Aug. 11, 1942. W. L. WOOLF ET AL 2,292,856

PRECISION POSITIONING MEANS FOR SOUND HEADS

Filed March 1, 1940 2 Sheets-Sheet 1

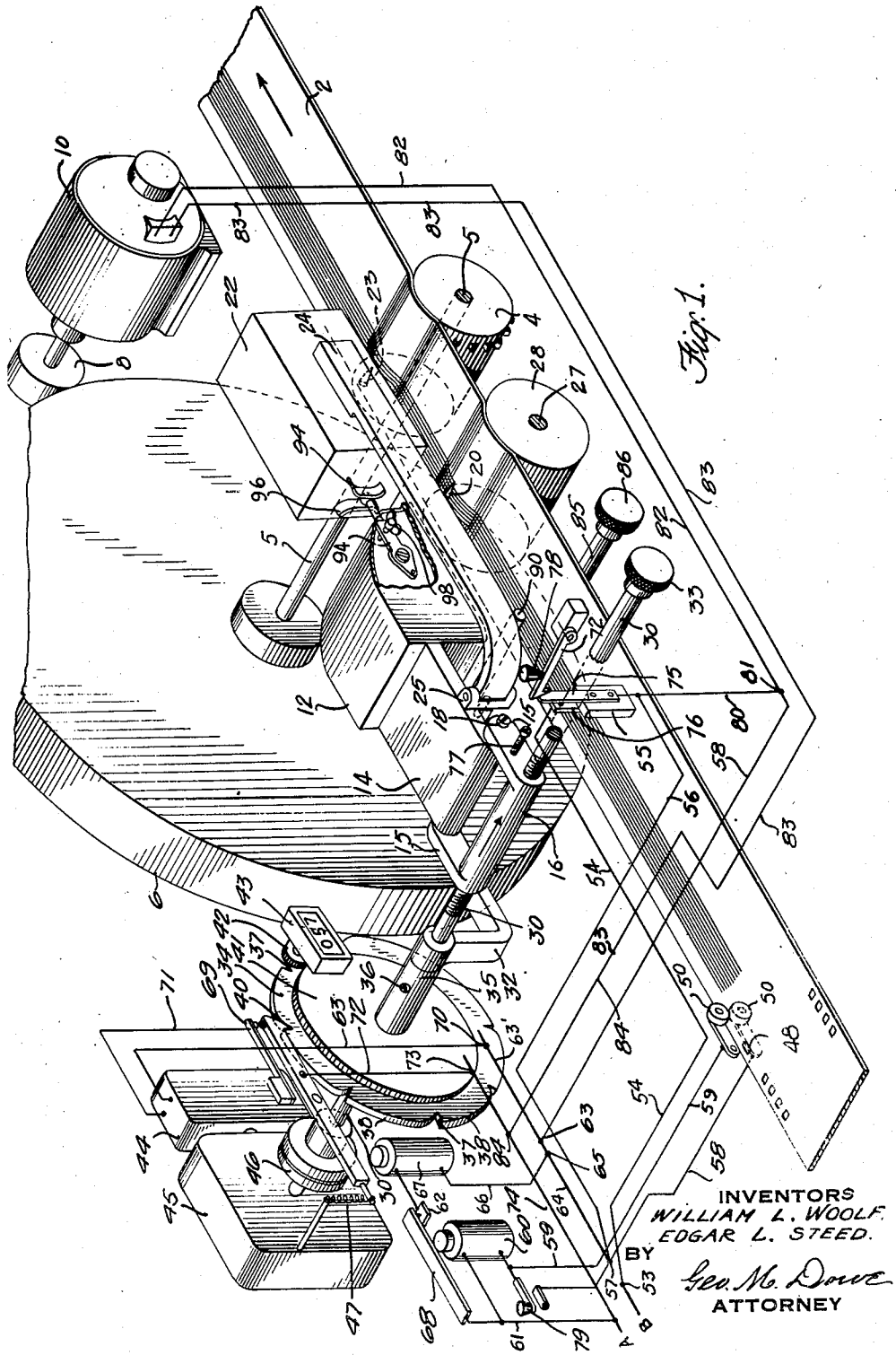

Fig. 1.

INVENTORS
WILLIAM L. WOOLF
EDGAR L. STEED.
BY
Geo. M. Dowe
ATTORNEY

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Fig. 2.

