(No Model.) 5 Sheets—Sheet 1.

S. D. McKELVEY.

PHONOGRAPH.

No. 519,614. Patented May 8, 1894.

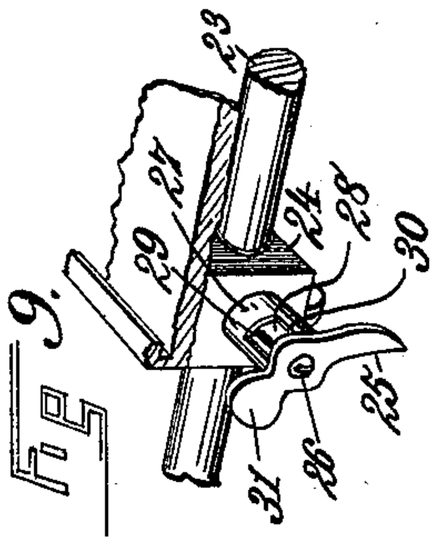

FIG. 9.

FIG. 1.

FIG. 8.

FIG. 7.

WITNESSES:

E. J. Cross.

Elmer R. Eckis

INVENTOR

Stewart Dixon McKelvey

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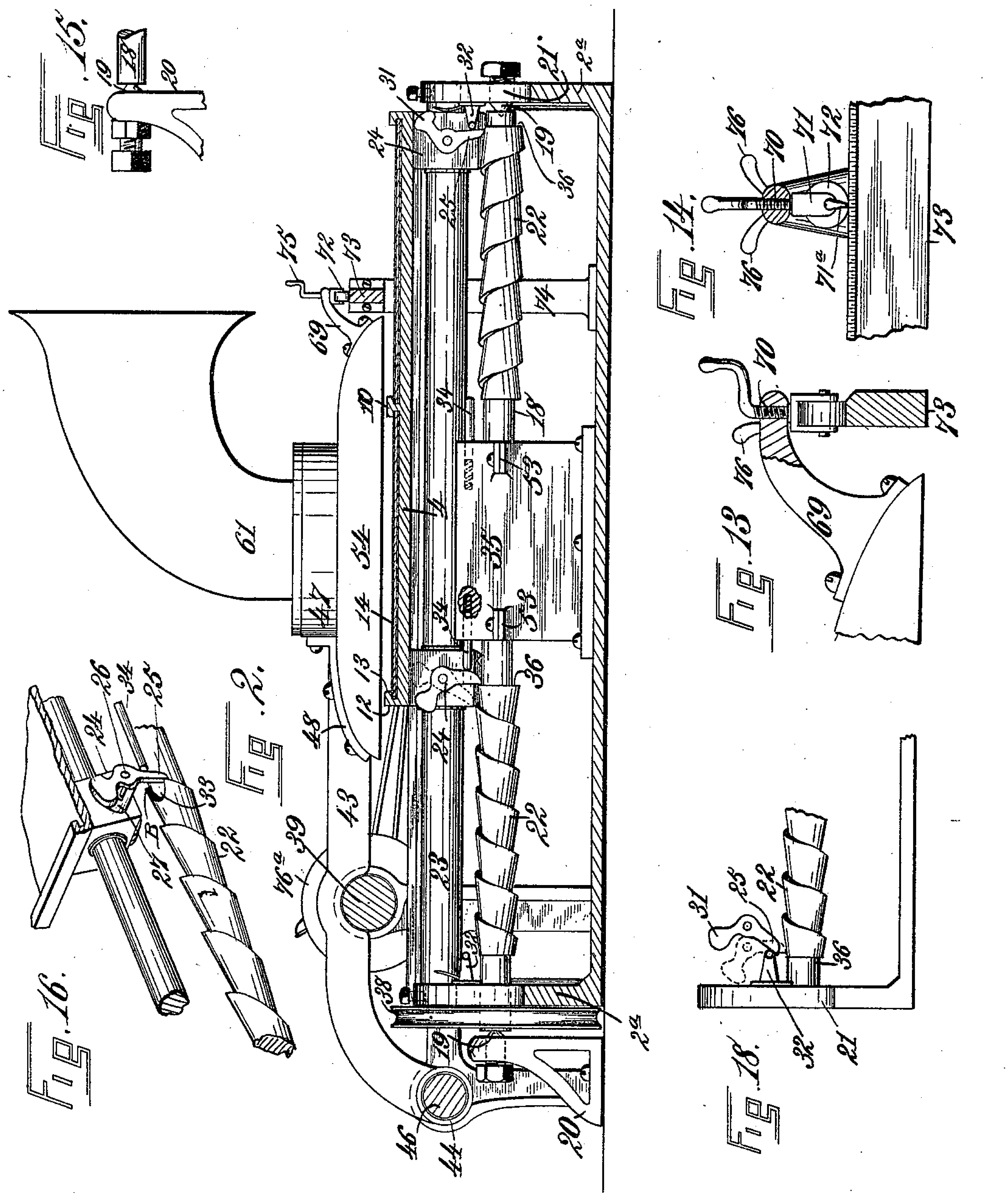
WASHINGTON, D. C.

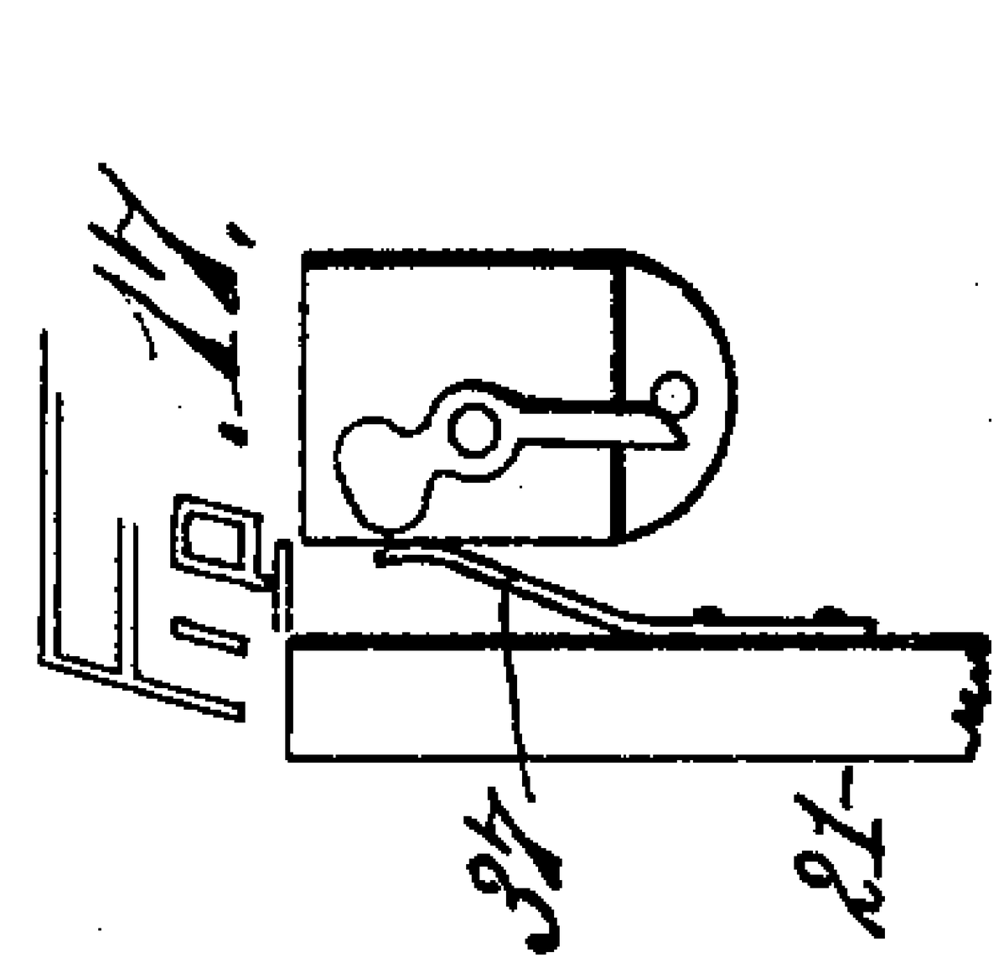
(No Model.) 5 Sheets—Sheet 2.

S. D. McKELVEY.

PHONOGRAPH.

No. 519,614. Patented May 8, 1894.





WITNESSES:

J. Gross.

Elmer R. Eckis

INVENTOR

Stewart Dixon McKelvey

(No Model.) 5 Sheets—Sheet 3.

S. D. McKELVEY.

PHONOGRAPH.

No. 519,614. Patented May 8, 1894.

Fig. 3.

