

Feb. 1, 1944.

S. REY

2,340,562

SOUND RECORDING DEVICE

Filed Aug. 10, 1942

4 Sheets-Sheet 1

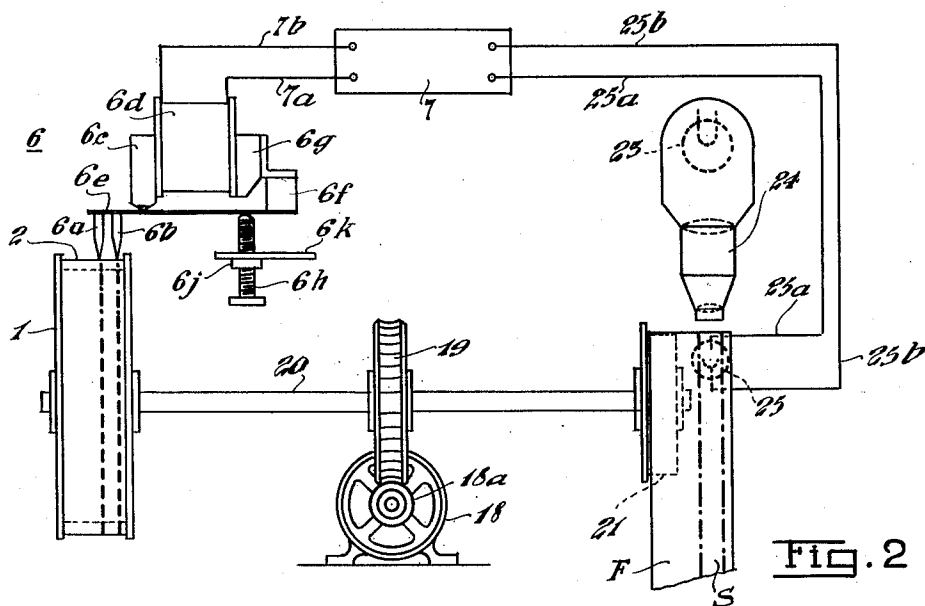


Fig. 2

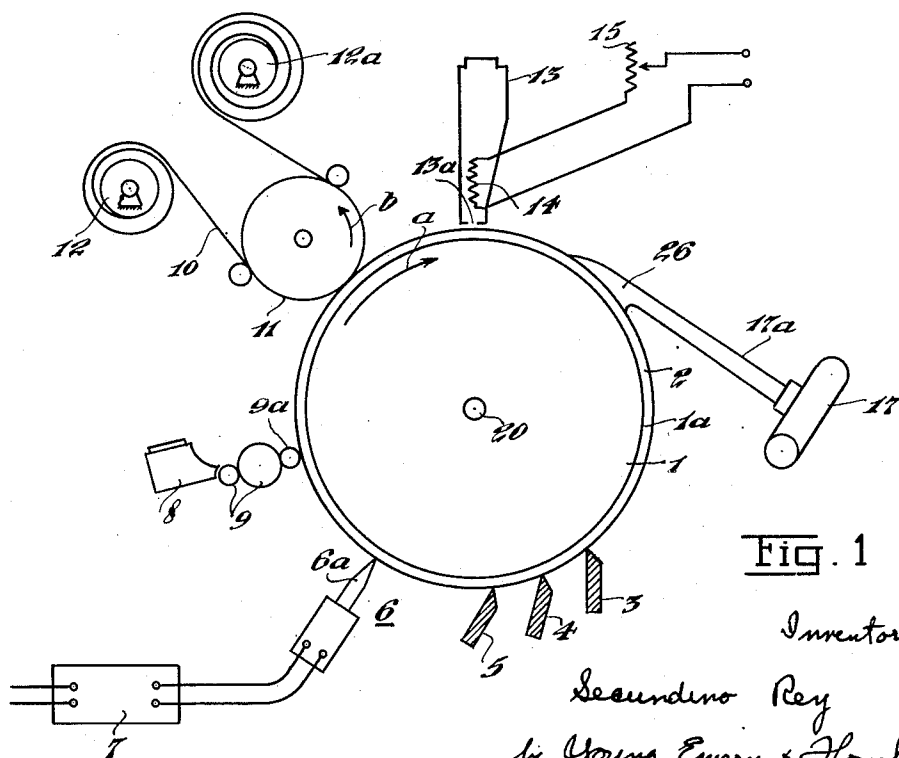


Fig. 1

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4 Sheets-Sheet 2

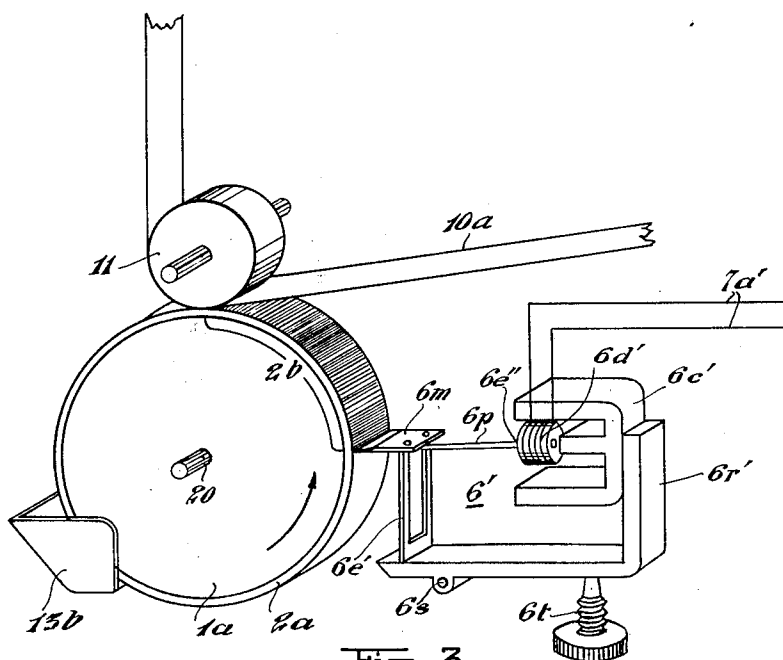


Fig. 3

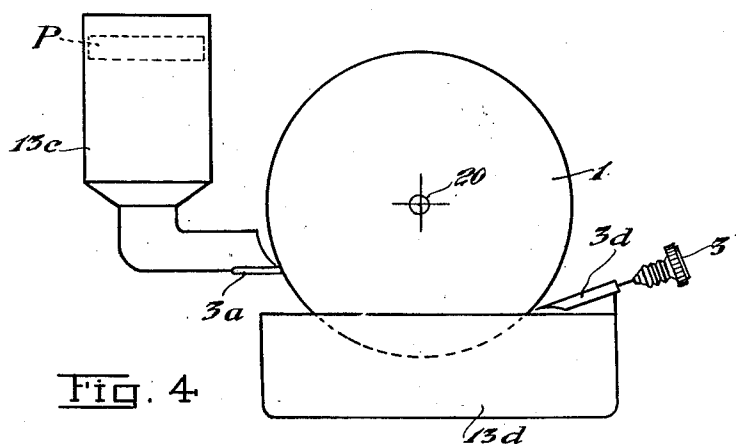


Fig. 4

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4 Sheets-Sheet 3

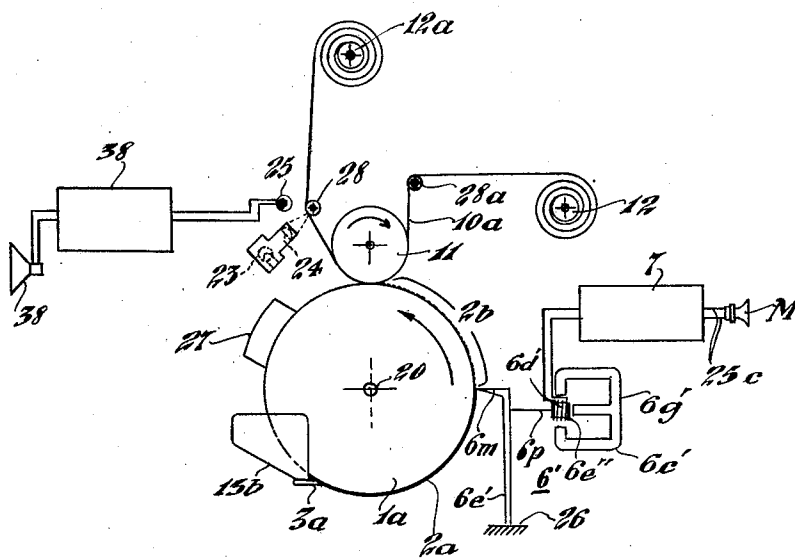


Fig. 5

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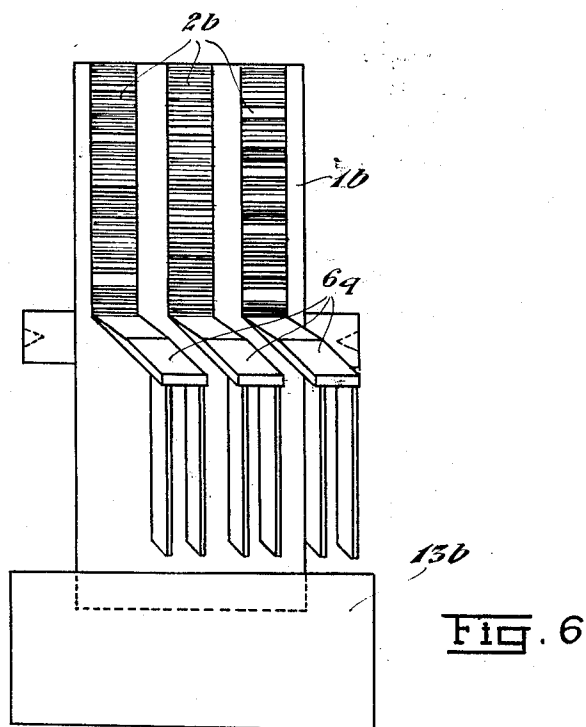
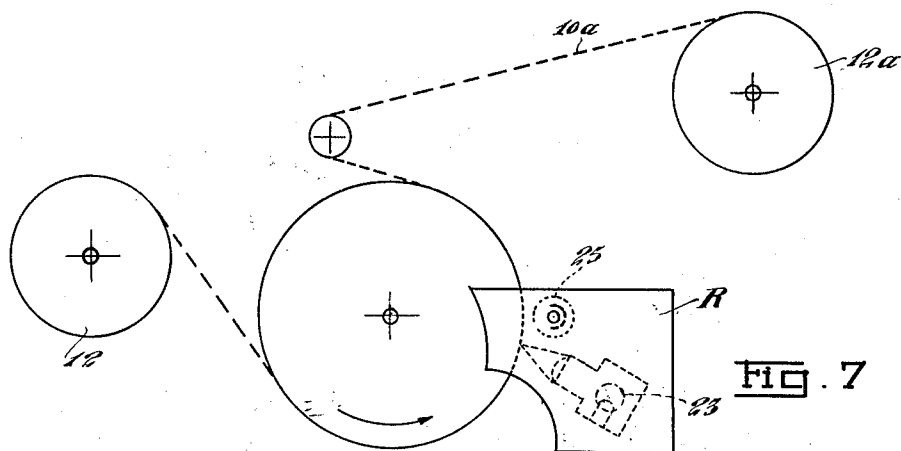
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Filed Aug. 10, 1942

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,340,562

SOUND RECORDING DEVICE

Secundino Rey, Buenos Aires, Argentina

Application August 10, 1942, Serial No. 454,330

In Argentina October 31, 1941

