Feb. 29, 1944. L. NEUMANN 2,343,114

RECORDING AND REPRODUCING SOUND

Filed Aug. 30, 1940 2 Sheets-Sheet 1

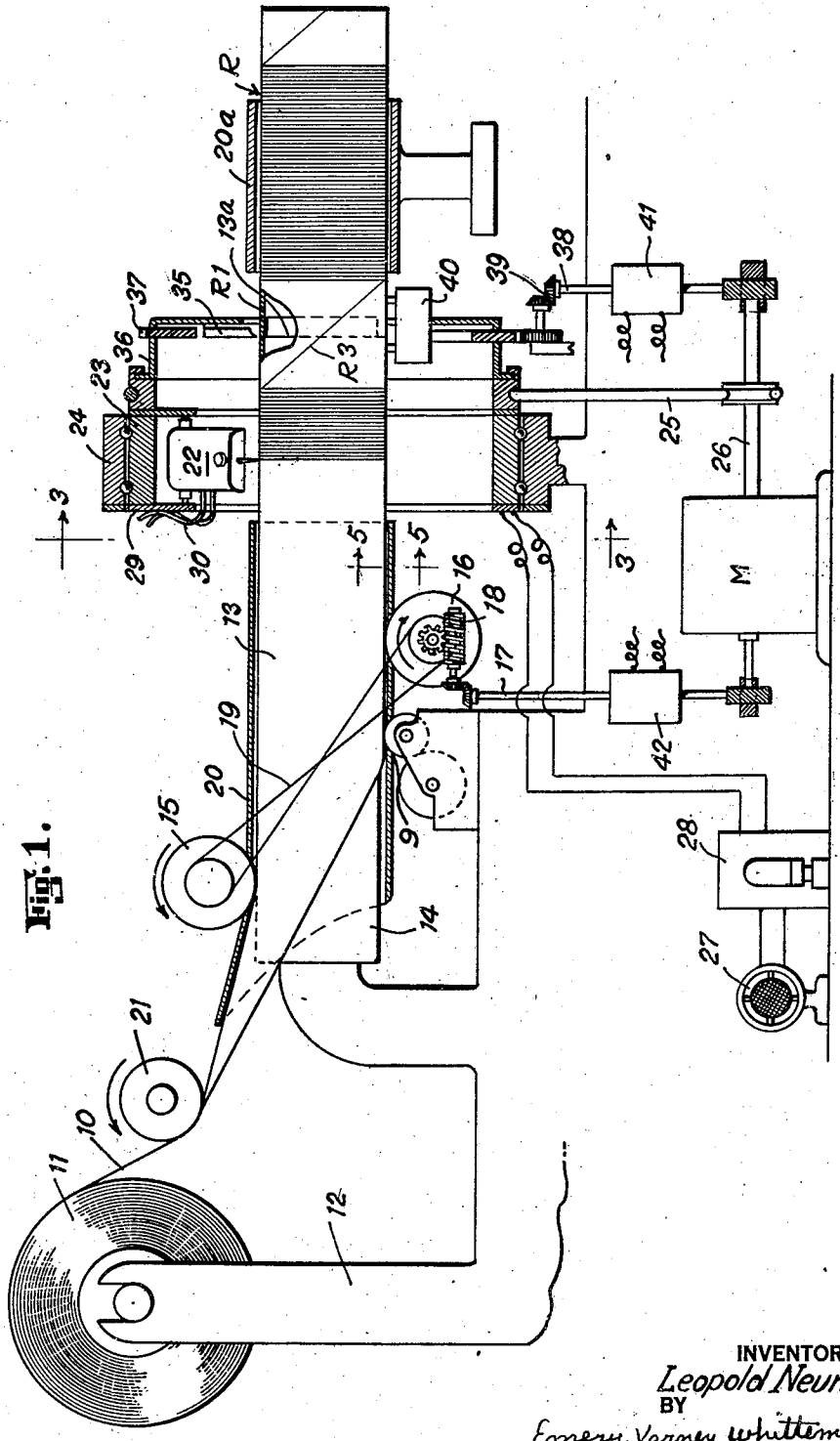


Fig. 1.