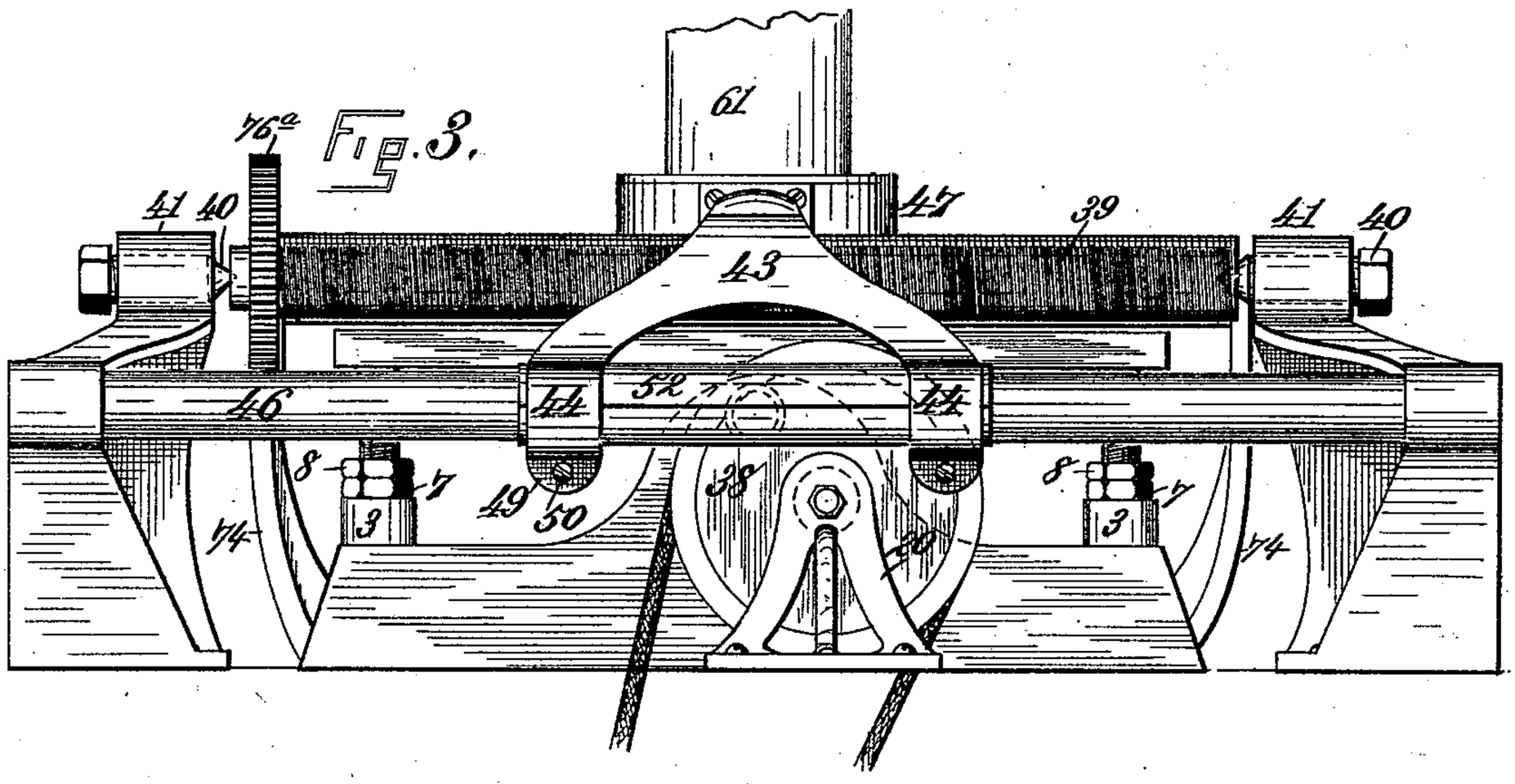


Fig. 4.

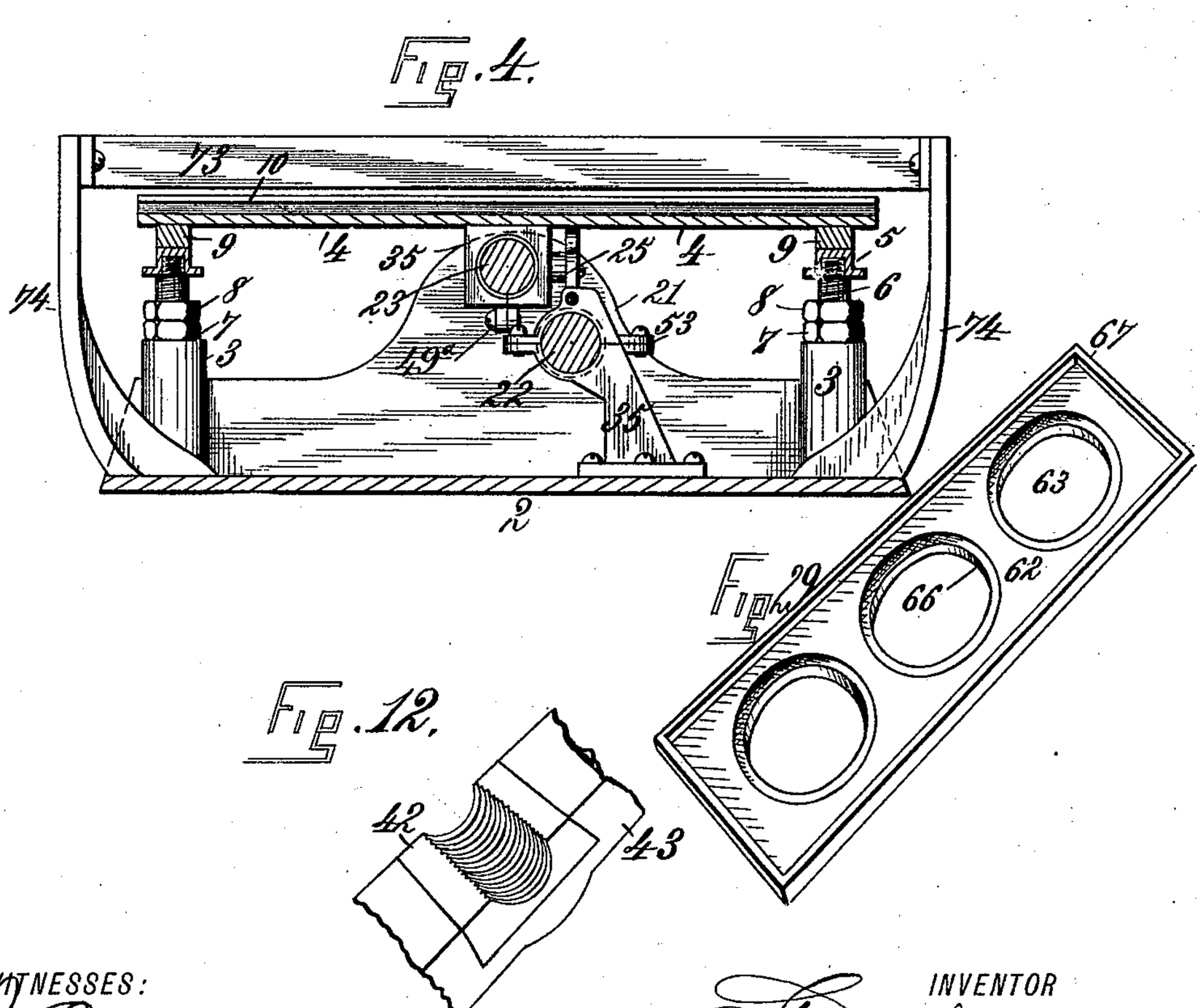


Fig. 12.

Fig. 5.

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C. L. Ross.

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(No Model.) 5 Sheets—Sheet 4.

S. D. McKELVEY.

PHONOGRAPH.

No. 519,614. Patented May 8, 1894.

Fig. 5.

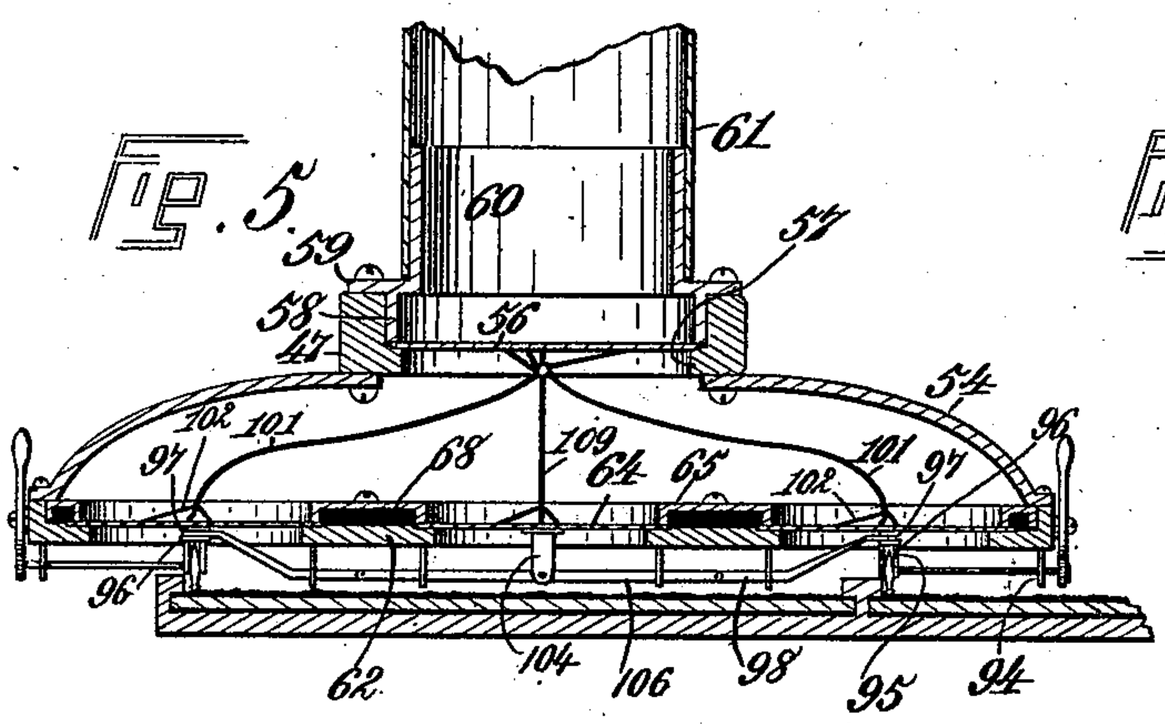


Fig. 6.

