinary sheet of letter paper. Such a record has clear advantages of cheapness, small bulk, and infrangibility, but presents serious problems in the matter of its use for recording and reproducing purposes.

The illustrative, through-deformable record becomes indented through by the formation of

the sound record groove, and tends to curl. When simply spread out flat it has no substantial rigidity, at least no rigidity sufficient properly to transmit an adequate and positive driving force to the cutting point. The record also presents difficulties in the matter of securing a properly cut sound record, both because of its tendency to transmit machine noises and vibrations into the record track, and because of its tendency to impose upon the record track grain pattern characteristics of any solid backing or platen that may be opposed to the stylus. The generation of background noises at reproducing also presents a difficulty. Important objects of the present invention have to do with the overcoming of these difficulties.

Briefly, the illustrative machine desirably includes a mounting spindle, upon which a thin, flexible disc record may be impaled, and opposed feed rollers spaced from the spindle for engaging opposite faces of the record and driving the record about the spindle axis. The spindle is mounted upon a carriage, and is connected to drive a feed screw, which is also mounted upon the carriage. Rotation of the record is transmitted to the spindle and thence to the feed screw. The feed screw cooperates with an axially immovable half-nut, which is adapted to be engaged with and disengaged from the feed screw at will. When the half-nut is engaged with the feed screw the carriage is caused to be moved axially of the feed screw and to move the record spindle away from the record driving rollers, so that that zone of the record which extends radially between the spindle and the record driving rollers is maintained constantly under tension during the driving of the record.

A stationary stylus is mounted to act upon the record in the tensioned radial zone of the record which extends between the spindle and the point of contact of the record with the driving rollers, and closely adjacent to the latter point. The fact that the stylus acts upon a portion of the record which is constantly under tension is a very important one in connection with the control of the record and also with the application of an adequate driving force. The fact that the stylus is located closely adjacent to the feed rollers causes the record to progress past the stylus at a substantially uniform linear speed, and this point is an important one from the standpoint of uniform distribution of the recording along the sound track.

The record is supported for recording and reproducing upon a stationary, parti-cylindrical

support, and cooperating guides are provided for maintaining the record in substantial conformity with the curved support. This manner of supporting the record is important from many points of view. The spiral record groove is cut from a point starting near the center and is caused to progress outward toward the circumference of the record. As the groove progresses the record becomes indented through, and these indentations constitute a multiplicity of fine corrugations which are disposed crosswise of the radius of the record which join the axis of the spindle with the point of engagement of the feed roller, and which are bent downward at opposite sides of such radius. The maintaining of the record thus bent, together with the fact that these fine corrugations are present, causes the radial zone of the record engaged by the spindle, the stylus, and the feed rollers to be quite rigid. This is a very important point in connection with the securing of a firm and adequate driving of the record past the stylus.

The curved support has the further advantage that it acts as a brake upon the record. When the driving rollers are separated, the record and the parts driven by it, which are all of very slight mass, are caused to come instantly to rest. The curved support for the record has the further advantage that one horizontal dimension of the machine may be considerably shorter than the diameter of a record.

The curved support also takes the curl out of the record and causes all portions of the record to be controlled in an orderly manner at all times.

The fact that the record and the parts which rotate in uniform relation to the record have relatively slight mass and slight inertia has an important bearing on the accurate production of the desired variable rotary speed of the record, regardless of whether the record is started and stopped from time to time. The uniformly running motor and the relatively massive parts which run in uniform relation to the motor are not perceptibly influenced by the gradual and slight change of load which results from the progressive change in rotary speed of the record. From this point of view it is an important point that the need for a turntable is obviated. The obviation of a turntable is also very important from the standpoint of securing instantaneous stopping of the record and instantaneous acceleration of the record to the desired speed after a stop.

The recording operation does not start at the very center of the record but at a substantial distance outward from the center. The central portion of the record is without indentations and, therefore, without stiffening corrugations. It is a feature of the invention, however, that this central area of the record has affixed to it a label which both affords a writing medium for receiving notes relative to the material recorded, and a reinforcement for the central area of the record to maintain that area flat and substantially more rigid than the surrounding area. Prior practice has involved the provision of a separate, loose memorandum slip for association with each record, but no provision has been made for assuring the maintenance of such association. No claim is made herein to the record, per se, the record being claimed in continuation in part applications of Barton A. Proctor, Serial No. 438,713, filed April 13, 1942, for Records for recording and reproducing sound, and Serial No. 75

436,243, filed March 26, 1942, for Records for recording and reproducing sound.

The machine further embodies means for keeping out of the sound track extraneous noises, such as scratch noises, background noises, and noises originating from the vibration of various machine parts. It is not possible to produce a satisfactory sound groove in a thin, plastic material supported directly on a hard metal surface without developing background noise in the record caused by the grain pattern of the material of which the supporting base is made. In order to avoid such a result the machine of the present invention is made to include a platen in the form of a resilient cushion for engaging the back of the record material.

It is a further feature of the invention in accordance with an advantageous form thereof that not even the resilient platen is directly opposed to the stylus, but that the stylus is rather caused to engage the record material under tension with the record held in bridging relation to supporting points of the platen.

In reproduction it is important that the record material, at the point of contact with the reproducing stylus, be not allowed to run in frictional engagement with any underlying material because such friction will inevitably introduce objectionable noises into the reproducer pickup. Such defective operation is avoided in the machine of the present invention by making the platen free to roll in contact with the record material.

The machine desirably involves both electrical recording and electrical reproducing, separate styluses being used for the two purposes, and separate circuits being established, according to whether recording or reproducing is in progress. It is a feature of the invention that mechanism is provided under the control of a single operated member or finger-piece for shifting the styluses alternatively into and out of operative position, and for simultaneously and coordinately changing the circuit connections so that the proper circuit will be automatically established for each stylus. The electrical circuits desirably include crystal translating devices of the piezoelectric type, such devices being ideally suited to the purpose because of the powerful drive which may be transmitted to the recording stylus and because of the delicate and accurate responsiveness to the reproducing stylus which may be secured.

