No. 670,442. Patented Mar. 26, 1901.

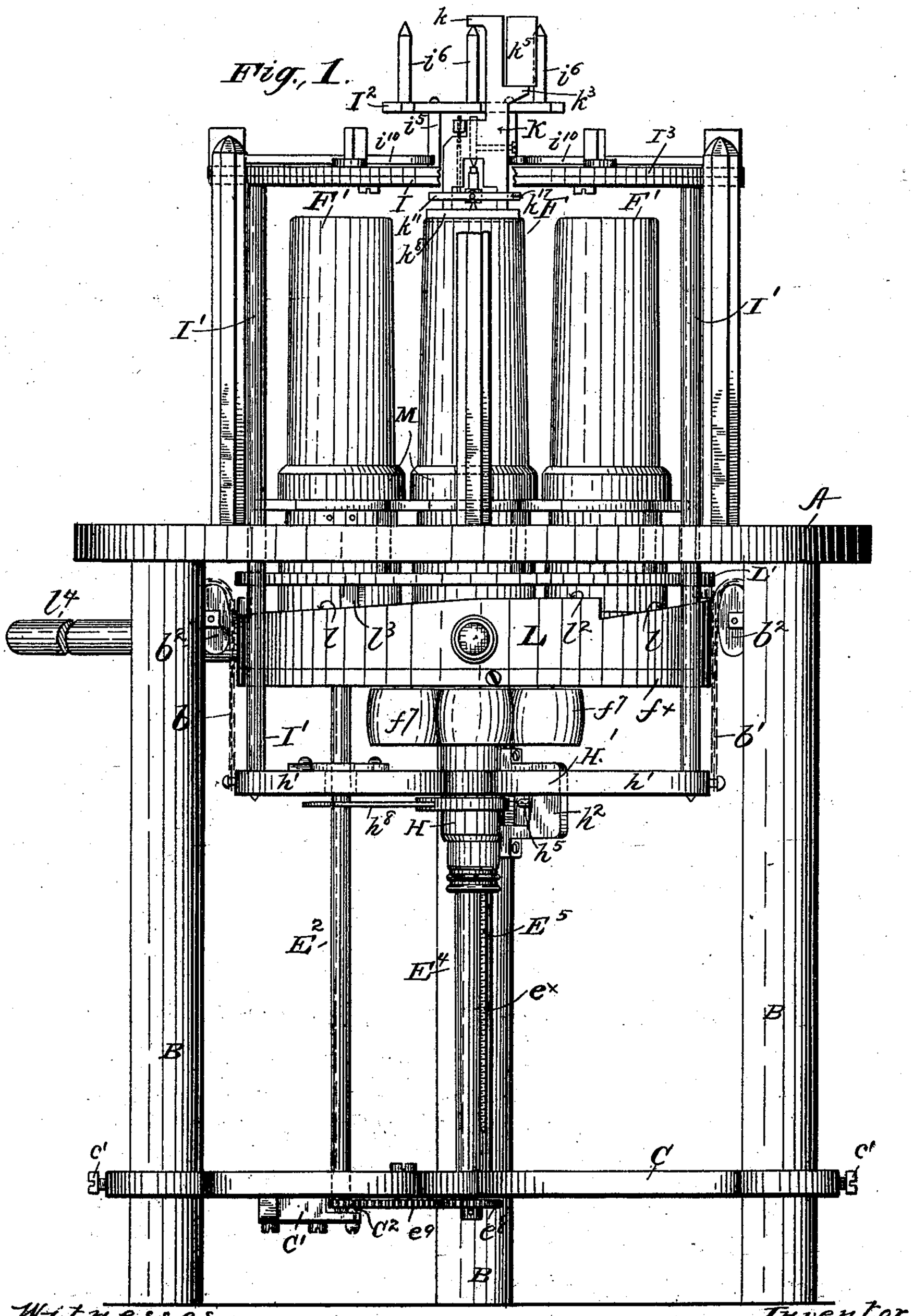
C. S. TAINTER.

GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 1.

Fig. 1.



Witnesses.
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No. 670,442. Patented Mar. 26, 1901.

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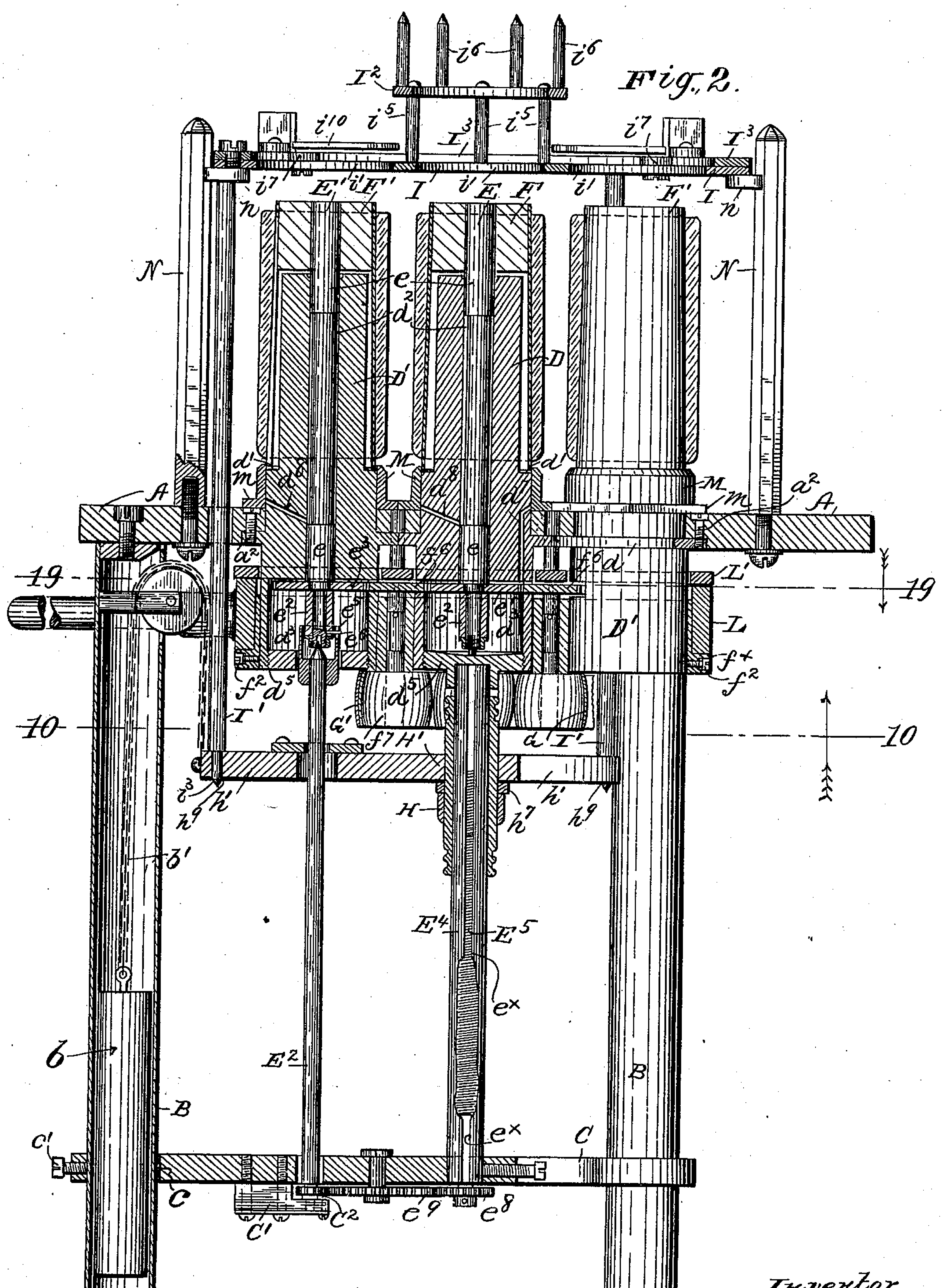
(No Model.) 11 Sheets—Sheet 2.

Fig. 2.



Witnesses
W. R. Edelen,
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

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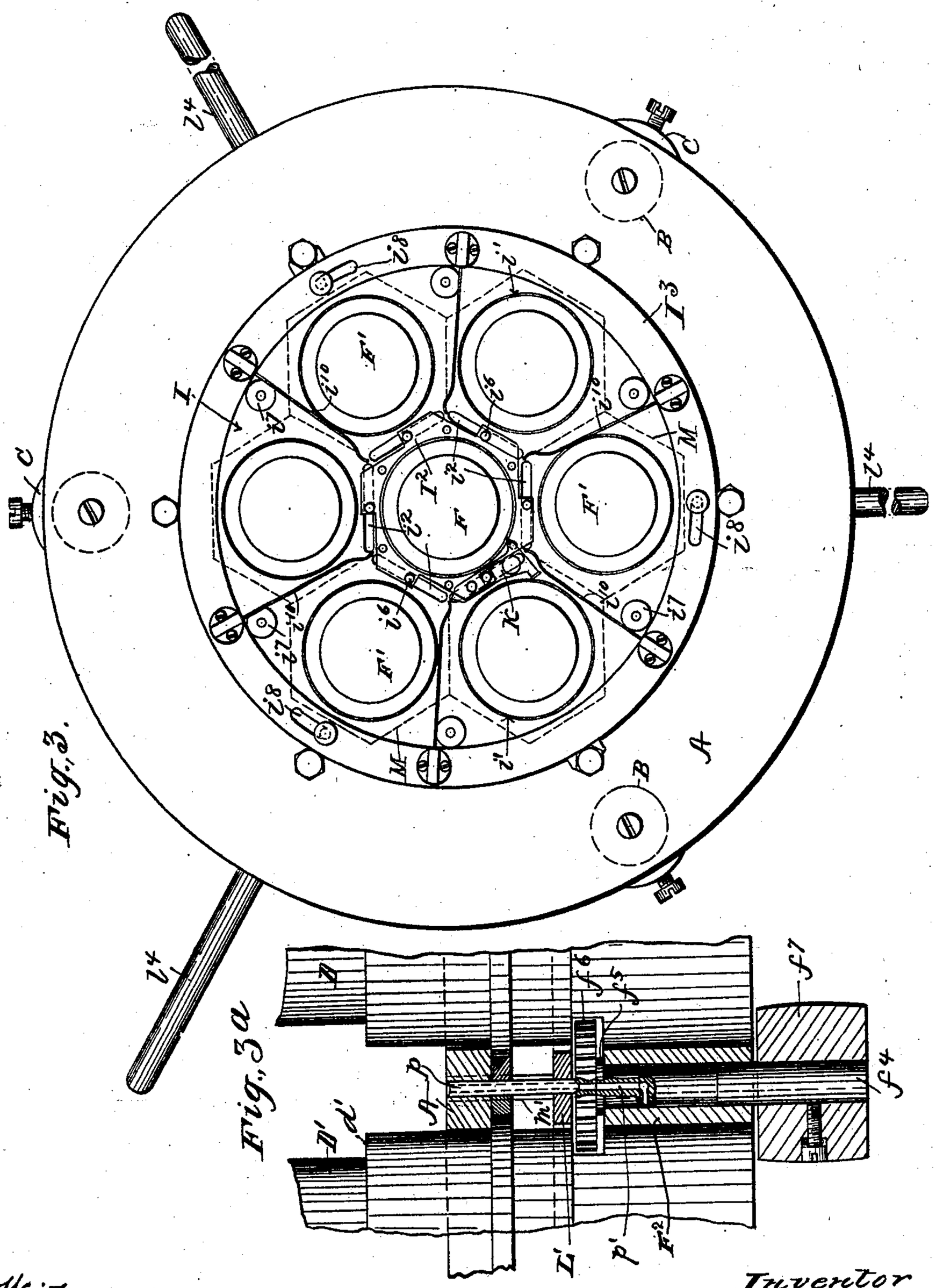
(No Model.) 11 Sheets—Sheet 3.



Witnesses
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GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 4.

