July 13, 1937. M. F. J. WIELAGE 2,087,135

SOUND RECORDING AND REPRODUCING APPARATUS

Filed June 23, 1936 4 Sheets-Sheet 1

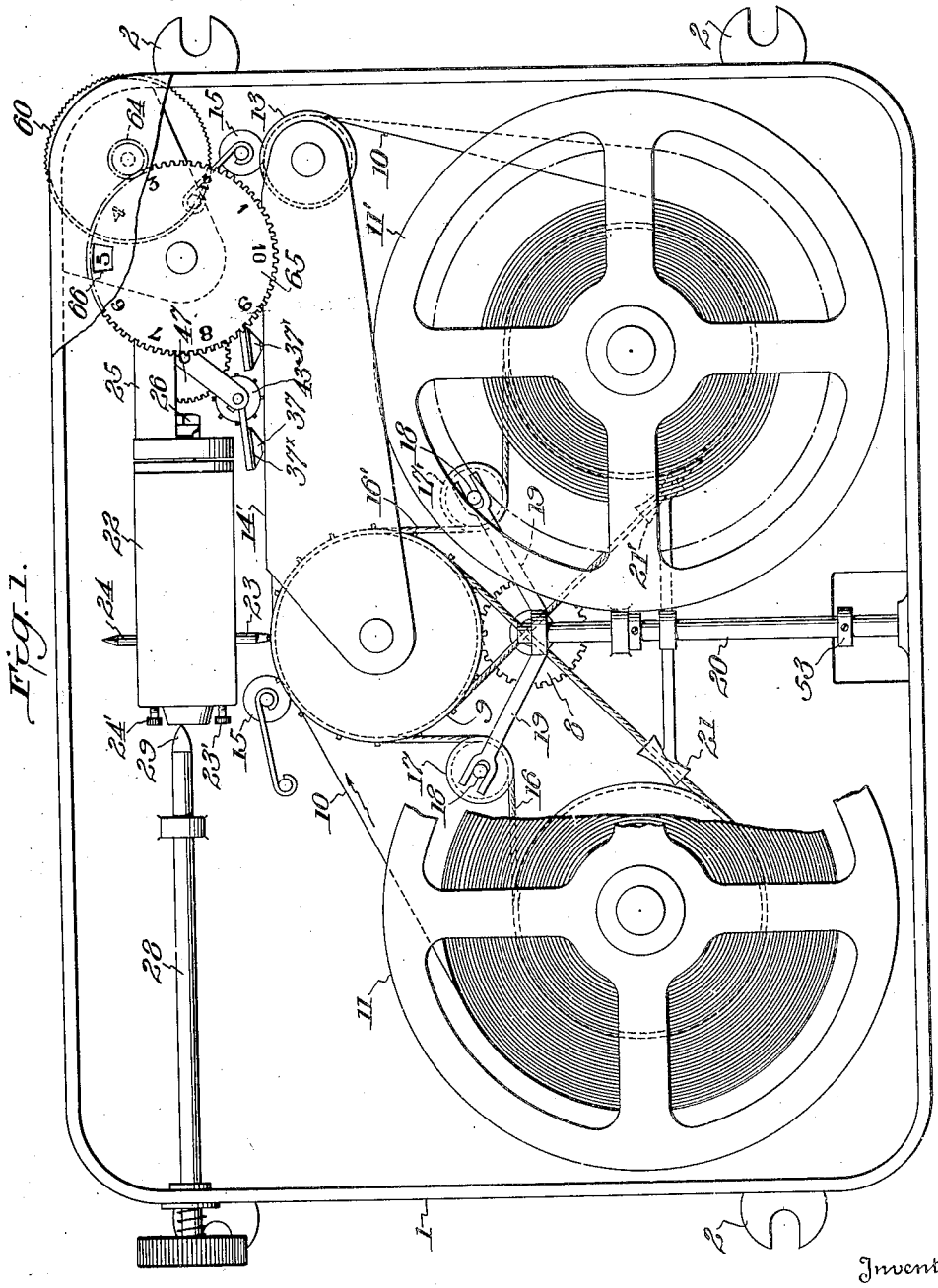


Fig. 1.

Inventor:

M. F. J. Wielage,

By Potter, Pierce & Scheffler,

Attorneys.