In accordance with still another feature of the invention, provision is made in the electrical part of the machine of an overload protective device for limiting the amplitude of the electrical vibrations, and hence of the reproduced sound. This device desirably consists of a glow tube connected inductively to the input of the recorder circuit and to the output of the reproducing circuit. A circuit including such a tube has the characteristic that it will absorb no energy from the primary or input circuit with which it is inductively coupled unless and until the conditions of the primary circuit are such as to induce a potential in excess of a definite value. When such definite value is exceeded, however, the tube will glow, and the circuit will substantially modify the current flowing in the primary circuit with which the glow tube circuit is coupled.

No claim is made herein to the recording and reproducing units and the electrical apparatus combined and associated therewith because that subject-matter is claimed in our continuation in

part application Serial No. 436,244 filed March 26, 1942, for Sound recording and reproducing.

A further advantageous feature resides in the fact that the machine embodies a record storage compartment. This compartment desirably extends along the front and bottom of the main frame of the machine, and is rather thin. It is capable, however, of holding a very substantial number of thin, flexible disc records, and the records, because of their flexibility, can be very readily caused to follow the curvature of the compartment as they are introduced into it or withdrawn from it.

It is a further feature that provision is made of a retractable reference scale, cooperative with the record spindle for indicating to the user of the machine the points on the record at which various matters are recorded.

Other objects and advantages will hereinafter appear.

Fig. 1 is a front elevation of the machine;

Fig. 2 is a top plan view of the machine;

Fig. 3 is a side elevation as view from the left hand end of Fig. 1;

Fig. 4 is a vertical side view in section, the figure being taken on the line 4—4 of Fig. 3;

Fig. 5 is a perspective view of a cam unit which effects the setting of the reproducer and the recorder;

Fig. 6 is a side elevation as seen from the right hand side of Fig. 1, with the right hand end plate removed;

Fig. 7 is a sectional side view taken on the line 7—7 of Fig. 8 and looking in the direction of the arrows;

Fig. 8 is a sectional front view taken on the lines 8—8 of Fig. 6;

Fig. 9 is a view similar to Fig. 8 with some of the parts removed and showing the carriage in a different position;

Fig. 10 is a sectional top plan view taken on the line 10—10 of Fig. 4;

Fig. 11 is a fragmentary, sectional, top plan view of the machine;

Fig. 12 is a vertical section taken on the line 12—12 of Fig. 18;

Figs. 13 and 14 are detail front views in section showing the relative positions between the reproducer arm and the lifting arm therefor;

Fig. 15 is a fragmentary top plan view in section, taken on the line 15—15 of Fig. 16, showing the reproducer and the recorder and their shifting mechanisms;

Fig. 16 is a sectional side view taken on the line 16—16 of Fig. 15 and looking in the direction of the arrows;

Figs. 17 and 18 are views similar to Figs. 15 and 16 respectively but show the reproducer in its active position, the section of Fig. 17 being taken on the line 17—17 of Fig. 18;

Fig. 19 is a view similar to Fig. 18 but shows the parts shifted to render the recorder effective;

Fig. 20 is a fragmentary sectional side view, of the right hand end of Fig. 6, showing the parts shifted to their effective positions;

Fig. 21 is a detailed front view in section of the record platen roller;

Fig. 22 is a section view of a fragment of the roller shown in Fig. 21; and a portion of the record bearing thereon;

Fig. 23 is a top plan view of the record;

Fig. 24 is a sectional detailed view of the means whereby the record is held connected to the spindle; and

Fig. 25 is a circuit diagram showing the elec-

trical connections between the various parts of the machine.

Referring to Figs. 1 to 4, there is provided a casing in which the component parts of the device are suitably mounted and supported, said casing comprising a rear wall 53, base 54, a front wall 55 which is shorter than the rear wall, a top wall 56 having a depending portion 57, and end walls 58 and 59. The top wall extends downwardly as shown at 60 in Fig. 1 to provide a flat surface 71 at a lower level to accommodate certain controls to be described later. Also as shown in Figs. 1 and 2 the end wall 58 is lower than end wall 59 and at its top level a narrow shelf or bracket 61, secured to the rear wall 53, extends horizontally to provide a support for the hinge block 62 secured thereto by screws 63. A frame 64, having the spaced apart parallel arms 65 to the outer ends of which a graduated scale 66 is secured, is hinged to block 62 by the pivoted supports 67. For the purpose of supporting the scale when it is moved back on its hinge in order to insert a record, a rearwardly extending support arm 68 is secured to frame 64, its lower end being bent over to provide a support 69 which engages and rests on the block 62 when the scale is thrown back. It will be obvious from Fig. 2 that, when the scale is thrown back, a large open area is presented at the top of the casing for the insertion of a thin, flexible record 70, to be later described. Also as shown in Fig. 2, the flat portion 71 of the top of the casing is extended as shown at 72 and terminates at 73 so as to leave a space between it and the front wall 55. This space forms part of an opening or slot 74 extending across the front of the casing and provided as a storage place for used or unused records. The extended portion 72 of the casing top also has a slot 76 through which a switch handle 75 of an "on-off" switch 2 (see Fig. 25) extends, and also accommodates a volume control knob 50. The opening 74 extends between the corner posts 77 which engaged the end plates and along the length of this opening the front wall and base are connected by a thin concave strip 78 which serves to guide the record as it is inserted for storage.

The vertical portion of the storage space is defined at the rear by an upright wall 79 which is convexly curved near its lower end opposite the strip 78 and is secured to the front of a wide horizontal member 80 which supports the electric motor 40 and other parts of the driving mechanism, the supporting member 80 extending to rear wall 53. As shown more clearly in Fig. 8, member 80 is secured to and supported by a generally rectangular shaped bar 81 which extends across the other end. The larger parts of the end plates 58 and 59 of the casing are perforated with holes 83 so as to permit circulation of air and dissipation of the heat generated in the motor and amplifier unit to be described later. These perforated end plates are made separate from the main body portion of the casing and are secured in position by screws 84 and 85. In inserting a record in the vertical portion of the slot or storage space 74 when its edge meets the concave strip 78 it slides along this strip and is guided into the horizontal portion 86 of the open space between the flat support 80 and the bottom casing wall 54. Fan blades 87 are preferably secured to the motor shaft to create a circulation or current of air through the casing.