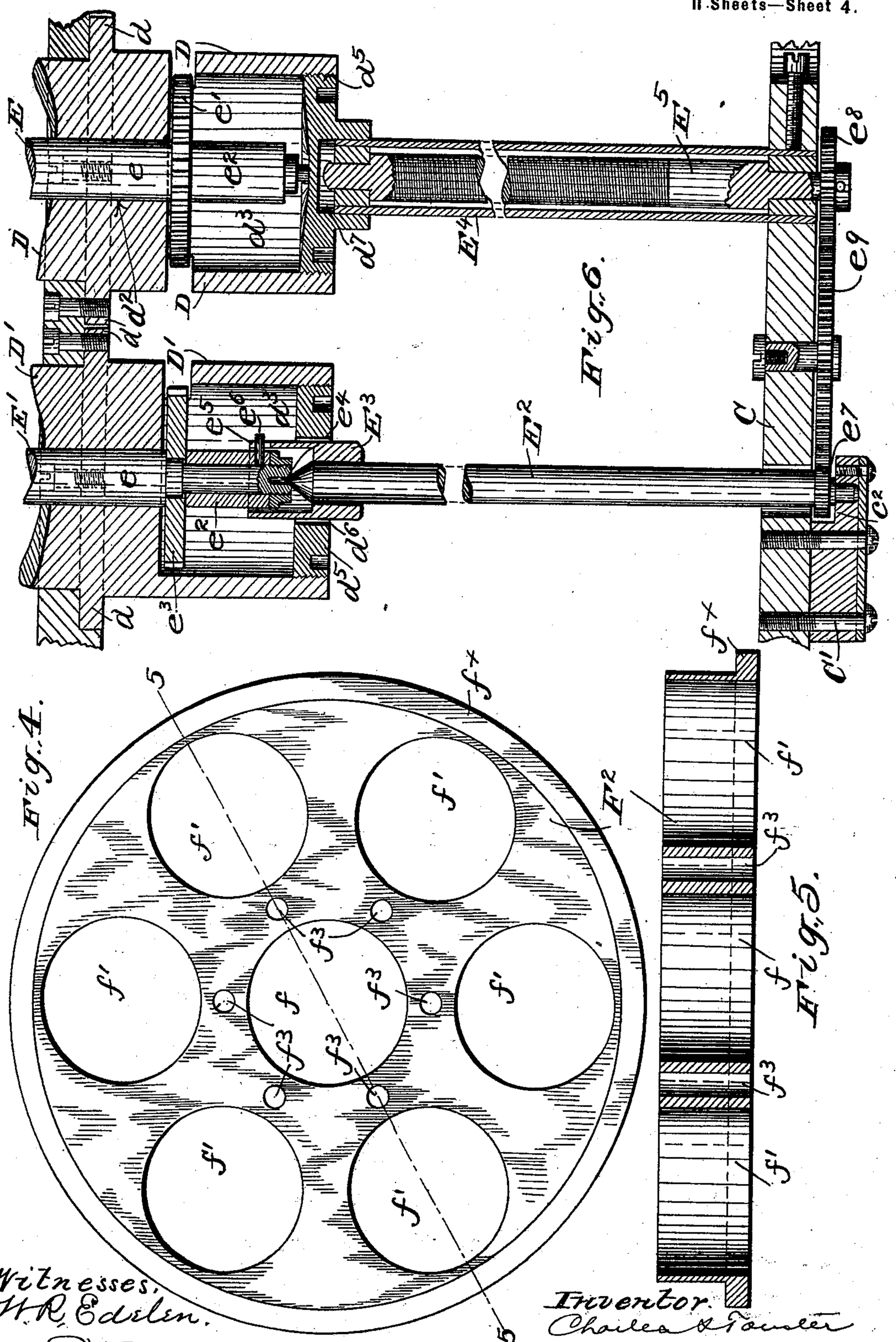

Fig. 6.

Fig. 4.

Fig. 5.

Witnesses,
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No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

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(No Model.) 11 Sheets—Sheet 5.

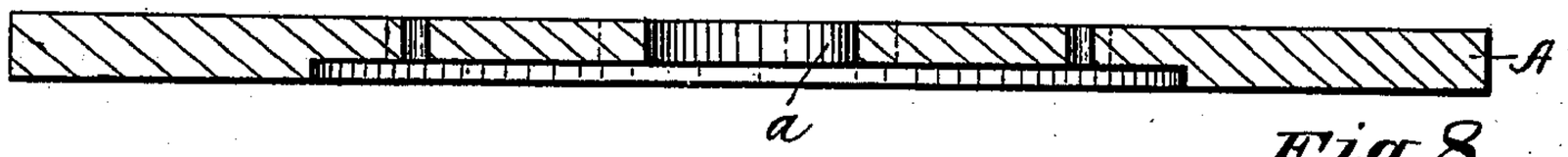

Fig. 8.

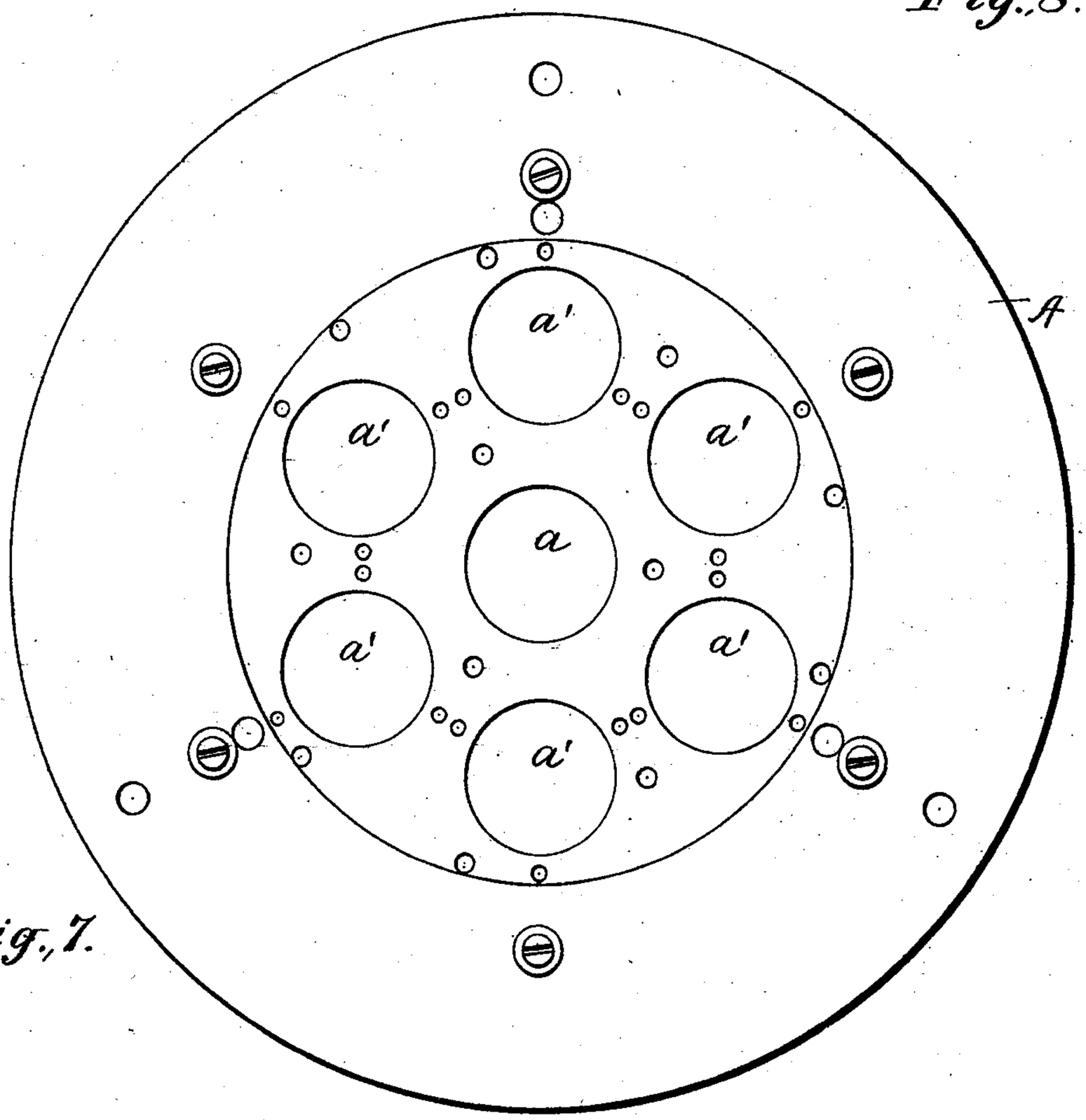

Fig. 7.

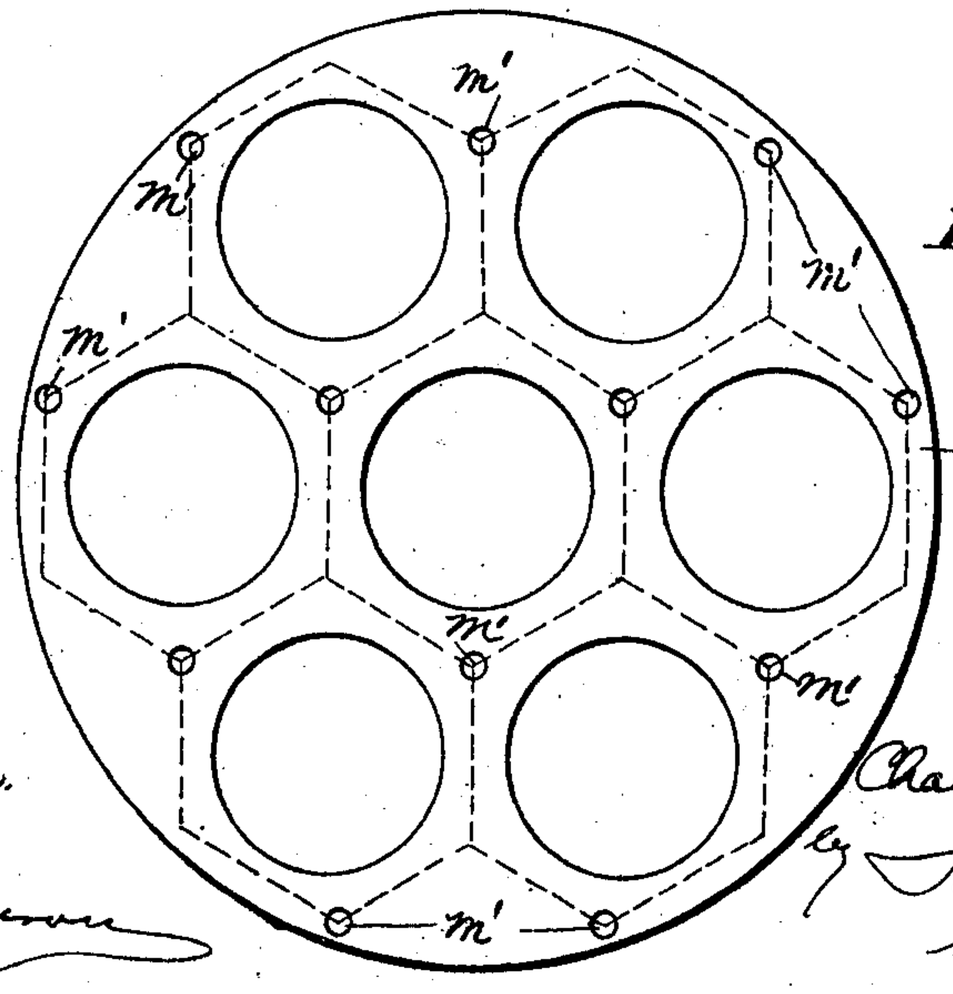

Fig. 9.

Witnesses
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No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

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(No Model.) 11 Sheets—Sheet 6.

Fig. 10.

