

No. 702,887.

Patented June 17, 1902.

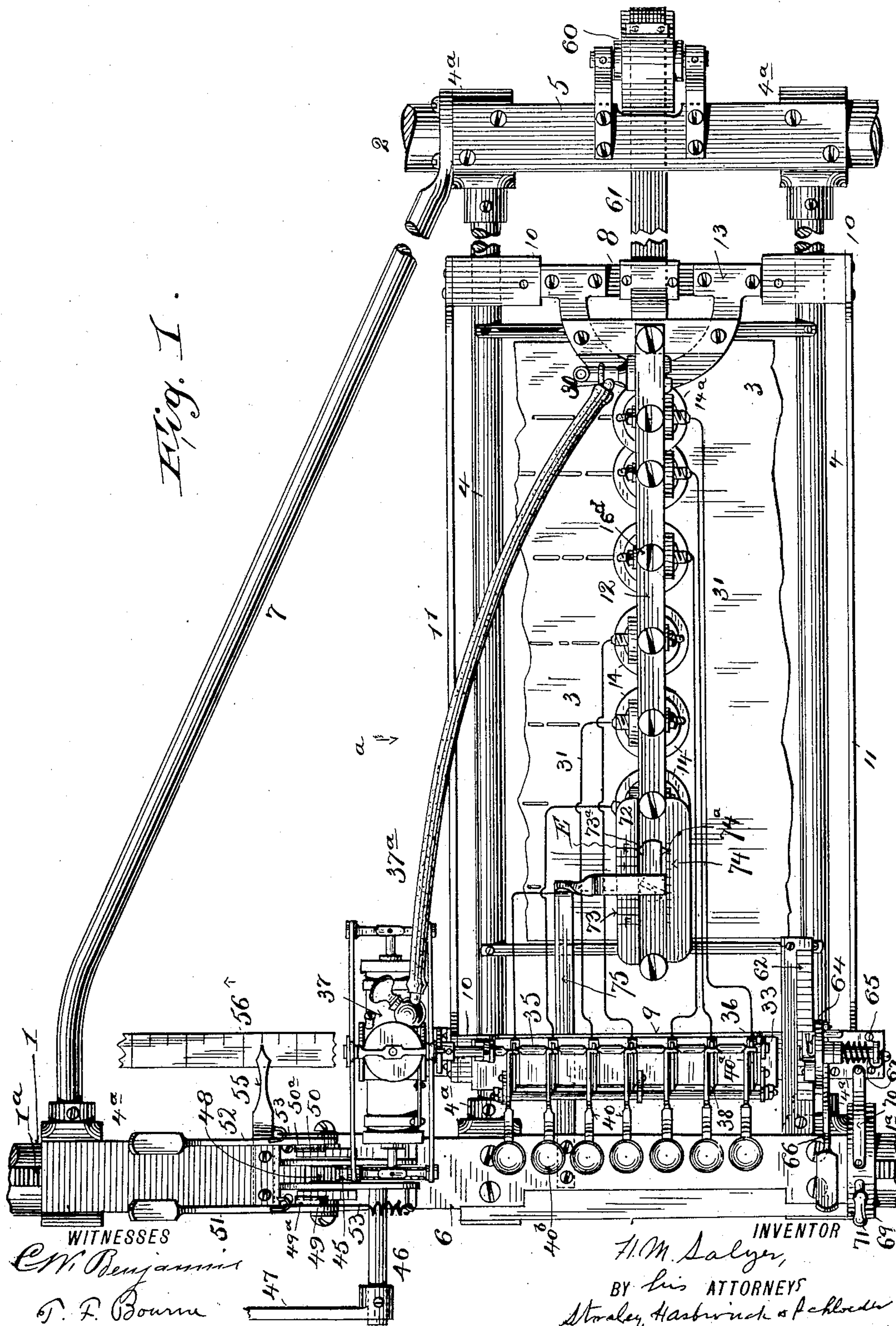
H. M. SALYER.

APPARATUS FOR PERFORATING MUSIC SHEETS.

(Application filed Sept. 25, 1901.)