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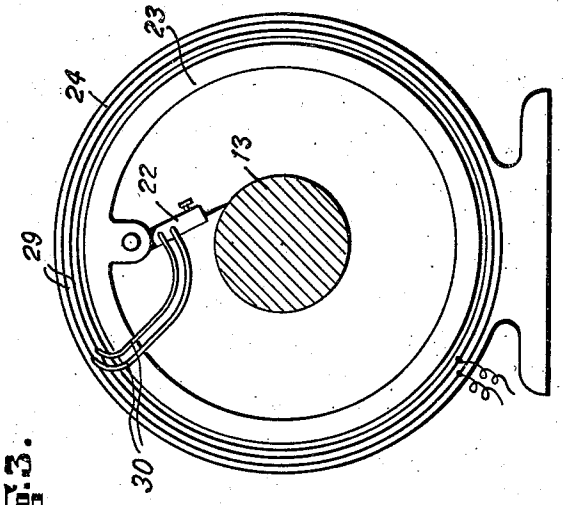


Fig. 3.

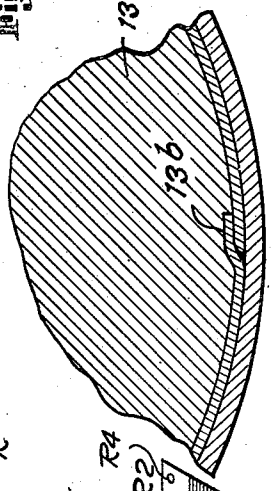


Fig. 5.

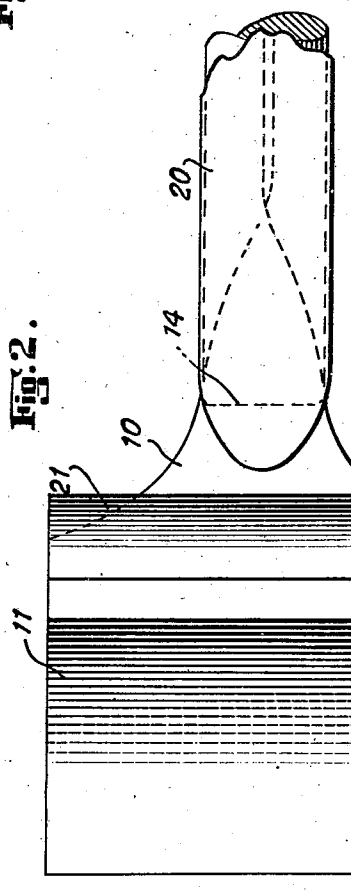


Fig. 2.

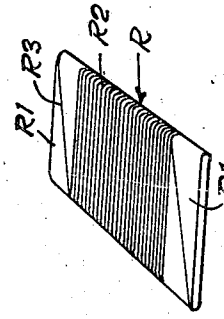


Fig. 6.

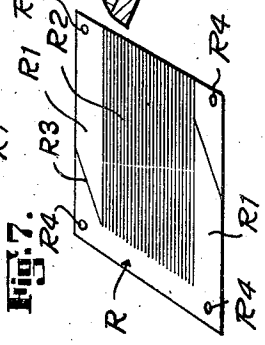


Fig. 7.

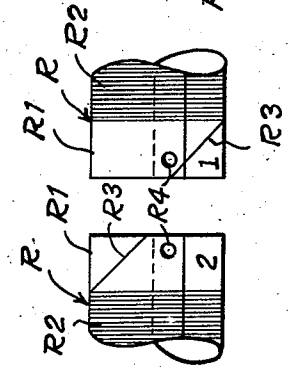


Fig. 4.

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RECORDING AND REPRODUCING SOUND

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Application August 30, 1940, Serial No. 354,824

9 Claims. (Cl. 274—17)

This invention relates to sound recording and reproducing and has for an object the provision of improvements in this art.

Among the objects of the invention is that of recording sound in a substantially continuous manner, thus avoiding interruptions which have proved so annoying during dictation and which have caused a loss of material during speeches, conferences and the like.

Another object is that of providing records in predetermined lengths and in convenient form for reproduction in order that any particular record may be readily located, marked and indexed when desired. It has heretofore been proposed to record sound in a continuous manner, and while these proposals have been many and varied it is believed that none of them offers the advantages provided by the present invention.