As shown more clearly in Fig. 4, a curved sheet of thin metal 88 formed into the shape of a transverse section of a turtle back is provided to

properly support the record 70 from below, the under surface of the record, frictionally engaging member 88 as the record rotates. The turtle back 88 is supported at the front by its lower edge resting on the curved portion of strip 79, a spacing member 89 serving to hold these members in proper spaced relation. An angle shaped member 90 serves to support the lower edge of the turtle back at the rear, a spacing member 91 maintaining it at a suitable distance from rear wall 53. Angle iron 90 also serves to support an amplifier device or unit 92 which is supported near its front by a strip 93. As shown, the record support 88 is substantially flat at its top portion and lower ends and substantially curved like a cylinder in the regions therebetween, and along its top is provided with a slot 94 (see Fig. 2) to permit the passage of the record spindle 95 therethrough. A bracket 97 secured to the inner surface of wall 79 and extending along the top thereof serves to partially conceal the front portion of record support 88, its curved rear surface 96 being spaced from 88 to provide proper clearance space.

RECORD DRIVE

Referring to Figs. 6, 8, 10 and 11, the shaft 98a of motor 40 is provided with a pulley 98 over which passes belt 99 engaging pulley 100 secured near the end of a shaft 101 carrying a friction drive wheel or feed roller 102 at its inner end, the latter wheel directly engaging the lower face of the record to cause its rotation. A partition wall 103 extends across the casing near one end and having a slot 103a therein through which shaft 101 passes freely, this shaft being journaled in a pair of spaced apart bearing lugs 104 extending from a stationary supporting bracket 105 which has parallel end walls 106 and 107 extending toward the rear of the casing, end wall 106 lying along partition wall 103 and wall 107 having an aperture 108 to permit free passage of a rod 109 forming part of the record carriage 109a. As shown in Fig. 7, bracket 105 is supported by the oppositely disposed channel bars 110 and the spear bar 110a. A pair of guide members or rods 51 and 52 (Fig. 8) are provided to guide the record carriage, one end of rod 51 being supported in the end wall 106 and its other end in an arm 111a of a bracket 111 located near the end of the casing. The outer end of rod 52 is supported by bracket 111 and its inner end by bracket 105.

The record carriage comprises a frame 112 secured to the left end of the hollow rod 109 and a depending arm 113 secured at its right hand end, a shaft 114 being journaled in frame 112 and arm 113 and being threaded for that portion of its length between these members. As shown in Fig. 4, rod 52 passes through a notch 112a in the lower end of frame 112 and rod 51 through a bore near its top whereby the frame is supported and guided, rod 51 also passing through a bore in arm 113 near its top to support and guide it. Frame 112 in its hollow portion houses a gear 116 secured to shaft or screw 114, gear 116 engaging a skew gear 117 secured to the record spindle 95. Frame 112 is provided at one end with two projecting bosses 118 to which the ends of a transversely extending thrust member 119 are secured by screws 120. The end of threaded screw shaft 114 is slightly bored to receive a steel ball 121 which also abuts against member 119 so that the endwise motion of shaft 114 is transmitted through the ball to

the record carriage. In order to cause endwise motion of the screw shaft 114 upon its rotation by the record spindle and gears 116 and 117 described, an arm 122 is secured to a shaft 123 which may be rotated slightly by means to be described later, the end of the arm being provided with a threaded portion 124 which may be brought into engagement with the threads on shaft 114. When so engaged, arm 122 serves as a stationary nut, causing endwise motion of shaft 114. A coil spring 124a secured to the end of the arm and to a stationary pin 125 biases the arm towards engagement with the shaft 114 (see Fig. 7). A short slot 126 (Figs. 7 and 8) is provided in record support 88 through which friction wheel 102 extends slightly in order to engage the record.

Referring now particularly to Figs. 7, 8 and 11, a frame 126 is pivotally mounted on a shaft 127 and comprises a cross bar 128a having spaced apart lugs 128 in which is journaled a shaft 129 which carries at its end a friction wheel 130 mounted to engage the upper surface of the record 70 directly over wheel 102. This shaft is driven by a friction wheel 130', arranged to engage the hub portion 101' of pulley 100, the peripheral portions of wheels 102, 130 and 130' preferably being formed of rubber. An arm 131 bent as shown in Fig. 7 is secured to bar 128a of frame 126, a coil spring 132 having one end secured to the arm and its other end to a pin 133 carried by a bracket 134 attached to the rear wall of the casing. When it is not desired to drive a record, the parts are in the position shown in Fig. 7 with wheel 130 elevated above the record, and wheel 130' not engaging driving hub 100'. As shown, a vertical arm 135 is secured to a shaft 135a carrying a gear 136 which meshes with gear 137 secured to a vertical shaft 138 supported by a bracket 134, secured to the rear wall 53. The shaft 138 passes through the top portion 71 of the casing where it is provided with an operating handle 139. When the handle is in the neutral position shown in Figs. 1, 2 and 7, arm 135 serves to hold wheel 130 elevated so that the record is not driven; when handle 139 is moved either toward the right to record or to the left to reproduce, arm 135 moves up, as in Fig. 20, to allow spring 132 to depress and hold the wheel 130' in engagement with hub 100' and wheel 130 in firm engagement with the record which is then driven by the wheels 102 and 130.

To provide a ready means for the operator to stop a record at any time independently of the handle 139, an upstanding arm 140 is secured to the bar 128a of the frame 126 and adapted for engagement by a head 141 (Fig. 7) secured to the end of a flexible Bowden wire 142 which is enclosed by the usual flexible casing 142'. A bracket 143 projected from the inner wall of the casing serves to support one end of the wire 142. The other end of the wire is attached to a plunger 144 terminating in a knob 145, the plunger being slidable in a casing 146 having a hand or finger grip 147 and a bayonet slot 148. A compression spring 149 engaging the end wall of casing 146 and the end of plunger 144 biases the Bowden wire to its outer position, permitting wheel 130 to engage the record. To stop the record, it is only necessary for the operator to press knob 145 which will cause the head 141 to push arm 140 backwards, thereby raising idler wheel 130. The bayonet slot 148 is provided in the casing in which a pin 151 may be advanced and

slightly rotated, when the operator desires to elevate wheel 130 for an extended time.

Record and its attachment

Referring now to Figs. 23 and 24, the record 70 is made in circular or disc form of a thin sheet of a material, preferably of cellulose acetate which is transparent. We have found that when used in our machine, a thickness of .005 inch is satisfactory for recording from a microphone and also for reproducing. Such records require very small space to store them, are very flexible and may easily be inserted and stored in the machine as heretofore described. Before use, both faces of the record are smooth, the sound track being formed as the recording is made and causing the record to become distorted or wrinkled so that it is no longer flat.

