

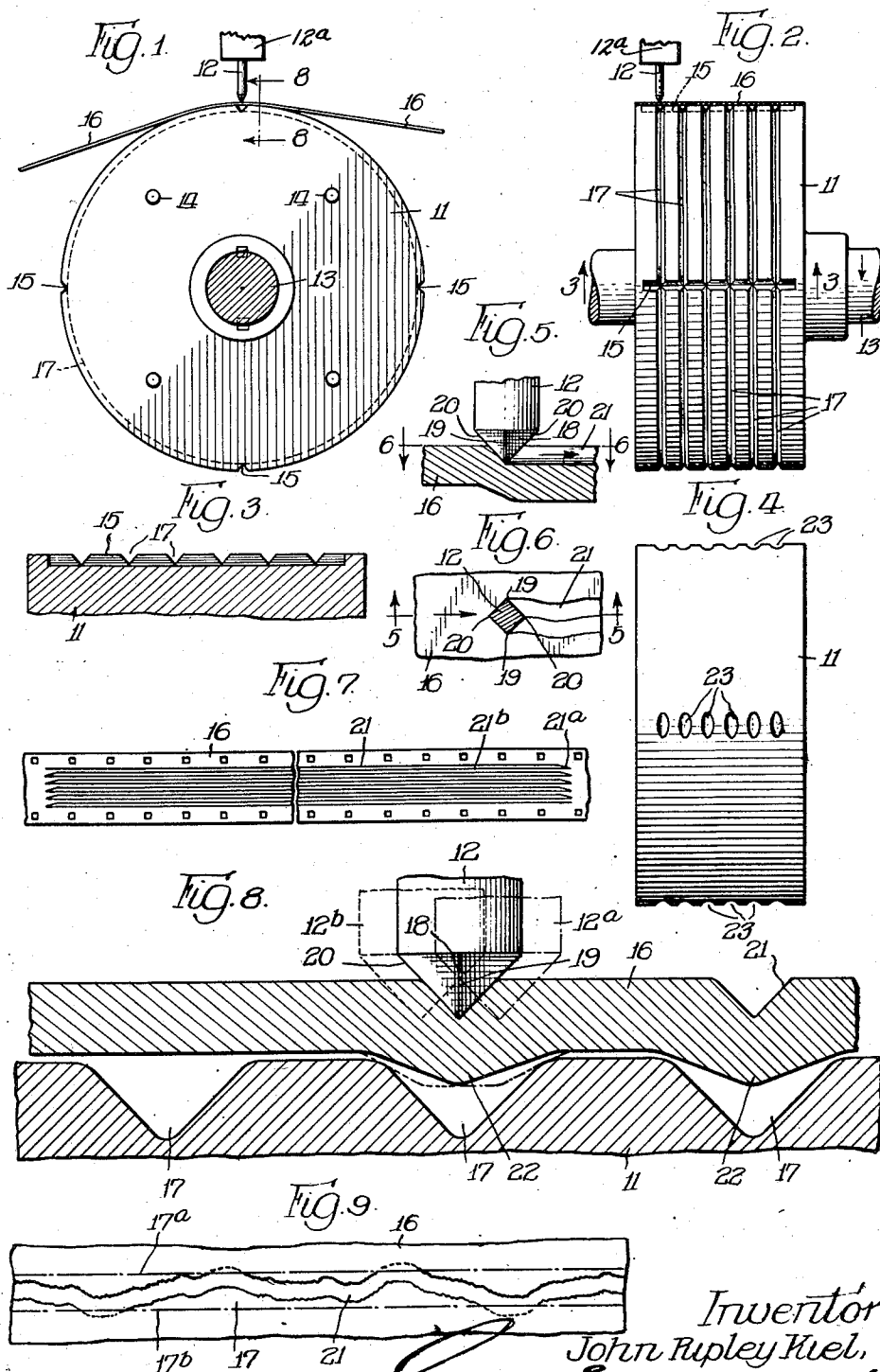
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SOUND RECORDING

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SOUND RECORDING

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7 Claims. (Cl. 274-11)

This invention relates to the forming of a sound groove upon a permanently deformable material serving as a sound carrier by impressing a sound groove therein as distinguished from cutting away the material.

The formation upon the reverse side of a ridge or embossment corresponding to the sound groove is a necessary result of displacing the material of the groove, and provision is made in the supporting anvil for accommodating the material displaced into such resultant ridge within a channel of the support lying beneath the recording stylus.

Such apparatus for and method of sound recording is exemplified in my copending application Serial No. 41,189. There is present the problem of providing an adequate support beneath the strip of film adjacent the stylus to prevent other than local yielding under the pressure and yet not interfere with the displacing of the material by the stylus particularly at the extremes of its amplitude range.