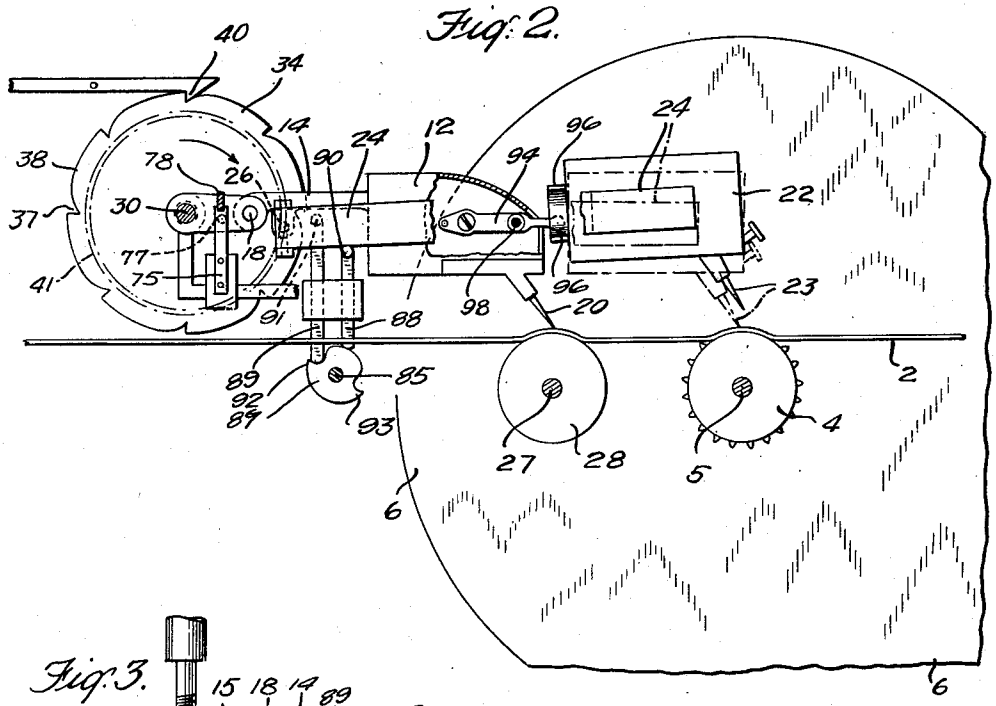
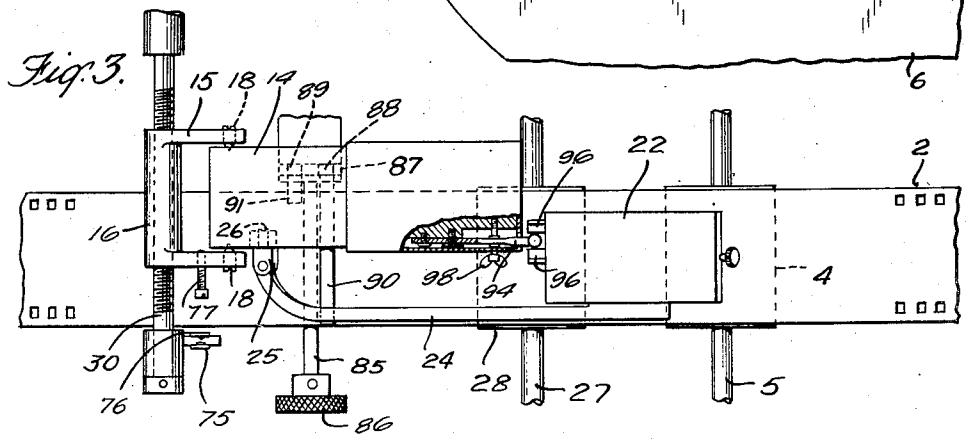


Fig. 3.



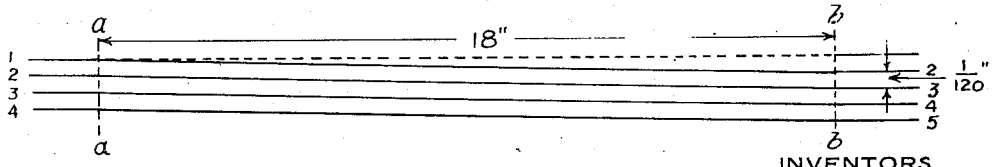


Fig. 4.