July 13, 1937. M. F. J. WIELAGE 2,087,135

SOUND RECORDING AND REPRODUCING APPARATUS

Filed June 23, 1936 4 Sheets-Sheet 2

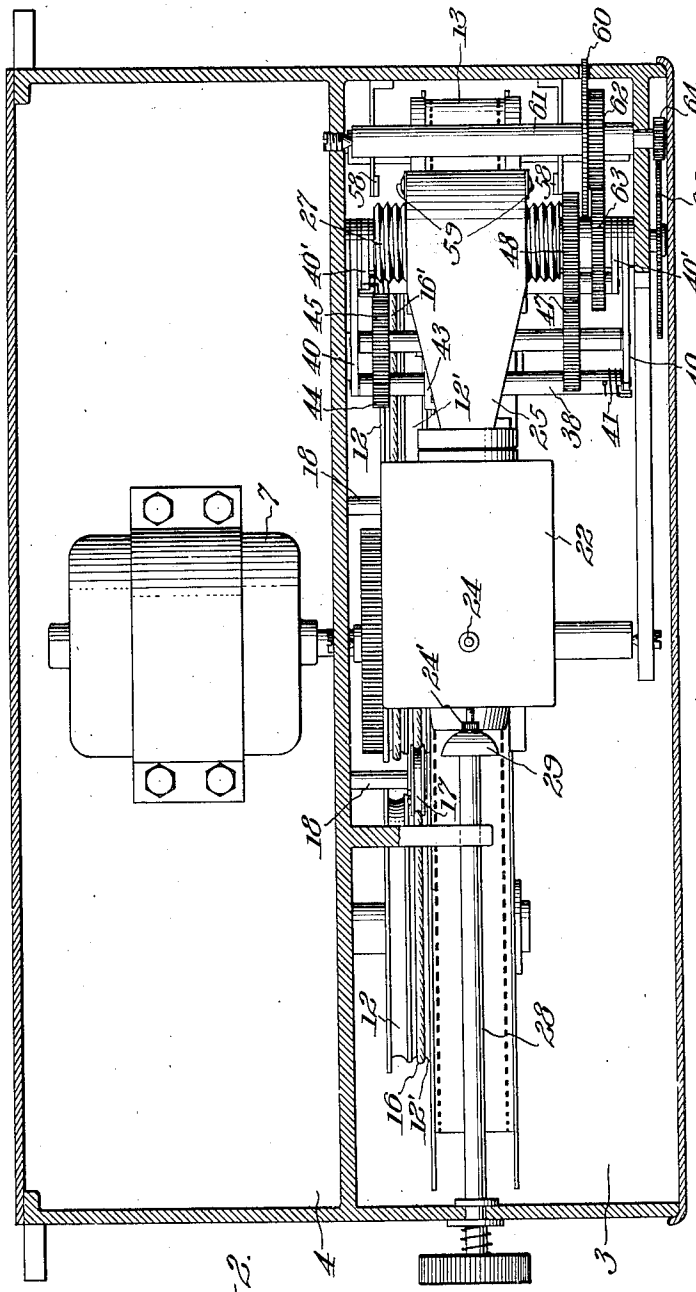


Fig. 2.

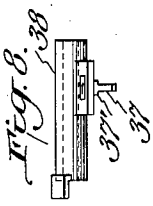


Fig. 8.

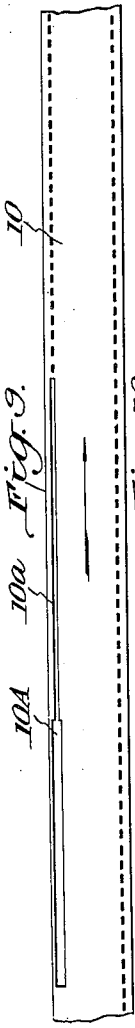


Fig. 9.

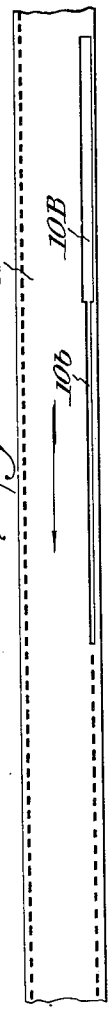


Fig. 10.

Inventor:

M. F. J. Wielage,

By Potter, Pierce & Scheffler,

Attorneys.

July 13, 1937. M. F. J. WIELAGE 2,087,135

SOUND RECORDING AND REPRODUCING APPARATUS

Filed June 23, 1936 4 Sheets-Sheet 3

Fig. 3.

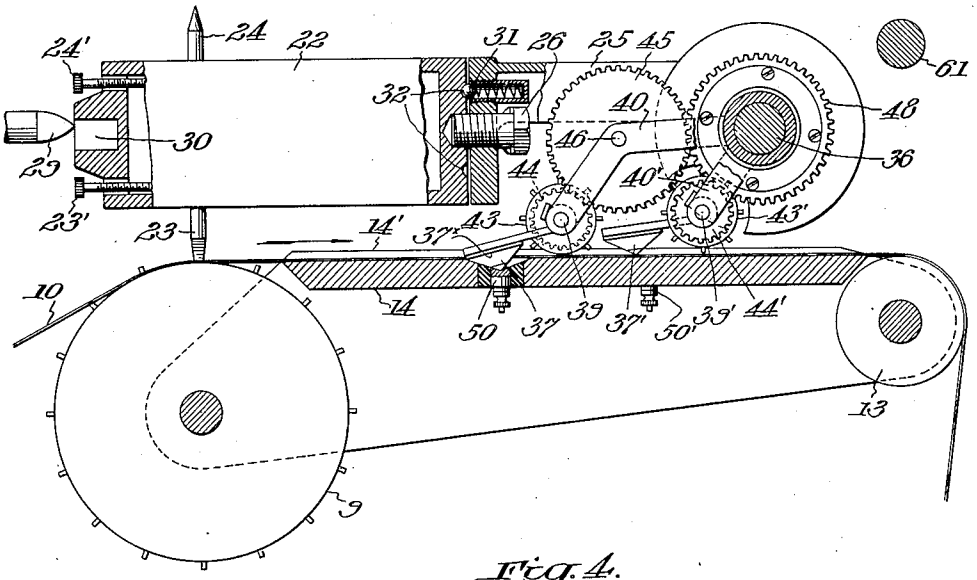



Fig. 4.