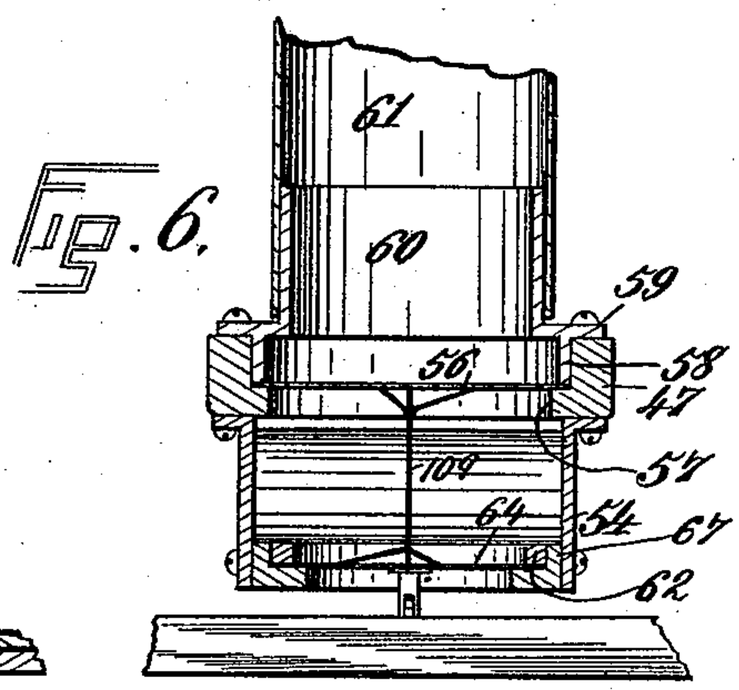


Fig. 26.

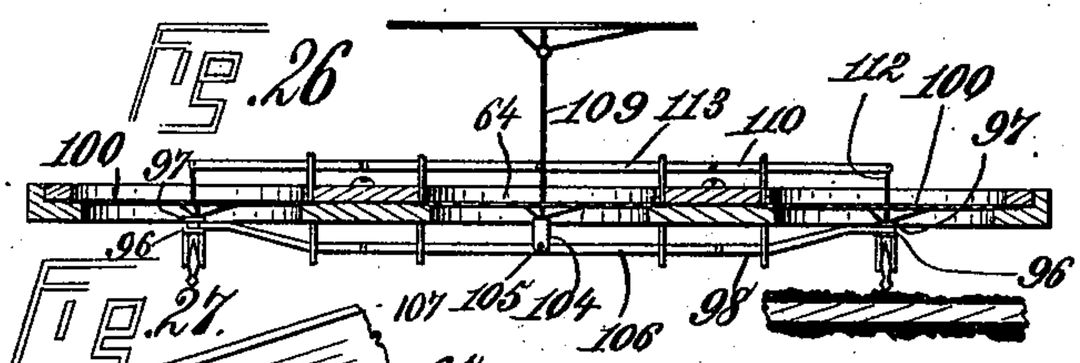


Fig. 27.

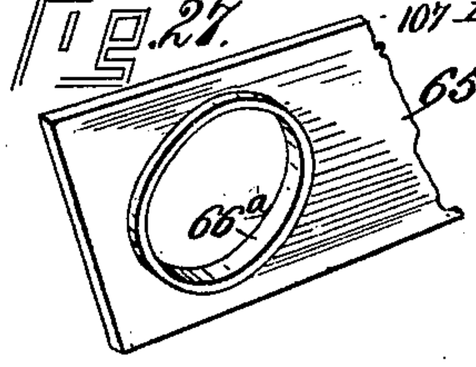


Fig. 28.

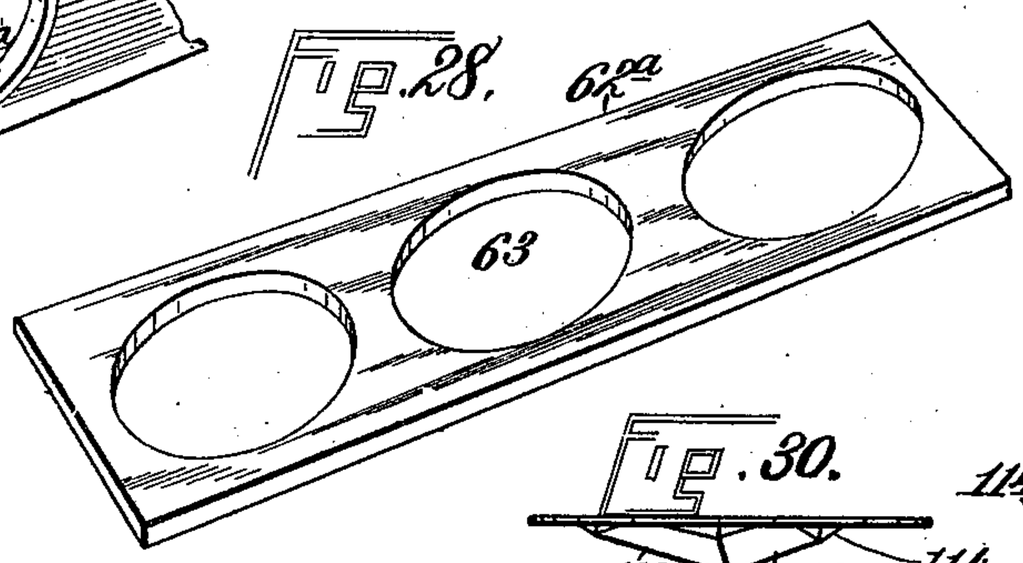


Fig. 33.

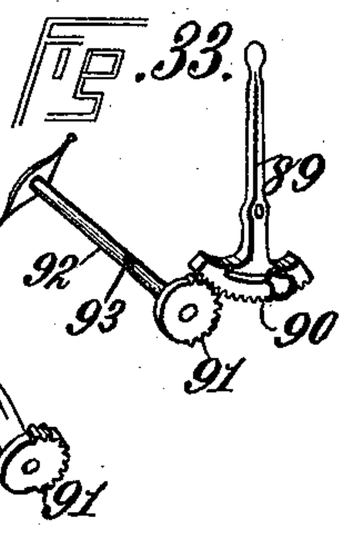


Fig. 34.

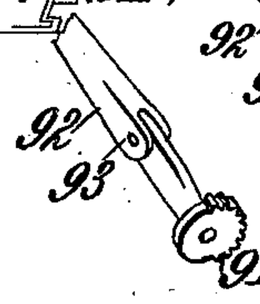


Fig. 30.

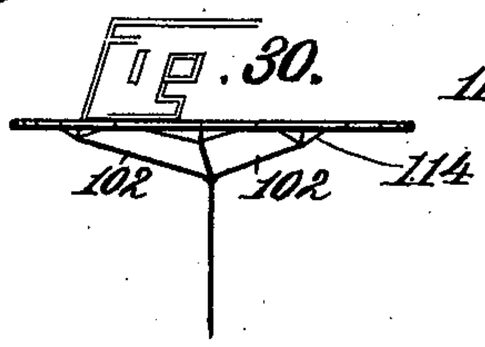


Fig. 39.

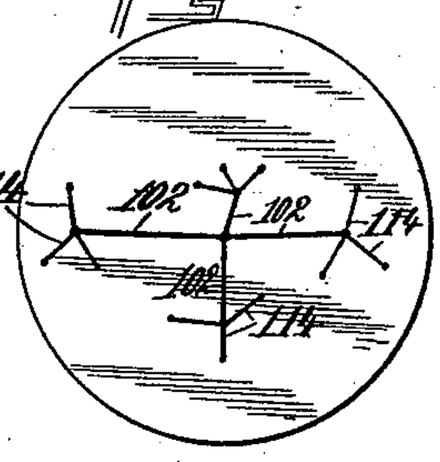


Fig. 35.

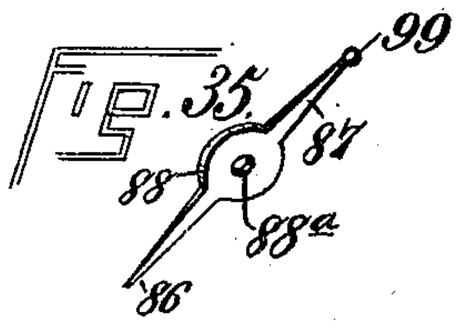
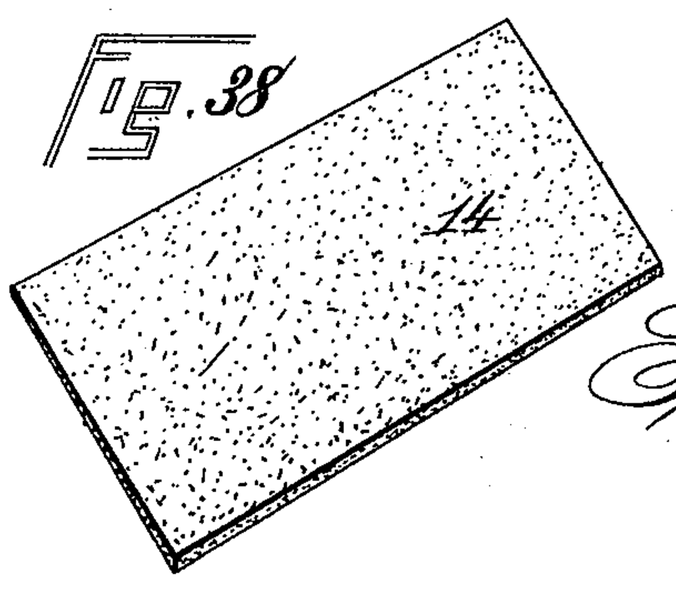


Fig. 38.