In my application before mentioned I met this problem by a careful proportioning of the channel width to the groove width at slightly more than twice. According to the present invention I may narrow the channel generally from the stated ratio to groove width and locally widen the channel at the point of impression, whereby to accommodate a wide amplitude range of the stylus while providing substantially the same adequate support for the carrier strip as would the narrower channel.

In a preferred form of apparatus I employ as a sound carrier a strip of permanently deformable material, such as the ordinary 16 mm. moving picture celluloid film, with or without an emulsion. The supporting anvil, advantageously stationary, is of steel or other suitable metal and has a highly polished arcuate face provided with one or more U or V-shaped channels extending about the perimeter thereof in parallel spaced relationship. The carrier strip is drawn longitudinally over the channels of the curved face.

As in my pending application above mentioned, there being a relative difference of surface speed between the carrier strip and the supporting anvil, the support acts as a brake upon the strip and the strip is caused to hug the support and maintain a close contact at the place of recording, thus avoiding the use of any supplemental hold-down device.

The recording stylus is vibratory, either laterally or axially, to produce lateral or hill and dale undulations under the sound impulses, and

it is mounted perpendicularly or normal to the face of the support to exert pressure upon the carrier strip immediately above and in line with one of the channels, whereby a sound record groove is formed in the carrier with undulations corresponding to the sound-actuated vibrations of the stylus.

The stylus has a symmetrical point, advantageously in section a parallelogram such as a square or other polygonal figure having corners diametrically disposed, two longitudinally of the strip presenting points of cleavage in forming the groove and two transversely of the strip for acting upon the sides of the groove to impress therein the sound record. The symmetrical shape of the stylus and its perpendicular mounting enables the strip to be reversed as to direction of movement to form adjacent sound record grooves in substantially parallel relation.

If the vibratory stylus be so mounted to produce a hill and dale undulatory sound record, the groove will vary in width due to the variable depth of penetration into the material by the wedge-shaped point of the vertically vibratory stylus when recording sounds of low and high frequency. When the stylus is mounted for transverse vibration, to produce a laterally undulatory record, the variation of amplitude to include in its range low and high tones results in a longitudinally wavy sound groove of substantially constant width by swinging to one side or the other between parallel lines bounding the extremes of range.

Obviously, unless the width of the underlying channel in the support be wide enough to accommodate the material displaced thereinto by the stylus,—that is to say, wide enough to include the full range of the stylus vibration on both sides of a median line plus the thickness of the carrier strip, the vertical or lateral path of the stylus will be cramped by the carrier material impacted against the channel wall or the material so compressed will later spring back and as a consequence the modulations of the low frequency notes, expressed by the extreme range of amplitude, will be distorted and the record and reproduction will lack absolute fidelity.

In both cases one encounters the problem of a channel sufficiently wide to permit full range of the vibrating stylus, whether vertical or transverse, and yet sufficiently narrow to support the carrier strip closely adjacent and beneath the stylus.

The present invention solves the difficulty by providing in a narrow channel a local widening

immediately beneath the stylus to accommodate displaced material under extreme amplitude ranges and yet without substantially decreasing the support by an increase of the space laterally

between the channel wall and the stylus.

To facilitate an understanding of the invention and the manner of its functioning the accompanying description is predicated upon a drawing, schematic in character, illustrating a preferred and a modified form of the apparatus and stages in the formation of the sound record.

In the drawing:

Fig. 1 is a diagrammatic front elevation of the supporting anvil, the carrier strip and the stylus;

Fig. 2 is a side elevation of the elements shown in Fig. 1;

Fig. 3 is an enlarged fragmentary section on the line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 2 but of a modification;

Fig. 5 is an enlarged vertical longitudinal section through the strip at the point of recording, with a stylus in elevation;

Fig. 6 is a plan view of Fig. 5 with the stylus in section;

Fig. 7 is a plan view of the finished carrier strip with the sound record thereon;

Fig. 8 is a greatly enlarged transverse section indicated by the line 8—8 of Fig. 1; and

Fig. 9 represents a magnified sound groove on the carrier strip.

Having particular reference to the drawing, there is represented at 11 a circular supporting anvil. Instead of being a perfect circle this may well be of different shape provided it has a curved perimeter at those places beneath the stylus 12. The anvil 11 is advantageously stationary but subject to angular adjustment upon the shaft 13 by means of positioning studs 14, variable in number, but preferably displaced at equal angular distances in order that any one of the transverse channels 15 may be brought beneath the stylus 12. The purpose of such adjustment is to compensate for wear of the curved surface as the carrier strip or film 16 is dragged over the same.

By reference to Fig. 2 it will be observed that not only is the curved face of the anvil 11 provided at spaced intervals with the transverse channels 15 but also with a series of longitudinal channels 17 arranged in parallel relation adjacent each other. Both the channels 15 and 17 are advantageously of U or V section.