INVENTORS
WILLIAM L. WOOLF
EDGAR L. STEED
BY
Geo. M. Dowe.
ATTORNEY

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2,292,856

PRECISION POSITIONING MEANS FOR SOUND HEADS

William L. Woolf, Bayside, Long Island, and Edgar L. Steed, Woodside, Long Island, N. Y., assignors, by mesne assignments to Amertype Recordgraph Corporation, Elizabeth, N. J., a corporation of Delaware

Application March 1, 1940, Serial No. 321,750

5 Claims. (Cl. 274—11)

This invention relates to recording and reproducing mechanism and more particularly to a device of this kind wherein the record consists of a plurality of parallel sound tracks made by a stylus engaging a record medium in the form of a strip or film.

The object of ths invention, generally stated, is to provide precision positioning means for the recording and reproducing heads which heads may collectively be referred to as sound heads.

More specifically stated, the invention has for one of its objects the provision of means for shifting the sound heads from one sound track to another at the appropriate time and to the precise extent and to means for preventing the shifting means from running the stylus off the film.

A further object is the provision of a tracking device whereby the pick-up needle automatically finds the proper groove and the proper location in the groove.

The various features of the invention whereby the above mentioned, and other objects, are accomplished will be better understood from the following detailed description and claims when taken, in connection with the accompanying drawings in which:

Figure 1 is a perspective view showing the principal parts of the mechanism more or less diagrammatically;

Figure 2 is an elevation showing the sound heads and means for controlling their engagement or disengagement with the record medium; and for aligning the pick-up head with the recording head;

Figure 3 is a plan of the parts shown in Figure 2; and

Figure 4 is a section of the film, very much enlarged, showing several sound tracks with cross-over tracks.

Referring to Figure 1, the film 2 is provided with perforations at its edge, which perforations are engaged by the teeth of a sprocket 4 secured to a shaft 5. The shaft carries a fly wheel 6, the periphery of which is engaged by a roller 8 driven from a motor 10. The recording head 12 is provided with a rearwardly extending tone arm 14 pivoted for vertical movement between two arms 15 which project from and form part of a sleeve 16. The tone arm is supported by trunnion screws 18 one only of which is shown in Figure 1, but both are shown in Figure 3. The recording head is therefore capable of vertical movement to enable its recording stylus 20 to be moved into and out of engagement with the record strip, such movement being under control of a cam to be later described. It is held against sidewise movement, relative to the sleeve 16, by the trunnions 18.

The pick-up head 22 carries a stylus 23 by which the record made by the stylus 20 is reproduced. The pick-up head is connected to the recording head in such manner that the pick-up head may be moved vertically independently of the recording head and also may be permitted a slight lateral movement in respect thereto. To this end the pick-up head has secured to it a bar 24. The rear end of this bar is pivoted in a bracket 25 which bracket is in turn pivoted to the tone arm. This pivot is shown in dotted lines in Figure 3 and indicated by the reference character 26. Thus the pick-up head may move in a vertical direction by pivoting about 26 and may move slightly in a horizontal direction by pivoting about the pivots carried by the bracket 25.

A shaft 27 carries a roller 28 for supporting the film in contact with the stylus 20 of the recording head when the recording head is in recording position.

Since it is contemplated to record a great many parallel sound tracks on the record medium, it is necessary that these tracks be as close together as is practically feasible. For instance, in a record strip of the width of the standard moving picture film, namely 35 centimeters, it is practical to record more than 100 parallel sound tracks on such a film.

It is contemplated furthermore that the film be a continuous one and therefore it is desirable to shift the sound heads from one sound track position to the next, at predetermined intervals.

According to this invention, this shifting is done while the recording stylus is in engagement with the record medium so that the record made by the recording stylus is a continuous one. In reproducing, of course, the reproducing stylus 23 follows the sound tracks made by the recording stylus 20. Since the sound tracks are very close together, it is essential that the lateral movement from one sound track position to the next be effected with the greatest accuracy and the mechanism by which this is accomplished will now be described.

The sleeve 16 which supports the sound heads is interiorly threaded and similar threads formed on shaft 30 engage the threads of this sleeve. The shaft 30 is supported by brackets 32 only one of which is shown in Figure 1, since to show

the other would obscure some of the essential parts of the mechanism. It is also to be understood that the shafts 5 and 27 are also properly supported although these supports are not shown.

