Feb. 1, 1944. W. J. GREEN 2,340,806

SOUND RECORDING APPARATUS

Filed Dec. 4, 1941 2 Sheets-Sheet 1

Fig. 1.

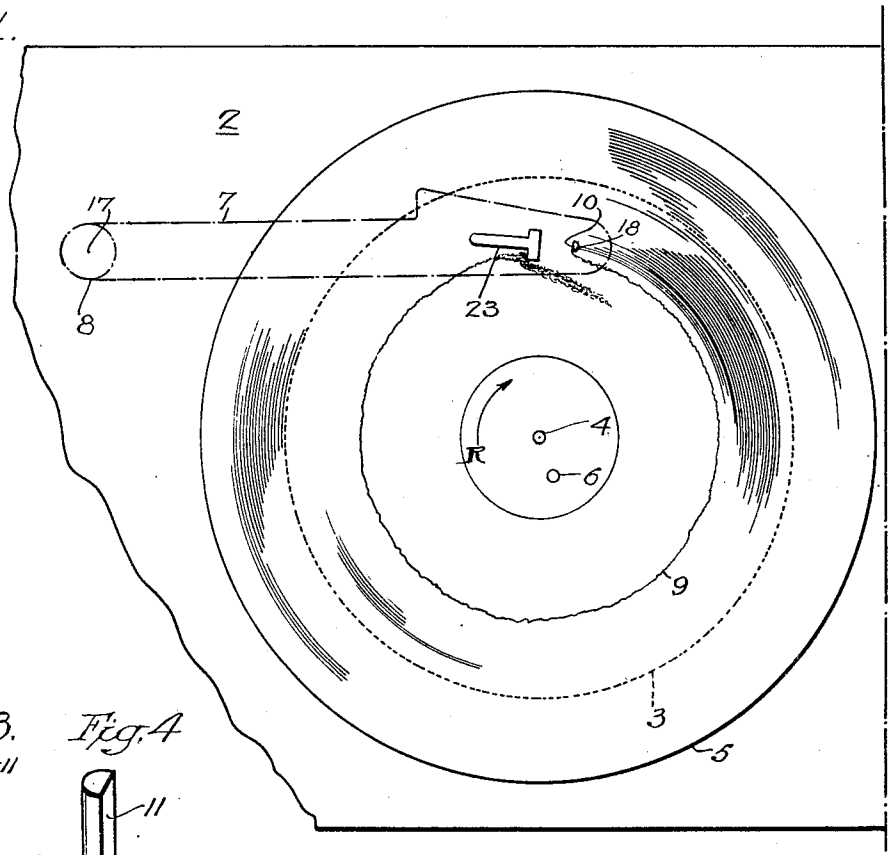


Fig. 3.