(No Model.)

5 Sheets—Sheet 1.



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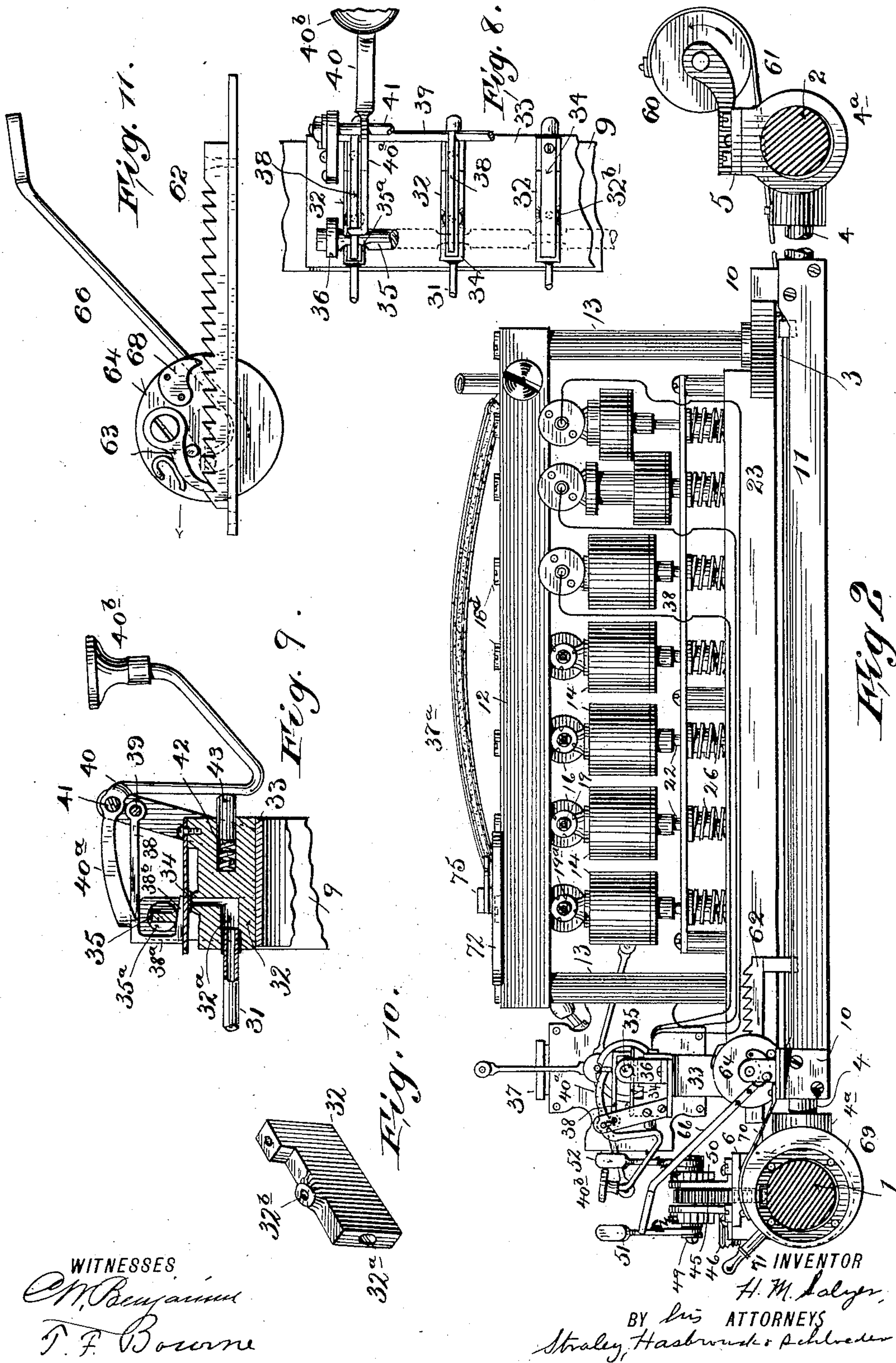
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(Application filed Sept. 25, 1901.)

(No Model.)