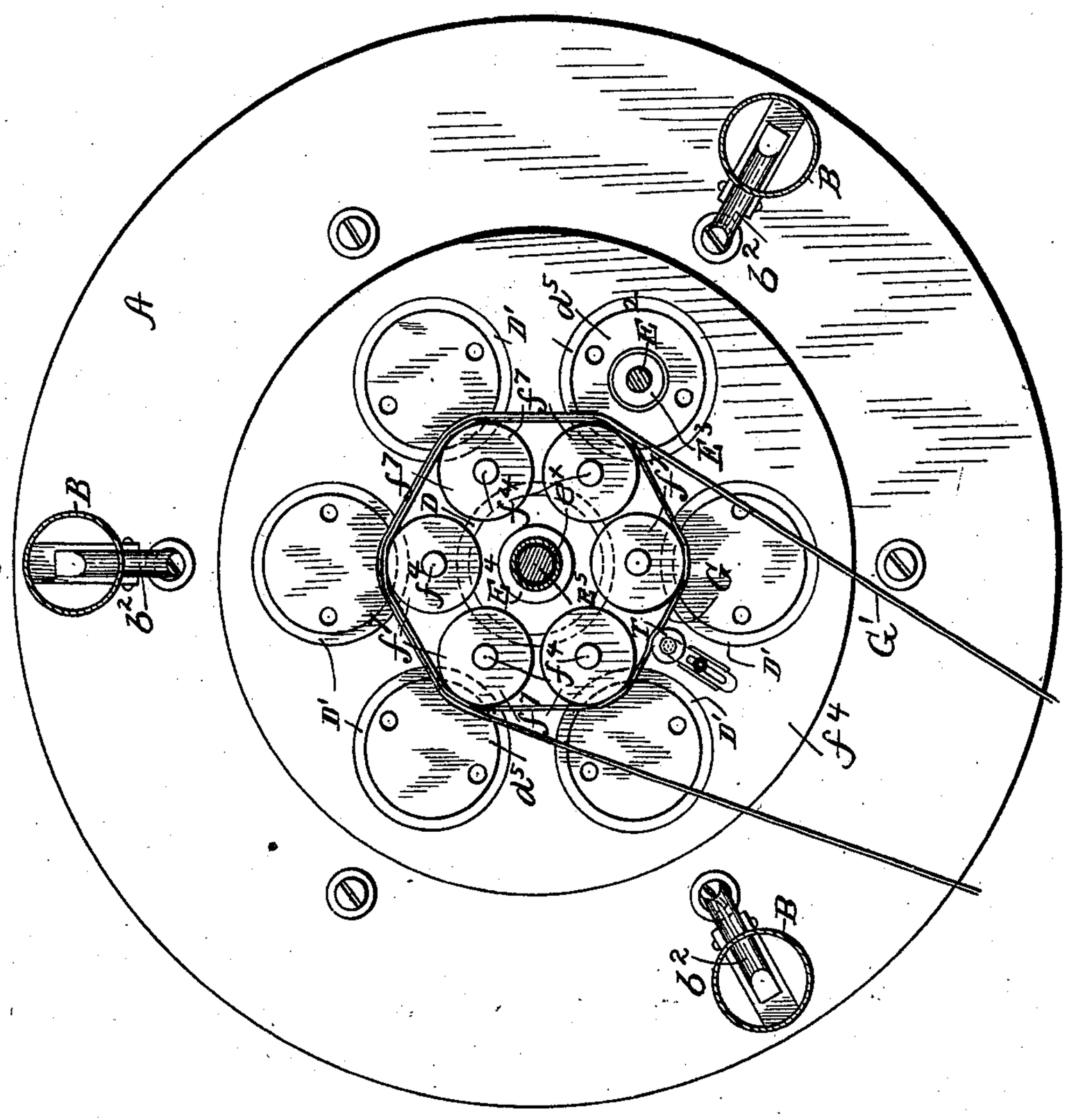
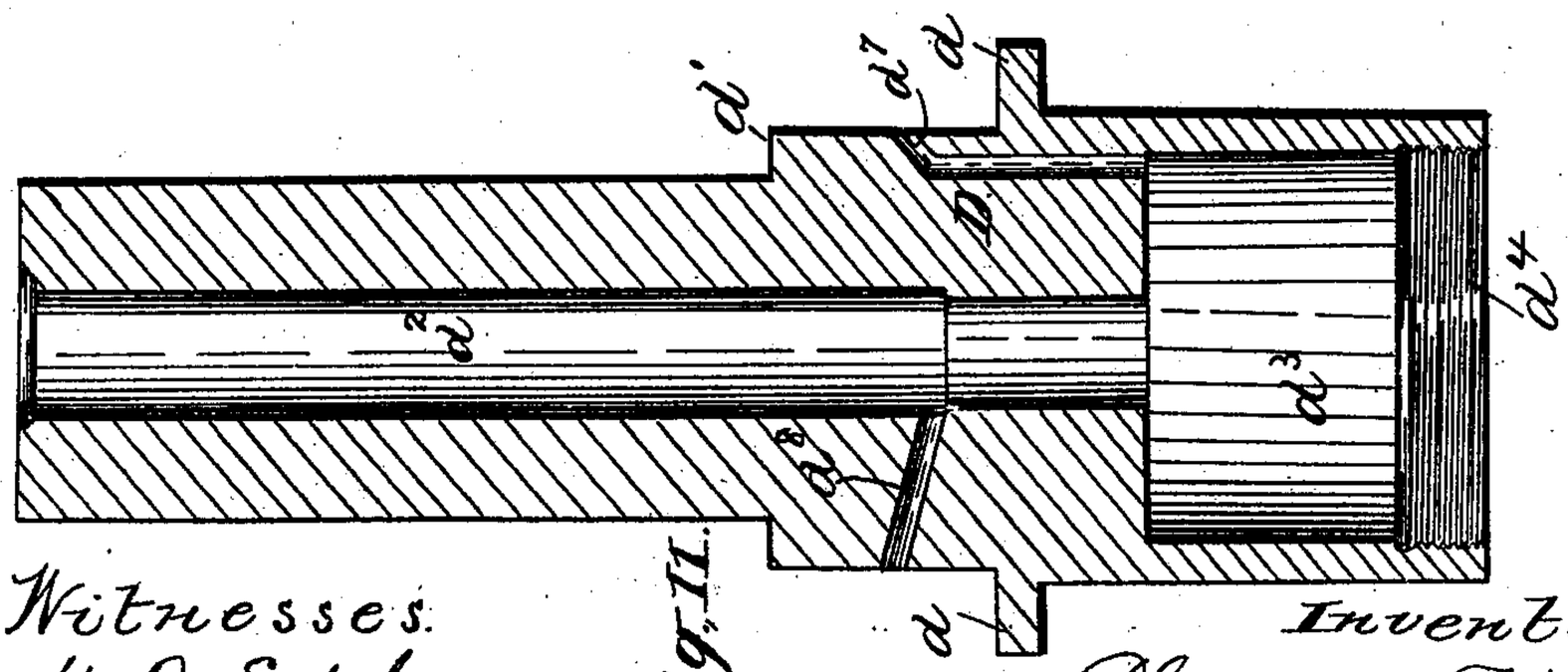


Fig. 11.



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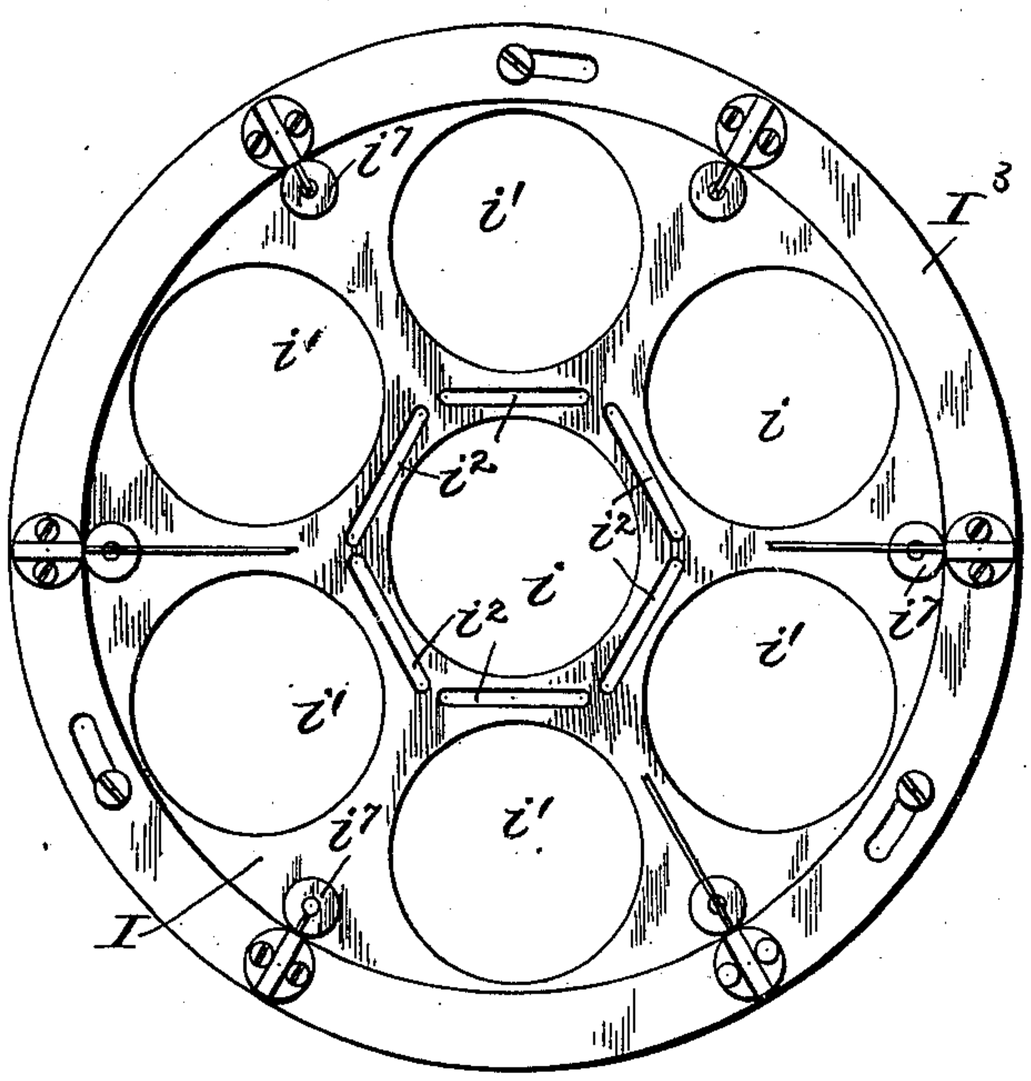
GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 7.

Fig. 12



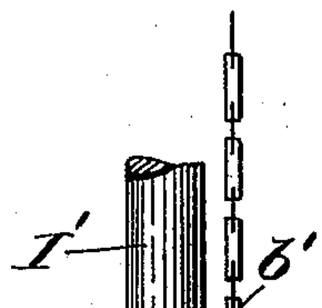
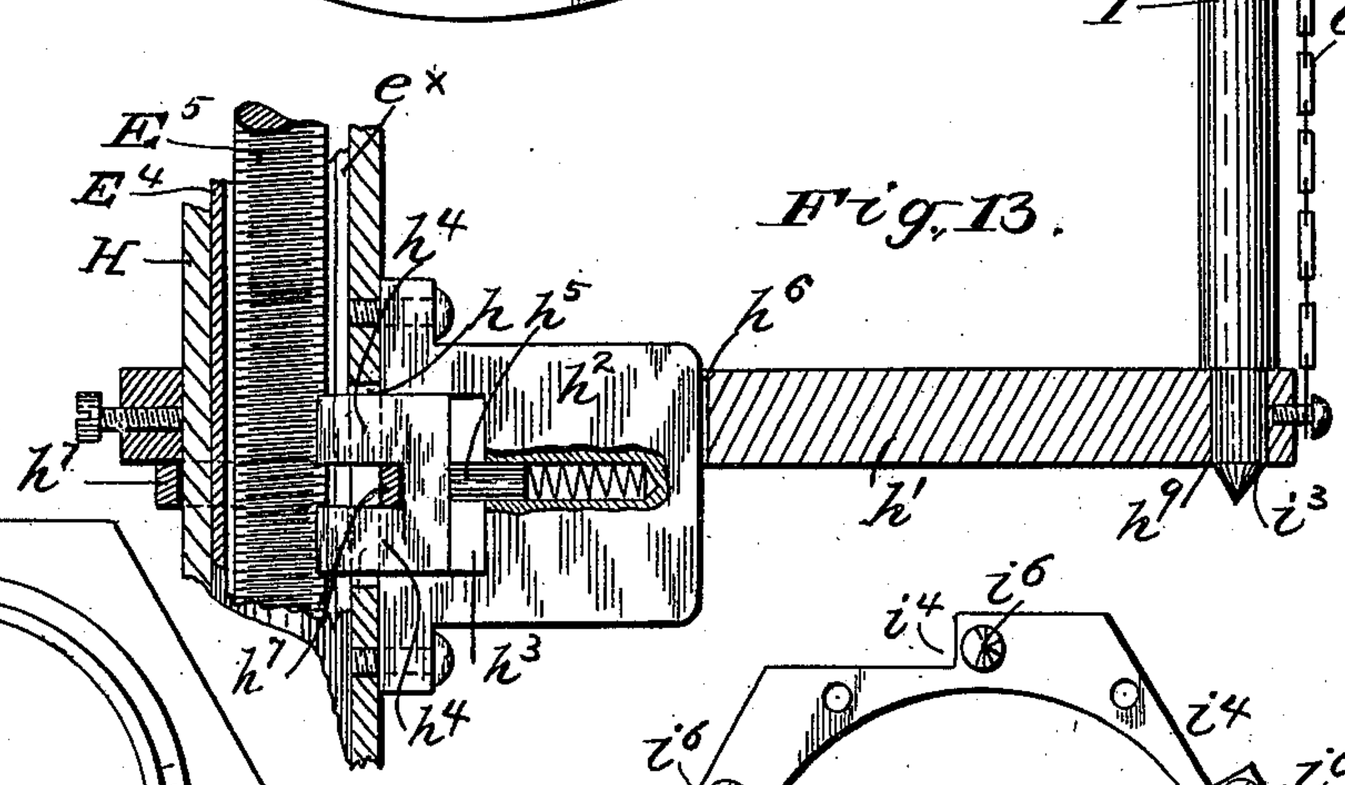


Fig. 13.