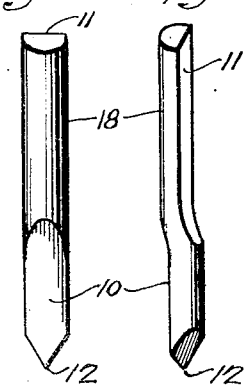


Fig. 4

Fig. 2

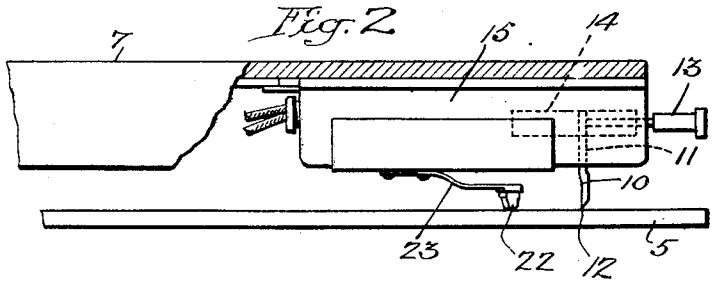


Fig. 6

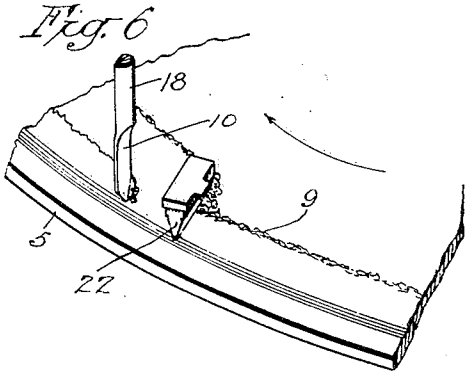
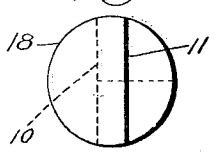