WITNESSES:

Elmer R. Eckis

INVENTOR

Stewart Dixon McKelvey

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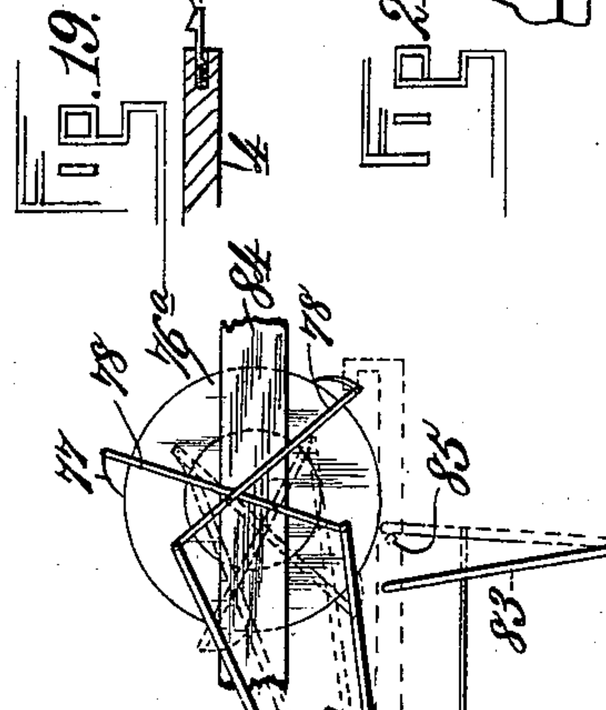
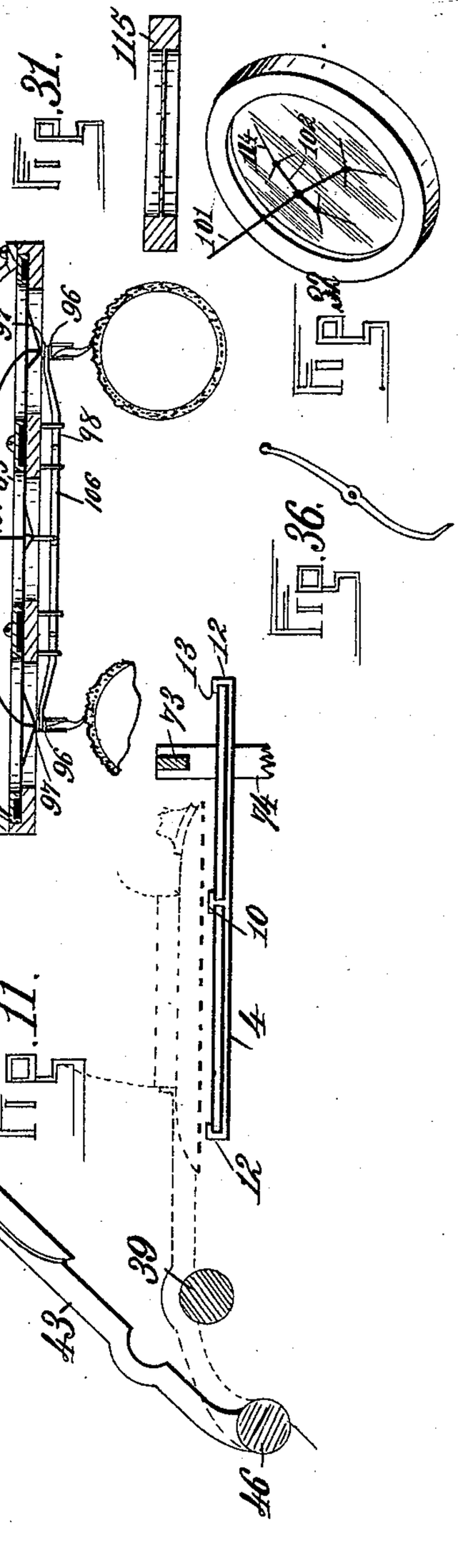
(No Model.) 5 Sheets—Sheet 5.

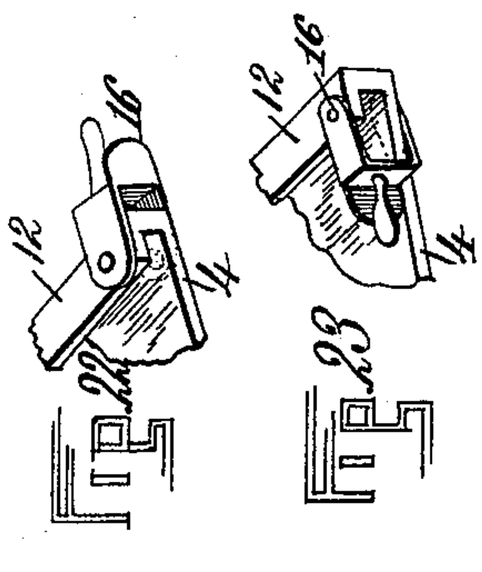
S. D. McKELVEY.

PHONOGRAPH.

No. 519,614. Patented May 8, 1894.







WITNESSES:

J. J. Cosgrove.

Edwin R. Eckis.

INVENTOR

Stewart Dixon McKelvey

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UNITED STATES PATENT OFFICE.

STEWART DIXON McKELVEY, OF CANTON, OHIO, ASSIGNOR OF ONE-THIRD TO JOSEPH A. LINVILLE, OF SAME PLACE.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 519,614, dated May 8, 1894.

Application filed November 5, 1891. Serial No. 411,001. (No model.)

To all whom it may concern:

Be it known that I, STEWART DIXON McKELVEY, a citizen of the United States, residing at Canton, in the county of Stark and State of Ohio, have invented new and useful Improvements in Phonographs, of which the following is a specification.

My invention relates to certain improvements in phonographs, the purpose thereof being to make provision for the use of a flat surface for recording the sound vibrations, instead of the cylindrical form now in general use, and to enable a duplicate record to be formed at the same time and from the same vibrations, upon a separate surface, or tablet to serve as a retained copy of the matter recorded upon the tablet, which is mailed or otherwise used.

It is my purpose also, to provide means enabling a continuous and unbroken phonographic record to be made upon a flat tablet of suitable material; the path of the recorder being from side to side, or end to end of the tablet; to so actuate the feeding devices that the sharp turns of the recorder, at the rounded ends of the successive lines, shall be made in such a manner that the reproduction shall not be varied or impaired in any manner; to provide automatic means for feeding the tablet to give the line-space and for reciprocating said table beneath the recorder, or reproducer, and to enable a duplicate record to be made upon an independent tablet and by a separate, or secondary recorder, actuated by a separate diaphragm, but operating in unison with the main, or primary diaphragm.

It is further my purpose to provide novel devices for supporting the recorder and for transmitting the vibrations of the diaphragm thereto, and to provide simple means whereby two duplicate records may be made upon different surfaces, by a single primary diaphragm, and to provide for the adjustment of the recording or reproducing devices, with relation to the surface, or surfaces, upon which they operate.

It is one purpose of my invention to provide means whereby, as already set forth, double or duplicate records can be simultaneously produced upon, or reproduced from, independent surfaces, to provide a retained copy in case one duplicate should be mailed to a correspondent, or otherwise pass out of the hands of the person making it.

It is also my object to provide for the employment of such duplicate records in the reproduction, and thereby materially increase the volume of sound.

It is my purpose, also, in this connection, to provide a construction and combination of parts whereby the position of either one of the recording instruments, or the reproducers may be adjusted as to the angle at which it acts, or removed entirely from action; to provide a novel method of connecting the said instruments to the diaphragms by which they are supported, whereby no two points of connection shall be in the same nodal circle, or line, and to connect the main phonetic diaphragm upon which the sound is concentrated, to the individual supporting diaphragms in such manner that the latter shall have more or less vibratory movement in unison with the main diaphragm.

It is one object of my invention, also to obviate the false vibrations which are frequently produced in phonographs, and by reason of which crackling, or harsh grating, sounds of considerable strength are given by the reproducer.

I propose, moreover, to provide certain novel improvements in the construction of the recording and in the reproducing instruments, or needles, whereby rapid wear and deterioration from often repeated use of the recorders in reproducing is avoided.

It is my object, also, to improve the diaphragm, to render it more sensitive, and to provide simple and novel means for supporting and holding the composition upon which the record is made, either singly, or in duplicate.

The invention consists, to these ends, in the several novel features of construction and new combinations of parts hereinafter fully set forth, and then more particularly pointed out and defined in the claims following this specification.