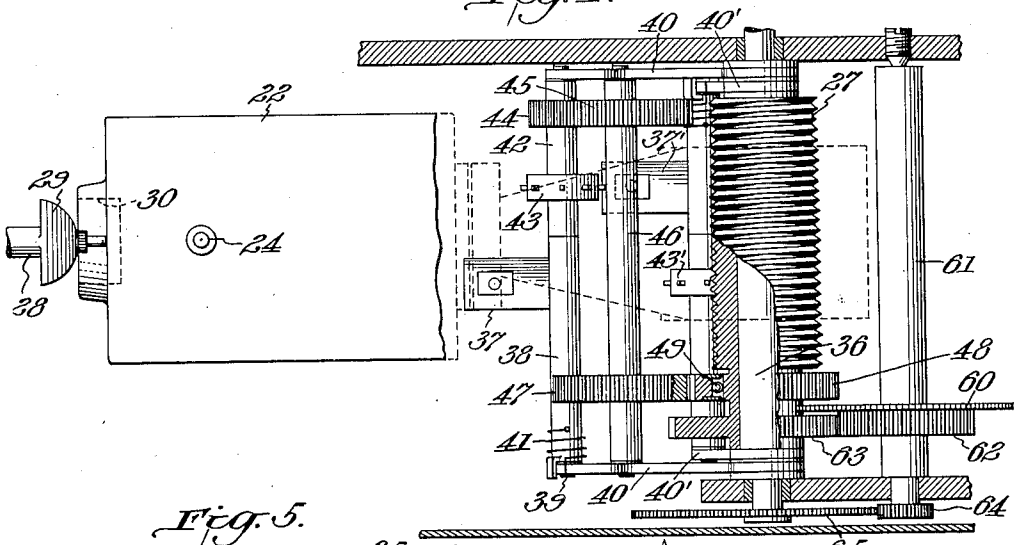



Fig. 5.

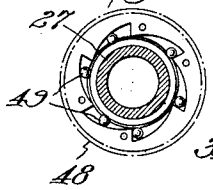



Fig. 6.

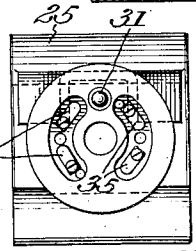
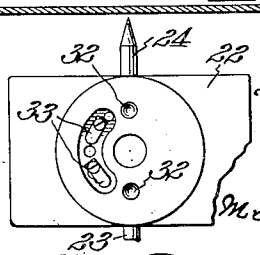



Fig. 7.




Inventor:

M. F. J. Wielage,

By Potter, Pierce & Scheffler,

Attorneys.

July 13, 1937. M. F. J. WIELAGE 2,087,135

SOUND RECORDING AND REPRODUCING APPARATUS

Filed June 23, 1936 4 Sheets-Sheet 4

Fig. 11.