8 Claims. (Cl. 179—100.1)

This invention relates to sound recording devices and in particular to such devices in which the sound is recorded on strips or tapes of paper and the like flexible materials, in the form of imprints of varying intensity and/or length obtained by means of ink depositing or printing members and means causing the deposition or printing in response to audio frequency vibrations of an electrically controlled driving member.

One such system has been proposed in which a strip or band of paper is caused to travel lengthwise past the edge of a disc mounted on a shaft extending substantially parallel to the direction of displacement of the paper strip, said disc having a groove adapted to receive a liquid rapidly drying ink, and the strip being adapted to be oscillated towards and away from the edge of the disc by means of a frame which is driven in response to audio-frequency currents and which is so arranged as to permit the strip to travel therethrough. Such a device has the disadvantages of being restricted to the use of a rapidly drying liquid ink, of generally requiring the addition of drying means for the applied ink, and, principally of causing undesirable bending and torsion of the paper strip by reason of the motions of the frame.

In my prior application Ser. No. 393,300, filed May 13, 1941, I have described a process for recording sounds by direct lithographic printing according to which a band or strip of paper is caused to travel past an inking roller supplied with printers' ink, and the printing element consists of a second roller continuously engaging the strip on the side thereof remote from the inking roller and operatively connected to the oscillating tongue of an electromagnetic reproducer energized by currents representing the sounds to be recorded.