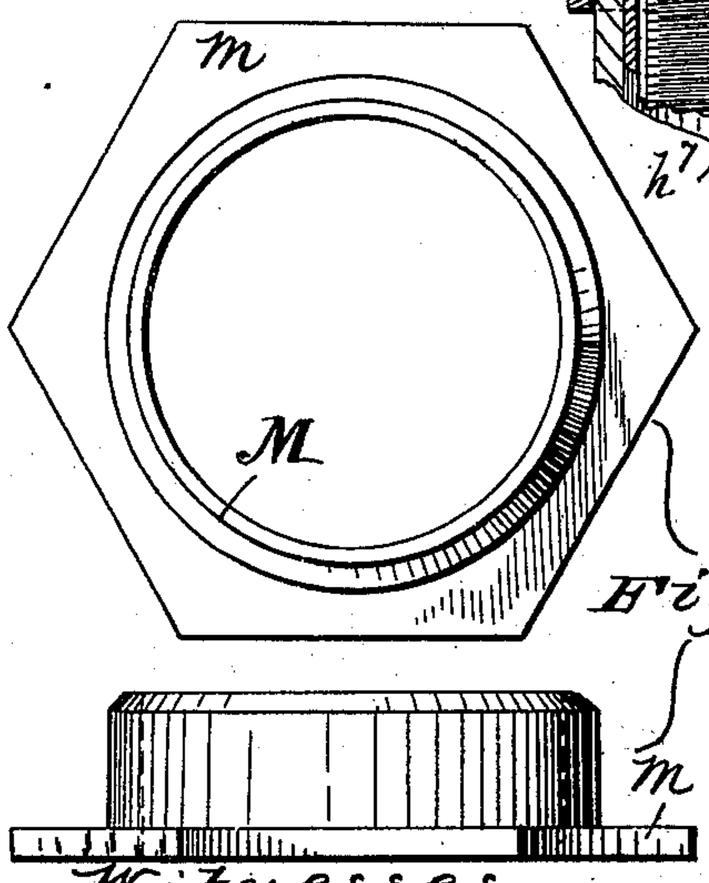
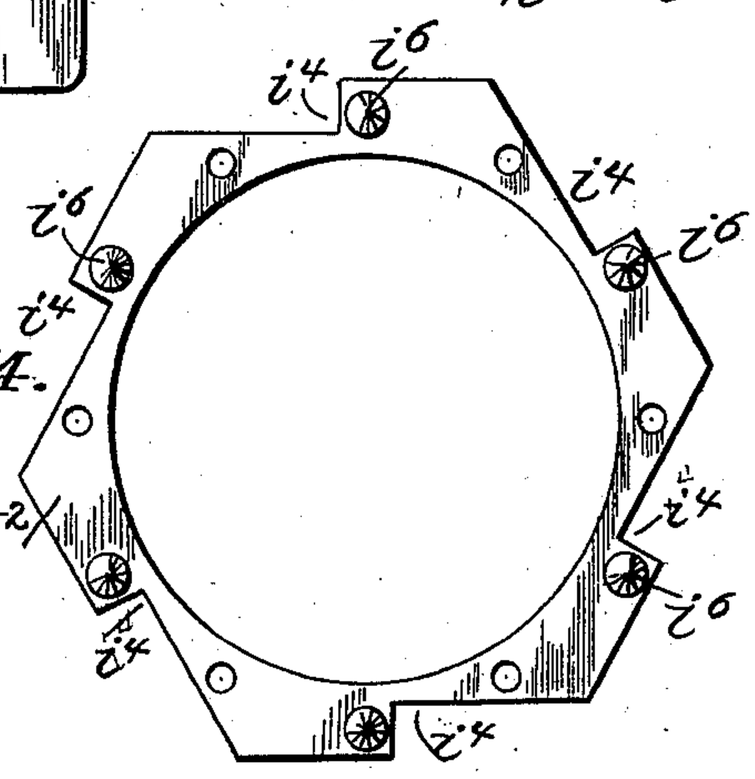


Fig. 15.

Fig. 14.



Witnesses.
H. R. Edelen.
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No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 8.

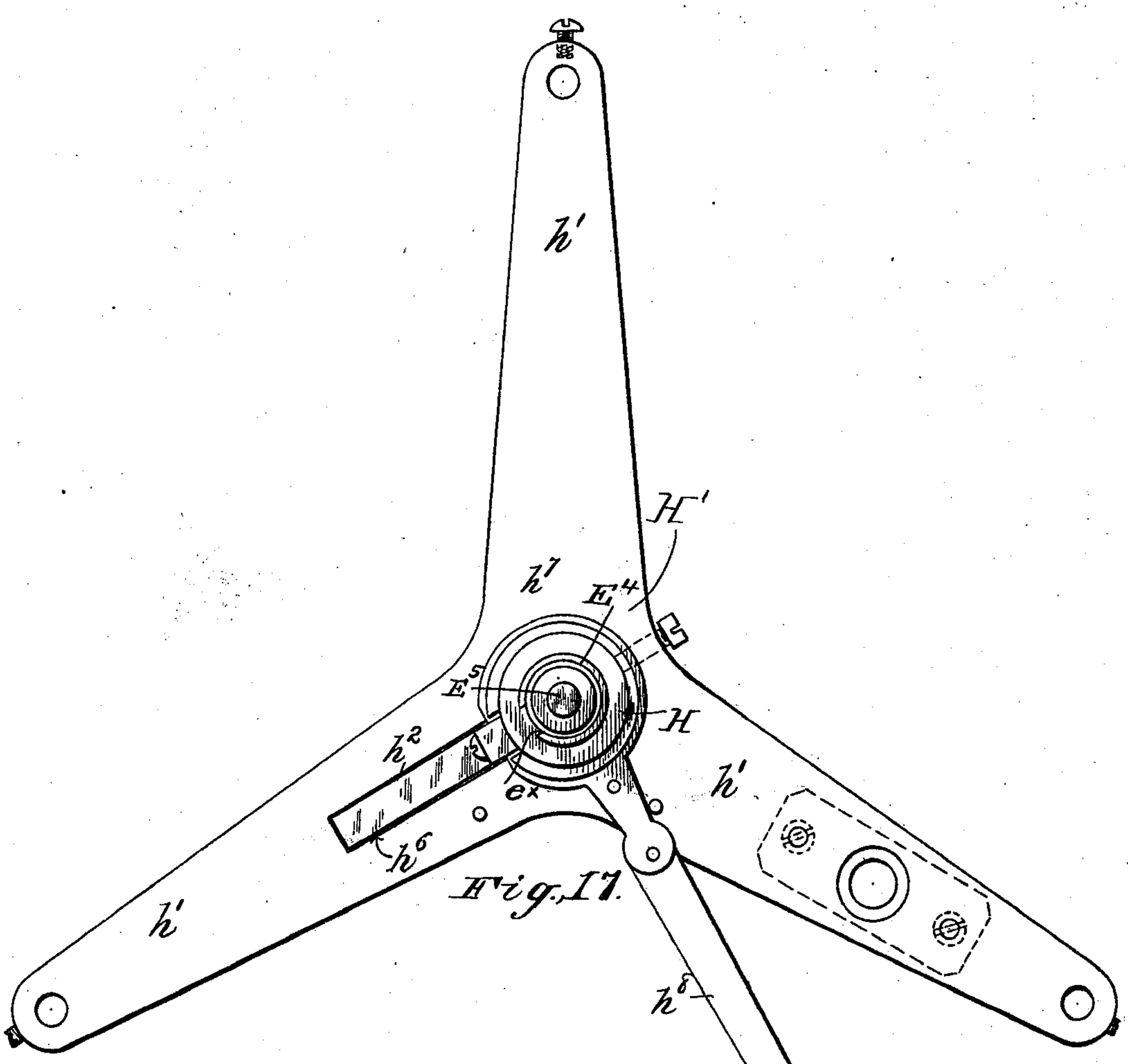

Fig. 17.

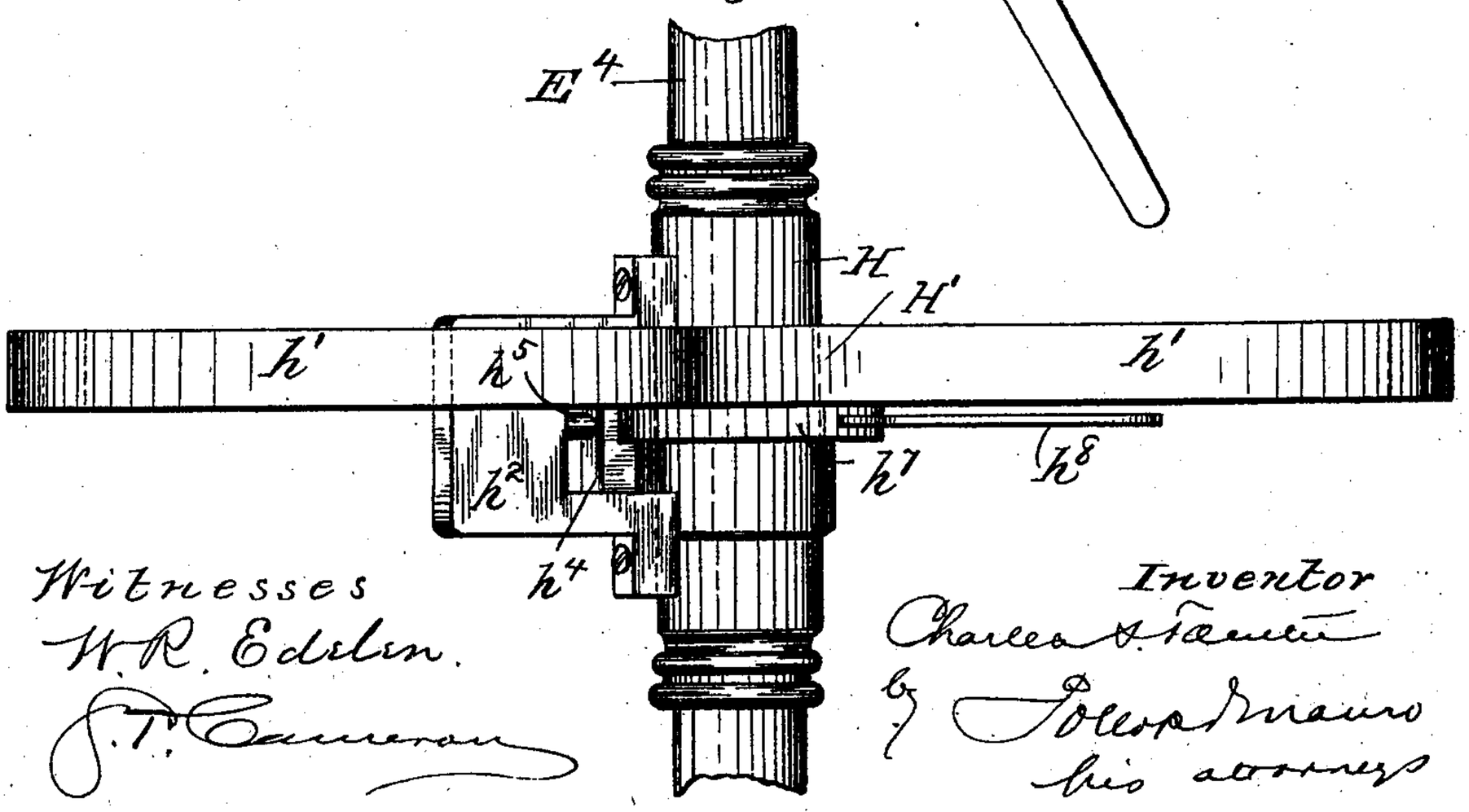

Fig. 16.

Witnesses
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No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 9.