5 Sheets—Sheet 2.



WITNESSES  
C. M. Benjamin  
T. F. Bowne

INVENTOR  
H. M. Salyer  
BY HIS ATTORNEYS  
Straley, Hasbrouck & Pichler



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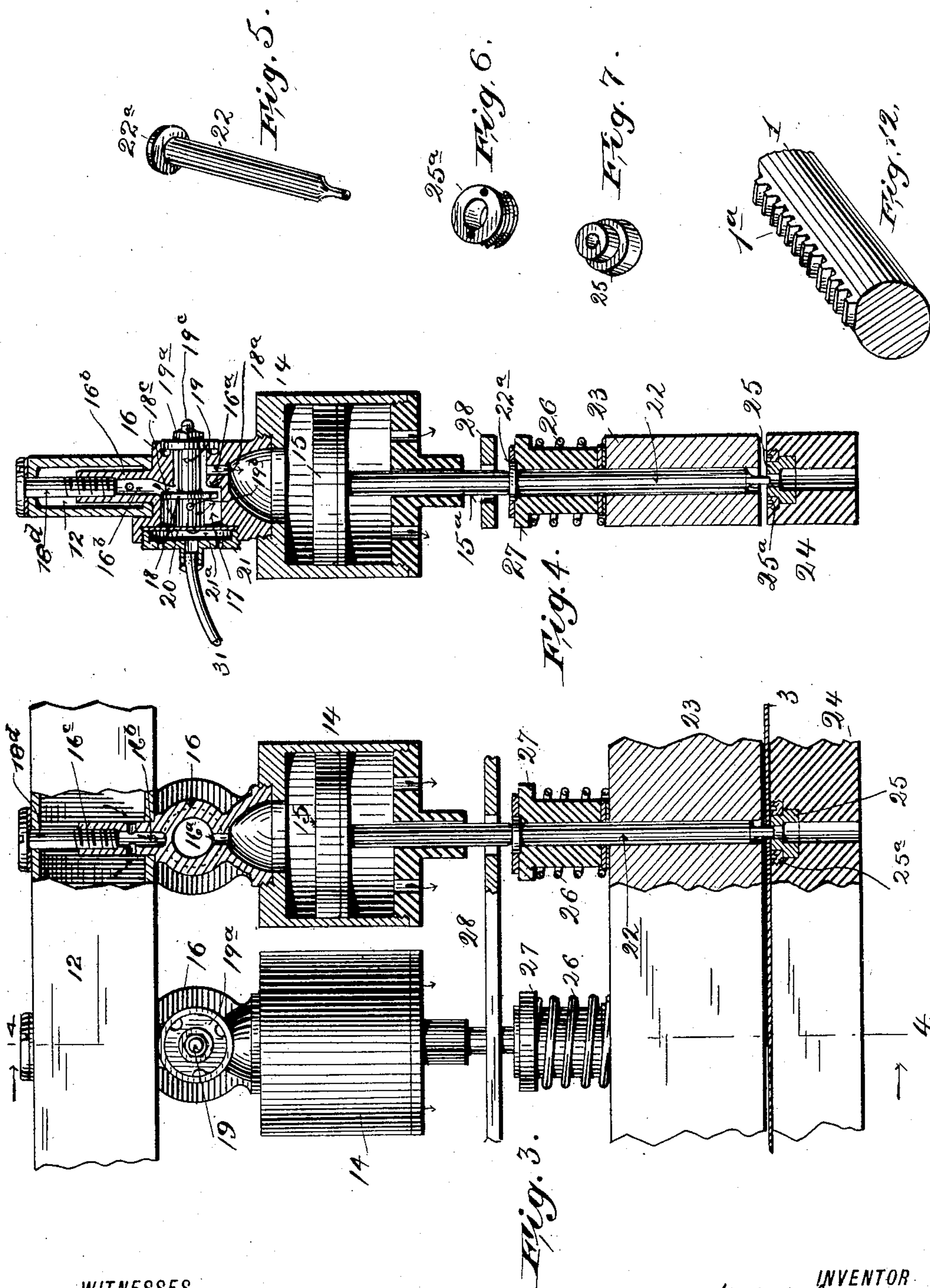
H. M. SALYER.