The shaft 30 extends to the right and carries a knob 33, by which it may be rotated manually. The exact amount of rotation of the shaft 30 to cause the precise degree of lateral movement of the sound heads is controlled by a ratchet 34 secured to a sleeve 35 which sleeve is in turn fastened to the shaft 30 by a screw 36. The ratchet 34 is shown as having eight notches 37 with an intermediate portion 38 between each notch. The ratchet 34 is normally held locked by a pawl 40 which seats in one of the notches 37. This pawl and a notch 37 are so shaped that the pawl holds the ratchet 34 from rotation in a clockwise direction but permits rotation in an anti-clockwise direction.

Means are provided whereby at predetermined intervals in the movement of the record strip, the pawl 40 is released from a notch 37 and the ratchet 34 and shaft 30 are driven one-eighth of a rotation, at which time the pawl 40 seats into the next adjacent notch and positively stops the rotation of the shaft 30 and thereby accurately determines the extent of lateral movement of the sound heads.

The sleeve 35 also carries a toothed wheel 41 which engages a pinion 42 connected to the shaft of an ordinary counter 43. The pawl 40 not only acts to limit the rotation of the shaft 30 but also limits the movement of the counter whereby an accurate indication is given of the sound track which is being engaged at any time by the stylus 20 or the stylus 23. The threads on the shaft 30 are such that one-eighth rotation of said shaft will move the sound heads a distance from one sound track to the next when the ratchet 34 is moved in a clockwise direction from one notch to the next. This will result in moving the stylus across the film from left to right with step by step movement.

When it is desired to position the stylus to the extreme left or to some intermediate track position, the knob 33 is turned in an anti-clockwise direction, which the pawl 40 permits.

The movement of the sound heads step by step across the film is brought about by motor means and in the embodiment illustrated a separate motor 44 is provided for this purpose. The motor operates through a reduction gear located in the gear box 45 and is connected to the shaft 30 through a friction clutch 46. With the parts in the position shown in Figure 1, the pawl 40 is held seated in a notch of the wheel 34 by means of a light spring 47, and assuming that the motor 10 is in operation, the film 2 is being fed through the machine in the direction of the arrow shown on the film. It is contemplated that at each complete revolution of the film, the sound heads be moved one step to the right. In order that this may be brought about, the ratchet 34 must be released and the motor 44 started.

These operations are initiated through means of an electrically conducting portion 48 carried by the film and extending on both sides thereof. When this electrically conducting portion 48 passes between contacts 50, one on each side of the film, a circuit is closed which energizes relay 60 which in turn closes a circuit which energizes solenoid 67 of which the pawl 40 constitutes the armature. Release of the pawl 40, closes a circuit through the motor due to the pawl riding on the high part 38 of a tooth of wheel 34. The motor through the reduction gearing 45 and clutch 46 rotates shaft 30. The motor 44 receives current until pawl 40 drops into the next notch in the wheel 34 at which time the circuit to the motor is broken. The pawl dropping into the next notch positively stops further rotation of ratchet 34 and the shaft 30 and the parts controlled thereby, but the motor may continue to run for a few turns due to the slippage provided by the clutch 46.

The circuits involved in the above operations may be traced as follows. From terminal B current passes to junction 53, wire 54, and through switch 55, which is normally closed, through wire 56 to junction 57; along wire 58 to contacts 50; thence along wire 59 leading to relay 60. From this relay the current flows through wire 61 back to terminal A. Energization of the relay 60 closes a contact 62 in switch 68 and as soon as said contact is closed, the current passes from junction 57 along wire 64 to junction 65 and through wire 66 to solenoid 67. From said solenoid it passes through switch 68 and wire 61 to terminal A. Energization of solenoid 67 lifts the pawl 40 as already described, which pawl upon being lifted closes contact at 69 whereby establishing a circuit through the motor 44 which circuit may be traced as follows: from terminal B along wire 54 to switch 55, thence along wires 56 and 64 to junction 70 to the motor. From the motor it passes along wire 71 to contact 69; thence through the pawl 40 which is connected to wire 72, through which the current flows to junction 73 and through wire 74 to terminal A.