I have now designed a new and improved sound recording device based on the general principle of recording by printing, my new device being of a simplified construction and having the considerable advantage of being applicable to a variety of highly useful purposes.

My novel sound recording device involves as a basic idea permanent and direct contact during the operation of the device, of the ink depositing roller with the band of flexible material intended to serve as the record support, and the modification of an impression receiving skin or layer provided around the periphery of said roller, as well as the continuous restoring of the modified layer, after the printing step, to a smooth impression receiving or blank condition.

In this manner, I am able not only rapidly to produce a sound record under conditions enabling a reproduction of the sound to be obtained within a few seconds or even less, of the actual recording, but also to produce, without any substantial change in the fundamental parts of the device, a matrix record adapted to print any desired number of copies of the sound record at any later time. Such matrix record may be of a permanent or semi-permanent nature depending on the class of material used for the record support.

With these general and specific ends in view, I shall now describe certain preferred embodiments of my novel sound recording device, which I have illustrated in the accompanying drawings, in order that the nature and advantages thereof may be more readily appreciated by those skilled in the art.

In the drawings:

Fig. 1 is a diagrammatic view of the essential parts of one embodiment of the novel sound recorder of the present invention.

Fig. 2 is a diagram illustrating the application of the recorder of Fig. 1 to taking a "copy" record of the sounds corresponding to the sound track of a sound film.

Fig. 3 is a perspective diagrammatic view of a modified form of my novel recorder.

Fig. 4 is a diagram illustrating two forms of inking device.

Fig. 5 is a diagram illustrating the use of my novel recorder for recording and substantially simultaneously reproducing sounds.

Fig. 6 is a diagrammatic side view of a portion of the recorder showing the simultaneous production of a plurality of parallel sound tracks on the same record support, and

Fig. 7 is a diagram illustrative of the reproduction of the sounds from a record made by the novel recorder.

Referring first to Fig. 1, the essential parts of the novel sound recorder comprise a roller 1 of relatively large diameter having an accurately cylindrical and highly polished surface 1a, said roller being mounted on a shaft 20 adapted to be driven in one direction by suitable driving means, not shown. The direction of rotation assumed for purposes of description, is from left to right for the device of Fig. 1 as indicated by the arrow a. The cylindrical surface 1a, is adapted to be coated or provided with a thin skin 2 of a material adapted to receive impressions, a supply of which is kept in a reservoir 13 and is fed therefrom as required and as will hereinafter be made

clear, onto the surface 1a, through a feed opening 13a.

The nature of the material adapted to receive impressions, hereinafter denominated "impression receiving material," may vary within wide limits. I may, for example, use a wax or wax-like substance, such as paraffin wax, a solution of celluloid or other suitable cellulose derivative, or a low melting point relatively soft metal or alloy, such as lead or an antimony-lead or lead-tin alloy, or even a quick-drying paint, and finally a viscous printer's ink. When necessary, as in the case of a normally solid impression receiving material, I provide liquefying means, such as a heater 14 located within the reservoir 13, and a control resistance 15 in series with the heater, said means being adapted to be connected to a source of current, not shown.

It is essential for the proper operation of the device, that the impression receiving surface be as smooth and of as uniform thickness as possible. To this end, I provide smoothing means located at a point displaced from the reservoir in the direction of rotation of the roller 1. In the embodiment of Fig. 1, which is shown as suitable for a normally solid impression receiving material, such as paraffin wax, the smoothing means may take the form of a plurality of scrapers, 3, 4 and 5, so adjusted that on leaving the smoothing zone, the skin coating the roller 1, will be free from irregularities and of a uniform radial depth.

Beyond the smoothing means, in the direction of rotation of the roller, I provide the impression producing means, indicated in a general manner at 6, and adapted to be connected to an amplifier 7 which is fed with a current-representative of the sounds to be recorded, in any convenient well-known manner.

The impression producing means 6 may be of any convenient design and construction, and comprises an impression producing member 6a, which may take the form of a stylus, a knife-edged blade or the like. Certain preferred constructions of the impression producing means will be described hereinbelow.

Between the impression producing means and the reservoir 13, I provide a guide roller 11 for the record supporting band 10, whereby said band is adapted to be guided into light substantially line contact with the smooth outer surface of the impression receiving material coating the roller 1, during the passage of the band from a supply or feeding roller 12, to a receiving roll 12a. Motion may be imparted to the band in the direction of the arrow b in Fig. 1, by driving the receiving roll 12a, in any convenient manner as is well-known to those skilled in the art.