We have found by experiment that a slight coating of high melting point wax, which is applied to the surface of the record in a solution of carbontetrachloride which dries very rapidly, is desirable and acts as a stylus lubricant in the operation of drawing the groove in the record material. Alternatively, a coating formed of ethylcellulose and wax may be employed with the added advantage that the wax does not readily rub off and the heat developed in the process of recording serves to liberate the wax lubricant.

A disc of paper 152 is cemented to the upper face of the record 70 at its center, this disc permitting notations to be written upon it for giving the positions of various matters recorded on a record. The disc also serves to reinforce the record at the region where it is attached to the spindle. As shown, an aperture is formed through both the label and record having a plurality of inwardly directed projections 153 resembling gear teeth.

Record spindle 95 is formed with a circular shoulder or flange 154 upon which the center of the record rests. Just above this, a series of flutes 155 is formed into which the projections 153 on the record extend to thereby effectively transmit the rotation of a record to spindle 95. A hollow bushing or cap 156 rests on the upper surface of the record, its upper end being bored to receive the end of the spindle which is of smaller diameter than the fluted portion.

A groove 157 is here formed into which two metal balls 158 engage for the purpose of securing a cap 159 to the end of the spindle, each ball being biased by a pin 160 secured to the lower end of a spring 161 whose upper end is secured to the cap by a screw or rivet 162. This arrangement permits ready removal of the cap and a record from the record spindle. The cap 156 has a conical shaped head 159 at its upper end, the point or apex of the cone serving as an indicator in connection with scale 66 (see Fig. 2) to indicate the position of matter recorded on the record. The recording device forms a spiral shaped sound track 163 in the record in a manner to be described.

It is not necessary to use the cap as a means of holding the record in place. The center hole in the record is made small enough to cause the record to be held by friction to the spindle 95. The cap, however, constitutes a convenient index member which can be readily removed to facilitate application and removal of records.

Recording and reproducing units

Referring to Figs. 15 to 22, a platen wheel 164 engages the under side of the record 70 opposite

the stylus 165 of the recording unit 30 (see Fig. 8 also). Wheel 164 is mounted on the end of a shaft 166 journaled for rotation in a bearing member 167 which is mounted for pivoted movement on a pin 168 carried by a lug 169 of bracket 105. Shaft 166 is recessed as shown to receive a pin formed on the end of a screw 170, thus retaining the shaft in proper position axially. Member 167 is bored to receive an adjusting screw 171 which engages a threaded hole in a lug 172 projecting from the bracket 105. Cylindrical blocks of soft rubber 173 and 174 are arranged as shown, under compression, so that upon adjustment of screw 171, wheel 164 may be slightly adjusted in position with reference to the stylus. The wheel 164 is formed of alternate laminations 175 and 176 of soft rubber and steel respectively held in place against a flange 166a by a screw 177 threaded into the end of shaft 166, the end of screw 177 being extended to form a head 177a of large diameter cooperating with the adjacent disc 176. A thrust ball 178 is seated in a recess formed in the end of the screw, and is retained in position by a spring 179 whose end is secured to lug 172 by screw 180. The stylus may engage the record directly over one of the rubber laminations 175 to permit the sound track to be formed therein, the rubber permitting the lower surface as well as the upper surface of the record to be deformed by the action of the stylus which forms the sound track by its moving sidewise. Fig. 22 shows on an enlarged scale, depressions of the sound track in the upper surface of a record and corresponding projections formed on its lower surface.

As shown in Fig. 11, control shaft 135a passes through partition wall 103 and is journaled in the end walls 106 and 107 of bracket 105 and also extends through a partition wall 182 extending across the top of the casing. The end of this shaft carries a cam unit 183 (see Fig. 5 also) which controls the positioning of the recorder 30 and reproducer 29. The recorder 30 is supported for vertical movement by two substantially parallel arms 184 and 185 connected to it by screws 186 and 187, the rear ends of these arms being pivotally supported by screws 188 and 189 threaded into a lug 188a extending from wall 182 (see Figs. 15 and 16) and a lug 189a on a bracket 190 on the wall 182. Arm 184 carries a roller 190a which engages a cam 191 forming a part of cam unit 183 and having a rise portion 192 which raises or lowers the recorder and a large dwell portion 193 which maintains it in its elevated or inoperative position. The parallel supporting links serve to maintain the recorder unit in parallel position as it is raised or lowered.

The reproducer unit 29 is mounted for both sidewise and vertical motion by its attachment to the end of a lever 194 having an offset extension 195, the lever being pivoted loosely on a shoulder screw 196 threaded into the inner end of another lever 197 which is in turn pivotally supported for up and down movements on a cylindrical extension 198 (Fig. 15) formed on its inner end, this extension engaging a bore made in an enlarged hub portion 199 formed on the end of a third lever 200. A vertical screw 201 passing through a bore formed in the hub 199 and threaded into the fixed bracket 190 serves as a pivotal support for sidewise motion of all three levers. A spring 203 (Fig. 17) having one end fixed to a pin 204a on hub portion 199 and its other end to a fixed pin 204 biases the levers toward the cam unit 183. The levers 197 and 200

also have offset end portions 205 and 206, respectively, to which the ends of a spring 207 are attached. Cylindrical extension or pivot 198 is retained in position within hub 199, as by a screw 208 (Fig. 15).

The cam unit 183 is more clearly shown in Fig. 5 wherein it comprises an axial cam having a rise portion 213 and an extended dwell portion 212 and between this cam and cam 191 is located another radial cam having two extended dwell portions 209 and 210 connected by rise portions 211. Referring now to Figs. 15 to 18, lever 200 carries a projecting pin 214 shown in Fig. 15 in engagement with the outer dwell portion 212 of the cam unit 183 whereby the reproducer is held in its inoperative position, the recorder now being free to be lowered to its operative position. If, however, the cam element 183 is rotated in a counter-clockwise direction from the position in Fig. 16, pin 214 rides down the rise portion 213 of the axial cam, the high dwell portion 193 of the recorder operating cam keeps the recorder in its upper, inoperative position while the reproducer is moving into its position over the platen roller 164. While moving, the lever 194 is supported by lever 197, the upturned end 206 of which is provided with a notch 215 in which lever 194 rests as shown in Fig. 13. At this time spring 207 serves to support lever 197. When the reproducer stylus is in position over platen 164 the rise portion 211 of the radial cam engages a pin 216 projecting from lever 197, a slot 217 being provided in lever 200 to clear this pin. The cam depresses lever 197, against the action of spring 207, to the position shown in Fig. 14, by an amount more than enough to lower the stylus onto the record so that the front of lever 194 no longer rests in notch 215 but is free to move vertically, the stylus now resting on the record. Fig. 18 shows the reproducer and associated parts in this position. The foregoing operation is brought about by moving the control handle 139 from its "neutral" position to its "reproduce" position in Fig. 2.