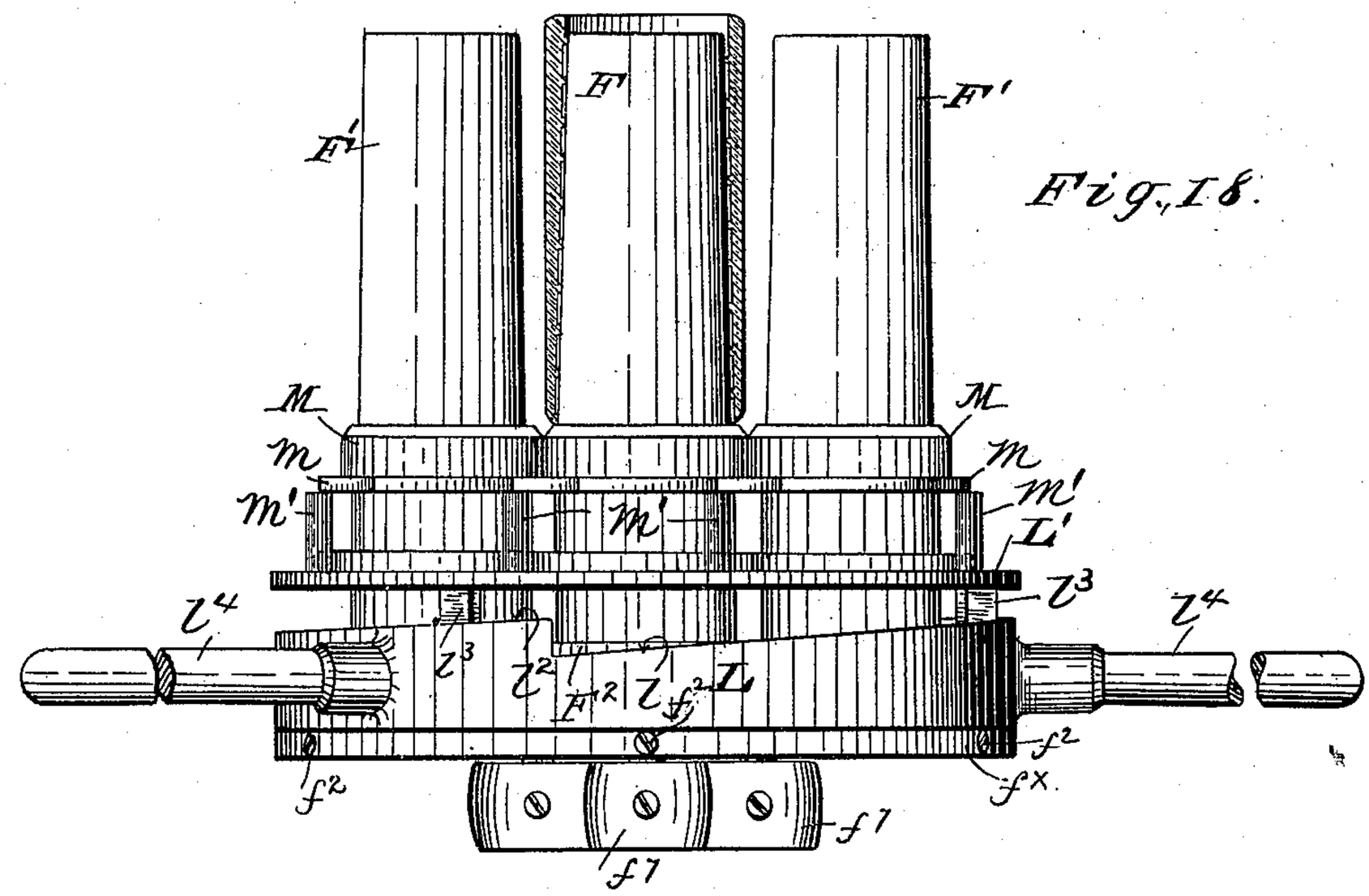
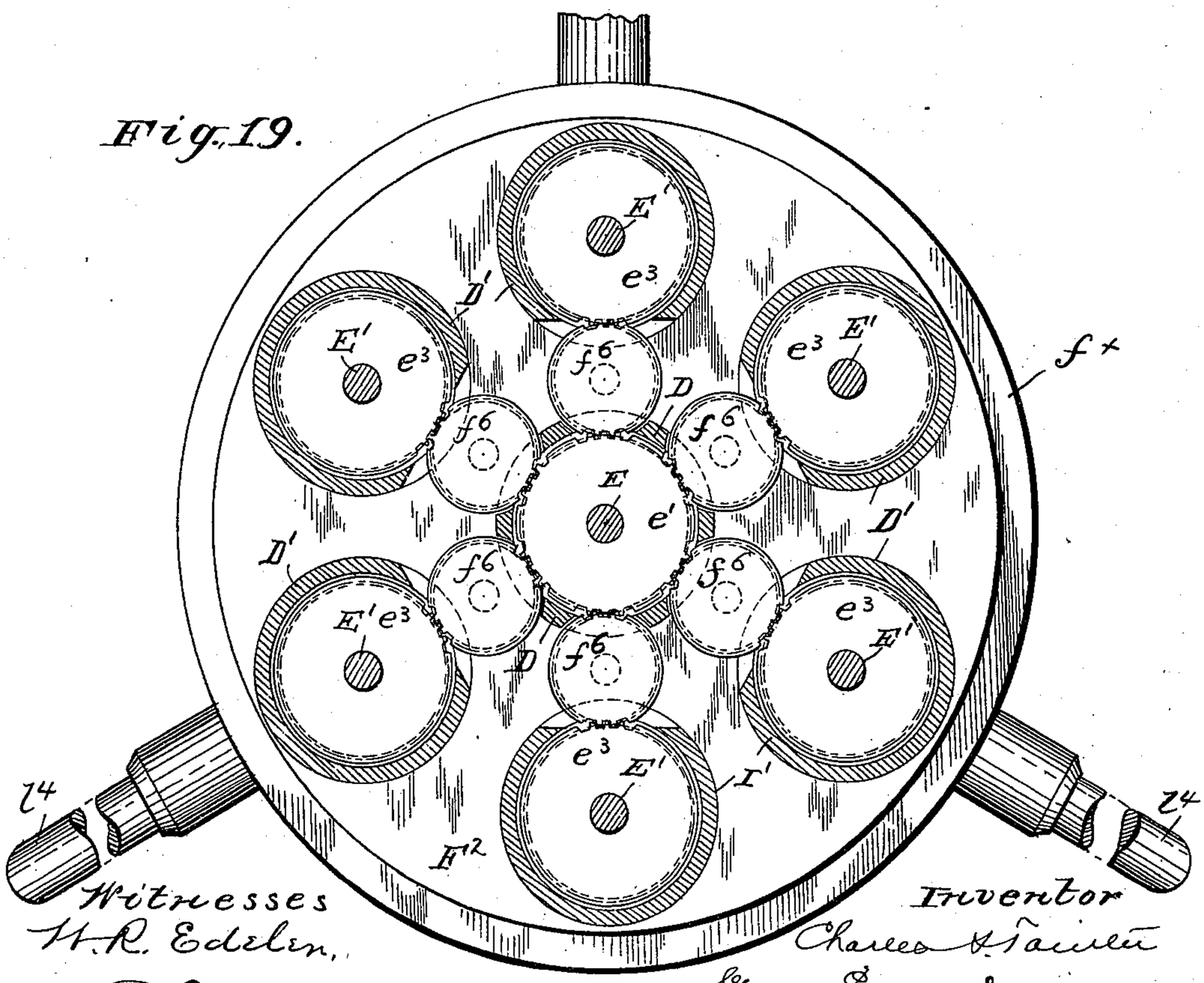


Fig. 18.

Fig. 19.



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(No Model.) 11 Sheets—Sheet 10.

Fig. 20.

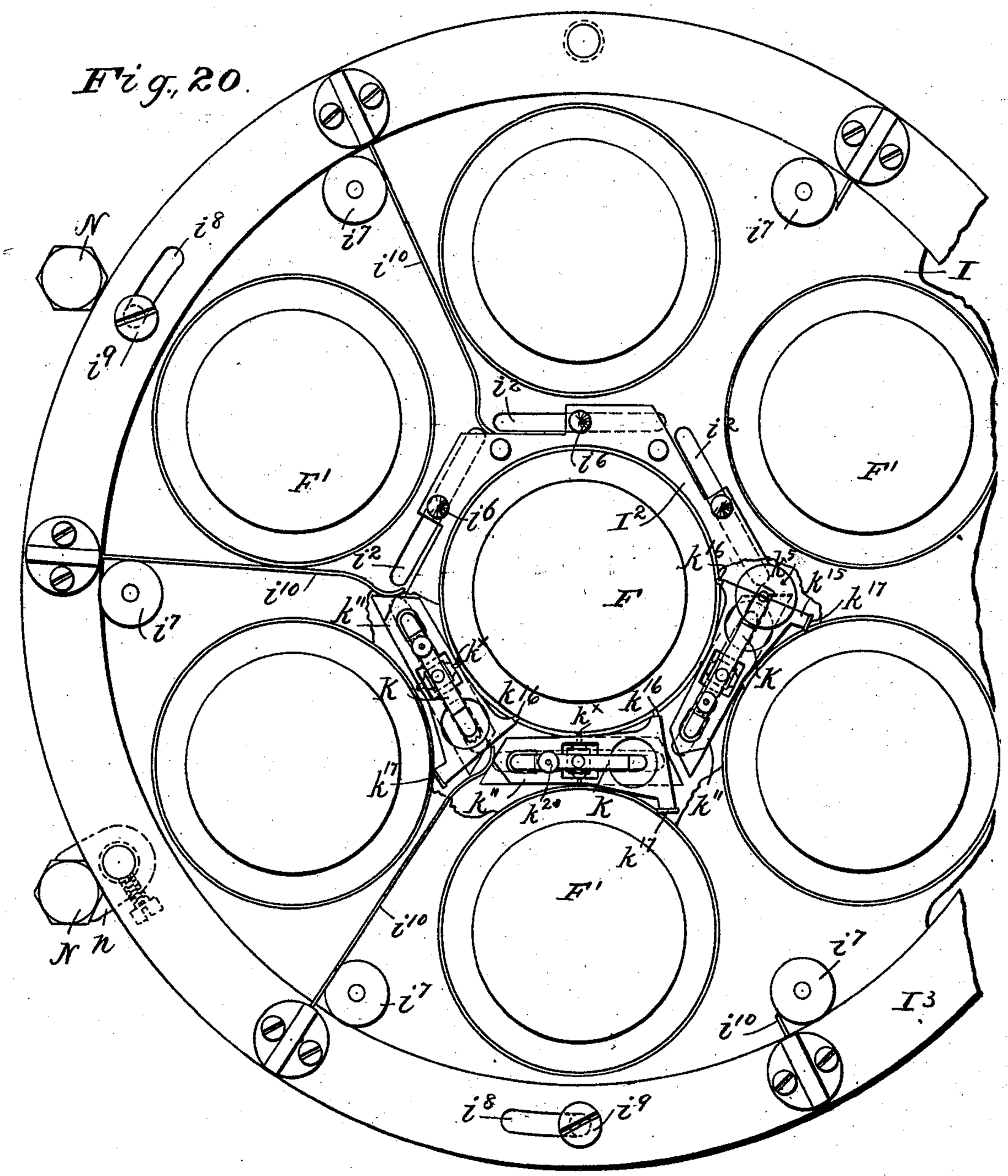
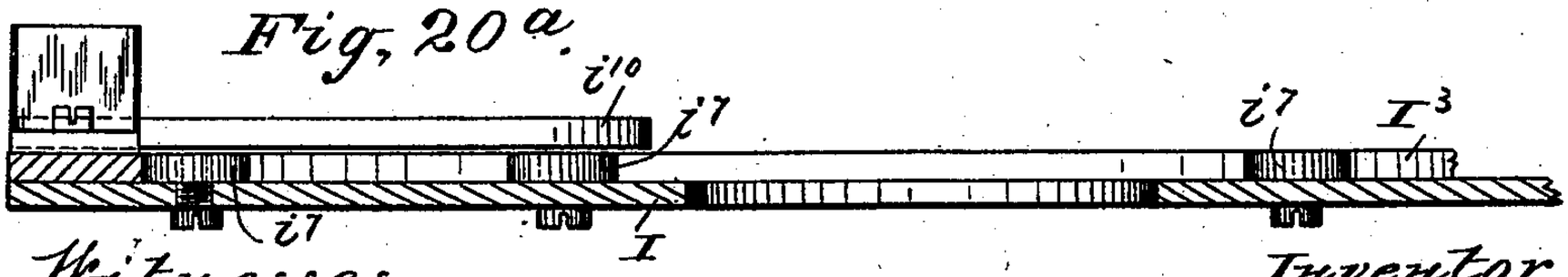


Fig. 20a.



Witnesses.
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No. 670,442. Patented Mar. 26, 1901.

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GRAPHOPHONE RECORD DUPLICATING MACHINE.

(Application filed Aug. 16, 1898.)

(No Model.) 11 Sheets—Sheet 11.

Fig. 24.

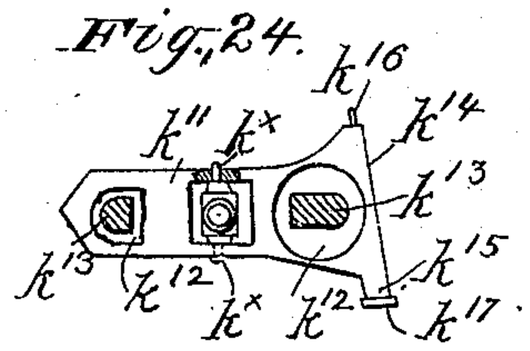
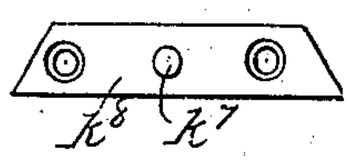


Fig. 25.