When the impression receiving material 2 is not itself capable of producing a printed record on the band 10, as when paraffin wax is used, I provide at a point between the impression producing means and the guide roller 11, an inking device, shown diagrammatically as comprising an ink reservoir 8 and a train of inking rollers 9, one of which, 9a is positioned to be in inking contact with the surface of the material 2.

If necessary, I may provide solidification or drying acceleration means at a point between the reservoir 13 and the smoothing means 3, 4, 5. Such drying acceleration means may consist of a blower 17 connected by means of a duct 17a to a mouth 26 located in proximity to the sur-

face of the impression receiving material 2 a short distance in advance of the reservoir 13.

In Fig. 2 I have shown a diagrammatic arrangement of parts to illustrate one application of the novel sound recording device. According to this arrangement, the shaft 20 has fast thereon a wormwheel 19 meshing with a worm 18a fast on the shaft of an electric motor 18. Said shaft extends beyond the worm-wheel 19 on either side thereof and at one end, the left hand end in Fig. 2, has mounted thereon the printing roller 1 with its skin of impression receiving material 2. It should be understood that for simplicity, the material applying, cooling and smoothing means, as well as the inking means and the guide roller and record supporting band have been omitted from Fig. 2, but would normally be associated with the roller 1 as shown in Fig. 1. The other end of the shaft 20 has mounted on it a driving means, such as a pulley 21, which in practice may be a sprocket roller, adapted to drive a film F comprising a sound record track indicated at S. The arrangement is shown to be such that the sound track S projects laterally beyond the driving means 21 to enable a photoelectric cell indicated at 25, to be positioned under said sound track to receive light from a source 23 focused by an optical system 24 in a manner well known in the art. The modulated current output of the photoelectric cell 25 is fed by conductors 25a, 25b, to an amplifier 7, the output of which is applied by conductors 7a, 7b, to the impression producing means 6. As shown in Fig. 2, the impression producing means comprises an electromagnet 6c, including a coil 6d the ends of which are connected to said conductors 7a, 7b, and a vibrating armature 6e anchored at one end to a support 6f for the core 6g of the electromagnet, and having affixed thereto in the neighborhood of its other end, the impression producing members or blades 6a, 6b, which are preferably of tapering cross-section. The vibrations of the armature 6e are adapted to be adjusted by means of an adjustment screw 6h threaded through a nut 6j fixed to an auxiliary support 6k.

As the shaft 20 rotates, varying currents are fed into the amplifier 7 from the photo-electric unit 25, in response to the variations of the sound track S, and the amplified output from the amplifier 7 is impressed on the coil 6d to cause armature 6e to vibrate and thus cause the impression producing members to move towards and away from the coating 2, whereby grooves are formed in said coating, the width of the grooves at the surface of the coating varying in accordance with the depth of penetration of the impression producing members, by reason of the fact that said members have a tapering section at their free ends. The variations in the surface width of the grooves will be representative of the variations of the amplified current which in turn respond to the variations of the sound track S.

Bearing in mind the above explanation of the manner in which the sound record is impressed on the impression receiving coating 2, the way in which said impressed record is transferred to the band support, and the manner in which the same coating 2 can continuously be used for taking impressions and transferring them to the permanent record supporting band 10, will now be described with particular reference to Figs. 3 and 5. In these figures the cylindrical roller 1a is adapted to rotate counter-clockwise, as shown, and a