To change back to "neutral" position from the position in Fig. 18, control handle 139 is moved to its "neutral" position, thereby rotating shaft 135a in a clockwise direction (Fig. 18), causing the pin 216 to move upward along the rise portion 211 of its control cam under the influence of spring 207, thereby raising the stylus above the record. The rise portion 213 of the axial cam then engages pin 214 to move lever 200 and reproducer 29 sidewise out of the way of recorder 30. Instead of arresting the control handle in its "neutral" position, its movement may be continued until it is arrested in its "record" position against a stop 218 (Fig. 2). Thus, as the handle moves from its "central" position, roller 190a rides down the rise portion 192 of its cam from the position in Fig. 18 and the recorder comes into operative position with its stylus 165 resting on the record. Fig. 19 shows the recorder and associated parts in this position.

In order to faithfully record sound in tough material, we found that a recorder with ample power to drive the stylus was required and that the Rochelle salt crystal was the most efficient agent for converting the electrical energy of the amplifier output circuit into the mechanical energy of the vibrations of the stylus. We therefore preferably employ such crystal pickups for both recording and reproducing and for use with such pickups prefer a stylus made of diamond ground to the proper shape.

We also found that a background noise was developed if the plastic record material opposite either the recording or reproducing stylus was supported on a hard metal surface and that this noise should be eliminated and also the vibration arising from the operation of the machine would not be recorded, by providing a resilient cushion such as platen 164 for the underside of the recording material. We also found that by supporting the record so that the point of recording is under a state of tension as hereinafter described in detail, a further reduction in background noise resulted. Both of these expedients are utilized in the above described machine.

The use of rubber rollers for driving the disc is important because they prevent the transmission of machine noise to the record material and the resiliency of the rubber compensates for the difference in the surface travel of the disc as it travels in its spiral movement. The drive used results in constant velocity of the disc at the time of recording irrespective of the diameter of the circle. This brings to disc recording the one outstanding advantage of recording on a cylinder and eliminates the variation in both amplitude and frequency characteristics that is inherent in other forms of disc recording.

Another important feature of the construction described is that recording is started near the center of the disc which is reinforced by the label and an area of maximum strength. The grooves are formed as the disc travels under the stylus and they serve to greatly increase the rigidity of the material in the transverse direction as the distance between the driving roller and the record spindle increases.

By positioning the recording stylus slightly in advance of the point of contact between the grooved roller and the disc in the direction of rotation, we are enabled to secure good lateral formation of the record material, whereas, if the stylus point is directly over the roller with the record between, the formation is restricted by the sides of the groove on the roller. The groove is drawn into the material, the groove taking the shape of the diamond stylus and not being influenced by the roughness of the sides of the groove being impressed in the reverse side of the material. This method of operation is further helped by the fact that the record is continually moving away from the driving rollers 102 and 130, which creates a tension in the record and helps support the material. The tension in the record between the driving rollers and the record spindle gives the lateral support and the roller, the forward support. Under these conditions it is not necessary to load the grooves in the platen roller with rubber.

In reproducing a record, we prefer to mount the pickup stylus so that it is approximately one eighth of an inch ahead of the driving roller in the direction of rotation, the tension of the record material being sufficient to support the reproducer, there being no support under the record directly at its point of contact with the stylus.

Backspacing device

When dictating to or transcribing from a record it is sometimes desirable to have a portion of it repeated. A backspacing device is provided whereby from one to three grooves may be run under the stylus again. Referring to Figs. 1, 2, and 15 to 18, a vertical shaft 217 extends above the top of the casing where it is provided with a

knob 218 having a pointer 219 which may be set opposite the graduations 0, 1, 2 or 3 according to the number of grooves on the record to be repeated, the pointer normally standing at the zero position. Shaft 217 has an eccentric cam 220 secured thereto, which bears against a pin 221 slidable in a bore formed in a lug 221a of bracket 190. When the reproducer 29 is in operative position, as shown in Figs. 17 and 18, the end of pin 221 bears against the end of a screw 222 carried by lever 200 near its lower end. An adjustment of pointer 219 to the numeral 1 will therefore cause the eccentric 220 to be rotated approximately 60° and to move lever 200 about its pivot 201 by an amount sufficient to move the stylus back one groove or spiral on the record. The distance between the centers of the rubber laminations 175 of platen 164 corresponds to the distance between the grooves of the record, so that the reproducer stylus will now be directly over the center of the next rubber lamination of the platen. As shown in Fig. 15 the ends of screw 222 and pin 221 are not in engagement when the reproducer is in its inoperative position.

Switch control

The automatic control of the amplifier, reproducer and recorder switches is secured by operation of handle 139 which rotates shaft 181 as explained heretofore. Referring to Figs. 6, 9, 11 and 20, shaft 135a carries three spaced apart arms 135, 223 and 224, arm 135 serving to allow roller 130 to be brought into engagement with a record 70 as heretofore explained. Arm 223 engages an arm 225 secured to shaft 123 so that when arm 223 is either raised or lowered from the position shown in Fig. 6, arm 122 is lowered as in Fig. 20 so that its threaded portion 124 engages screw 114 to move the record carriage as heretofore explained. Arm 224 carries a projecting pin 226 which engages the side of a slot 227 formed near the end of a switch control lever 228 which is loosely mounted on shaft 123. The sides of slot 227 are curved outward near the bottom as shown by dotted lines in Fig. 6 to permit a further rotation of the shaft 135a after the lever 228 has been fully operated. A slot 229 is formed near the lower end of lever 228 into which projects a pin 230 secured to an arm 231 fastened on the end of switch shaft 24. The arrangement is such that upon moving handle 139 from neutral to the reproducing positions, pin 226 causes the upper end of lever 228 to move to the right (Fig. 20), this in turn causing pin 230, arm 231 and switch shaft 24 to move to the left, thereby connecting the reproducer to the amplifier by circuit connections to be explained later. Upon moving handle 139 from neutral to the recording position, the upper end of lever 228 (Fig. 20) will be moved to the left and arm 231 and switch shaft 24 to the right, thereby connecting the recorder to the amplifier by the circuit connections mentioned.