The stylus 12, as here shown, is so mounted as to vibrate laterally under the actuation of sound waves acting through a microphone (not shown) but is also movable bodily to bring the same into alignment with any one of the channels 17 and, moreover, has definite pressure applied thereto whereby to compress the film 16 into that channel 17 with which it is in alignment. The application of pressure contact between the stylus 12 and the anvil 11 may be obtained by a shiftable eccentric mounting of the anvil shaft 13 in its bearing as illustrated and described in connection with my copending application Serial No. 41,189 or by pressure applied to the stylus itself as illustrated diagrammatically at 12^a. The positioning of the stylus relative to the anvil is such that it is in axial alignment not only with one of the longitudinal channels 17 but with a transverse channel 15 at their intersection.

The stylus 12 has a point 18, preferably a diamond, which is of polygonal cross section,

preferably a parallelogram and advantageously square and constituting an inverted pyramid as here shown, the essential feature being that the figure has two opposed corners 19 at right angles to the channels 17 and two opposed corners 20 aligned with said channel, the purpose being that whether the film strip 16 moves forwardly or backwardly the corners 20 shall serve to cleave the material as the groove is being formed and the corners 19 to impart the modulations of the sound record to the walls of the groove as the stylus vibrates.

Of great advantage is the fact that in a recording point of polygonal section the angle measuring the corners at whatever distance from the tip remains constant, or where these corners are slightly rounded, as is preferable in practice, the radius of the rounded corner remains constant whether closely adjacent or farther removed from the tip. This is not true in the case of an inverted conical tip where the cross section is a circle and where the radius grows larger with an increase in distance from the tip. The action of the former upon the strip is uniform whether a deep or shallow groove is being formed whereas the latter is non-uniform.

The pressure upon the stylus 12 serves to form a groove 21 in the carrier strip, displacing the material downwardly into a particular channel 17 and into the cross channel 15. This is best shown in Figs. 5 and 8, forming on the opposite side of the carrier strip an embossment or ridge 22.

In the operation of making a sound record as above set forth (but without the cross channel) the embossment, in the intermediate frequencies and higher frequencies of vibration, will be accommodated wholly within the channels 17 but in the lower frequencies where the amplitude range is much greater the material will be crowded within the channels and, as indicated in Fig. 9, may in some cases tend to extend beyond the walls of the channel. For instance, referring to Fig. 9, the range may be so great that at portions indicated in dotted lines the embossment might be flattened by the channel wall and form a straight line rather than that of the normal modulations of the low frequency tone which should extend beyond the channel walls 17^a and 17^b on one side or the other. The range of stylus vibration is indicated in Fig. 8 in broken lines at 12^a and 12^b. The result of such interference by the walls of the channels 17 with the full amplitude range of the stylus is, as above stated, a lack of fidelity in the record and its reproduction.

To avoid the cramping of the sound groove by the channel walls and yet maintain adequate support for the film closely adjacent the stylus the cross channel 15 is provided so that the embossment may expand into the channel 15 to the requisite extent beyond the channel walls immediately below the stylus as the record is being made; and inasmuch as the hugging of the support 11 by the sound carrier strip decreases beyond the point of recording, the embossment is being lifted from the channel shortly after it leaves the stylus so that there is no impairment of the record by the channel walls.

It is to be observed that the points of intersection between the walls of the longitudinal channel 17 and the walls of the cross channel 15 are spaced apart a distance equal to the width of either and consequently the carrier strip is sup-

ported at distances from the stylus equal to the width of each of the channels, yet leaving a greater effective width into which the embossment on the film resulting from the forming of the groove may expand under the lateral vibration of the stylus.

Thus it will be appreciated that the provision of the cross channel 15 beneath the carrier strip at the point of recording enables the use of a narrower longitudinal channel 17 than would otherwise be required if the channel 17 only were employed.

In Fig. 4 is shown a modified form of construction over that represented in Fig. 2. Here the cross channel 15 is omitted but in place thereof the longitudinal channels 17 are locally widened along a transversely extending line intersecting 23 at the point of recording beneath the stylus thus permitting the displacement of the material of the carrier strip into these recesses 23. These elongated recesses or enlargements may be equally spaced about the surface of the supporting anvil as in the former instance whereby to provide for angular adjustment of the anvil.

The channels 17 need not extend far beyond the cross channels 15 or the enlargement 23, but are shown in Fig. 2 as continuing throughout the circumference of the anvil support 11, being most easily thus formed by a cutting tool upon a rotating anvil. The locally widened channels shown in Fig. 4 at 23 with gradual approach may be made by a milling cutter disposed in the same plane as the stationary anvil with the cutting edge intersecting but slightly the curved surface of the anvil, as will be readily understood.