portion of its cylindrical surface passes through a reservoir 13b of impression receiving material, which in the example of Figs. 3 and 5, is a relatively viscous printer's ink. The reservoir 13b is provided with a graduating member 3a (best seen in Fig. 5) located at the point where the roller 1a leaves the reservoir, and adapted to ensure that the coating 2a applied to the roller 1a shall be of uniform thickness. I have found it preferable to employ thicknesses of from 2 to 6 microns for ink coatings. The impression producing means, indicated by the general reference 6', comprises a knife-edge type impression producing member 6m, and electromagnetic actuating means 6c' adapted to cooperate with an armature member 6e'' to cause vibration of a flexible supporting member 6e' of the member 6m. The flexible supporting member 6e' has its end remote from the member 6m fixed in any suitable manner, as is indicated diagrammatically at 26 in Fig. 5, and is operatively connected at an intermediate point to the armature 6e'' by means of a connector member 6p. The armature 6e'' has mounted on it a coil 6d' connected to conductors 7a'. As shown in Fig. 5, conductors 7a' connect coil 6d' to the output of an amplifier 7, the input of which is connected by conductors 25c to a telephone or the like circuit represented by the telephone M. Hence in a manner similar to that explained above, the impression producing member 6m is caused to reciprocate in response to the variations in the current flowing in the coil 6d', which is controlled by the telephone circuit. In reciprocating with respect to the cylindrical surface of the roller 1a, the impression producing member 6m causes variations in the thickness of the coating 2a, as that coating passes said member, and, if the ink used is of the right consistency, these variations in thickness will persist at least over the zone 2b, extending from the member 6m to the line of contact of the coating with the record supporting band 10a. It should be noted that the arrangement is such that the coating of uniform thickness emerging from the impression producing member 6m is somewhat thinner than the coating leaving the reservoir 13b, so that said thinner coating will leave a neutral grey trace the full width of the coating, on the band 10a. Consequently when the portion of coating passing at any time into contact with the band 10a has had its uniformity modified by the reciprocation of the knife edge 6m, the impression left on the band will also be a modification of the normal neutral grey. In fact such impression will consist of darker or lighter zones either abruptly separated from each other by substantially black or white zones, or merging into intermediate grey zones, in response to the nature of the sounds impressed on the telephone M. The impression producing means 6' may, as shown in Fig. 3, be mounted for adjustment as a whole in order to enable a desired thickness of the coating in the zone between the impression producing member 6m and the line of contact with the band 10a to be preset. Thus the flexible support 6e' and the electro-magnetic actuating means 6c' may be secured to a frame member 6r rockably mounted on a pin 6s and engaged by an adjusting screw 6t which may be calibrated if desired. In passing the guide roller 11, the surface of the coating, if modified tends to become distorted (smoothed) by the printing pressure, even though such pressure be a barely perceptible alteration

of the normal contact pressure between the band 10a and the unmodified coating 2a. However, this is of no consequence, since by the time the distortion is produced the impression will have been made and the sound record thus obtained. Although the subsequent passage of the distorted modified part of the coating through the reservoir 13b and past the graduating member 3a would in general be sufficient to provide a uniform coating over the zone between said graduating member and the impression producing member 6m, I prefer, even when using a normally viscous impression receiving material such as printer's ink, to provide smoothing means, such as a pad 27 (see Fig. 5), for positively smoothing out the impressions made by the member 6m on the coating, after the latter has passed the guide roller 11.

As in the example of Fig. 1, the record supporting band 10a as shown in Fig. 5 is continuously drawn off from a supply roller 12 and wound, after being printed, onto a receiving roller 12a. Supplementary guide rollers 28, 28a may be provided, and one such supplementary roller, 28, may be positioned to deflect the record supporting band towards an optical projecting system 24 associated with a source of light 23, so located that the light reflected from the printed surface of the supporting band 10a shall be directed to a photoelectric device 25 which supplies sound currents through an amplifier 30 to a sound reproducing device such as a loud speaker 31. Such an arrangement renders it possible to obtain a reproduction of the sound recorded almost immediately after the record is made.

The arrangement just described is adapted to make only "original" records and if copies are required, either the record obtained as described must be reproduced as by means of photography, or a plurality of impression producing members 6g (see Fig. 6), all acting in alignment on a relatively long cylinder 16 must be used. It is, however, readily possible to produce the "original" record in the form of a matrix from which any number of copies may be easily obtained by printing. While such matrix records might be obtained by the apparatus of Fig. 5 with the use of a viscous ink, I prefer to use in such event, a device of the type illustrated in Fig. 1, since a solid impression receiving coating modified in response to the sound and then inked, will be less liable to lead to smudging in the record, when a non-absorbent material, such as copper strip, is used as the record support, as would generally be the case when preparing a matrix record of a relatively permanent nature.