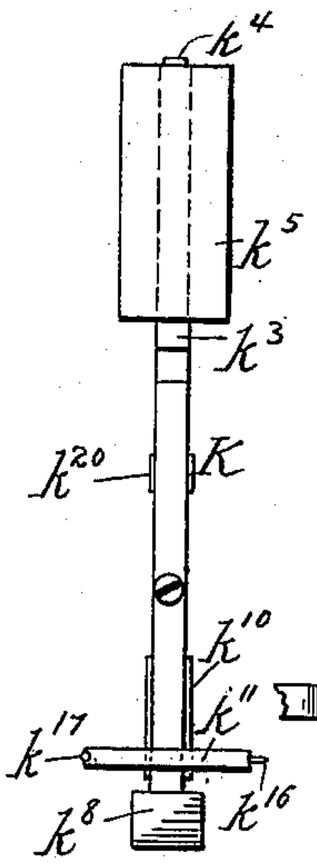


Fig. 22.

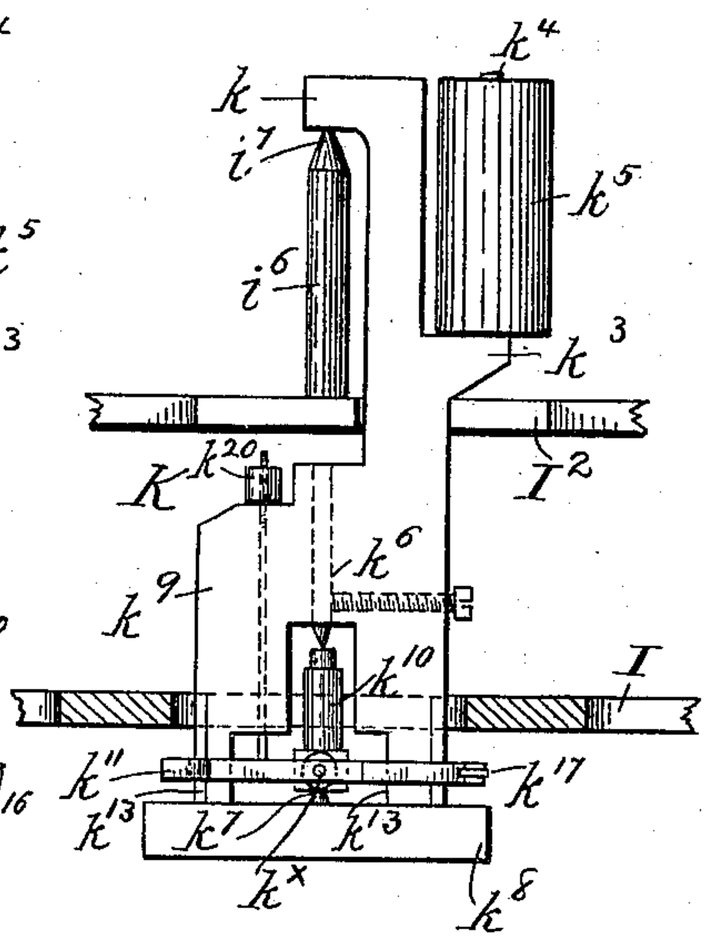


Fig. 21.

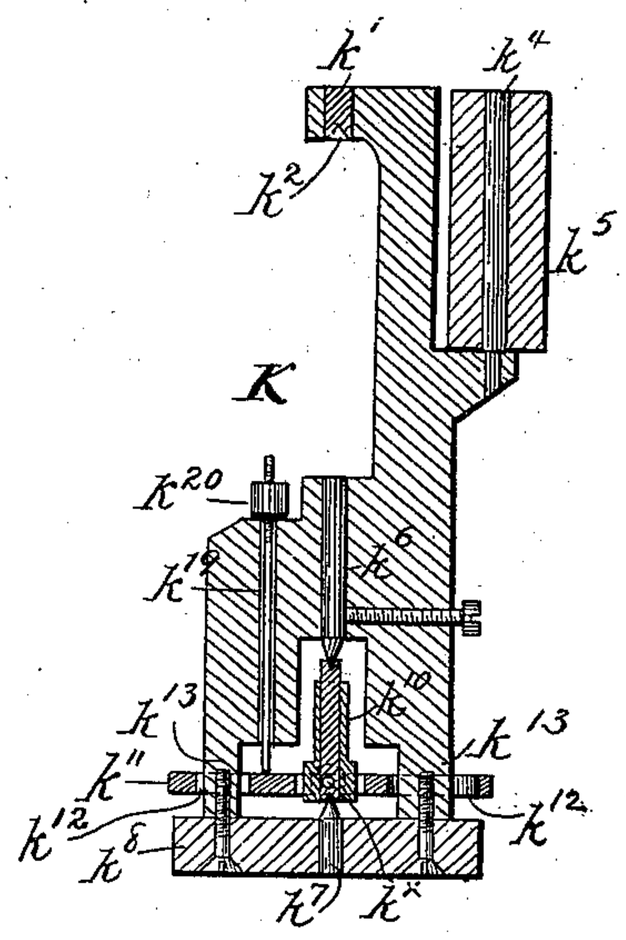


Fig. 23.

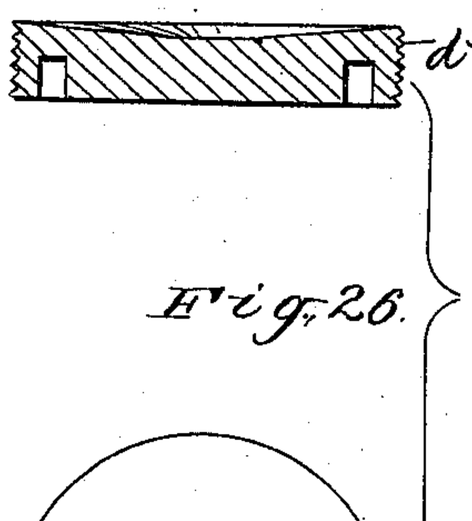


Fig. 26.

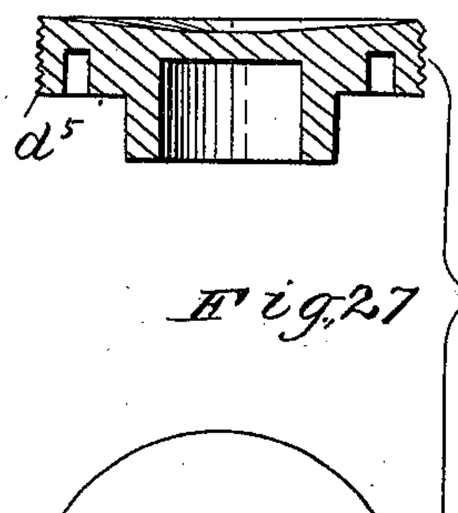


Fig. 27

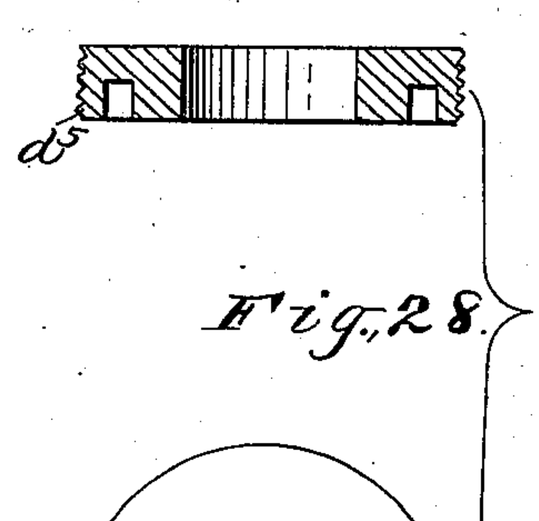


Fig. 28.

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UNITED STATES PATENT OFFICE.

CHARLES SUMNER TAINTER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE AMERICAN GRAPHOPHONE COMPANY, OF SAME PLACE.

GRAPHOPHONE-RECORD-DUPLICATING MACHINE.

SPECIFICATION forming part of Letters Patent No. 670,442, dated March 26, 1901.

Application filed August 16, 1898. Serial No. 688,717. (No model.)

To all whom it may concern:

Be it known that I, CHARLES SUMNER TAINTER, of Washington, District of Columbia, have invented a new and useful Improvement in Machines for Duplicating Graphophonic Sound-Records, which improvement is fully set forth in the following specification.

My invention relates to the art of duplicating sound-records for graphophones or talking-machines.

Most of the sound-records sold on the market at the present time are not the original sound-records formed by the vibrations of a cutting-style attached to a diaphragm upon which the sound-waves are caused to impinge, but are copies or "duplicates" of the records thus originally made by the direct action of the sound-waves. In the manufacture of such duplicates an original sound-record is first formed by causing the sound-waves to be recorded to impinge upon a vibrating diaphragm bearing a cutting-style whose point is embedded in the surface of a suitable recording-tablet. A record thus formed by the direct action of the sound-waves is known in the art as an "original" sound-record. This original record and a blank tablet are then mounted to revolve parallel to each other, and a follower with a fine blunt edge is caused to track in the record-groove and is connected by a suitable lever to a cutting-style whose point is embedded in the blank tablet. The blunt edge of the follower in the original sound-record rubs over the bottom of the undulatory groove constituting such record, and thus impresses upon the cutting-style whose point is embedded in the blank tablet vibrational movements exactly corresponding to the waves or undulations in the groove constituting the original sound-record, thereby causing the cutting-style to duplicate in the blank tablet the undulating groove of the original. There is thus produced a duplicate sound-record which is in every way as perfect a record of the original sound-waves as is the original sound-record itself and one which may be and is used to reproduce the original sound-waves in conjunction with a reproducer on a graphophone exactly as is done with the original record. The duplicate may itself also be used as a master in the production of additional duplicates. This method of causing a sound-record, whether original or duplicate, to impress vibrational movements corresponding to the recorded sound-waves upon a cutting-tool or graver in contact with a record-tablet was patented to me in United States Patent No. 341,287, granted May 4, 1886, and an improved duplicating-machine operating in accordance with said method is shown in United States Patent to Macdonald, No. 559,806. Such machines are efficient in operation and produce accurate and satisfactory duplicate sound-records; but as they can make but one duplicate at a time it is necessary where a large number of duplicate records are to be made to employ a large number of duplicating-machines and workmen for operating the same.

The object of my present invention is to provide a duplicating-machine which shall be capable of simultaneously making a plurality of duplicate sound-records from a single master-record, thereby rendering it possible to largely increase the production of a factory over that obtained by the machines now in use and without any corresponding increase in the number of machines or in the operatives therefor.

To this end my invention, broadly stated, consists in means for simultaneously revolving a master-record and a plurality of blank tablets arranged in proximity thereto, each blank tablet having a cutting style or point embedded in its surface, which point is connected by a vibratory lever to a rubbing-style tracking in the record-groove of the master.

The invention further consists in mechanism for duplicating in a plurality of blank cylindrical tablets arranged in a vertical position a sound-record on or in a master-tablet, also operating in a vertical position, in which mechanism a series of rubbing-styles tracking in the record-groove of the master are connected to cutting-styles embedded in the blank tablets, the rubbing and cutting styles being yieldingly held in their proper operative positions by gravity or equivalent

spring action, whereby errors due to irregularities in the surfaces of the tablets are avoided.

The invention also consists in certain details of construction which will be hereinafter fully described and then pointed out in the claims.

I have illustrated one form which my invention may assume in the accompanying drawings, in which—

Figure 1 is a front elevation of my duplicating-machine, parts being removed. Fig. 2 is a vertical section, parts being in elevation. Fig. 3 is a top plan with some of the transferring-levers omitted. Fig. 3^a is a broken detail showing means for oiling the driving-pulley shafts. Fig. 4 is a top plan of the steadying-block. Fig. 5 is a vertical section on the line 5 5, Fig. 4. Fig. 6 is a vertical section showing the connections for driving the screw-shaft. Fig. 7 is a bottom view of the bed-plate. Fig. 8 is a vertical section thereof. Fig. 9 is a top plan showing the means for removing the tablets from the mandrels. Fig. 10 is a horizontal section on the line 10 10, Fig. 2, looking upward. Fig. 11 is a vertical section of one of the mandrel-supporting columns. Fig. 12 is a top plan of the carriage-plate. Fig. 13 is a sectional detail showing the means for actuating the carriage from the feed-screw. Fig. 14 is a plan of the support for the transferring-levers. Fig. 15 shows a plan and side elevation of a ring for removing tablets from the mandrels. Fig. 16 is a view of the spider which supports the carriage, showing its connection to the screw-shaft. Fig. 17 is a bottom view of the same. Fig. 18 is a side elevation showing the cam-ring and coöperating parts for removing tablets from the mandrels. Fig. 19 is a horizontal section on line 19 19, Fig. 2, looking downward. Fig. 20 is an enlarged top plan of the carriage, some of the transferring devices being shown in position and others being removed. Fig. 20^a is a partial vertical section thereof. Fig. 21 is a side elevation of the swinging block supporting the lever connecting the rubbing and cutting styles, which block, together with all the parts supported thereby, is for convenience of description herein referred to as a "transferring device." Fig. 22 is an edge view of Fig. 21, and Fig. 23 is a vertical section thereof. Fig. 24 is a plan view of the transferring-lever and the rubbing and cutting styles connected thereby. Fig. 25 is a plan of the bottom part of the swinging block, and Figs. 26, 27, and 28 are views in section and plan of bottom pieces for the columns hereinafter referred to.