To enable others skilled in the art to which my invention pertains, to make, construct and use the same, I will proceed to describe my invention in detail, reference being had for that

purpose to the accompanying drawings, in which—

Figure 1, is a perspective view, showing the complete mechanism, save only the motor, or other actuating device. Fig. 2, is a transverse vertical section of the parts shown in Fig. 1, taken a little to the side of concentrator. Fig. 3, is a rear elevation of the parts shown in Fig. 1, the concentrator being partly broken away. Fig. 4, is a vertical section, taken longitudinally a little in front of the guide rail, or track 73, Fig. 1. Fig. 5, is a vertical section taken centrally through the concentrator and through the diaphragm chamber beneath. Fig. 6, is a vertical section of Fig. 5, the section plane being at right angles with the line of section in Fig. 5. Figs. 7 and 8, are detail perspective views showing the metallic, or fiber sleeves, for taking up the wear. Fig. 9, is a detail perspective, showing the automatic feed-dog which engages with the double threaded shaft for imparting a reciprocating motion, or transverse feed, to the platform carrying the recording tablets. Fig. 10, is a detail end elevation, showing the mechanism by which the line-feed is effected. Fig. 11, is a detail vertical section, showing the manner of connecting the sound-conveyer and concentrator and diaphragm chamber, and engaging the same with the threaded shaft, imparting a periodical line-feed. Fig. 12, is a detail perspective, showing part of the carrier and the threaded pillow-block set therein to rest upon the shaft giving the line-feed. Fig. 13, is a detail section, showing the means for adjusting the position of the stylus relatively to the surface upon which it operates. Fig. 14, is a detail section, showing the same parts, and the front edge of the graduated guide bar or track. Fig. 15, is a detail elevation, showing one of the adjustable end bearings for the feed shafts. Fig. 16, is a detail perspective, showing parts of the shaft by which the transverse feed is effected, with the feed-pawl and part of the platform. Fig. 17, is a detail view, showing the action of the feed-pawl, and one of the springs for facilitating the return-feed of the platform, and preventing all shock or jar to the reverse movement of the table. Fig. 18, is a detail view, showing the action of the feed-pawl, or dog, in reversing the feed of the platform. Fig. 19, is a detail view, showing the edge of the platform and the latch holding one of the pivoted stops, by which the tablet is arrested, when introduced to proper position. Fig. 20, is a detail perspective, showing one of the pivoted stops. Fig. 21, is a detail perspective, showing the stop (Fig. 20), mounted and engaged with the latch shown in Fig. 19. Fig. 22, is a detail perspective, showing one of the pivoted detents for securing the tablet and preventing longitudinal displacement after said tablet is placed upon the platform. Fig. 23, is a detail perspective, showing the detent illustrated in Fig. 22, closed. Fig. 24, is a detail section of a part of the platform, showing one of the tablets in place with the stop closed. Fig. 25, is a perspective view of one of the stops shown in Fig. 24. Fig. 26, is a view in vertical section, showing the main diaphragm, and the auxiliary, or secondary diaphragms, the connections between the same, the styles, the devices intermediate between the styles and the diaphragms, and part of one of the tablets. Fig. 27, is a partial perspective, showing the construction of the under part of the support for the auxiliary or secondary diaphragms. Fig. 28, is a detail perspective of the upper part of the said diaphragm support. Fig. 29, is a detail perspective, showing the construction of the upper surface of the lower plate, and in which the secondary or auxiliary diaphragms are supported. The under surface of said plate is flat, the same as the upper surface of plate as shown in Fig. 28. Fig. 30, is an edge elevation of the parts shown in Fig. 39. Fig. 31, is a central section of a diaphragm and its supporting frame, showing the preferred construction. Fig. 32, is a detail perspective, showing a diaphragm and its frame, and illustrating manner of attaching the stylus connections. Fig. 33, is a detail perspective, showing one of the duplex recording and reproducing styles, with the reversing devices. Fig. 34, is a detail view upon a somewhat enlarged scale of part of the stylus-supporting-lever shown in Fig. 33. Fig. 35, is a detail perspective upon an enlarged scale, of the style shown in Fig. 33, detached from its lever or support. Fig. 36, is a detail perspective showing a modification of the stylus shown in Fig. 35, when used on cylindrical tablets as shown in Fig. 37. Fig. 37, is a sectional view, showing a slight modification, adapting the duplex recording and reproducing devices to a cylindrical tablet. Fig. 38, is a perspective view of one of the preferred flat tablets. Fig. 39, is a face view of one of the diaphragms, showing one method of connecting between different nodal circles.

The reference numeral 1, in said drawings indicates the supporting frame of the machine, which consists, essentially, of a rectangular base-plate, raised, if desired, upon legs. The construction of the frame is not necessarily of importance in practicing the invention and may be widely varied. I will, therefore, in referring to this part, be understood as comprehending any preferred form of construction, and the use of any desired material therein.

Upon the base-plate 1 is usually placed a somewhat smaller table 2, from which rise posts 3, to sustain the rails traversed by the reciprocating platform, or carriage 4, which supports and retains the tablets on which record is to be made, or from which recorded matter is to be reproduced. The rails consist of bars 5, of suitable material, having in cross section the form, approximately, of a letter T inverted. They are supported at or near their ends upon the posts 3, by means of

threaded pins 6, having their reduced upper ends tapped, or swiveled into the lower faces of the rails, while the other ends of said pins enter threaded apertures in the tops of the posts and rest upon nuts 7, which are held in place by jam-nuts 8. This construction permits a delicate and accurate adjustment of the platform at each of its four corners separately.

The carriage 4 consists of a perfectly flat, rectangular plate, provided with slide-blocks, or ribs 9, which may extend from side to side of its lower face and serve as stiffening ribs. These bars, or blocks, rest and slide upon flat upper surfaces of the rails 5. This arrangement is capable of modification, and I do not wish to be limited as to construction, as I have found by placing a journaled traveler at or near the four corners of the table, similar to one shown by reference to 71 and 72, (Fig. 14) and placed so that the traveler shall rest upon the guide bars 5, that the friction is considerably reduced. These travelers may be constructed so as to roll in either direction upon the guide bars, and may be supported by suitable brackets, attached to the under surface of table 4.

The carriage is of such size as to provide two similar spaces, divided from each other by a T flange 10, rising from the surface and extending from end to end, the outer edges parallel with said flange, being provided with flanges 12, having overhanging ribs 13, and the corresponding rib on the central or dividing flange 10. Each space is preferably of the same length and width as the tablet to be inserted, so that the ends of the latter are flush with the ends of the carriage. To make the specification more clear, it should be here noted that the concentrator 61, faces the front of the machine as shown in Figs. 1 and 2. The tablets 14 are pushed into place and their ends are arrested or butted against suitable stops, which may be of form shown in Figs. 24 and 25. It is preferable that the stops on either end of the table do not project across the slotted openings in table 4, so that dust or shavings from tablet 14, may be easily removed. The ends of the tablets on the left or entering end of the table are held in place by suitable stops (Figs. 21, 22 and 23), pivotally mounted upon the angles 10 and 12 of table.

The table or carriage is moved by means of a threaded shaft 18, arranged centrally, or substantially so, beneath and transverse to the length of the tablet-spaces, so that the lines of record will cross the tablet. It will be noted that the same principles will be evolved in making record lines longitudinally on the tablet, or end to end. Shaft 18 is supported at its ends in cone-bearings 19, one of which is adjustable in a bracket 20, the other being tapped through a riser 21. Upon said shaft are formed worm-threads 22, both of which may be left, or right-hand threads, formed by cutting one first and then turning the shaft end for end, and cutting the other. Each of these threads is of such extent as to feed the carriage the length of a record line. The carriage or table is guided and its movement, rendered perfectly rectilinear by a rod or bar 23, supported at its ends by the riser 21, and by a similar support at the opposite end of shaft (Figs. 1, 2 and 4). The said bar is rigidly held in place by means of cap screws (Fig. 2). Embracing said bar or boxes 24, depending from the carriage and having suitable bushings 45 (Fig. 7) to take up the frictional wear.

Upon each of the boxes 24, is pivoted a dog 25, its pivotal support being afforded by a stud or pin 26, tapped into a lateral boss 27, which projects from the boxes, the outer ends of said bosses giving lateral support to the dogs against the side-thrusts of the worm-threads 22. In the surface of the boss 27, is formed a recess 28, in which lies a pin or lug 29, the latter being rigid with the dog, and adapted to move freely between the shoulders 30, at the ends of said recess, (see Fig. 9) said shoulders serving as stops to limit the swinging movement of the dog, and one of them being in such position as to maintain it rigidly in substantially the position shown in Fig. 2 in full lines, its point being in engagement with the worm-threads. Above its point of pivotal support, the dog is extended to form a shank or arm 31, which is enlarged at its end to increase its weight. This shank or arm is inclined at such an angle to the portion below the pivot pin, that when it is thrown backward and when the working end or point of the feed-dog is raised out of operative engagement with the worm-thread, it will be maintained in such position by the gravity of its weighted arm, as seen in dotted lines in Fig. 2. The form of construction of this feed-pawl or dog is capable of modification, and I may substitute for the pin 29, working in recess 28, two pins, set in the side of box 24, above the pivotal point of support, to limit the swing of the feed-dog or pawl, to accomplish the same movements as already described and shown in Fig. 9. The shaft 18, is driven continuously by any suitable power, such as an electric motor, a foot treadle, a spring actuated train of gears, or other suitable means.