From the foregoing it will be apparent that during the continuous longitudinal movement of the film the sound heads are moved laterally step by step and if the recording head is in recording position, a continuous sound groove is formed. The distance, however, which the film travels during the time that the recording head is making its step of movement from one sound track position to the next is very large in proportion to such lateral movement. It is important that this ratio be quite large so that the angle which the oblique portion of the record groove makes with the parallel portion be very small. This is desirable in order to prevent the possibility of one sound track getting too close to another thereby causing interference when the sound is reproduced. For instance, if the motor 10 is running at such speed as to move the record strip at about eight inches per second, the speed of the motor 44 may be such as to cause the lateral movement to occupy about two and one-quarter seconds in moving the recording stylus from one sound track position to the next. If this movement occupies two and one-half seconds, the film is moved longitudinally a distance of eighteen inches during this time. The later movement, however, may be as small as one-one hundred and twentieth of an inch, assuming one hundred twenty sound tracks to the inch are being recorded.

The beginning and ending of each cross-over sound track is illustrated diagrammatically in Figure 4 which is necessarily drawn out of proportion in order to make the operation readily visible. The numbers 1 to 4 at the left indicate four sound tracks. Each point on the sound tracks along the line *a—a* represents the beginning of the cross-over movement. The dotted line from track 1 indicates the path which the

stylus would take if it were not moved laterally at this time. The full line connecting track 1 with track 2 indicates the path which the stylus actually takes during its lateral movement. The points along the line *b*—*b* indicate the points at which the stylus has completed its lateral movement and it also represents the beginning of a new sound track. It will also be noted that when the stylus reaches the point 2 on the line *b*—*b* the counter also registers 2. When the film has made a complete cycle, the conducting portion 48 again closes contacts 50 and the stylus has arrived at a point along the line *a*—*a* of the sound track where it is again moved laterally to start new track #3, at the point 3 on the line *b*—*b*.

If there was no means to prevent it, the motor would move the stylus entirely off of the film. This, however, is of course not desirable and means to prevent such movement are provided. This consists of the switch 55 already referred to. This switch is normally closed by means of a spring arm 75 contacting a stationary conducting element 76. The right hand arm 15 of the sleeve 16 carries a screw 77 which when the recording head starts to move toward the right after completing the last track on the right of the film, presses against the spring member 75 of the switch 55 thereby breaking the contact and opening the circuits to the motor 10 and to the motor 44. When the spring member 75 is thus moved to open the switch, it is held in open position by a latch provided with a knob 78 by which the latch may be moved to release the spring member 75 when it is again desired to start the motor 10. As long as the switch 55 is closed, current is supplied to the motor 10 but it is not supplied to the motor 44 unless the conducting portion 48 of the film bridges contacts 50 or the circuit to motor 44 is otherwise closed. Manual means are provided for this purpose in the form of a lever 79 which closes a circuit in parallel with the contact 48 and members 50 whereby the motor circuit may be closed at any time provided the switch 55 is also closed. By means of the lever 79 therefore, the recording head may be moved step by step towards the right to position it at any desired sound track.

Current to motor 10 may be traced as follows: From terminal B to junction 57, wire 54 to switch 55, thence by wire 80 to junction 81. From here it passes along wire 82 to motor 10. Returning, the current flows along wire 83 to junction 84, to wire 74, to terminal A.

When the recording head is stepped across the film by lever 79, it is desirable that the recording head be in raised position, otherwise the stylus 20 might damage the film by scraping across it.

In the application of Henry Flood, Jr., Serial No. 320,084, filed February 21, 1940, means are provided to prevent lateral movement of the stylus when the same is in engagement with the film and therefore such preventing means are not shown in the present case.