Amplifier and circuit connections

Fig. 25 is a schematic circuit diagram showing the circuit connections of the device. The driving motor 40 may be connected to the alternating current supply mains M through the "on-off" switch 2, the main M also supplying current to the amplifier tubes 335, 336 and 337 and the rectifier 301. The rectifier 301 supplies unidirectional current to the circuits of the amplifier tubes through a filter circuit of known type comprising the inductors 303 and condensers 304. The

current corresponding to the sound to be amplified is applied across the ends of primary winding 307 of transformer 306 whose secondary winding 308 is connected across the grid and cathode of tube 335, as shown. Resistance coupling is used to transfer this amplified current from the plate circuit of one tube to the grid circuit of the succeeding tube, resistors 309, 310 in the plate circuit of tube 335 being connected through condenser 311. transmission line 312 and resistor 313 to the grid and cathode of tube 336. A contact 314 adjustable along resistor 313 serves as a manual volume control permitting the user to operate the device at any desired volume level so as to secure optimum results in either recording or reproducing. Resistor 315 and condenser 316 transfer the amplified current to the grid circuit of tube 337, the current corresponding to the amplified sound or signal passing through primary winding 318 of the output transformer 317.

As shown, transformer 317 preferably has three secondary windings 319, 320 and 322, winding 320 being connected through resistors 321 to the two electrodes of a neon tube 323 which functions as an automatic volume control device, as will be described later. One end of secondary winding 322 is connected to one terminal of the recording unit 330 through a resistor 343 and its other end to a switch contact 342 engageable by a switch blade 327 carried by a switch control shaft 324. The ends of secondary winding 319 are connected to a pair of switch contacts 341 adapted to be engaged by the switch blades 325 also operated by the shaft 324. The switch blades 325 connect to the terminals of a jack 326 in which may be inserted the jack plugs 331 or 332. Jack plug 331 is shown connected to the ends of a telephone search coil 333 and plug 332 to a unit 334 functioning as either a loud speaker or a microphone transmitter. The reproducer unit 29 has its high potential terminal connected to a switch contact 344 engageable by a switch blade 328 also connected to shaft 324, switch blade 328 serving to complete the circuit across transmission line 312 in the position shown.

With the switches in the position shown, the sound received by the microphone may be recorded by inserting plug 332 in jack 326 after closing switch 302 by the "on-off" switch key 75 on top of the casing. Current corresponding to the sound waves passes through primary winding 307, is amplified by tubes 335, 336 and 337 and transferred to recorder 30 through secondary winding 322 of the output transformer and switch blade 327. This causes the stylus of the recorder to move back and forth sidewise and form a groove in the record which corresponds to the sound waves. In forming the groove, the stylus merely displaces the material of the record; that is, the material is not removed from the record as when a cutting action is used. We have found when a glow tube, such as one containing neon or argon gas, is connected as shown, if the microphone is subjected to very loud sounds, the gas in the tube breaks down or glows and causes a substantial decrease in the voltage applied to the recorder. The sounds of low and medium intensity, however, do not produce sufficient voltage to cause tube 323 to glow so that the fully amplified voltage corresponding thereto is impressed on secondary winding 322 and the recorder. The glow tube thus serves to limit the energy applied to the recorder from a sound of excessive intensity, whereas that corresponding

to a sound of low or medium intensity is not limited but applied with full effect.

To record a message passing over a telephone line the plug 331 is inserted in jack 326 and the coil 333 placed close to the line and inductively coupled therewith as closely as possible. The currents induced in the search coil are then amplified and recorded in the manner above described.

To reproduce the sound recorded on a record, handle 139 is moved to the "reproduce" position which causes the reproducer stylus to engage the record and also rotates shaft 324 clockwise (Fig. 25), thereby disconnecting recorder 330. Engagement of contact 344 by switch arm 328 causes the output voltage of 29 to be impressed on the grid of tube 336. The voltage is amplified in tubes 336 and 337 and is transferred to switch terminals 341 by primary 318 and secondary winding 319. Switch arms 325 being now in engagement with these terminals, the sound, as reproduced, may be heard from speaker 334 whose plug 332 is in position in jack 326. It thus appears that the switching arrangement is such that three stages of amplification are used for recording the signal, whereas for its reproduction only two stages of amplification are used. It is to be noted that the handle 139 not only moves the recorder or reproducer into operative position but also effects the proper circuit connections with the amplifier to secure the desired degree of amplification for recording or reproducing.

The volume control arm 314 is operated by means of a knob 50 located on top of the casing and connected to the arm by a flexible shaft 232 as shown in Fig. 6.

We have described what we believe to be the best embodiments of our invention. We do not wish, however, to be confined to the embodiments shown, but what we desire to cover by Letters Patent is set forth in the appended claims.

We claim:

1. In a sound translating device, in combination, a record receiving spindle, opposed friction driving rollers for directly engaging the upper and lower surfaces of a record, a roller-operating motor connected to one of said driving rollers, a stylus arranged to engage said record, and a rotary record-engaging platen having a definite zone thereof constantly opposed to the stylus.

2. In a sound translating device, the combination of means for rotatably supporting a thin, flexible, through-deformable disc record, a first friction wheel directly engaging one face of said record, a motor for rotating said friction wheel, a second friction wheel, means for moving said second wheel into direct engagement with the other face of said record at a point substantially opposite said first friction wheel, a stylus arranged to engage one face of said record, and a rotary, record-engaging, platen for constantly engaging the other face of the record in opposition to the stylus.

3. In a sound translating device, in combination, means for rotating a thin, flexible, disc record, a record-engaging platen wheel, said wheel comprising a plurality of spaced discs formed of resilient material, and a stylus for engaging the other surface of said record at a point opposite the periphery of one of said discs.