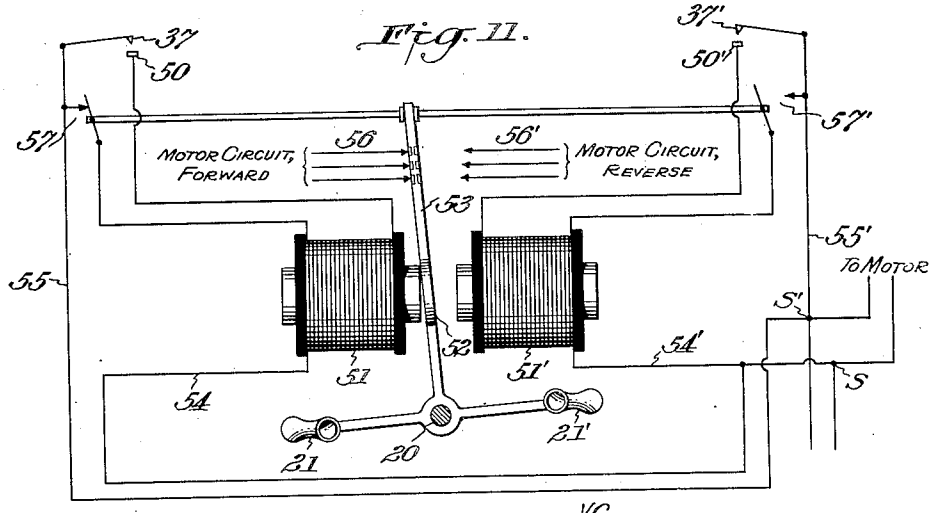
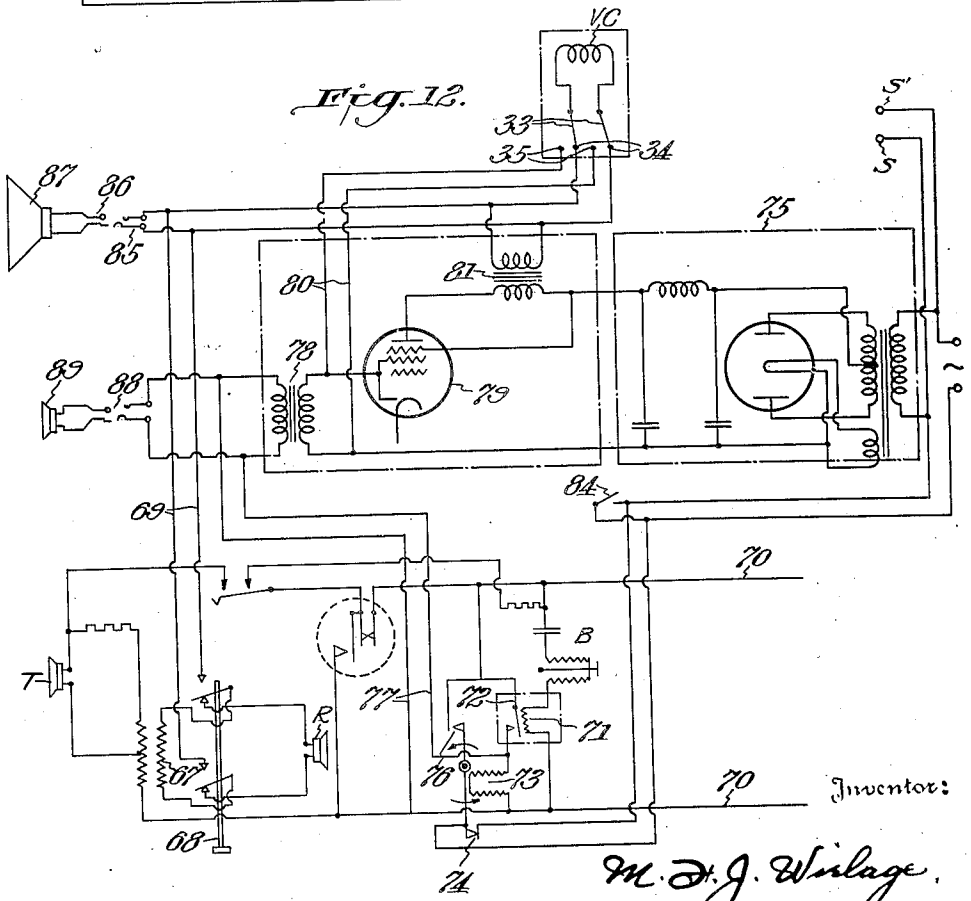



Fig. 12.




Inventor:
M. F. J. Wielage,
By Potter, Pierce & Scheffler,
Attorneys.

Patented July 13, 1937

2,087,135

# UNITED STATES PATENT OFFICE

2,087,135

## SOUND RECORDING AND REPRODUCING APPARATUS

Marcus Frans Josef Wielage, Miami, Fla.

Application June 23, 1936, Serial No. 86,869

14 Claims. (Cl. 179—100.4)

This invention relates to sound recording and sound reproducing apparatus, and more particularly to apparatus of the type in which speech, music and the like are recorded by cutting a sound track on a band or sound film.

An object of the invention is to provide a compact apparatus including mechanism for supporting and moving a film longitudinally in opposite directions, a head having recording and reproducing mechanism overlying the moving film, and mechanism operable automatically as the ends of the film approach the head for reversing the direction of travel of the film and shifting the head laterally to a new sound track path. An object is to provide apparatus of the type stated in which the automatic mechanism is operated by slots cut through the film adjacent the ends thereof. A further object is to provide a sound recording and reproducing apparatus including a mechano-electric transducer carrying a cutting stylus and a reproducing stylus which may be alternatively contacted with a sound film, and manually operable mechanism for lifting the head to raise one stylus from the film and then turning the head to present the other stylus to the film. Other objects of the invention are to provide novel mechanisms of simple and compact design for effecting a constant speed travel of a sound film past a cutting head having a stylus in engagement with the film, and for reversing the direction of film travel and moving the cutting head laterally to a new sound track path.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawings, in which:

Fig. 1 is a side elevation of an embodiment of the invention, with the major portion of one side of the casing broken away for the better illustration of the film feeding mechanism and the sound transducer;

Fig. 2 is a horizontal sectional view through the casing, the several parts of the apparatus being shown in plan;

Fig. 3 is an enlarged and fragmentary side elevation of the mechanism for reversing the film travel and displacing the cutter head;

Fig. 4 is a plan view of the same;

Fig. 5 is a sectional detail view of an overrun clutch including the gear trains for moving the cutting head laterally;

Figs. 6 and 7 are end elevations of the meeting surfaces of the cutting head support and the cutting head, respectively;

Fig. 8 is a front elevation of one of the electrical contact members of the switches for reversing the film travel;

Figs. 9 and 10 are fragmentary plan views of the opposite ends of the sound film;

Fig. 11 is a schematic view of the apparatus and electrical circuits of the relay for effecting a reversal of the direction of film travel; and

Fig. 12 is a circuit diagram of the wiring employed when the invention is used to record telephone messages in the absence of the subscriber.