One previous proposal was to use a plurality of wax records on a plurality of recording machines and to shift from one to the other as the records were filled, but the expense of duplex machines is great, the change-over mechanism is likely to be complex, and in the end there are still heavy and bulky records to deal with. There is also a high service cost for shaving records. Moreover, shaving destroys the recorded material.

Another proposal was to use a continuous tape in rolls. This requires a great length of tape for a small amount of recorded sound and afterwards it is very difficult to pick out desired selections of material because this means running the whole roll through each time a selection is wanted.

Other prior proposals might be mentioned; and while they all may have advantages for certain purposes they also all have disadvantages from the standpoint of the purposes or applications of the present invention.

According to this invention a tape of record material is folded longitudinally into cylindrical form and the sound track is made in a circumferential spiral thereon. The record tape is supported in folded condition upon a mandrel while the sound track is being recorded thereon. Thereafter the tube of material may be cut into desired lengths and marked with indicia for indexing. The resulting record is very light and may be left flat or if formed into a permanent cylinder it may be reduced to a flattened or even a flat creased condition. In any case the record is very small and may be stored in a very small space or easily mailed. When the record cylinder is placed upon a mandrel for reproducing the sound there will be practcally no appreciable effect from the flattening or even from the seam where the cylinder is jointed; and more important, there will be no difficulty in correctly following the record track across the seam. Indeed the invention makes possible the formation of an improved joint seam which further insures correct tracking.

When a permanent cylinder is not formed, the sheet material while in temporary cylindrical form may be punched or otherwise formed or marked adjacent the longitudinal edges to assure matching of the circumferential sound track convolutions when the record again assumes a cylindrical shape for reproduction.

Further objects and features of the invention will be revealed by the following description of an illustrative embodiment of the invention and one form of apparatus employing the invention, which is shown in the accompanying drawings wherein:

Fig. 1 is a schematic elevational view partly in section of one form of apparatus embodying the invention;

Fig. 2 is a top plan view of the parts shown at the left of Fig. 1;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1;

Fig. 4 is a side view of parts of two finished records showing the line of severance between them;

Fig. 5 is a partial enlarged section taken on the line 5—5 of Fig. 1;

Fig. 6 is a view showing how the cylindrical record may be flattened for mailing or filing; and

Fig. 7 is a view showing a finished record which has been returned to flat sheet form.

In the exemplary embodiment of apparatus for practicing the invention illustrated herein, the tape, sheet or strip of record material 10 is fed from a roll 11 mounted in brackets 12 for convenient replacement. The record material is thin and flexible in order that it may readily be formed into a cylinder 13 on a mandrel 14 and also that it may be folded almost if not quite to a crease without breakage as shown in Fig. 6. There are perhaps several hundred materials which for various requirements might be employed. As one example, gelatin tape has proved satisfactory. It has the further advantage of being smooth and almost frictionless so as to slide easily along the mandrel, especially if the mandrel has a highly polished surface.

The tape and mandrel have movement relative to each other longitudinally of their length but do not have relative circumferential movement. Both may rotate together or both may be fixed. Considering simplicity of mechanism and convenience of manipulation, it is preferred to use the form shown herein in which the mandrel and tape supply means are fixed.

The tape is fed forward by friction driving rolls 15 and 16 driven by a shaft 17 with suitable gearing 18 and connected by a sprocket or belt 19. As many driving rolls may be used as are needed at any convenient point along or around the mandrel.

The sheet material is folded or wrapped around the mandrel by a surrounding tube 20, the entering end of the tube being suitably shaped to progressively form the sheet as it passes under a roller 21.

In case it is desired to form the sheet into a permanent cylinder, means 9 may be provided for applying glue or other adhesive to the seam before it is laid up on the mandrel.

Means are provided for forming a circumferential sound track on the record cylinder while it is held in position securely on the mandrel. In addition to the forming tube 20 other means such as a tube 20a may be provided for thus holding the record cylinder. The sound track forming means may comprise a vibratory stylus 22 mounted in a supporting ring 23 for revolution around the cylinder within a supporting shell 24. The ring 23 may be driven as by a belt 25 from the shaft 26 of a motor M. Sound may be transmitted by a portable microphone 27, an amplifier 28, annular tracks 29 and contacts or brushes 30 to the revoluble stylus 22.