As described hereinabove, in operating the device of Fig. 1, the molten impression receiving material, such as paraffin wax or a low melting alloy, is delivered onto the cylindrical surface of the roller 1 through the outlet 13a of the heated reservoir 13, the deposit is allowed to harden, if necessary with the assistance of accelerating means 26, is smoothed by the scrapers 3, 4, 5, and is modified by the impression producing member 6. Subsequently the modified coating is inked by the inker 9 and in this condition passes into contact with the record supporting band 10. As just stated, this band, for the purpose of taking matrix records, is of an etchable material or at least of a material such that the printed impressions on it may readily be converted into a printing surface. For example, the band may be of Celluloid or, preferably, of metal such as copper. After leaving the zone of con-

tact with the band, the modified portion of the coating 2 again passes under the outlet 13a where more molten impression receiving material is fed onto it, thereby obliterating the previous modification. The obliteration is finished and a uniform surface again obtained when the renewed coating again passes under the scrapers 3, 4, 5. Obviously the scraped material may be collected and returned as may be most convenient to the reservoir, by any suitable means, not further described in this specification.

When the printing of the sound record on the band 10 has been finished, such band, if of the materials mentioned above, may be treated in a number of well-known ways, as by etching with acid or the like, to convert its surface into an ink receiving printing surface, and thereafter as many copies as desired may be taken off as and when required, by contact printing of a copy record supporting band, which may be of paper or the like, with the treated matrix record.

In Fig. 4 I have shown diagrammatically two modified forms of container, 13c and 13d, both of which are shown as suitable for a normally liquid or viscous impression receiving material. The container 13c is provided with a thickness gauge or adjusting device 3a and with a positive pressure member P, such as a plunger or weighted float. The container 13d is adapted to be used with less viscous impression receiving materials, and the roller 1 merely dips into the material within the container. The thickness of the coating is automatically maintained uniform by the adjusting member 3d which is shown as provided with an adjustment screw 3'. In Fig. 7 is illustrated a reproducing unit R mounted about a portion of the guide roll 11b so that the printed record passes on its way to the receiving roll 12a, through a zone illuminated by the source of light 23, the reflected beams being intercepted by a photoelectric cell 25, as explained above in connection with Fig. 5.

It will be obvious to those skilled in the art, that many modifications may be made in the details and construction of my novel recording device, without departing from the spirit and scope of the appended claims. For example, in using the embodiment of Fig. 6, I may arrange for each or some of the impression producing members 6q to be actuated by different electromagnetic means so that I may record simultaneously different series of sound side by side. I may likewise use different types of container and smoothing members, as well as impression producing members and/or actuating means therefore of designs different from those illustrated in the drawings. All such variants are held to lie within the scope of the appended claims.

I claim:

1. A sound recording device comprising a reservoir having a discharge opening, a supply of normally non-solid impression receiving material in said reservoir, an ink depositing roller having an accurately cylindrical, polished surface located to receive a coating of said impression receiving material from said reservoir, driving means connected to drive said ink depositing roller past said discharge opening in one direction, smoothing means adapted to smooth said coating and located in the neighborhood of the point where the coated surface of the ink depositing roller leaves the reservoir, impression producing means located beyond the smoothing means in the direction of rotation of the ink depositing roller and adapted to penetrate partly

into the smoothed coating, sound responsive means adapted to reciprocate said impression producing means with respect to said coating, a sound record supporting band of flexible material, band driving means adapted to cause longitudinal translation of said band in one direction and a guide roller located to cause said band to contact said coating at a point between said impression producing means and said reservoir, said coating being adapted to deposit on said band an ink record of varying intensity representing the sounds to be recorded.

2. A sound recording device according to claim 1 in which an additional smoothing means is provided at a point between the guide roller and the reservoir.

3. A sound recording device comprising a reservoir having a discharge opening, a supply of normally solid liquifiable impression receiving material in said reservoir, heating means operatively associated with the reservoir and adapted to liquify said impression receiving material, an ink depositing roller having an accurately cylindrical polished surface located to receive a coating of said impression receiving material from said discharge opening, driving means connected to drive said ink depositing roller past said discharge opening in one direction, graduating means adapted to graduate the thickness of the coating to a uniform depth and located at a point displaced from the reservoir in the direction of rotation of the ink depositing roller, impression producing means located beyond said graduating means in the direction of rotation of the ink depositing roller and adapted to engage said coating, sound responsive means adapted to reciprocate said impression producing means with respect to said coating to modify the same in response to the sounds to be recorded, inking means located beyond said impression producing means in the direction of rotation of the ink depositing roller and arranged to be in inking engagement with said coating when not modified by the impression producing means, a sound record supporting strip of printable material, driving means adapted to cause longitudinal translation of said strip in one direction, and a guide roller located to cause said strip to contact the inked coating at a point between said inking means and said reservoir, whereby said coating is adapted to deposit on said strip an ink record of varying intensity representing the sounds to be recorded.