As before stated the positioning of the stylus 12 normal to the surface of the supporting anvil permits the carrier strip 16 to move across the face of the anvil beneath the stylus in either direction. The recording having continued until the end of the strip is approached forming the first sound groove 21, the stylus is moved laterally into a position above and in alignment with the next adjacent channel 17, the combination of the lateral movement of the stylus and the forward movement of the carrier strip imparting a diagonal movement forming the inclined groove portion 21^a. Immediately the strip reverses its direction of movement, forming the record groove 21^b, the record therein reading in an opposite direction from that in the groove length 21. This is repeated each time the direction of strip movement is reversed whereby there is formed a sound record continuous from end to end and represented in adjacent grooves and reading in opposite directions. The provision of the cross channel 15 or the channel enlargements 23 enables this lateral shifting of the stylus to the next adjacent groove without lifting the same out of the channel or requiring it to ride over the face of the support between adjacent channels.

Mechanisms for reversing the direction of travel of the carrier strip when it reaches its end and for concurrently shifting the stylus laterally into register with the next adjacent channel, also for forcing the stylus into and for removing the same from pressure contact with the carrier strip, are illustrated and described in my copending application Serial No. 41,189, and they are not herein shown inasmuch as the details thereof form no part of the present invention.

It will be understood that the illustration of the channels 15 and 17 in the anvil support and the sound grooves 21, as also the stylus 12, are greatly enlarged and also that the exact propor-

tions are not accurately shown. It may be said, speaking generally, that the width of the channels may be approximately .01", the width of the sound groove .004", the amplitude range of the vibratory stylus .002" plus or minus, and the carrier strip thickness .0055".

I claim:

1. Sound-recording apparatus including a rigidly mounted supporting anvil having a face provided with a longitudinally extending channel locally widened along a transversely extending intersecting line, a vibratory sound-actuated recording stylus mounted adjacent the support at the point of widening of the channel, means to move a sound carrier strip over the channeled face beneath the stylus, and means to press the stylus upon the strip whereby to deform the material into the channel at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

2. Sound-recording apparatus including a rigidly mounted stationary supporting anvil having a curved face provided with a longitudinally extending channel locally widened along an intersecting line, a vibratory sound-actuated recording stylus mounted adjacent the support in line with the point of widening of the channel, means to slide a sound carrier strip of a deformable material over the channeled face beneath the stylus, and means to press the stylus upon the strip whereby to deform the material into the channel at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

3. Sound-recording apparatus including a rigidly mounted stationary supporting anvil having a curved face provided with a longitudinally extending channel locally widened by a transversely extending intersecting channel, a laterally vibratory sound-actuated recording stylus mounted adjacent the support in axial alignment with the point of intersection of the channels, means to slide a sound carrier strip of permanently deformable material over the channeled face beneath the stylus, and means to press the stylus upon the strip whereby to deform the material into the channel at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

4. Sound-recording apparatus including a rigidly mounted stationary supporting anvil having a curved face provided with a plurality of parallel longitudinally extending channels locally widened along a transversely extending intersecting line, a vibratory sound-actuated recording stylus mounted adjacent the support in line with the point of widening of the channel, means to slide a sound carrier strip of a deformable material over the channeled face beneath the stylus, and means to press the stylus upon the strip whereby to deform the material into the channel at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

5. Sound-recording apparatus including an angularly adjustable rigidly mounted stationary supporting anvil having an arcuate face about a central point forming the axis of the supporting anvil, said face provided with a longitudinally extending channel locally widened at spaced intervals, a vibratory sound-actuated recording stylus mounted adjacent the support at the point of widening of the channel, means to slide a sound carrier strip over the channel face beneath the stylus, and means to press the stylus upon

the strip whereby to deform the material into the channel at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

- 5 6. Sound-recording apparatus including an angularly adjustable rigidly mounted stationary supporting anvil having an arcuate face about a central point forming the axis of the supporting anvil, said face provided with a plurality of
10 parallel longitudinally extending channels locally widened at spaced intervals by transversely extending intersecting channels, a laterally vibratory sound-actuated recording stylus mounted adjacent the support in axial alignment with the
15 point of intersection of the intersecting channels, means to slide a sound carrier strip of permanently deformable material over the channeled face beneath the stylus, means to press the stylus

upon the strip whereby to deform the material into a longitudinal channel at the point of intersection with the transverse channel to form a sound groove in the face and a corresponding ridge upon the back of the strip.

- 5 7. Sound-recording apparatus including a stationary supporting anvil having a face provided with a recess locally widened along a transversely extending intersecting line, a vibratory sound-actuated recording stylus mounted adjacent the
10 support at the point of widening of the recess, means to move a sound carrier strip over the recessed face beneath the stylus, and means to press the stylus upon the strip whereby to deform
15 the material into the recess at the locally widened part to form a sound groove in the face and a corresponding ridge upon the back of the strip.

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