The stylus normally produces an evenly spaced or uniform circumferential sound track which because of the slow uniform longitudinal feed of the record cylinder is of a spiral shape. It is thus seen that in effect there is an indefinite formation and feed of record strip and an indefinite formation of a circumferential sound track—or a transverse sound track when the cylinder is returned to a flat sheet form as shown in Fig. 7.

This uniform recording may continue indefinitely or it may be interrupted at predetermined intervals to form records R of definite length. Preferably the recording is continued during this interruption in order that the transmission may be continued without even the small loss or annoyance which might otherwise be entailed. As illustrated, the feed of the record strip is speeded up at intervals to form substantially clear spaces R1 wherein the strip may be severed by a rotary or other cutter 35. The sound track then changes from its uniform close spiral form R2 to the long or open spiral form R3.

The cutter may be mounted upon an annular ring 36 bearing an annular gear 37 by which it may be revolved through a shaft 38 and gearing 39.

The mandrel may be formed with a shoulder 13a, as shown in dotted lines in Fig. 1, to cooperate with the cutter. This cooperative interior support is necessary with thin sheet material.

The severing operation should be performed when the record strip is travelling at slow speed. Little or no provision is then required for accommodating the forward travel of the record strip during the cutting operation.

It may be desirable to place identifying indicia on one or both clear ends of the record and this may be done by mechanism 40 which operates cooperatively with the cutter 35. At the same time and by the same general mechanism 40 the strip may be provided with markings or formations which assure precise re-registry of the sound convolutions if the strip is unfolded to flat sheet form after recording and then later formed into a cylinder for reproduction. As shown in Figs. 4 and 7, this may take the form of punched holes R4 adapted to fit upon projecting pins of the mandrel or rotating cylinder upon which the strip is placed for reproduction. The holes may pass through both ends of the sheet when it is overlapped as shown in Fig. 5. Even when the seams are glued to form a permanent record cylinder, the holes may be useful for cooperating with pins on the mandrel of the reproducing machine to avoid slippage.

It was stated above that the invention permitted a special seam joint to be formed. This is shown in Fig. 5 where the cylinder is provided with a longitudinal groove 13b which receives one edge of the strip to allow the mating edge to form a smooth surface across the joint with the material on the other side. This is possible because there is no relative rotation between the mandrel and the record strip. A similar groove in the reproducing mandrel will assist rotation and minimize slippage of the record.

It is thus seen that the invention provides substantially continuous and unlimited recording because the roll of record tape may be made as large as desired. Also the recording may be substantially continuous and unlimited because the sound track is made transversely of the length of the tape (circumferentially of the formed cylinder). Moreover, since the record track is compactly produced within a short length of tape it is made feasible to cut off short lengths for separate identification, indexing or mailing. Heretofore, so far as is known, when continuous records were made on a tape the sound track ran parallel to the length of the tape and hence required a great length of tape for a short record. Belt forms of record sheet have also been proposed but these were of definite length as supplied for recording, hence did not provide unlimited recording.

The present record is particularly useful when taken off as a flat sheet for then it may be filed or mailed like ordinary letters in a flat envelope. If copies are desired it is only necessary to place the original on a reproducing machine and connect this with one or more recording machines of the type illustrated. This may be done by either the sender or receiver of the original record.

The record is very inexpensive, its cost being less than the usual cost of shaving a wax cylinder record. A sheet record containing the same amount of record material as a common wax record may cost less than one cent; whereas the shaving cost for the wax record is from three to five cents. The initial cost of a wax record may average fifty cents. The present sheet record can therefore be permanent because of low cost and small storage space required; whereas it is almost impracticable to maintain permanent wax records of routine office material and the like or in fact of anything except very important subject matter.

As may be seen in Fig. 7 the completed record when returned to flat form has a concentrated sound track between two parallel edges and substantially clear spaces near these edges. The concentrated portion extends to an end edge and

to a line spaced a short distance from the opposite edge (which was folded underneath during recording). The less concentrated portion of the sound track (in the two lines here) extends to the first said parallel edges. The entire sound track thus touches three edges and extends to a line near the fourth edge. The holes are in the four corners in the clear spaces. Such a record has inherent usefulness whether formed by the present or some other method.