In the drawings, the reference numeral 1 identifies a compact casing housing the several elements of the apparatus, the casing preferably having lugs or ears 2 for attaching the same to a wall or other vertically disposed support. The casing is divided by an interior wall into elongated compartments 3, 4; the forward compartment 3, as seen in Fig. 2, housing the film and the transducer elements, and the rear compartment housing vacuum tube amplifiers, relays and motors, and control apparatus. Only the motor 7 for driving the sound film 10 is shown in Fig. 2 as the other elements to be positioned in compartment 4 may be varied at will to meet particular design requirements.

Motor 7 is a small reversing motor, for example of about 50 watts input, located in the upper portion of compartment 5 and having a shaft which extends into compartment 3 and carries a gear 8 in mesh with the toothed wheel or sprocket 9 that drives the sound film 10. The film 10 is provided with perforations along each side, see Figs. 9 and 10, and may be discarded or used with 16 millimeter motion picture film. Specially prepared film with a coating of gelatin, celluloid or other material which may be readily cut by a stylus and which is sufficiently rigid to impart movement to a reproducing stylus may be used, but it is convenient and economical to use a discarded motion picture film. The film 10 is wound upon reels 11, 11', having fixed pulleys 12 and loose pulleys 12', and passes over an idler wheel 13 and a table 14 having side flanges or plates 14' which prevent lateral movement of the film during the recording and reproducing operations. Small spring pressed rollers 15 rest upon the film to hold it in contact with the sprocket 9 and idler 13, respectively. The reels 11, 12 are driven from the sprocket drum or driving wheel 9 by belts 16, 16' which are engaged by idlers 17, 17' slidably mounted on fixed shafts 18 and adapted to be shifted laterally by forked arms 19 on an oscillatory belt tightening shaft 20. Guide sleeves 21, 21' which engage the belts are also mounted on the shaft 20. As indicated by the

arrows in Fig. 1, the film 10 is traveling towards the right and belt 16 is on loose pulley 12' of reel 11 while belt 16' is on the tight pulley of reel 11' to take up the film. The belts are preferably of the elastic spring type and the pulleys are so related that the winding reel tends to move the film more rapidly than the sprocket 9. The belt shifting mechanism includes idlers 17, 17' slidable on shafts 18, yokes 19 on a rock shaft 20, and belt guides 21 also mounted on the shaft. The mechanism for rocking the shaft 20 will be described hereinafter.

The cutting and reproducing mechanism comprises a head or casing which houses the mechano-electrical transducer for converting the electrical energy of audio frequency currents into mechanical vibrations of a cutting stylus or, alternatively, for converting the mechanical vibrations of a reproducing stylus into electrical currents. The exact design of the transducer is not material and known arrangements of an alternating current or voice coil pivotally supported in the field of a permanent magnet may be used. As shown in Figs. 1 to 3, the transducer casing 22 or cutting and reproducing head is of rectangular form with a cutting stylus 23 and reproducing stylus 24 projecting from the upper and lower faces of the casing. The cutting stylus is preferably of triangular cross-section and has a symmetrically arranged wedge-shaped end as the film travels in opposite directions. Screws 23', 24' for securing the styli in place project from the end of the casing 22. The casing is mounted on a supporting frame 25 by a screw 26 which permits rotation of the casing about its longitudinal axis to present either stylus towards the sound film. The frame 25 is pivotally mounted on a shaft 27 that extends transversely above the film, and the lower stylus of the transducer unit is held in contact with the film by gravity. A cutting pressure of the order of 100 grams has been found satisfactory when using motion picture film, and this or any appropriate pressure may be obtained by adjustment of the weight and balance of the cutting head and supporting frame.

The cutting head should be raised before it is rotated to prevent scratching of the film, and this operation takes place automatically when the rod 28 is pressed in to force the wedge-shaped head 29 into the non-circular recess 30 that is formed in the end of casing 22. The recess is located on the axis of the casing but the rod 28 is slightly above that line and the casing 22 is therefore lifted as the head 29 enters the recess. The rod 28 may then be turned to rotate the casing through 180°. A spring pressed ball 31 is mounted in the supporting frame to engage in one of the recesses 32 in the adjacent surface of the cutting head, thus facilitating the setting of the cutting head to position the lower stylus normal to the film. The electrical circuit to the transducer is automatically completed, for either setting of the cutting head, by spring contacts 33 on the frame 25 and cooperating sets of contacts 34, 35 on the cutting head.

The hollow shaft 27 is journalled on a spindle 36 and has external threads engaging with the supporting frame 25 to effect a lateral adjustment of the cutting head. The mechanism for reversing the direction of film travel and simultaneously shifting the cutting head laterally of the film is preferably controlled by the traveling film itself which, as shown in Figs. 9 and 10, is provided with a notch or cut-out portion, such as an elongated slot at each end. The slot at the farther edge of the film, as viewed in Figs. 2 and 9, includes a narrow section 10a which opens into a wider section 10A, and this slot is near the left end of the film 10 while the corresponding slot 10b, 10B at the near edge of the film is adjacent the right end of the same.