Fig. 5



Inventor
Willard J. Green
by his Attorneys
Howson & Howson

Feb. 1, 1944. W. J. GREEN 2,340,806

SOUND RECORDING APPARATUS

Filed Dec. 4, 1941 2 Sheets-Sheet 2

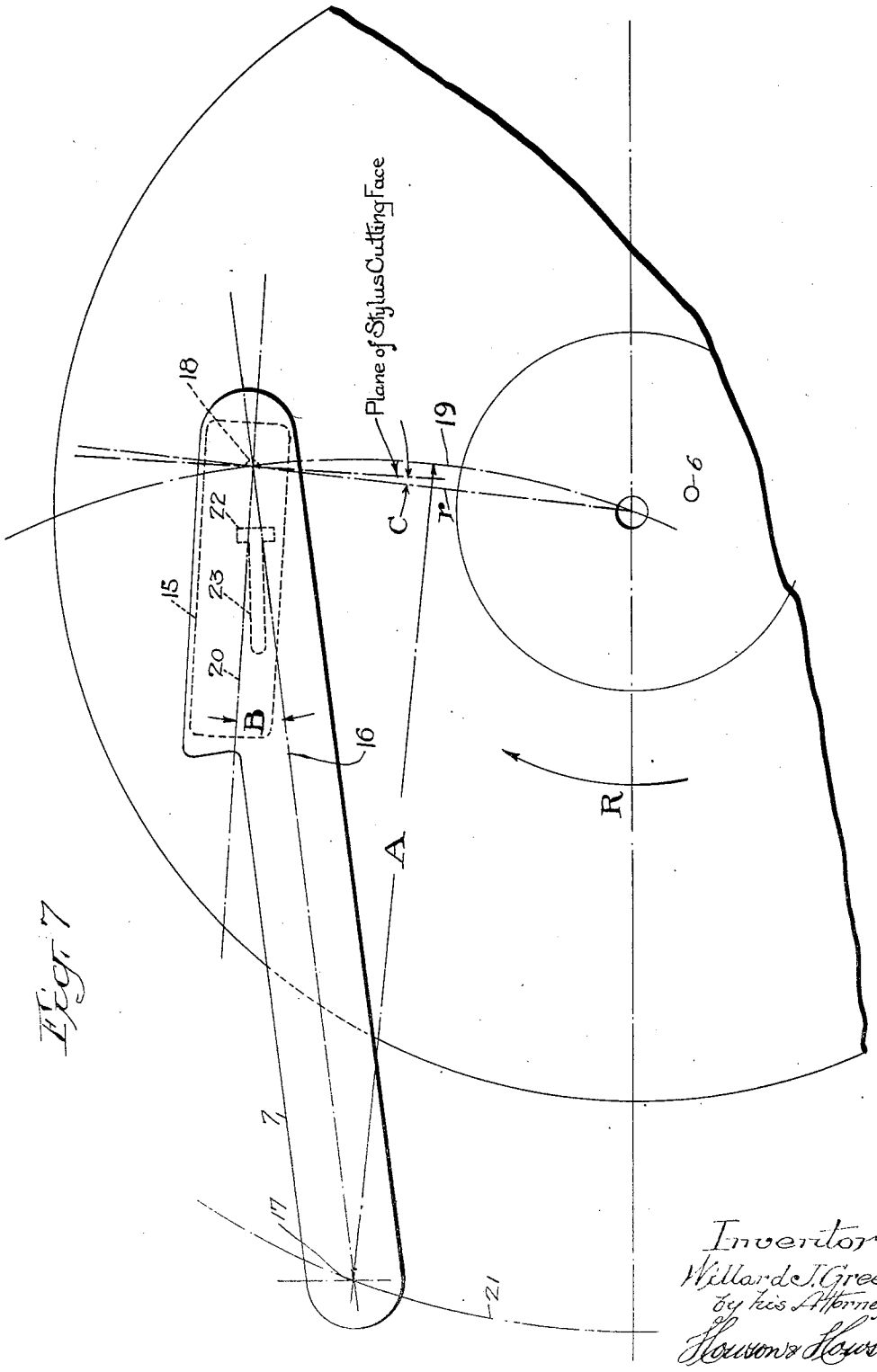


Fig. 7

Inventor
Willard J. Green
by his Attorneys
Howson & Howson

Patented Feb. 1, 1944 2,340,806

UNITED STATES PATENT OFFICE

2,340,806

SOUND RECORDING APPARATUS

Willard J. Green, Philadelphia, Pa., assignor to Philco Radio and Television Corporation, Philadelphia, Pa., a corporation of Delaware

Application December 4, 1941, Serial No. 421,661

1 Claim. (Cl. 274—1)

This invention relates to mechanisms for recording sound on disc records, and is especially concerned with recording apparatus of the type which cuts its own spiral groove during the recording operation.

More particularly, the invention is concerned with machines which cut inwardly, beginning at the outside edge of a record, for example, home recorders.

Serious difficulties have been encountered in this type of machine, due to the fact that the long thread-like strand, or swarf, cut from the record, interferes with the proper operation of the cutting stylus. This swarf, because the material is compressed somewhat by the pressure between the stylus and the surface approaching it, tends to shorten and will trail-out from the point of cutting and assume a position around the record slightly inwardly of the groove being cut. As the cutting arm moves in it encounters the swarf, and the stylus may be deflected sufficiently to produce very objectionable distortion of the recorded signal. This condition is emphasized by the fact that the strand will at times draw out of the groove only at spaced zones, due to the clinging effect produced by an electrostatic charge developed in the strand during cutting. This, of course, results in certain portions of the strand lying across the record on a line approaching a radial line, as the swarf is generally of sufficient strength to maintain unbroken connections between concentric arcs thereof.

In addition to the above difficulty, sufficient material will often pile up against the flat cutting face of the stylus to produce a pronounced periodic vertical movement of said stylus, as it moves over the collected material. This produces additional undesirable modulation of the recorded signal, and may at times even throw the stylus back into a previously cut groove.

Attempts have been made to overcome the aforesaid difficulties by the provision of devices for removing the swarf, but these have not proved satisfactory, as they have demanded too much attention from the operator (who may be playing a musical instrument for the recording), or have been too costly for use with machines adapted for inexpensive home recording.

It is, therefore, the primary object of the present invention to provide a recording apparatus of such a nature that clogging or other interference with the stylus is eliminated.

A more particular object of this invention resides in the provision of a recording apparatus in which the swarf is moved away from the cutting point as soon as it is cut, and in which means is provided for continuously maintaining a clean record surface for the stylus to cut.

It is also an object of the present invention to provide means of the above type, which is positive in its action, inexpensive to manufacture, and requires no attention by the operator either before or during the recording operation.

A further object of the present invention resides in the provision of a recording apparatus in which the torque required to cut a groove of given depth, is less than that required in prior practice.