The overall advantages of the present invention are very pronounced and tend to bring into larger everyday use this form of transmitting intelligence which heretofore has not reached its full usefulness. From recording through reproducing it provides benefits and savings.

The record may be reproduced with present reproducing machines with only small alterations. The record in its cylindrical form is in fact the embodiment of a single recording on a wax cylinder record. Therefore by providing a suitable mandrel for holding it in position it may be treated like a cylindrical record during reproduction. Several forms of mandrel or holding mechanism may be devised for the reproduction stage. There may even be provided a form of mechanism for reproducing the message when the record is in the flat condition, though at present the rotary cylindrical type is preferred. The essential requirement is that the sheet record be firmly backed or held at the point where the reproducing instrument is operating and that the mechanism will insure correct movement along the sound track.

While one embodiment and certain advantages of the invention have been particularly described it is to be understood that the invention may have various embodiments within the limits of the prior art and the scope of the subjoined claims.

I claim:

1. Apparatus for recording sound, comprising in combination, means for producing relative movement between a record tape and a recording element in the direction of the length of the tape, means for folding the tape longitudinally into a cylinder as it approaches the recording element, and means for causing the recording element to form a sound track in a circumferential direction on the cylinder thus formed.

2. Apparatus for producing sound records, comprising in combination, means for producing relative movement between an initially flat sheet of record material and a recording element in the direction of the length of the sheet, means for folding the sheet longitudinally into cylindrical form as it approaches the recording element, and means for recording transverse sound tracks on the shape thus formed.

3. Apparatus for producing sound records, comprising in combination, means for forming a cylinder of record material of indefinite length by folding a strip longitudinally, means for recording a circumferential spiral sound track of indefinite length thereon progressively along the length thereof, means for periodically interrupting the normal formation of the spiral sound track to form a clear space of substantial size, and means for severing the record in the clear space.

4. Apparatus for producing sound records, comprising in combination, means for feeding a tape of record-receiving material forward and progressively wrapping it in a straight longitudinal fold around a mandrel to form a tubular cylinder, means for forming a circumferential spiral sound track on the cylinder while it is supported on and moving along the mandrel, means for periodically greatly increasing the speed of travel of the record cylinder along the mandrel, and means for severing the cylinder in the clear space created by the fast feeding movement.

5. Apparatus as set forth in claim 4 which further comprises in combination, means for placing identifying indicia in a clear space of the severed record.

6. Apparatus for forming sound records, comprising in combination, a fixed mandrel, means for feeding a tubular record blank longitudinally along the mandrel, and means having movement circumferentially around said mandrel for recording a circumferential spiral sound track on said blank as it advances along the mandrel.

7. Apparatus for forming sound records, comprising in combination, a fixed mandrel, means for supporting a roll of record tape adjacent one end of the mandrel, means for feeding tape longitudinally to said mandrel and wrapping it around the mandrel to form a cylinder, a sound recording element mounted for circumferential movement around said mandrel for recording a transverse sound track on said cylinder, and means cooperating with the end of said cylinder for severing lengths from said cylinder at intervals.

8. Apparauts for forming sound records, comprising in combination, an axially fixed mandrel provided with a longitudinal seam groove, means for supporting a roll of record tape adjacent one end of the mandrel, means for feeding tape longitudinally to said mandrel and wrapping it around the mandrel to form a cylinder with the seam thereof in the cylinder groove, a sound recording element revoluble about said mandrel, means at the exit end of the mandrel for severing lengths of the record cylinder, and means for placing indicia on the records.

9. Apparatus for producing sound records comprising in combination, means for forming a cylinder of record material of indefinite length from sheet material by folding a band longitudinally, means for recording a circumferential spiral sound track thereon, means for cutting the cylinder at intervals to form separate and distinct records, means for placing track-matching indications near the longitudinal edges of the records while still in cylindrical form, whereby the record may be allowed to resume the flat sheet form and later accurately placed on a reproducing mandrel.

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