The mechanism which cooperates with these slots of the film is best shown in Figs. 3, 4 and 8. A wedge-shaped electrical contact 37 is carried by a sleeve 38 which is journalled on a shaft 39, the lower portion of contact 37 being of such width as to pass through the slot 10b, while the upper portion or insulating support 37x is of greater width to pass through slot 10B, but not through the slot 10b. Shaft 39 is mounted in brackets 40 that are loosely journalled on the spindle 36, and the shaft 39 is held in a relatively elevated position when the electrical contact 37 rests on the film as a spring 41 tends to raise the right end of the contact member. A sleeve 42 on the shaft has a feed pinion 43 in line with the further row of film perforations and a gear 44 in mesh with a gear 45 on a countershaft 46. A gear 47, of the same pitch diameter as gear 45, is fixed to shaft 46 and meshes with a gear 48 that is connected to the hollow threaded shaft 27 by one-way clutch balls 49, see Fig. 5.

Assuming that the film 10 is moving towards the right in Fig. 3, as indicated by the arrow, the slot 10a passes beneath the contact point 37 as the end of the film is approached, and the lower portion of the contact drops through the film and thus lowers the feed pinion 43 into mesh with the perforations of the film. The pinion is thus turned counter-clockwise as the film moves, and operates through the gears 44, 45 and 47, 48 to turn the threaded shaft counter-clockwise to effect a lateral displacement of the cutting head downwardly, as viewed in Fig. 4. When the wider slot section 10A comes beneath the contact 37, the wider upper section 37' of the contact element passes through the film to bring contact 37 into engagement with a stationary contact 50 which is mounted in an insulating bushing in a recess in the film table 14. The electrical circuit thus closed effects a reversal of the motor, through relay circuits to be described, and the film travel is reversed. Due to the one-way clutch connection between gear 48 and the transverse feed shaft 27, the clockwise rotation of the feed pinion 43 does not effect a corresponding backward movement of the cutting head upon the reversal of the film travel.

The reversing and transverse feed elements which cooperate with slot 10b, 10B to effect the next reversal of the motor and lateral displacement of the cutting head are of similar construction, except that the idler countershaft is omitted as to the clockwise rotation of the feed pinion 43' must effect a counterclockwise rotation of the transverse feed shaft 27. Corresponding elements of the mechanism are identified by primed reference numerals but will not be described in detail.

As shown schematically in Fig. 11, the relay for reversing the motor 7 and operating the belt shifter includes a pair of electromagnets 51, 51' having a common armature 52 that is mounted on an arm 53 secured to the rock shaft 20. One side of the operating winding of each magnet is connected to a terminal S or source of current, preferably the usual 110 volt lighting circuit, by leads 54, 54' and the other terminals of the operating windings are connected to the contacts

50, 50', respectively. The contacts 37, 37' are connected to the other terminal S' of the current source by leads 55, 55', respectively. The armature lever 53 carries contacts cooperating with the sets of motor circuit contacts 56, 56', respectively, which control the direction of rotation of the motor. Lever 53 also operates holding circuit switches 57, 57' which are effectively in shunt with the automatic switches 37, 50 and 37', 50' but which, preferably, energize holding circuits of higher resistance than the operating windings. With the parts in the positions shown in Fig. 11, the motor is rotating clockwise, the belt shifter elements on shaft 20 have transferred the drive to reel 11' and the film is moving towards the right, Figs. 1 and 2. The stationary contacts 58 of limit switches in the motor circuit are arranged at opposite sides of the supporting frame 25 for engagement by cooperating contacts 59 on the cutting frame to open the motor circuit when the cutting head reaches either of its extreme positions. The threaded shaft 27 may be rotated manually by the knurled wheel 60 to set the cutting head above the desired sound track. As shown in Figs. 1 and 2, the knurled wheel 60 is mounted on shaft 61 which carries a gear 62 meshing with the gear 63 that is fixed to the transverse feed shaft 27, and also a gear 64 which rotates an indicator disk 65 that is positioned back of a window 66 in the casing 1 and has numbers indicating the sound track above which the cutting head is positioned.

The path indicating wheel 65 is marked with numbers from "1" to "10", as the illustrated apparatus was designed to cut ten sound tracks on a sixteen millimeter film. The width of each sound track is somewhat less than one millimeter and the transverse feed mechanism is designed to effect a lateral movement of the cutting head of exactly one millimeter to shift from one sound track path to the adjacent path. A film speed of about twenty centimeters per second gives good results, and the record for a complete hour can be made on a film of about seventy-two meters length when ten sound tracks are cut. The number of sound tracks may be varied by using film of different widths and the length of the film may be selected to meet any desired conditions.

The described apparatus may be used for many purposes such as the recording of testimony in court proceedings, as a phonograph for recording speech and music, etc., and it is particularly useful in the recording of telephone messages when the subscriber is absent. An appropriate wiring circuit for this use of the apparatus is shown in Fig. 12 in which the normal telephone circuits of the receiver station are shown in light lines and the added wiring of this invention is shown in heavier lines.