Means ore provided, however, whereby the recording head and the pick-up head are controlled as to engagement or non-engagement with the film. The means whereby this is accomplished is best shown in Figures 2 and 3 and includes a cam shaft 85 having a knob 86 at its outer end, Figure 1, whereby the shaft may be rotated in an appropriate manner. The shaft carries a cam 87 the contour of which is shown in Figure 2. This cam engages two rods 88 and 89. The rod 88 has a right angle projection 90 at its upper end which extends to the right as shown in Figure 3 and beneath the bar 24, which it will be recalled is connected directly to the pick-up head 22 to provide for vertical movement of the head. The rod 89 is provided with a portion 91 projecting at right angles from its upper end and beneath the tone arm 14 of the recording head 12. With the cam 87 in the position shown in Figure 2 the recording head is in operative position with its stylus 20 in contact with the film. The pick-up head, however, is in raised position indicated by full lines in Figure 2. When the cam 87 is rotated anticlockwise, through an angle of about 45° a concentric portion of the cam rides under the rod 88 and holds it in position to maintain the pick-up head 22 in inoperative position. The cam is so shaped however, that with the 45° rotation, the rod 89 is lifted thereby raising the stylus 20 out of engagement with the film. If the cam 87 is further rotated in an anti-clockwise direction, the rod 88 is permitted to move downwardly under the weight of the pick-up head while the stylus 20 of the recording head remains in raised position. The cam is formed with two shoulders 92 and 93 which when either engages the end of the rod 88 or rod 89 prevents further rotation of the cam. Therefore, turning the knob 86 to the right as far as it will go results in lifting the pick-up head while permitting the recording head to be in operative position. By turning the knob 86 to the left or anti-clockwise as far as it will go, results in rendering the pick-up head operative and the recording head inoperative.

One of the objects of the invention has been stated to be the provision of a tracking device whereby the pick-up needle automatically finds the proper groove and the proper location in the groove.

The means for accomplishing this result includes a slide member 94 adjustably secured to the recording head 12 and a guide in the form of two spaced members 96 carried by the pick-up head 22. The guide members are obliquely spaced relative to each other and converge to a narrow portion, of sufficient width to barely permit the head of the slide 94 to pass. A screw 98 permits accurate alignment of the slide member 94 so that as the pick-up head 22 is moved vertically from inoperative position to a position where its stylus engages the record medium, the stylus is accurately guided to the proper groove and accurately located in the groove.

What we claim is:

1. In a recording and reproducing mechanism, a recording head for making a series of parallel sound tracks in a record medium, means for moving said recording head from one sound track to the next and positively arresting it at the end of such lateral movement, means for preventing any lateral movement of said recording head except as provided by said lateral moving means, a pick-up head for following in the same groove formed by the recording head, said recording head and said pick-up head being laterally movable together under control of said laterally moving means, said pick-up head being capable of a slight lateral movement independent of said recording head, means for moving the pick-up head from reproducing to non-reproducing position or vice versa, and means for correcting any lateral displacement of the pick-up head relative to the recording head as the pick-up head is moved from non-engaging to engaging position relative to the recording medium.

2. In a sound recording mechanism, a record-

ing head and a record medium, a screw threaded shaft operatively related to said head for moving it step by step transversely of the record medium, a locking disk on said shaft, means engaging said disk normally preventing rotation thereof in one direction and a motor operatively related to said shaft for rotating it, a circuit for said motor normally open, and means controlled by the record medium for releasing said disk rotation preventing means said latter means on its release closing the circuit to said motor.

3. In a sound recording mechanism, a recording head and a record medium, a screw threaded shaft operatively related to said head for moving it step by step transversely of the record medium, a notched disc on said shaft, a pawl for engaging the notches in said disc, normally preventing rotation thereof in one direction, a motor operatively related to said shaft for rotating said shaft and disc, a circuit for said motor normally open and means controlled by the record medium for releasing said pawl from the notch with which it may, at the moment, be engaged, said pawl by its releasing movement closing the circuit to said motor.

4. In a sound recording mechanism, a recording head and a record medium, a screw threaded shaft operatively related to said head for moving it step by step transversely of the record medium, a notched disc on said shaft, a pawl for engaging the notches in said disc, normally preventing rotation thereof in one direction, a motor operatively related to said shaft for rotating said shaft and disc, a circuit for said motor normally open and means controlled by the record medium for releasing said pawl from the notch with which it may, at the moment be engaged, said pawl by its releasing movement closing the circuit to said motor, said pawl on dropping into a succeeding notch in said disc acting to break the motor circuit and positively to stop rotation of said notched disc.

5. In a sound recording mechanism, a recording head, a record strip, means operatively related to said head for moving it step by step laterally of said strip said means including a motor and a circuit therefor normally open, means, including a ratchet and a pawl cooperating therewith, normally locking said head against lateral movement, means controlled by said record strip and operatively related to said pawl for releasing it from said ratchet and means brought into action on release of said pawl to close said motor circuit.

WILLIAM L. WOOLF.
EDGAR L. STEED.