The feed-dogs are brought into operative engagement with its worm-thread 22, by being automatically dropped by contact with the adjustable bracket arms 32, projecting from the risers 21, as shown more fully in Fig. 2. The engaging or lower portion of the dog is brought against said arm by the feed movements of the carriage, an instant prior to the reversing of said movement. The engagement of the lower end of the feed-dog with the worm-thread, is provided for by the formation of the adjustable bracket-arm 32, which may be so adjusted that the engaging point of the feed-pawl will drop into position just an instant before the end of the thread engages with said pawl. The feed-dogs may

be alternately tripped out of engagement with the worm-thread 22, by means of tripping bars 34, or by a leaf spring hereinafter described. The ends of the tripping bars 34, as seen in Fig. 2, are let into the opposite lateral faces of the pillow bearings 35, and are held in place by small spiral springs which are attached to the inner end of the tripping bars. The displacement of the tripping bars is prevented by a pin set through the pillow bearing cap, and the point of the pin working in an elongated slot, or between two shoulders as the construction of said bars may be preferred. I may also substitute for the spring-actuated arm or tripping bars 34, in pillow bearing 35, which supports the intermediate portions of the shaft 18, a leaf spring so adjusted that the pressure of the point of the spring shall be on the back edge of the pawl 25. The tension of the spring may be regulated by being wrapped around a small pin in the lower part of the box 24, and with the end resting against the under surface of the table. It will be readily seen that there are several forms of construction to accomplish the same movements with reference to the operation of the feed-pawl, and I do not want to be limited to specific forms of construction, as I have found in experiments that either construction previously described, will give the same satisfactory results. It should be noted however, that in either of the constructions, the pin or pins limiting the swing of the pawl should be covered with rubber tape or tubing, to deaden the clicking sound caused by the rapid action of the feed-pawls. The outer ends of these tripping bars project so as to abut that portion of each dog lying below its pivotal support, as seen in Figs. 2 and 16. It will be noticed from these figures that the final convolutions of the worm-threads pass into, or terminate in a circumferential shoulder 36, which lies at right angles with the shaft 18. The recesses 33 are formed at, or near the point where the said convolutions are merged into these shoulders, at which moment the carriage is at its extreme limit of movement. As this limit is reached the advancing edge of the carriage has been pressed against a leaf spring 37, and places the latter under tension as is seen in Fig. 17 and also in Fig. 2. The recoil of this spring, one of which is mounted on each of the risers 21, aids in overcoming the inertia and in imparting the initial reverse movement of the carriage. It also assists in steadying the movements and preventing all shock or jar by sudden reverse movements.

It should be noted that one end of the shaft 18, is carried through the riser 21, and caused to project on its opposite side, to receive the pulley 38, which is belted to the source of power. Both the risers 21, are formed by side pieces 2^a of the table 2, and the cone bearing 19, supporting the projecting end of the shaft, has support in bracket 20, which is mounted on the main frame of the machine. This construction enables the operator to wholly remove all parts constituting the carriage, its supports and operative mechanism, by simply throwing the belt off the pulley and detaching the fastening connecting the bracket 20, with the main frame. The space whereby the record is caused to appear in a series of transverse lines lying upon the table in close parallelism, is produced by the intermediate action of the threaded shaft 39, arranged above and at right angles with the shaft 18. The ends of shaft 39 are mounted in cone bearings 40, supported in brackets 41, mounted on the main frame, at or near the side thereof, and the shaft is driven by a movement which will be explained hereinafter. Upon this surface is formed a screw thread of extremely low pitch, containing any suitable number of threads to the inch, from about thirty to fifty or more. The threaded surface engages the pillow-block or bearing 42, (see Fig. 12) having an interiorly formed (half-round) recess, adapted to fit the shaft and mesh its threads accurately. The block is suitably fastened in an arm 43, bifurcated at one end to provide two widely separated points of support. Each of said arms is provided with an eye 44, containing a split or longitudinally cleft bushing 45, which closely surrounds a supporting and guiding bar 46, the end of the latter being sustained in the brackets 41^a. The line-feed shaft 39, lies between this guiding and supporting shaft and a point just above the table, and the bifurcated portions of the arm 43, unite, before reaching the shaft 39, and the arm extends from the point of engagement of the pillow-block, to a point over the carriage, its end being united with, or forming part of a vertical curved flange 47, and a curved attaching plate 48, uniting with said flange at the lower edge of the latter, and thence extending beneath and laterally upon each side of the arm 43, to form, in conjunction with the flange, a means of attachment to the lower part of the sound-conducting tube, as fully described in a subsequent part of this specification. It will be observed that by this metallic construction of the attachment between the arm 43, and the diaphragm chamber, the frictional vibrations of the mechanism operating the line-feed, may be conducted along the shaft 39, and through the pillow-block 42, and arm 43, to the diaphragm chamber, which would be objectionable, especially in making a record. To obviate and overcome this, I make the slotted opening in arm 43, a little larger than the half nut or pillow-block, and insert pieces of felt or other suitable material to deaden the sound. I also place beneath the flanges 47 and 48, and above the diaphragm chamber, a piece of rubber or felt for the same purpose. Suitable belt washers are also provided for the attaching screws so that all metallic, or sound conveying connections are broken. The bushing 45, which is inclosed by means of eyes 44, at the forked ends

of the same arm 43, are formed of any suitable metal capable of resisting frictional contact and wear, such as aluminum, bronze, or other suitable metal or alloy. The bushings are cleft as shown in Fig. 8, to enable them to close upon the guiding and supporting shaft 46, as the contacting surfaces wear away and at all times maintain a firm sliding connection, having no play. The bushing 52, is preferably of the same length as the distance between the outer ends of the eyes of the bifurcated arms. The length of the bushings, may, however, be made to conform with the width of the eyes or boxes. The eyes 44, inclosing the bushings may also be cleft or divided, preferably, in the manner shown in Fig. 3, in which the eye is formed in two parts, both uniting with the arm at the fork, each forming a lug 49, to permit the insertion of a set screw 50, which passes through one lug and is tapped through the other to enable the bushing to be clamped on the shaft as the wear renders such adjustment necessary. I may however, effect this result by other means; for example, by tapping a screw through each eye inclosing the bushing as shown in Fig. 1.

I may mention here, that the cleft bushing 45, shown in Fig. 7, is for a similar purpose, and is used upon the guide-bar or rod 23, inclosed by the split boxes 24. These boxes, or bearings, are provided with lugs 49ª, (see Fig. 4) substantially the same as eyes on arm 43, heretofore described. (See Fig. 3.) The arm 43 constitutes the main support of a diaphragm-chamber 54, shown in Figs. 1, 2, 5, and 6. It is composed of a top, which is usually arched, or slightly convex, externally, especially near the ends. The longitudinal line of this chamber substantially coincides with the central longitudinal line of the arm 43. Upon the central portion of the top is seated the ring, or collar 47, secured in place by screws, or it may be cast or molded solid to the chamber as preferred. Said ring forming a support for what I term, the primary or main diaphragm 56, which I form, preferably, of glass, or its equivalent, in a thin film, properly annealed. There are many constructions by which this diaphragm may be secured in place, and I do not restrict my right to any one thereof, as it may be found desirable to modify the parts, as shown, in this respect. I have found a convenient method to consist in seating the diaphragm on an inwardly turned flange 57, and confining, or clamping it, by a ring, or annulus 58, entering the ring 47 and resting upon a suitable packing, or cushion, upon the edge of the diaphragm. A flange 59 on the annulus projects over the ring 47 and from its inwardly projecting edge rises a short tube 60, which serves as an attachment for the sound-conveyer, 61, which may be of any usual construction. I may here state, that I have found by experiments with the sound-conveyer, constructed similar to the forms shown in Fig. 1, that record can be satisfactorily reproduced, using the same, curved, funnel-shaped tube, or conveyer, but when it is desired to limit the number of persons hearing the reproduction, the individual conducting tube may be used with the same satisfactory results. The ring 47 surrounds an opening in the top of the diaphragm-chamber, which is closed and sealed hermetically, or substantially so, by the diaphragm 56. The lower portion, or floor, of the diaphragm-chamber, is preferably, though not necessarily, formed of a flat, continuous strip, or plate 62, (shown in Fig. 29,) containing a series of openings 63 at substantially equal intervals. I have shown three of these openings, each of which is closed by a diaphragm, the central one, 64, being located directly beneath the primary diaphragm 56. The central and two outer diaphragms I have termed the secondary, or auxiliary diaphragms, each being formed of the same material as the primary diaphragm. They rest upon flanges 66 formed by counter-boring from the upper side of opening 63, flange 67 being formed around the margin plate 62, (as shown in Fig. 29.) The secondary or auxiliary diaphragms are laid upon suitable cushions resting upon flanges 66, and clamped down by superimposed plate 65, part of which is shown in Fig. 27. This portion is provided with openings registering with those in the plate 62, a downwardly turned flange or rib 66ª being formed around its openings. The flanges 66ª rest upon the edges of the secondary diaphragms. The plates 62 and 62ª (Figs. 27, 28, and 29) are clamped together by means of screws passing through the upper plate and tapped into the lower one. I will here note that when the plates are put together in this manner it is preferable to have flanges or ribs 66ª a little longer, say one sixty-fourth to one thirty-second of an inch than the top opening above the flanges 66, so that when the secondary diaphragms are placed in position, and the plates put together, by means of screws, the diaphragms can be rigidly clamped and held in place. I have shown and will describe hereinafter another method of mounting these diaphragms, although I regard the form already described preferable, but I do not restrict my invention to the employment of any specific construction of these parts. I form the diaphragm chamber, and the floor plates of any suitable material not likely to produce secondary vibrations, hard rubber, vulcanite, laminar, vulcanized fiber, and other compounds being well adapted for the purpose. The lower surface of the floor-plate 68 approaches as close to the carriage as is consistent with the unobstructed movement of the parts, and its front end is sustained by means of an arm 69 (Figs. 2, 13, and 14) mounted on the end of the chamber-wall, and provided with a threaded pin, adjustable vertically in the end of said arm, and giving a delicate and accurate adjustment to a fork 71, in which is journaled a traveler 72, which rests and rolls in either di-