4. A sound recording device according to claim 3 in which a cooling means is provided in operative relationship with the coating at a point between the reservoir and the graduating means, whereby the setting of the coating after application to the ink depositing roller is accelerated.

5. A sound recording device according to claim 3, in which a smoothing means is provided in operative engagement with the modified coating at a point between the guide roller and the reservoir.

6. A sound recording device comprising a reservoir having a discharge opening, a supply of impression receiving material in said reservoir, an ink depositing roller having an accurately cylindrical, polished surface located to receive a coating of impression receiving material from said discharge opening, driving means connected to drive said ink depositing roller past said discharge opening in one direction, smoothing means adapted to smooth said coating to a uniform thickness and located at the side of the

reservoir which the surface is leaving during rotation of the roller, a plurality of impression producing means located in widthwise spaced relationship with respect to said surface at a point beyond the smoothing means in the direction of rotation of the ink depositing roller and adapted to engage the smoothed coating, sound responsive means adapted to reciprocate said impression producing means with respect to said coating, a sound record supporting strip of printable material, strip driving means adapted to cause longitudinal translation of said strip, and a guide roller located to cause said strip to contact said coating at a point between said impression producing means and said reservoir, and to move at said point in the same direction as and at a fixed distance from said surface, said coating being adapted to deposit on said strip an ink record of varying intensity representing the sounds to be reproduced.

7. A sound recording device adapted to copy a given sound record of the type in which the sound is intended to be reproduced by photoelectric means, said device comprising a shaft, driving means operatively connected to said shaft at a point intermediate the ends thereof and adapted to drive the shaft in one direction, a reservoir having a discharge opening and located in the neighborhood of one end of said shaft, a supply of impression receiving material in said reservoir, an ink depositing roller having an accurately cylindrical, polished surface fast on the shaft and adapted to be rotated past said discharge opening to receive a coating of impression receiving material, smoothing means adapted to smooth said coating to a uniform thickness and located at the side of said reservoir which the surface is leaving during rotation of the ink depositing roller, impression producing means located beyond the smoothing means in the direction of rotation of the ink depositing roller and adapted to engage the smoothed coating, electromagnetic means adapted to reciprocate said impression producing means with respect to said coating, a rotary sound record advancing member fast on the shaft in the neighborhood of the other end thereof and adapted to cause longitudinal displacement of a ribbon-like sound record supporting member including a sound record track, a source of light and a photoelectric unit operatively positioned with respect to the sound track to produce a varying electric current responsive to variations of the sound track, the output of said

unit being operatively connected to said electromagnetic means to energise same and thereby actuate the impression producing means in response to the sounds represented by the track, a sound record supporting strip of printable material, strip driving means adapted to cause longitudinal translation of said strip, and a guide roller located to cause said strip to contact said coating at a point between said impression producing means and said reservoir and to move at said point in the same direction as and at a fixed distance from said surface, said coating being adapted to deposit on said strip an ink record of varying intensity representing the sounds to be reproduced.

8. A sound recording and reproducing device comprising a reservoir having a discharge opening, a supply of impression receiving material in said reservoir, an ink depositing roller having an accurately cylindrical polished surface located to receive a coating of impression receiving material from said opening, driving means connected to drive said ink depositing roller past said discharge opening in one direction, graduating means located on the side of the reservoir which said surface is leaving during rotation of the ink depositing roller and adapted to smooth said coating to a uniform thickness, impression producing means located beyond the graduating means in the direction of rotation of the ink depositing roller and adapted to engage the smoothed coating, sound responsive means adapted to reciprocate said impression producing means with respect to said coating to modify the same in response to the sounds to be recorded, a sound record supporting strip of printable material, driving means adapted to cause longitudinal translation of said strip in one direction, a guide roller located to cause said strip to contact said coating at a point between said impression producing means and said reservoir, said coating being adapted to deposit on said strip an ink record of varying intensity representing the sounds to be recorded, a sound reproducing device, and photoelectric sound translation means operatively associated with said strip at a point thereof beyond said guide roller in the direction of motion of the strip, and connected to said sound reproducing device, whereby the recorded sounds may be reproduced substantially immediately after recording.

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