The manner in which the above and other objects and advantages are realized, will be best understood by considering the following description taken with the accompanying drawings, in which:

Fig. 1 is a somewhat diagrammatic plan view of a recording mechanism incorporating the invention;

Fig. 2 is a detail view of the cutting arm head, with a portion of the wall of the cutting arm broken away;

Fig. 3 is a perspective view of the cutting stylus preferably employed in the invention, showing the flat cutting face;

Fig. 4 is a view similar to Fig. 3, but taken from another angle to better illustrate the needle indexing-flat;

Fig. 5 is a plan view of the stylus;

Fig. 6 is a fragmentary perspective view illustrating the operation of the invention; and

Fig. 7 is a full scale illustration of the cutting arm and an associated recording disk, by means of which the invention may be clearly explained.

Referring more particularly to the drawings, in Fig. 1 are illustrated the essentials of an apparatus constructed in accordance with the invention. The baseplate, generally designated by the reference character **2** carries the usual turntable **3**, mounted for rotation about a central spindle **4**. The turntable carries a record **5** and, as is customary for recording, is provided with a record drive pin **6** to ensure that the record will not slip thereon. Disposed above the turntable is the cutting arm **7**, mounted for swinging movements about pivot **8**. Suitable means (not illustrated) may be provided to move arm **7** gradually inward about its pivot, as commonly provided in such devices. As will be seen from the drawings, the outside section of the record has already been cut, and a strand of swarf is shown at **9** trailing around the record.

Turning to Figs. 2 to 6, it will be seen that the

stylus preferably employed, includes a flat cutting face 10 (see Fig. 3), an oppositely facing indexing-flat 11, and a beveled chisel point generally indicated at 12. Fig. 6 shows that the flat cutting face 10 (which extends down to the cutting point) is generally faced toward the zone of record about to be cut; while Fig. 2 illustrates the manner in which the adjusting screw 13 cooperates with surface 11 and secures the stylus in the armature 14 of the cutting head or "cartridge" 15. The latter may be any known form of device for driving the stylus by the signal to be recorded.

An important feature of the present invention resides in the angular orientation of the cutting face of the stylus, as will now be explained. In accordance with this invention, the cutting face of the stylus is so angled with respect to the effective radius of the cutting arm as to continuously roll the cut material inwardly toward the center of the record, and the angle chosen is sufficiently great to produce this rolling action throughout substantially the entire travel of the stylus across the face of the disk. At the same time this angularity of the cutting face is chosen so as not to produce (at any point of the stylus travel) perceptible distortion of the recorded signal. This feature of the invention may be clearly understood by reference to the illustration of Fig. 7 which shows the preferred form of the cutting arm in cooperation with a record blank of a particular size.

By the "effective radius" of the arm 7 is meant the line 16 extending between the pivot point 17 and the stylus 18. This is a radius of the arcuate line 19 along which the stylus point moves. The length A of radius 16, in the cutting arm illustrated, is equal to 7 inches. The angularity of the cutting face, mentioned above, is preferably achieved by a predetermined angular disposition of the longitudinal axis 20 of the cartridge 15 with respect to the effective radius 16 of the cutting arm. With a 10 inch record blank, as illustrated, in order to achieve the objects of the invention, it has been found that the angle C, i. e., the angle formed by the plane of the stylus cutting face and a radial line r at the point being cut, should vary from approximately 10° at the outer edge of the disk to approximately zero degrees at the inner end of the cut, and should always be in a direction to cause the swarf to roll inwardly of the groove. The angle C, and the compression of the swarf during the cutting thereof, with its consequent tendency to lie in a circle of smaller radius than the groove from which it was cut, mutually contribute to ensure that the stylus will always remain free of cut material. This desired angularity is obtained by assigning a predetermined value to the angle B, which is the angle formed by a line perpendicular to the stylus cutting face and the effective radius of the cutting arm. In the device illustrated, angle B is the angle between the cartridge axis 20 and the arm radius 16. With an arm of the length illustrated, the angle B is equal to 11°. However, it must be borne in mind that the size of this angle must be determined by the length of the cutting arm radius in order to maintain the angle C within the above-mentioned preferred limits. Although preferred limits have been given, it should be borne in mind that these limits might be varied somewhat, as long as the proper rolling action is maintained and the angularity is not permitted to become so great as to objectionably distort the recorded signal.