rection upon a rail 73, supported upon brackets 74 arising from the table 2 and overhanging the carriage at a point a little above the same. The pin 70 is provided with a crank-arm 75 for convenience in turning it, and the arm 69 is usually provided with lugs to furnish a convenient handhold in raising the diaphragm chamber and its adjuncts to unmesh the pillow-block from the threaded shaft and remove the recorders, or reproducers from the tablets, and to set the diaphragm-chamber back, in case it was desired to have any portion or all of the record reproduced. For convenience in locating any part of the record, the upper edge of rail 73 is graduated, and index 71^a attached to the lower end of fork 71 (Fig. 14). The relation of the recording and reproducing points to the tablet may be very delicately adjusted by means of the threaded pin 70, by which, also, the meshes of the pillow-block with the line-feed shaft is controlled. The line-feed is imparted by a partial revolution of the shaft 39, a quarter rotation being usually found sufficient, even with a screw-thread fifty to the inch, thus giving a line-space of one two-hundredths of an inch, though this may be increased if desirable, I would prefer, however, to use a V screw of higher pitch, say thirty-five to forty threads to an inch. The intermittent revolution of the shaft 39 is produced by means of a ratch-wheel 76^a, rigid upon one end of the shaft, and operated by means of push-pawls 77, pivotally connected to the extremities of arms, or bars, 78, which cross each other between these pivotal points, and their opposite ends, the latter being connected to the ends of longer bars 79, which converge to a point of pivotal attachment 80, upon a vibratory arm 81, rising from the frame 1 just beyond the end of the shaft 39. The said arm is connected by a rod 82 to a counterpart 83, also hinged, or pivoted, by its lower end to the frame 1, so that both will move in unison and in parallelism. Each of the arms 78 is pivotally connected to a rigid support 84, at such point (Fig. 10) that the sweep of said arm through an arc of ninety degrees, or thereabout, will not materially remove its extremity from the position it occupies with relation to the teeth of the ratchet, with which the pawls 77 engage. If the pivotal point 80 be moved horizontally, in the direction of the connecting arm 82, it will be seen that the ends of the arms 78 carrying the pawls, will separate, and then approach each other on the other side of the axis of the ratchet, as indicated in dotted lines in Fig. 10. As the pawls 77 both mesh the same way, or in the same direction of movement, and as the points of pivotal attachment of the pawls move in opposite directions, one of the pawls will be retracted to prepare for its operative movement, while the other is carrying the ratchet 76 forward.

The movement of the devices described, which somewhat resemble a "lazy-tongs," is effected by a stud, or finger-bar, 85, mounted on the carriage 4 at such point that it moves between the upper ends of the swinging bars 81 and 83, the distance between which is exactly equal to the full length of a line of the record. As the pawls act in opposite directions of movement, as already described, they alternately advance the ratchet 76 and alternately move back to re-engage its teeth. Bearing in mind the fact that the action of each pawl is produced by the movements of the carriage, it will readily be seen that during the time occupied by the stud or finger-bar 85, in swinging either bar 81 or 83, the line-feed shaft will act concurrently with the direct-feed, their conjoint operation giving a rounded, or curved angle to the record as it passes the interval between the connected ends of the adjacent lines. The manner in which and the means by which periodic movement is imparted to the line-feed shaft may be considerably varied, but it must be so connected with the action of the direct feed, that the combined function of both shall effect a continuous, unbroken record, which shall be followed by the reproducer with ease, and without substantial variation or indistinctness in the sounds. It will be noted that if the arm 78 was journaled on the end of line-feed shaft 39, one of the arms being located upon either side of ratchet 76^a, the rigid support 84 heretofore described, and shown in Fig. 10 would be dispensed with. It will also be noted that by placing two lugs or pins on the end of the table at suitable distance apart, and dispensing with the arms 82 and 83, substantially the same movement or movements of the line-feed shaft will be produced, as that which has been heretofore fully described.

The recording stylus I employ is of duplex form, or, in other words, is so constructed as to act both as a recorder and as a reproducer. It is shown in detail in Fig. 35, and consists of a slightly rounded recording point, or portion 86, and a rounded reproducing point, or portion, 87, both connected to an intermediate part 88, which is provided with an opening 88^a, to receive a pivotal support, or journal, upon which the stylus may be turned, to bring either point into action. This reversal in position is effected by means of a lever 89, fulcrumed upon the end-wall of the diaphragm-chamber, as shown in Fig. 5, its end being provided with a segmental gear, or curved rack, 90, meshing with a pinion 91 on the end of a small shaft 92, supporting the stylus, and having a hinge, or pivotal point 93, as seen in Fig. 34, so formed as to permit the free movement of the stylus in response to vibratory impulses from the diaphragm. The shaft is sustained at, or near, the pivotal or other joint 93 in a drop-bearing 94, (Fig. 5) and its end is supported in an exceedingly light frame 95 (see Fig. 5) in which the stylus hangs. This frame consists of two parallel drop-plates, united at their upper ends by a head 96 and provided a little above the latter

with a similar head, 97, said parts being connected by a neck, which is engaged by the forked end of an impulse-lever, 98, hereinafter to be described. The stylus being compelled to cut in three different directions, first along the transverse line, second over the line space at one end of the line, and third along the succeeding transverse line, it may be provided with an equal number of cutting faces upon the end, or portion 86. The reproducing end 87 I provide with a small spherical point 99, which I prefer for this purpose, as being less liable to wear or injure the record.

One of the duplex styles described is attached to, or connected with, each of the outer diaphragms 100, lying adjacent to the diaphragm 64, the connection being made in the following manner: The upper head of the frame in which the stylus is mounted is usually laid against the center of the diaphragm, and cemented, or otherwise attached thereto, in such a manner as to respond fully to every vibratory movement of the diaphragms. As the non-central diaphragms 100 are not as directly exposed to the phonetic vibrations as the main diaphragm, it is desirable, in order to obtain the full effect, to connect the main diaphragm with each secondary diaphragm, in order that the latter may be caused to vibrate in unison with the former, and with the same intensity. I, therefore, connect the center of the diaphragm 56 with the centers of each of the secondary diaphragms 100, by means of elastic filaments, or needles 101, having a reflex curve, which causes their extremities to point toward the respective diaphragms. These needles, or filaments, which may be made of metal, glass, or other suitable substance, are secured to the diaphragms by means of radiating filaments 102, of unequal length, (see Figs. 5, 30, 32, 39) their ends being attached to the filaments 101 at a point a little beneath the main diaphragm, 64, and their other ends attached to the diaphragm at points unequally distant from the center, from which they radiate at suitable intervals, or angles, according to the number of radial filaments used. The connecting filament 101 is continued from the point of its union with the radial filaments to the center of the diaphragm, or substantially so, to which it is connected by cementing or welding, or by drilling and inserting the extremity of the filament through, or into, an aperture in the diaphragm. The other extremity of each filament is connected with one of the secondary diaphragms 100 in a similar manner, the only difference being that the connecting filaments 101 radiate from the upper, instead of the lower face of the diaphragm, the end of the connecting filament being continued to the center thereof. If preferred, it may be passed through an aperture in the center and connected directly to the hanger-frame 95.

By means of the non-central attachment of the filaments 102, at points unequally distant from the center of the diaphragm 100, I am enabled to take the vibrations off the main diaphragm at different points, and between different nodal circles, whereby I can transmit to the secondary diaphragms very nearly all the energy of each vibration of the main diaphragm, and obtain a clear, well defined record. It should be noted, in this connection, that the secondary diaphragm will ordinarily respond to the action of the main diaphragm, by reason of the fact that the diaphragm-chamber is hermetically closed, and the confined body of air therein must necessarily receive and transmit any action of the main diaphragm. The position of the secondary diaphragms 100, however, is not as favorable as that of the central diaphragm, 64, and to obtain for all sounds a full response, in the action of the recorder, and secure a perfect reproduction of the record, I have found it advantageous not only to connect the main diaphragm 56 with the secondary diaphragms 100, in the manner described, but to also connect the central diaphragm 64, in the secondary series, with each diaphragm 100 in the following manner: The lever 98 being connected at its end to the hanger-frame 95, as already pointed out, its power-end is pivotally connected to a hanger 104 on the central diaphragm 64, the fulcrum 105 of the lever being secured to the floor-plate 62 of the diaphragm-chamber at such point that the longer arm of the lever shall be between the fulcrum and the point of attachment to the hanger 95. To the other end of the lever 98 is pivotally connected the end of a second lever 106, the power end of which is connected to the hanger on the central diaphragm 64, the fulcrum 107 of the said lever being at such a point that its longer arm is between said fulcrum and the point of attachment to the said hanger, thus restoring the power lost by the position of the fulcrum of the lever 98. A similar system of levers is also arranged to connect this hanger with the support for the other stylus. It is unnecessary to state that the arrangement is such that the distance between the two recording instruments is substantially equal to the distance from the edge of one tablet, when placed upon the carriage, to the corresponding edge of the other tablet. The main diaphragm 56 may, also, be connected to the central diaphragm by means of a straight, vertical needle, or filament, 109, its extremities being provided with the radiating, connecting filaments, in the manner already described.