The telephone circuit includes the usual mouthpiece or transmitter T, receiver R and bell B. The secondary of the transformer 67 is connected to the movable contacts of a switch 68 having sets of fixed contact points connected, respectively, to the receiver R and to the leads 69 that extend to the recording contacts 34 on the cutter head support 25. The bell B is not connected directly across the telephone lines 70, but is in series with a thermal relay 71. The contacts 72 of the relay are adapted to close when the bell circuit current is passed through the relay for a predetermined interval, for example one minute, to connect the relay 73 across the telephone line. Relay 73 actuates a double switch having contacts 74 for closing the power circuit to the rectifier-filter unit 75 and to the motor circuits, and contacts 76 which complete a holding circuit for the relay 73 and also connect the leads 77 of the recorder input transformer 78 across the telephone line.

The secondary of the transformer 78 is connected across the amplifier tube 79 in parallel with the leads 80 from the reproducing contacts 35 on the cutter head support, and the output transformer 81 of the amplifier tube is coupled by the leads 69 to the recording contacts 34 on the cutter head support. As described above, the contacts 33 of the coil VC of the transducer head are automatically connected to the appropriate terminals 34 or 35 as the transducer head is adjusted for recording or reproducing, respectively.

With the switch 68 in the position illustrated, the operation is as follows. The normal telephone circuits are completed and the telephone may be used in the customary manner. If the telephone is not answered, the thermal relay 71 closes after the predetermined interval and a direct current circuit is completed through relay 73; thus stopping the ringing of the telephone, energizing the power circuit of the recorder and connecting the recorder input transformer 78 across the telephone line. The caller knows that the recording apparatus is in operation as no answer is forthcoming, and he delivers his message. This is amplified by the tube 79 and passes to the cutting apparatus through the contacts 34, 33. When the caller hangs up his telephone, this breaks the direct current circuit and relay 73 is deenergized, thus breaking the power circuit of the recorder at switch 74. When the subscriber returns and observes from the indicator dial 65 that one or more messages have been recorded, he lifts the transducer head by the rod 28, shifts the control armature manually to reverse the motor, and closes the switch 84 which is in parallel with the relay-controlled switch 74 of the recorder power circuit. When the film is restored to the position in which the subscriber had left it, he stops the motor, lowers the reproducer stylus 24 to the film, actuates switch 68 to connect the telephone receiver R across the secondary of the amplifier output transformer 81, and then starts the motor in reversed direction. The electrical vibrations pass from the pick-up to the amplifier tube 79 and its output transformer to the receiver. When the message is finished, the motor is stopped by opening switch 84, and the apparatus is restored to its original condition by reversing the switch 68 and turning the transducer head over to place the cutting stylus 23 on the film.

If desired, a jack 85 may be included in the leads 69, by which messages are repeated in the telephone receiver, for receiving a plug 86 to connect a loud speaker 87 into the repeater circuit. Preferably, also, a jack 88 is connected into the leads 77 to input transformer 78 to permit the subscriber to plug in a microphone 89 for recording upon the film independently of the telephone system.

It will be apparent that there is considerable latitude in the design, shape and relationship of the component parts of the apparatus, and that many variations may be made in the illustrated embodiment without departing from the spirit of my invention as set forth in the following claims.

I claim:

1. In sound recording and reproducing apparatus of the type employing a sound film having

a plurality of sound tracks extending longitudinally thereof, the combination with a transducer unit, film feeding means for moving a sound film longitudinally and in opposite directions along a path beneath the transducer, means supporting the transducer for movement transversely of the film, and track-shifting means operable mechanically by the moving film for effecting transverse movement of said transducer, of means contacting the film and controlled by notches formed therein for reversing the direction of movement of said film feeding means and for substantially simultaneously moving said track-shifting means into engagement with the film, whereby the film actuates the track-shifting means to bring said transducer into position to operate upon another sound track path.

2. In apparatus for recording and reproducing sound, the combination with means for supporting a sound film for longitudinal travel in opposite directions, a driving wheel having teeth for engaging perforations at the edges of the film for moving the same longitudinally, motor means for rotating said driving wheel in opposite directions, transducer means for cutting a sound track in said film and adapted alternatively to be actuated by a sound track, means pivotally supporting said transducer above said film and in position to engage the same by gravity, said supporting means including means for adjusting said transducer to alternative positions for recording and for reproducing, and means operable automatically by the film as the ends thereof approach said transducer means for reversing the direction of rotation of said motor means.

3. In apparatus for recording and reproducing sound, the combination with means for supporting a sound film for longitudinal travel in opposite directions, a driving wheel having teeth for engaging perforations at the edges of the film for moving the same longitudinally, motor means for rotating said driving wheel in opposite directions, transducer means for cutting a sound track in said film and adapted alternatively to be actuated by a sound track, means operable automatically by the film as the ends thereof approach said transducer means for reversing the direction of rotation of said motor means, normally inoperative means adapted to be actuated mechanically by said film to move said transducer means laterally of the film to an adjacent sound track path, and means for moving said normally inoperative means into engagement with the film when the ends of the film approach the transducer.