It will be apparent that when a record blank of smaller diameter than that illustrated is employed with the cutting arm illustrated, the upper limit of angle C, i. e. the value of this angle when the stylus is at the outer edge of the record, will be smaller but the lower limit of angle C will always be the same, as it is customary to terminate the cut at the same distance from the center of the record blank irrespective of the diameter of the record.

It will also be apparent that the pivot point 17 of the cutting arm illustrated may be disposed at any point on the arcuate line 21 whose center coincides (in the embodiment illustrated) with the center of the record blank.

While the cutting arm illustrated in Fig. 7 is the preferred form, it will be obvious that the shape of the arm may be varied, while still obtaining the desired cutting face angularity in the manner illustrated. That is to say, the arm may assume any desired shape so long as the angular relations above mentioned are maintained. In addition, the arcuate line 19, if desired, may be constructed to pass ahead of or behind the center point of the disc, in which case the value of the angle B and/or the length of radius A would be adjusted accordingly, to maintain the angularity of the stylus cutting face within the desired limits.

Furthermore, it is possible to obtain the desired cutting face orientation by special construction of the stylus rather than by angular disposition of the cutter cartridge axis relative to the cutting arm radius. Thus, if the axis of the cutter cartridge is made to coincide with the cutting arm radius, the cutting face of the stylus may be so beveled relative to the screw-engaging flat 11 as to give the desired angularity.

In order to ensure a clean record surface for the stylus to cut, the invention further provides a "scrubber" element 22 which is secured to the outside casing of the cartridge 15, by means of a spring bracket 23. Element 22 is preferably made of a material having a relatively high coefficient of friction, such as rubber, neoprene or the like, and bracket 23 has sufficient resilience to maintain firm contact between element 22 and the record. The scrubber is angled similarly to but to a greater extent than the stylus cutting face, and in addition extends toward the center of the record beyond the stylus sufficiently far to ensure that material travelling toward the cutting point will always strike element 22 and be rolled inwardly thereby. This inward extension, as well as the relatively small space between the scrubber and the stylus, are of importance when the cutting is being done around the short radius curves adjacent the inner edge of the recording. For example, if the space between element 22 and the stylus be too great, the surface approaching the stylus will not encounter the scrubber, on short radius curves.

The operation of the device most clearly appears in Figs. 1 and 6, where it may be seen that the angular orientation of the stylus cutting face prevents clogging by rolling the swarf and depositing it inwardly of the cutting surface, after which it travels around the record on a substantially circular path, and encounters the angled surface of the scrubber, by which it is again rolled inwardly and thereby prevented from interfering with the cutting operation.

In addition, the invention provides a recording apparatus in which the stylus requires less driving torque, as the angularity of the cutting

surface introduces an appreciable slicing action, rather than forming the groove by gouging alone.

It will be evident that the embodiment illustrated may be modified in certain respects without departing from the spirit of the invention. For example, the scrubber may be moved behind the stylus (having reference to the direction of record rotation R) as long as it is positioned in such a way that the surface next to be cut, passes thereunder before encountering the stylus point. It will be understood, therefore, that the invention is limited only by the scope of the appended claim.

I claim:

In a device for recording sound on disk records by cutting a spiral sound groove in a disk, a turntable for rotatably supporting a disk and adapted for rotation in the usual clockwise sense, a cutting arm arranged for pivotal movement, and a stylus carried by said arm so as to perform the cutting operation on the disk, said stylus having a cutting face angularly displaced in a counterclockwise direction from the radial line between the center of the disk and the point of cut, said angular displacement varying throughout the recording operation from a predetermined small value at the initiation of recording to approximately zero at the conclusion thereof.

WILLARD J. GREEN.