Referring to the drawings, A is a bed-plate mounted upon hollow standards or supports B, the lower ends of which are properly spaced by a three-armed spider C, having openings c formed in the arms, through which openings the hollow standards B pass and in which they are secured by set-screws c', as shown. The bed-plate A has centrally formed therethrough an opening a, and around this opening a are a plurality of similar openings a'. I have shown six such openings a'; but more or less than six may be employed, if desired, and while it is preferable to arrange these openings symmetrically around the central opening a this is not absolutely necessary. In the central opening a through the bed-plate is secured a vertical column D, and in each of the openings a' similar columns D' project both above and below the bed-plate and are secured in place by means of screws a^2, passing downward through the bed-plate and engaging circumferential flanges d upon the columns D D', which flanges fit an annular recess formed on the under side of the bed-plate A. The columns D D' are shouldered, as shown at d', (see Fig. 11,) and have a central bore d^2, which bore is expanded below the bed-plate A into the circular chamber d^3, having interior screw-threads d^4 cut near the lower end thereof. This chamber d^3 is closed by a bottom piece d^5, Figs. 2 and 6, having its upper surface preferably somewhat dished, and upon this dished surface rests a shaft E of column D, which passes up through the bore d^2 in the column and has bearing-surfaces e e in contact with the surface of the bore, but is cut away between its ends to reduce friction.

On the upper projecting ends of the shaft E is secured a hollow mandrel F, which extends downward around the column, the mandrel preferably tapering slightly from its lower to its upper end and being at its open lower end nearly flush with the shoulder d'.

On the lower end of the shaft E is a gear e', secured in place by the sleeve e^2, which is forced up against the gear e' by a binding-nut on the end of the shaft, as shown.

Each of the columns D' has a shaft E', to which is secured a mandrel F' on its upper end and a gear e^3 on its lower end, the shafts E', mandrels F', and gears e^3 being in every respect like the shaft E, mandrel F, and gear e' and all the shafts E' except one resting upon dished bottom pieces exactly similar to bottom piece d^5 in column D. In the single case where the shaft E' is not supported by the dished bottom piece this piece has an opening d^6 formed therein, through which a conically-pointed shaft E^2 projects, its conical point entering a centering depression e^4 on the lower end of the shaft E'. (See Fig. 6.) The shafts E' and E^2 are coupled so as to turn together by a sleeve E^3, which is connected to the shaft E^2, preferably by a driving fit of the parts, the other end of the sleeve fitting loosely over the nut and sleeve e^2 on the shaft E' and having an open-ended slot e^5, into which projects a radial pin e^6 on the sleeve e^2. This construction enables the parts to be readily assembled by driving the sleeve E^3 onto the shaft E^2 and then slipping the sleeve and end of the shaft through the opening d^6 in bottom piece d^5, with the end of sleeve E^3

surrounding sleeve e^2 and the pin e^6 entering the slot e^5, while the conical point of the shaft E^2 enters the centering depression e^4 in the lower end of shaft E'. The shaft E^2 is passed through an opening in one arm of the spider C, its lower end resting in a bearing-block C', secured to the under side of the spider. A recess c^2 is cut in the upper surface of the bearing-block, at the inner end thereof, and a pinion e^7 is secured on the end of shaft E^2 and revolves in the recess c^2. The bottom piece closing the chamber d^3 of the central column D has a socket d^7 formed on the lower side thereof, and the upper end of a tube E^4 fits snugly in said socket and has its lower end secured by a set-screw in an opening at the center of the spider C. The tube E^4 has a slot $e^\times$, Fig. 2, extending throughout its length, and in each end is secured a collar or ring affording bearings for a screw-threaded shaft E^5, revolving within the slotted tube E^4. On the reduced lower end of the screw-shaft E^5, which projects below the spider C, is secured the pinion e^8, which is geared through the idler e^9 to the pinion e^7 on the shaft E^2.

Beneath the bed-plate A is a thick block F^2, Figs. 4, 5, and 19, having openings f f' therein, which enable it to be slipped up over the ends of the columns D D', which project below the bed-plate, the block F^2 being secured in place by means of set-screws f^2, Fig. 2, passing inward from the perimeter of the block against the columns D'. The openings f f' in the block F^2 are formed with great exactness both as to size and position, as it is a part of their office to exactly center the columns D D' and hold them so as to avoid any vibration of the mandrels supporting the tablets and also to insure the perfectly-accurate working of the gearing connecting the several shafts E' with the central shaft E, Fig. 19, it being desirable to avoid any backlash or other play between the parts that would interfere with perfect uniformity in the operation of the seven mandrels.

Holes f^3 are formed in the block F^2 intermediate the center of the opening f and the several openings f', and a shaft f^4 is inserted from above into each hole f^3, shoulders f^5 on the shafts resting upon the upper surface of the block F^2 and supporting the shafts. Upon the projecting upper ends of the shafts f^4 are secured pinions f^6, each of which intermeshes with and forms a driving connection between the gear e' in the shaft E and one of the respective gears e^3 on one of the shafts E'. (See Figs. 2, 3ª, and 19.) Each of the shafts f^4 projects below the block F^2 and carries a driving-pulley f^7, suitably secured thereto. It will be understood that the six pulleys f^7 are thus symmetrically arranged around the central column D, and each is arranged to drive a shaft which is geared to the central shaft E and one of the shafts E'. The pulleys f^7 are surrounded by a closely-fitting band or belt G, Fig. 10, preferably of elastic material, and a second belt G' passes around the band G and thence to any suitable source of power.

The operation of the device as thus far described is as follows: Power being applied to the belt G' it is communicated through the belt G to the pulleys f^7, the latter belt serving to distribute the strain with great evenness, to the end that the gears f^6 may act with perfect uniformity, and since the central gear e' on the shaft E is connected to each of the equal gears e^3 on the shafts E' it follows that the central mandral F and its surrounding six mandrels F' will all be smoothly and evenly driven at the same speed, and the shaft E^2, being coupled to one of the shafts E', turns with it and drives the screw-shaft E^5 through the gears on the end of said shafts and the idler e^9, connecting them.

Surrounding the slotted tube E^4 is a sleeve H, Figs. 1, 2, 13, and 17, to which is adjustably attached a spider H', having horizontally-extending arms h'. The sleeve H has a vertical slot h, Fig. 13, cut in one side, and opposite said slot h there is secured to the sleeve a block h^2, having a recess h^3 cut therein, within which rests a pair of nut-sections h^4, united at their outer extremities and having a spring-pressed pin h^5, entering an extension of the recess h^3. The block h^2 is located in a vertical slot h^6, cut in one of the arms h' of the spider H', and a cam-ring h^7 surrounds the sleeve H and passes between the nut-sections h^4, a lever h^8 being provided for shifting the cam. The nut is held at all times against the cam-ring by the spring pressing on the pin h^5, the nut-sections extending through the slot h in the sleeve H and the slot $e^\times$ in the tube E^4. When the cam-ring is in the position shown in Fig. 13, the nut-sections engage the screw-shaft E^5, revolving within the stationary tube E^4, being held in engagement by the spring, thereby causing the sleeve H to advance longitudinally along the tube E^4 and carrying with it the spider H; but when the cam-ring is shifted it throws the nut out against the tension of the spring, and thereby disengages the nut from the shaft.

I, Figs. 2 and 12, is a circular plate having the central opening i and six marginal openings i', each of which is of a size to slip freely over the tablets borne by the mandrels F F'. Six slots i^2 are cut in the plate, one between each of the openings i' and the central opening i, and form when thus arranged a regular hexagon around the opening i. The plate I is located above the bed-plate A and has attached to it three rods I', forming legs, which pass down loosely through the bed-plate A, but outside of the block F^2, and rest with their shouldered ends i^3 in sockets h^9 in the ends of the arms h' of the spider H'.

I^2, Figs. 3, 14, and 20, is a hexagonal plate having its center removed, so as to form an opening corresponding to the central opening i in plate I, and having notches i^4 formed

in its periphery. This plate I^2 is supported on pillars i^5, (preferably six in number,) attached to the upper side of the plate I, and bears six upwardly-projecting pointed standards i^6, each of which is secured thereto near one end of a notch i^4, as shown in Fig. 14. The sleeve H, spider H′, plates I and I^2, together with their connecting parts, constitute a vertically-moving carriage, and this carriage, with the parts supported thereby, is counterbalanced by weights b, attached to cords or chains b', passing over pulleys b^2.

Passing upward through each of the slots i^2 in the plate I is a block K, Figs. 1, 20, and 21, hung to swing on the pointed standards i^6. There are six of such blocks K, and as they are all identical in construction a description of one will suffice for all. On the upper end of the block is a horizontally-projecting arm k, in which is secured a piece of hardened steel k', with a depression k^2, forming a bearing-surface for the tempered point i^7 of the standard i^6. Extending from the side of the block opposite the bearing-arm k is a lug k^3, on which is a pin k^4, and k^5 is a weight or weights having a bore therethrough in order that it may be slipped on over the pin k^4. A vertically-adjustable bearing-point k^6 (preferably of hardened steel) is secured in a lower arm k^9 of the block K, which arm projects horizontally beneath the plate I^2. Between the bearing-point k^6 and a similar point k^7 on a bottom piece k^8, attached to the block K, is a block or hub k^{10}, which turns freely on a substantially vertical axis. The lower arm k^9 of the block K is cut away, as shown, so that the hub k^{10} turns in a recess thus formed and supports a lever k^{11}, which is hung on a horizontal axis to the hub k^{10}. The lever k^{11} has openings k^{12} near its opposite ends, through which legs k^{13} on the block K freely pass, so that the lever k^{11} may turn to a limited extent on its horizontal axis $k^\times$ or with the block k^{10} on its vertical axis. That end of the lever k^{11} which extends out under the weight k^5 is broadened into projecting points or arms k^{14} and k^{15}. A rubbing-style k^{16} is secured in the arm k^{14}, and a cutting-style k^{17} is fastened to the arm k^{15}, as clearly shown in Figs. 20 and 24, that end of the lever k^{11} supporting the styles being slightly heavier than the opposite end, so that if left free to turn about its horizontal axis the style-bearing end of the lever k^{11} would be depressed. A pin k^{19} fits loosely in the arm k^9 and has a small weight k^{20} on its upper screw-threaded end, the pin k^{19} extending down through the arm k^9 and bearing on that end of the lever k^{11} opposite the styles. The mass of the weight k^{20} is sufficient to overbalance the lever k^{11}; but by adjusting the weight k^{20} on the pin k^{19} it may be caused to bear upon that end of the lever k^{11} opposite the styles until the lever becomes horizontal, at which point the weight k^{20} is taken by the upper face of the arm k^9 of the block K. By this means the lever k^{11} is held yieldingly in a horizontal position, while the end bearing the rubbing and cutting styles is left free to move so as to accurately follow the record-groove in the master-record or respond to inequalities in the tablets.

Referring now to Fig. 20, the lever k^{11} is so proportioned and the rubbing and cutting styles so positioned thereon that the styles each come in contact with their respective tablets at the point where a line drawn through the vertical axis of the lever k^{11} is tangent to the tablet, the result being that the vibrations of both the rubbing and the cutting styles are substantially on radial lines of their respective cylinders, which is the direction along which said vibrations should occur for the production of the best results. By reason of the pendulum-like action of the block K the styles automatically find their proper position and are held to their work by the weight k^5, the mass of which is adjusted to a nicety to the end that it may yield sufficiently to allow the styles to conform to irregularities in the contour of the tablets and at the same time effectively prevent the styles from leaving the surfaces of the tablets. By thus mounting the style supporting and controlling lever so that it is free to turn about a universal joint and holding it to its work by the action of gravity I give to it all the sensitiveness and accuracy, when acting in conjunction with vertically-disposed tablets, that the well-known "floating" or "gravity" recorders and reproducers of the graphophone possess when acting to record or reproduce a record on a horizontally-disposed tablet.