4. A sound translating device as set forth in claim 3 in which said discs of resilient material

are spaced apart by a plurality of members formed of rigid material.

5. In a sound translating device, in combination, means for rotating a thin, flexible, disc record, a laminated platen wheel having spaced apart portions formed of resilient material adapted for peripheral engagement with one surface of the record, a stylus for engaging the other surface of the record at a point opposite one of said discs, and means for adjusting said wheel to vary its engagement with said record.

6. A sound translating device as set forth in claim 5 in which said wheel adjusting means comprises a pivotal support for said wheel, the axis of said support being substantially parallel to the plane of one of said laminated portions.

7. In a sound translating device, the combination of a stationary, record supporting member having a substantially flat top portion and downwardly directed, convex side portions, said flat top portion being provided with an aperture, a record spindle passing through said aperture, means comprising a pair of conforming walls spaced from the lower ends of said convex side portions, for engaging marginal portions of the record to thereby maintain the lower surface of said record in substantial conformity with said convex side portions, means for rotating the record relative to the record supporting member, and a stylus engaging the upper surface of said record above the top portion of said record supporting member.

8. In a sound translating device, the combination of means for rotatably supporting a thin, flexible, disc record, a first friction wheel for engaging the lower surface of said record, a motor for rotating said friction wheel, an arm, a second friction wheel mounted on said arm in a position to engage the upper surface of said record directly above said friction wheel, means supporting the arm with capacity for movement to carry the friction wheel toward and from the record, yielding means connected to said arm for urging said second wheel into engagement with said record, control means for operating said arm to cause it to withdraw said second friction wheel from said record, and a stylus adapted to engage said record.

9. A sound translating device as set forth in claim 8 in which said control means comprises a long, flexible member having a control knob on its outer end in a position convenient for the operator and its inner end operatively connected to said arm.

10. In a sound translating device, a spindle for engaging a thin, flexible, disc record and defining an axis of rotation for the record, separable friction wheels for engaging opposite surfaces of said record, a motor for rotating said friction wheels to drive the record, a stylus in engagement with said record, a stationary record supporting member having an upper surface of large area, and means for maintaining an extensive portion of the lower surface of said record in contact with said upper surface of the record supporting member, whereby said stationary member is caused to serve as a brake to stop the rotation of said record.

11. In a sound translating device, a frame having front and bottom surfaces, sound translating means mounted on the frame for cooperating with a thin, flexible, disc record to effect sound translation and a casing having a bottom wall spaced apart from the lower surface of said frame and a front surface wall spaced apart from

the front of said frame and having a concave portion connecting said front and bottom walls, whereby the end of a thin, flexible record inserted into the space between said front wall and frame is deflected by said concave portion of the front wall into the space along said bottom wall.

12. In a sound translating device, the combination of means for supporting a thin, flexible through-deformable, disc record for rotation, friction drive wheels having their outer portions made of rubber and in direct engagement with the opposite faces of said record at substantially opposite points, means for rotating said wheels in opposite directions, a stylus arranged to engage said record, a platen opposed to the stylus, and means for progressively changing the distance from the axis of rotation of the record to the feed wheels, and to the stylus and platen.

13. In a sound translating device, the combination with a stationary curved support for supporting a thin, flexible disc record, of means for rotating the record relative to its support, a stylus for engaging the surface of the record, means for causing relative separating movement of the record axis and the stylus along a radial plane of the record axis, as the record is rotated, and means cooperative with the stationary record support for continuously and progressively flexing the record.

14. A sound translating machine as set forth in claim 13, in which the stationary curved support is provided with an elongated slot through which the spindle passes and along which the spindle travels.

15. In a sound translating device, the combination with curved stationary means for supporting a thin, distortable, plastic disc record, and means defining an axis of rotation for said record, of means supporting and guiding the axis defining means for bodily movement in a direction substantially normal to the direction of the defined axis, opposed friction wheels for directly engaging and rotating said record, means for moving the axis defining means bodily in a direction substantially normal to the direction of the defined axis, a stationary stylus engaging the surface of said record, and means cooperative with the record support for progressively flexing said record to maintain it substantially in conformity with the stationary supporting means.

16. A sound translating machine comprising, in combination, means supporting a thin, flexible disc record of small mass and inertia for rotation about its center, sound translating means cooperative with the record, means for progressively changing the distance between the axis of rotation of the record and the sound translating means, means for rotating the record at variable rotary speed to traverse the record past the sound translating means at substantially uniform linear speed, said last named means comprising a constant speed motor, a constant speed rotor of relatively large mass and inertia driven by and with the motor, a pair of friction wheels driven from the rotor for directly engaging the record in opposed relation to rotate the record, and means supporting the friction wheels in substantially fixed relation to the sound translating means, means for moving one of the friction wheels into and out of engagement with the record, and means for establishing a driving connection from the rotor to said friction wheel independently of the record as the friction wheel engages the record and for inter-

rupting said driving connection as the friction wheel leaves engagement with the record.

17. A sound translating device including a record engaging spindle, a record-engaging stylus, a stationary record supporting member having curved side portions at opposite sides of the stylus, means for maintaining a substantial portion of said record curved into substantial conformity and in rubbing contact with said curved side portions of the stationary supporting member, and means for rotating the record about the axis of the spindle.

18. A sound translating device as set forth in claim 17 in which the supporting member is provided with an elongated slot through which the spindle passes, and which further includes screw means for moving the spindle along the slot.

19. In a sound translating device, the combination of means for supporting a thin, flexible, disc record for rotation and defining an axis of rotation for the record, means for rotating said record in one direction, a platen wheel in rolling engagement with a surface of said record over an area which is of small extent with relation to the record radius, means supporting the platen wheel for rotation about an axis transverse to the defined axis of the record, sound translating means including a stylus, and means for operatively supporting said sound translating means in fixed relation to the platen wheel axis so that its stylus engages a surface of the record in opposition to the platen wheel and in fixed relation to the point of contact between said platen wheel and record.

20. In a sound translating device for acting upon a thin, flexible, disc record, the combination of means for supporting the record and defining an axis of rotation for the record, opposed friction wheels directly engageable with opposite surfaces of the record for rotating said record in one direction about the defined axis, a platen wheel in rolling engagement with a surface of said record over an area which is of small extent with relation to the record radius, said platen having a circumferential zone into which record material may be depressed, means supporting the platen wheel for rotation about an axis transverse to the defined axis of the record, sound translating means including a stylus, and means for operatively supporting said sound translating means in fixed relation to the platen wheel axis so that its stylus engages a surface of the record in opposition to such zone and in fixed relation to the point of contact between said platen wheel zone and the record.