The construction described is capable of some modification. For example, the system of levers 98 and 106 may be duplicated above the secondary diaphragm, as seen in Fig. 26. In this form the lever 110, corresponding to the lever 98, has its power end connected to a filament, or needle, 112, which may be extended through the diaphragm and connected to the hanger 95. The second lever 113, which corresponds with the lever 106, is connected at its power-end to the straight filament 109.

When this duplicate system is used the filaments 102 may, if preferred, be dispensed with, and I shall also dispense with the filaments 101 and probably with the filaments 109. I may also connect the end of each of the radial filaments to the diaphragm 100, or to the main diaphragms, by a series of radial attaching filaments 114, as shown in Figs. 30, 32 and 39.

In the construction of the diaphragms, I prefer to adopt the mounting shown in Figs. 31 and 32, although the construction shown in Figs. 5, 26, and 29 will give good results. In Figs. 31 and 32 the diaphragm is set in a solid annulus; or, in what is substantially the same thing, a support-ring 115, surrounding its outer edge, and its upper and lower marginal surfaces. I have found in practice that this support is less susceptible to the action of false vibrations than others.

I use a preparation for the tablets which will give a smooth and unbroken record, free from air-cells and other inequalities, or comparatively so. These tablets may evidently be made as large as desired, but I have found a size suitable for a No. 6½ envelope is very convenient. The duplicate tablet is intended for preservation as a copy, but I may observe that in reproducing, this duplication of the phonetic record gives rise to some valuable and interesting results. The reproduction is multiplied in power by its use, and gains in distinctness, and uniformity of volume; and by recording a vocalization, for example, upon one surface first, and then recording a second part, bearing a relation to the first similar to that of the alto to the soprano, some very pleasing effects are produced. I may, also, here note, that the tablet being perfectly flat, or substantially so, either, or both sides of the tablet may be used in making a record.

By the use of the diaphragm-chamber, whose walls contain the main and secondary diaphragms, I am enabled to eliminate all, or nearly all, of the effects produced by what is known as false vibrations, which are amplified and lost in the diaphragm-chamber, or destroyed so far as to cause no unpleasant results.

I have found in practice that by using a diaphragm-frame similar to that shown in Fig. 31, in which the edge, and both the upper and lower margins of the diaphragm, which I form of malleable glass, are inclosed, I obtain less false vibrations with the construction in which the edge of the diaphragm is clamped down.

By connecting the main diaphragm 56, which is the largest, with the smaller central diaphragm 64, below, and with the two adjacent diaphragms 100, I am able to utilize the full power of the phonetic vibrations set up in the main diaphragm. It should be noted, also, that, by the radial filaments connected to the diaphragm at points unequally distant from the center, I am able to render the phonetic vibrations of varying intensity, from these different points, available in the operation of the stylus.

The attachment should be made at points between the nodal circles, and between different nodal circles, in order to obtain the full strength of the phonetic vibrations.

What I claim is—

1. In a phonograph, the combination with a diaphragm and drop-stud, of filaments set in the upper ends of the said drop-stud and connected at their other ends to the diaphragm in different nodal circles, substantially as described.

2. The combination in a phonograph, of a movable support adapted to receive and retain a plurality of recording surfaces, an independent stylus for each of said surfaces, a single main or primary diaphragm receiving and responding to phonetic vibrations, secondary diaphragms intermediate the styles and primary diaphragm, and devices by which the styles and diaphragms are connected to transmit the phonetic vibrations, substantially as described.

3. The combination in a phonograph of a support adapted to receive and retain a plurality of recording surfaces, a plurality of styles for recording upon, or reproducing from, said surfaces, a single primary diaphragm responding to the phonetic vibrations, secondary diaphragms intermediate of the styles and primary diaphragm, and intermediate connections by which the vibrations of the single main diaphragm are transmitted to both the secondary diaphragms, substantially as described.

4. The combination in a phonograph of a support adapted to receive and retain a plurality of recording or reproducing surfaces, a plurality of styles adapted to record or to reproduce in or from said surfaces in unison, a primary diaphragm receiving and responding to the phonetic vibrations, a series of secondary diaphragms one of which has its center substantially in the axial line of the primary diaphragm and a system of levers each supporting one of the styles at one end and at the other end connected to the central secondary diaphragm, substantially as described.

5. The combination, in a phonograph, of a carriage or support to receive and retain a plurality of recording or reproducing surfaces, a plurality of duplex styles pivoted between their ends and having separate recording and reproducing portions, a primary diaphragm, a series of secondary diaphragms, the middle one of which is arranged beneath the primary diaphragm, intermediate connections between said primary diaphragm and the secondary diaphragm, and a system of levers to the ends of which the styles are pivotally connected, their other ends being connected to the outer ends of levers the inner ends of which are connected with the central diaphragm, substantially as described.

6. The combination, in a phonograph of a primary diaphragm located in, or beneath,

the sound conveyer, and forming part of the closed top of a diaphragm chamber, a series of diaphragms arranged beneath the primary diaphragm and connected thereto, said series forming part of the floor of the diaphragm-chamber a plurality of levers having their ends connected to one of said series, a second system of levers having pivotal connection with the power ends of the levers of the first system, and a plurality of styles pivotally connected to the other extremities of the levers of the second system, substantially as described.

7. The combination, in a phonograph, of a primary or main diaphragm arranged to receive the phonetic vibrations, a series of secondary diaphragms, a corresponding series of connections between the primary and the secondary diaphragms, having attachment at a plurality of points located at unequal distances from the centers of said diaphragms a system of levers attached to one of the secondary diaphragms a second system of levers actuated by those of the first system, and a plurality of styles connected to and operated by the levers of the second system, substantially as described.

8. The combination, in a phonograph of a platform, or support, for a recording tablet, means for feeding the same, a closed diaphragm-chamber having a main diaphragm receiving the phonetic vibrations, and forming part of the top of said chamber, a series of secondary diaphragms arranged beneath and forming part of the floor of said chamber, and styles partly supported by two of said secondary diaphragms, substantially as described.

9. In a phonograph, the combination with a main or primary diaphragm receiving the phonetic vibrations, of a series of secondary or auxiliary diaphragms forming part of the floor of a diaphragm-chamber which is closed, above, by the main diaphragm, needles connecting the latter diaphragm with each of the secondary diaphragms, two independent styles supported by two secondary diaphragms at substantially equal distances from the center of the main diaphragm, and levers having their ends connected to the styles and to a central secondary diaphragm, respectively, and having their fulcra intermediate, substantially as described.

10. In a phonograph the combination with a suitable support, adapted to retain one or more tablets, of a shaft having continuous revolution and provided with threads of opposite pitch, which alternately engage feed dogs pivoted on said support and tripping-bars mounted on the machine frame at the ends of each opposite thread on said shaft to trip the dogs out of mesh with said threads, alternately, substantially as described.

11. The combination, in a phonograph, of a diaphragm, receiving the phonetic vibrations, and a stylus connected thereto by filaments radiating from a point on said stylus below the diaphragm and connected to the latter at points unequally distant from the center, substantially as described.

12. In a phonograph, the combination with a recording or reproducing stylus, of filaments connecting the same to the diaphragm by the vibration of which the device is rendered operative, said filaments being connected at one end at a little distance from the surface of the diaphragm and at their other ends attached to said diaphragm between different nodal circles, concentric with the stylus and diaphragm, but of unequal radii substantially as described.

13. In a phonograph the combination with a stylus of filaments attached at one end to the stylus a little distance from the surface of the diaphragm, and each of their other ends being connected to said diaphragm at a different distance from the center and by a plurality of connecting filaments, substantially as described.

14. The combination in a phonograph of a stylus, a main diaphragm receiving the phonetic vibrations, a secondary diaphragm beneath and connected to the main diaphragm, a second diaphragm adjacent to the first secondary diaphragm, a connection between the latter and the main diaphragm, and between the main diaphragm and the adjacent diaphragm, a stylus mounted on the latter and a lever connected at one end to said stylus, and at the other end to the end of a second lever, the power end of the latter being connected to the first secondary diaphragm, substantially as described.

15. The combination in a phonograph of a main diaphragm, a series of secondary diaphragms, a pair of styles connected to two of the secondary diaphragms, arranged adjacent to a central secondary diaphragm beneath the main diaphragm and a carriage or support for a duplicate record, the four diaphragms being set in the wall of a closed chamber directly beneath the sound conveyer and the main diaphragm and containing a body of air sealed therein, substantially as described.

16. The combination in a phonograph of a carriage, means for imparting reciprocating linear movement thereto, a threaded shaft intermittently rotated to impart the line feed, at the end of each parallel line of the record, a pawl and ratchet mechanism, and arms connected at one end to a vibratory bar, which is connected to a similar parallel bar, to operate the pawl-carrying arms in opposite directions, the carriage being provided with a stud, or finger, moving between the vibratory bars and coming alternately into contact therewith, substantially as described.

17. In a phonograph, the combination with a stylus consisting of a recorder, a reproducer and an intermediate pivotally supported portion mounted on a shaft provided with a pinion, of a segmental gear meshing with said

pinion, whereby the stylus may be reversed to bring either the recorder or the reproducer into action, substantially as described.

18. In a phonograph, the combination with two independent styles each of a duplex construction, of jointed shafts, on the ends of which said styles are mounted, diaphragms to which the frames supporting the ends of the jointed shafts are mounted, and means for imparting a semi-rotation to said shafts to reverse the styles, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

STEWART DIXON McKELVEY. [L. S.]

Witnesses:
J. W. ROEBUCK,
G. N. SHANER.