In action the carriage bearing the rubbing and cutting styles, as described, is placed in its lowermost position and is elevated by the feed-screw E^5 at the same time that the mandrels are revolved. The result is that the records are cut in a spiral line starting at the bottom and ending at the top, so that when the records are completed the carriage, with its transferring-blocks and their supported styles, is at the top. In order to remove the records, it is necessary that the carriage be depressed, and before this is done it is essential that the styles be shifted so that they will not come in contact with the records during the downward movement of the carriage. For this purpose a ring I^3 is mounted on the plate I and is preferably of equal diameter therewith. This ring I^3 bears with its inner circumference on loosely-turning rollers i^7, secured to the plate I in position to center the ring I^3 thereon. Slots i^8 are cut in the ring I^3, and screw-pins i^9 are passed therethrough into the plate I, so that the ring I^3 has a limited circular movement upon the plate I. Secured to the ring I^3 are six spring-arms i^{10}, extending inward from the ring to the pendulous blocks K. When the styles are in operation, the inner ends of the arms i^{10} are adjacent to but not quite in contact with that edge of the respective blocks K which is opposite to the styles, (see Figs. 3 and 20,) and by shifting the ring

I^3 from left to right the spring-arms will simultaneously strike upon and swing the pendulous blocks K to the right, and thus throw all the rubbing and cutting styles out of contact with their respective tablets. The lower ends of the blocks K are shaped as shown in Fig. 25, and when the blocks are hanging in operative position said lower ends together form a nearly-closed regular hexagon; but as the movements of the blocks under the action of the spring-arms are simultaneous they do not in the swinging movement above described interfere with each other. The blocks being swung aside, the carriage may be lowered without danger of injury to the records from the styles, and the records being removed and new tablets placed on the mandrels the styles may be returned to their active positions by shifting the ring I^3 from right to left, the weights k^5 promptly throwing the styles in contact with their respective tablets.

In order that the tablets may be readily removed from the mandrels, I provide a means whereby they may be raised and, because of the slightly-conical form of the mandrels, loosened, thereby placing them where they may be readily grasped by the fingers and lifted from the machine. I provide the block F^2 with a flange $f^\times$, and resting upon this flange and turning freely around the block is a cam-ring L, having formed in its upper edge cam-surfaces l. There are three such cam-surfaces shown, each extending from its lowermost point to the top of the ring L, where they run into flat surfaces l^2. Normally resting upon said flat surfaces is a plate L′, having lugs l^3 on its under side and resting in the cams l. The plate L′ is perforated to allow the lower tubular portions of the columns D D′ to pass therethrough, but is otherwise a solid plate. (See Fig. 9.) Any suitable handle l^4 is attached to the cam-ring, whereby it may be given about a one-third revolution, which causes the lugs l^3 to travel up the inclines or cams l and rest upon the flat surface at the top of the cam-ring, thereby raising the plate L through a distance equal to the rise of the cams l. Surrounding the base of each one of the columns D D′ and resting on the bed-plate A is a ring or collar M, Fig. 1, dotted lines, and Figs. 2, 3, 15, and 18, whose internal diameter but slightly exceeds the external diameter of the mandrel on the columns, as clearly shown in Fig. 2. This ring M has a horizontally-extending base or flange m, in the form of a regular hexagon, so proportioned that when the several rings M are in place around the columns D D′ the hexagonal flanges m meet and form, in effect, a complete and continuous flooring over all the space on the bed-plate between and around the columns, as is clearly indicated in dotted lines, Fig. 3. If desired, the flanges of the several rings might be united into one integral plate and the rings made separate therefrom and allowed to rest loosely thereon.

Passing loosely through the bed-plate A and resting upon the plate L are a number of pins m', whose length is just sufficient to reach from the top of the plate L when in its lowermost position to the top of the bed-plate A. These pins m' are clearly shown in Fig. 18, where the bed-plate A is omitted for the purpose of more clearly illustrating their operation and their relative distribution, whereby when the pins m' are raised above the bed-plate, as hereinafter described, they will press equally against all the flanges m of the rings M, and thereby lift them evenly and smoothly from the bed-plate, as shown in Fig. 9. Referring now to Figs. 1, 2, and 18 and assuming the parts to be in the position shown in Fig. 2, with tablets on the mandrels and the cam-ring L shifted to the right, with the plate L′ resting upon the flat surfaces l^2 and the lugs l^3 in the lowermost parts of the cams l, it will be seen that the upper edges of the rings M are immediately beneath the lower ends of the mandrels and that the pins m' rest upon the plate L′, with their ends flush with the top of the bed-plate A. If now one of the handles l^4 be grasped and the cam-ring L be shifted to the left, the lugs l^3 will ride up the inclines or cams l, forcing up the plate L′, which in turn raises the pins m', and through them the flanged rings M, which latter engage the lower ends of the tablets and force them upward. The mandrels are slightly tapering toward the top, and the upward movement of the tablets so loosens them that they may be readily removed. When the cam-ring is given its full throw to the left, it will have turned through nearly one-third of a revolution, and the lugs l^3 will then rest upon the flat surfaces l^2 at the top of the cam-ring, thereby securely retaining all the parts in their elevated position while the tablets are being renewed, after which the cam-ring is again shifted to the right preparatory to placing other tablets upon the mandrels.

The carriage supporting the pendulous levers K is guided in its up-and-down movements by ears or lugs n, embracing uprights N, firmly secured on the bed-plate A, and the weights b in the hollow standards B are so proportioned that their combined mass is just sufficient to counterbalance the carriage, with all its supported parts, to the end that the work of the screw E in elevating the carriage may be reduced to the minimum. A further result of this construction is that the carriage will remain stationary in any position in which it may be placed.

The parts of the mechanism needing lubricating are very few, and I have provided means whereby lubrication may be readily accomplished. Referring to Fig. 2, d^7 is a small hole in column D, extending inward from the surface of the column under the ring M and then downward till it enters the chamber d^3, just inside the wall of the chamber. Oil entering this hole 27 at the top passes down into the chamber d^3 and along the walls thereof to dished bottom d^5, where it acts to

lubricate the bearing of the shaft E on said bottom. A similar means is provided for oiling all the shafts E′, except the one shown to the left of Fig. 2, where it is omitted, because in that instance the shaft does not rest upon the dished bottom piece that passes therethrough. The lower bearing *e* of the shafts E E′ is lubricated through a hole d^8 in a manner that will be readily understood.

In order to lubricate the shaft f^4 of the driving-pulleys f^7, I pass a small tube *p* down through the bed-plate A, which tube registers with a longitudinal bore *p*′, extending from the top of the shaft f^4 downward in a vertical direction for a short distance and then outward to the periphery of the shaft. By lifting the rings M the tube *p* may be filled with oil, which will slowly find its way through the bore *p*′ to the bearings of the shaft f^4.

I have shown at T, Fig. 10, a means for tightening the belt G, which will be readily understood.

It will be understood that while I have specifically and in detail described the best form known to me which my invention may assume, I have done so only that the invention might be thoroughly understood and not as indicating that the invention is limited to the specific construction shown, as the generic inventive idea may be embodied in different specific mechanical forms, and all such are meant to be included by the terms of my claims.

Having thus described my invention, I claim—

1. In a machine for duplicating sound-records the combination, with a tablet having a record formed therein and a plurality of tablets for receiving records, of a plurality of followers rubbing over the record, and a plurality of cutters each of which is movable with one of the followers, and each of which is embedded in the surface of one of the blank tablets, and mechanism for revolving the tablets and causing the followers to simultaneously follow the record and the cutters to simultaneously trace a spiral line upon the blank tablets, whereby a plurality of duplicate sound-records may be simultaneously formed from a single master-record, substantially as described.

2. In a machine for duplicating sound-records the combination of a revolving tablet having a sound-record therein, with a plurality of revolving blank tablets, a plurality of followers rubbing over the record, a plurality of cutters each of which is movable with one of the followers and each of which is also embedded in the surface of one of the blank tablets, gravity-controlled devices yieldingly holding the followers and cutters in contact with the respective tablets, and mechanism for revolving the tablets and causing the followers to simultaneously follow the record and the cutters to simultaneously trace a spiral line upon the blank tablets, whereby a plurality of duplicate sound-records may be simultaneously formed from a single master-record, substantially as described.

3. In a machine for duplicating sound-records, the combination of a plurality of vertically-disposed revolving mandrels, one of which bears a tablet having a sound-record formed therein and the others bearing blank tablets with a cutter embedded in the surface of each blank tablet, and a corresponding number of followers simultaneously rubbing over the record of the record-tablet, the cutters being mounted to partake of all the movements of the followers, substantially as described.

4. In a machine for duplicating sound-records the combination of a plurality of vertically-disposed revolving mandrels, one of which bears a tablet having a sound-record formed therein and the others bearing blank tablets, with a cutter embedded in the surface of each blank tablet, a corresponding number of followers simultaneously rubbing over the record of the recording-tablet, the cutters being mounted to partake of all the movements of the followers, and gravity-controlled devices yieldingly holding the followers and cutters in contact with the respective tablets.

5. The combination with a sound-record formed in a vertically-disposed tablet, of a vertically-disposed blank tablet, a gravity-controlled follower rubbing over the sound-record, a cutter embedded in the surface of the blank tablet and movable with the follower, and means for revolving the tablets and causing relative longitudinal movement between the tablets on the one hand and the cutter and follower on the other hand, substantially as described.

6. In a machine for duplicating sound-records, the combination of a vertically-disposed revolving master-record, and a plurality of vertically-disposed revolving blank tablets, with a plurality of followers, a plurality of cutters each one of which is movable with one of the followers, and gravity-controlled devices holding the followers and cutters, yieldingly in contact with the master-record and blank tablets respectively, substantially as described.

7. In a machine for duplicating sound-records the combination of a vertically-disposed mandrel bearing a master-record, a plurality of vertically-disposed mandrels each bearing a blank tablet and each independently geared to the mandrel bearing the master-record, with a vertically-moving carriage bearing a plurality of followers and a like number of cutters each of which is movable with one of the followers, and a plurality of gravity-controlled devices each of which holds a single follower and its coacting cutter yieldingly in contact with the master-record and with one of the blank tablets respectively, substantially as described.

8. In a machine for duplicating sound-records, a master-record, a plurality of blank tab-

lets, and a plurality of pendulous levers, each lever supporting a follower in contact with the record and a cutter in contact with one of the blank tablets, whereby a plurality of duplicate sound-records may be simultaneously formed from a single master-record, substantially as described.

9. In a machine for duplicating sound-records a master-record, a plurality of blank tablets, a plurality of pendulous levers, each lever supporting a follower in contact with the record and a cutter in contact with one of the blank tablets, and means for simultaneously throwing all the followers and cutters out of contact with the record and tablets, substantially as described.

10. In a machine for duplicating sound-records, a vertically-disposed master-record, a plurality of blank tablets, a plurality of pendulous levers, each lever supporting a follower in contact with the record and a cutter in contact with one of the blank tablets, and a vertically-movable carriage supporting said pendulous levers, substantially as described.

11. In a machine for duplicating sound-records, a central, vertically-disposed mandrel, a plurality of mandrels surrounding said central mandrel and each geared thereto, combined with a screw-shaft, a vertically-movable carriage, a lever supported upon said carriage and capable of movement about a universal joint, a follower and a cutter each attached to said lever, and nut-sections connecting said carriage to said screw-shaft, substantially as described.

12. In a machine for duplicating sound-records, a vertically-disposed mandrel carrying a sound-record, a plurality of vertically-disposed mandrels each having a blank tablet, a vertically-movable, counterpoised carriage supporting a plurality of followers in contact with the record, a plurality of cutters each movable with a follower and each in contact with a blank tablet, and means for revolving all the mandrels and giving translatory motion to the carriage, substantially as described.

13. In a machine for duplicating sound-records, a vertically-disposed pendulous lever, a follower connected by a universal joint thereto, and a cutter movable with said follower, substantially as described.

14. In a machine for duplicating sound-records, a pendulous lever, a block attached thereto and turning on a vertical axis, a lever supported by said block to turn on a horizontal axis, and a follower and cutter connected to said last-mentioned lever, substantially as described.

15. In a machine for duplicating sound-records, a bed-plate, suitable supports therefor, vertically-disposed columns mounted in openings so as to project above and below said bed-plate, shafts taking bearing in said columns and projecting therefrom above and below, mandrels secured to the upper ends of said shafts and gears to the lower ends thereof, and means connecting all the gears to a common source of power, whereby the mandrels are all simultaneously revolved, substantially as described.

16. The combination of a plurality of shaft-supporting columns mounted on a bed-plate with a centering and steadying block supported by said columns, substantially as described.

17. The combination of a plurality of mandrels for carrying record-tablets, a series of rings or collars capable of longitudinal movement along said mandrels, a cam-ring, and devices interposed between the same and said rings or collars, whereby the turning of the cam-ring will produce the longitudinal movement of the rings or collars, substantially as described.

18. In a machine for duplicating sound-records, a plurality of mandrels supporting a sound-record and a plurality of blank tablets, a plurality of pendulous levers supporting a plurality of followers in contact with the sound-record and a plurality of cutters one in contact with each blank tablet, a plurality of arms one in proximity to each pendulous lever, and an adjustable support common to all the arms, whereby said arms may be thrown into contact with the pendulous levers and swing the same so as to carry the followers and cutters out of contact with the record and blank tablets, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TAINTER.

Witnesses:

E. T. ROCKWOOD,

WM. R. MILLER.