21. In a sound translating device, the combination of means for supporting a thin, flexible, disc record for rotation and defining an axis of rotation for the record, a pair of opposed friction feed wheels directly engageable with opposite faces of the record for rotating said record in one direction about the defined axis, a platen wheel in rolling engagement with a surface of said record over an area which is of small extent with relation to the record radius, means supporting the platen wheel for rotation about an axis transverse to the defined axis of the record, sound translating means including a stylus, means for operatively supporting said sound translating means in fixed relation to the platen wheel axis so that its stylus engages a surface of the record in opposition to the platen wheel and in fixed relation to the point of contact between said platen wheel and record, and means operatively associated with the axis defining

means, the stylus, the feed wheels and the platen for progressively changing the distance between the stylus, the feed wheels and the platen wheel on the one hand, and the axis defining means on the other.

22. A sound translating machine for acting upon a thin, flexible disc record of slight mass and inertia comprising, in combination, means for supporting and defining an axis of rotation for said record, means for rotating the disc record comprising a pair of opposed, record-driving feed wheels directly engageable with the opposite faces of the record itself when the record is mounted on said axis defining means, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels, and means operatively associated with said feed wheels, stylus, and axis defining means for progressively changing the distance between the said feed wheels and stylus, on the one hand, and the axis defining means on the other.

23. A sound translating machine comprising, in combination, a disc record, means supporting and defining an axis of rotation for said disc record, means for rotating the disc record comprising a pair of opposed feed wheels directly engageable with the opposite faces of the record itself, sound recording and reproducing styli laterally fixed with respect to the feed wheels, and means operatively associated with said record for progressively changing the distance between the said feed wheels and styli, on the one hand, and the axis defining means on the other.

24. A sound translating machine comprising, in combination, a thin, flexible disc record of slight mass and inertia having a central aperture therein, a spindle for supporting and defining an axis of rotation for said record, the spindle passing through the record and being secured thereto for rotating the spindle, means for rotating the disc record comprising a pair of opposed, record-driving feed wheels directly engageable with the opposite faces of the record itself, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels, a rotatable threaded member, gearing connecting said threaded member for operation by the spindle, normally stationary toothed means cooperative with the threaded member for causing the rotation of said threaded member to move the spindle and thereby progressively to change the distance between the said feed wheels and stylus, on the one hand, and the axis defining means on the other.

25. A sound translating machine comprising, in combination, a thin, flexible, disc record of slight mass and inertia, a spindle for supporting and defining an axis of rotation for said record, means for rotating the disc record comprising a pair of opposed, record-driving friction feed wheels directly engageable with the opposite faces of the record itself, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus laterally fixed with respect to the feed wheels and engageable with the record at a point between said spindle and said feed wheels, and means operatively associated with said feed wheels, stylus, and axis defining means for progressively increasing the distance between the said feed wheels and stylus

on the one hand, and the axis defining means on the other, whereby the portion of the record in engagement with the stylus is maintained in a state of tension.

26. A sound translating machine as set forth in claim 22 in which one of the friction wheels is constantly driven by the feed wheel driving means, and the second wheel is movable toward and from the first to establish and discontinue the record drive by controlling the pressure of the record against the first wheel, such movable wheel being of insignificant mass and inertia relative to the feed wheel driving means.

27. A sound translating machine comprising, in combination, a thin, flexible disc record of slight mass and inertia, a spindle for supporting and defining an axis of rotation for said record, means for rotating the spindle comprising the record itself, a pair of record-driving feed wheels directly engaging the opposite faces of the record itself in opposed relation, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels, and means actuated by the spindle for progressively changing the distance between the said feed wheels and stylus on the one hand, and the axis defining means on the other.

28. A sound translating machine comprising, in combination, a thin, flexible disc record of slight mass and inertia, a transversely curved, fixed record support adapted to serve as a record brake, a carriage, means supporting and guiding the carriage for rectilinear movement parallel to the longitudinal axis of said curved support, a spindle rotatably mounted in the carriage, to which the record is attached, for defining an axis of rotation for said record, means for rotating the spindle comprising the disc record itself, a pair of opposed, record-driving feed wheels directly engageable with the opposite faces of the record itself when the record is mounted on said axis defining means, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels, and means operated by the spindle for effecting movement of said carriage progressively to change the distance between the said feed wheels and stylus on the one hand, and the spindle on the other.

29. A sound translating machine for acting upon a thin, flexible disc record of slight mass and inertia comprising, in combination, means for supporting and defining an axis of rotation for said record, means for rotating the disc record comprising a pair of opposed, record-driving feed wheels directly engageable with the opposite faces of the record itself when the record is mounted on said axis defining means, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels in immediate proximity to the feed wheels, and means operatively associated with said feed wheels, stylus, and axis defining means for progressively changing the distance between the said feed wheels and stylus on the one hand, and the axis defining means on the other.

30. A sound translating machine comprising, in combination, a thin, flexible disc record of slight mass and inertia, means for supporting and defining an axis of rotation for said record,

means for rotating the disc record comprising a pair of opposed, record-driving friction feed wheels directly engageable with the opposite faces of the record itself upon a radial line of fixed direction, and means for driving the feed wheels at constant rotary speed, sound translating means including a stylus engageable with the record and laterally fixed with respect to the feed wheels, means operatively associated with said feed wheels, stylus, and axis defining means for progressively changing the distance between the said feed wheels and stylus on the one hand, and

the axis defining means on the other, and means supporting the feed wheels to turn about axes which extend parallel to one another and in such angular relation to the record radius engaged by the feed wheels that slack is eliminated from the record and the record is drawn taut along said radius by and between the axis defining means on the one hand and the feed wheels on the other.

BARTON A. PROCTOR.
FERDINAND C. W. THIEDE.

CERTIFICATE OF CORRECTION.

Patent No. 2,296,870.

September 29, 1942.

BARTON A. PROCTOR, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 8, second column, line 75, claim 11, strike out "surface" and insert the same before "of" on page 9, first column, line 1, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of November, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)