4. In apparatus for recording and reproducing sound, the combination with means for supporting a sound film for longitudinal travel in opposite directions, a driving wheel having teeth engaging perforations at the edges of the film for moving the same longitudinally, motor means for rotating said driving wheel in opposite directions, a transducer support, and means operable automatically as the ends of the film approach said transducer support for reversing the direction in which said driving wheel is rotated by said motor means and for moving said transducer support laterally of the film to an adjacent sound track, of a mechano-electric transducer having a cutting stylus and a reproducing stylus, a casing housing said transducer with said styli projecting from opposite sides thereof, and means mounting one end of said casing on said transducer support for angular movement through 180° to position the desired stylus for contact with the sound film, said transducer support being pivotally mounted on a horizontal axis, whereby the unbalanced weight of the casing turns said casing and support about said horizontal axis to hold the lower stylus in contact with the sound film.

5. In apparatus for recording and reproducing sound, the combination with means for supporting a film for longitudinal movement, and a substantially horizontal table upon which said film slides during said movement, of cutting and reproducing means comprising a mechano-electric transducer having a cutting and a reproducing stylus projecting from the upper and lower sides thereof, means pivotally supporting said transducer to position the lower stylus thereof in contact with the portion of the film which rests upon said table, and means for reversing said transducer to present the desired stylus to the film.

6. Apparatus as claimed in claim 5 wherein said means for reversing the transducer includes means operable automatically to lift the lower stylus above the film prior to the reversing of the transducer to present the other stylus to the film.

7. In apparatus for recording and reproducing sound by means of tracks cut into a film, the combination with means supporting a film for longitudinal movement in opposite directions, of a shaft and means supporting the same in fixed position above and transversely across the path of movement of the film, a cutting and reproducing head, means mounting said head upon said shaft, said head having stylus means spaced from said shaft and adapted to be moved into contact with the film by the weight of said head, means for displacing said head along said shaft into different sound track paths, and means operable by a film for actuating said displacing means.

8. Apparatus as claimed in claim 7 wherein said cutting and reproducing head comprises a casing, transducer means within said casing and including a cutting and a reproducing stylus projecting from said casing for alternative engagement with the film; and said mounting means includes means supporting said casing for angular movement to position the desired stylus for engagement with the film.

9. In apparatus for recording and reproducing sound by means of tracks cut into a film, the combination with means supporting a film for longitudinal movement in opposite directions, of a head having a cutting stylus and a reproducing stylus projecting substantially vertically from opposite sides thereof, means pivotally supporting said head for movement by gravity to carry the lower stylus into contact with the film, and means supporting said head for rotation about an axis substantially parallel to the length of the film to present either stylus towards the film.

10. Apparatus as claimed in claim 9, wherein said head has a non-circular recess located substantially at the axis of rotation of the head, in combination with manually operable means for rotating said head; said means comprising a rod supported for rotation and for longitudinal motion on an axis passing through said recess in the head and above the axis of rotation of said head, the end of said rod adjacent the head being complementary to and adapted to enter the said recess upon longitudinal movement of said rod, whereby said rod may be moved longitudinally to lift the head from the film and then turned to rotate the head.

11. Sound recording and reproducing apparatus of the type in which a plurality of parallel sections of a sound track are formed on an elon-

gated film having a row of perforations along the edges thereof, said apparatus including means for supporting and moving said film in opposite directions, a transducer head, and means for moving said head laterally, characterized by the fact that said head-moving means includes a threaded shaft for imparting lateral movement to said head, a pair of toothed wheels normally positioned above the film and in line with the rows of perforations thereof, motion-transmitting means connecting said toothed wheels to said threaded shaft for rotating the same, and means operable as the ends of the film approach the transducer head for selectively lowering one of the toothed wheels into engagement with the perforations of the film.

12. The invention as claimed in claim 11, wherein said motion-transmitting means include a different number of motion-reversing transmission elements, whereby said threaded shaft is turned in the same direction by the toothed wheels.

13. Sound recording and reproducing apparatus of the type including means for displacing a sound film longitudinally with reference to a sound transducer, means for reversing the direction of longitudinal displacement of the film, and means for effecting a relative movement of said film and transducer transversely of the film as the direction of longitudinal displacement is reversed; said reversing means comprising switch means including relatively movable contacts at opposite sides of and normally spaced apart by the film, and said last means comprising a feed screw for effecting transverse movement of said transducer and a sprocket wheel for driving said feed screw, said sprocket wheel being supported above the film by the upper one of the movable switch contacts, whereby said sprocket wheel is lowered to engage the perforations of a sound film when an opening in the film permits the upper switch contact to drop towards the lower switch contact.

14. In sound recording and reproducing apparatus, the combination with a transducer head adjustable to alternative positions for recording and for reproducing, said head including a coil having terminals, a support for said head having a set of recording terminals and a set of reproducing terminals positioned for alternative engagement with said coil terminals, a vacuum tube amplifier, an input impedance for said amplifier, means for impressing a signal wave upon said input impedance, circuit connections form the reproducing terminals of said transducer head support to said input impedance, an output impedance for said tube, a sound reproducer, and means connecting the sound reproducer and said recording terminals of the transducer head support in parallel across said output impedance, whereby an incoming signal wave is transmitted to the transducer head by said amplifier for recording and the pick-up from said transducer head during reproduction is transmitted to the sound reproducer through said amplifier.

MARCUS FRANS JOSEF WIELAGE.