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(Application filed Sept. 25, 1901.)

(No Model.)

5 Sheets—Sheet 3.



WITNESSES  
*C. H. Benjamin*  
*T. A. Bourne*

INVENTOR  
*H. M. Salyer*  
BY *his* ATTORNEYS  
*Straley, Harbrow & Pohlman*

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H. M. SALYER.

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5 Sheets—Sheet 4.

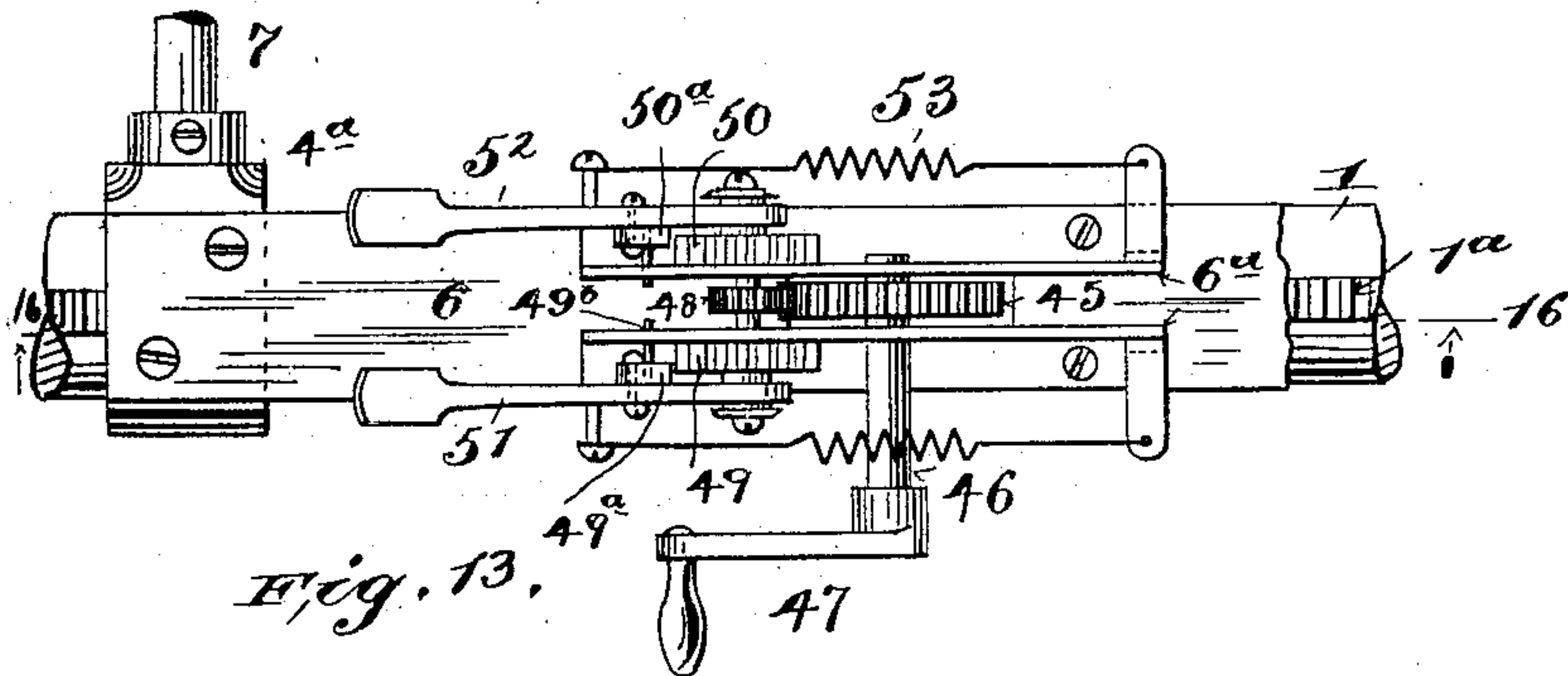


Fig. 13.

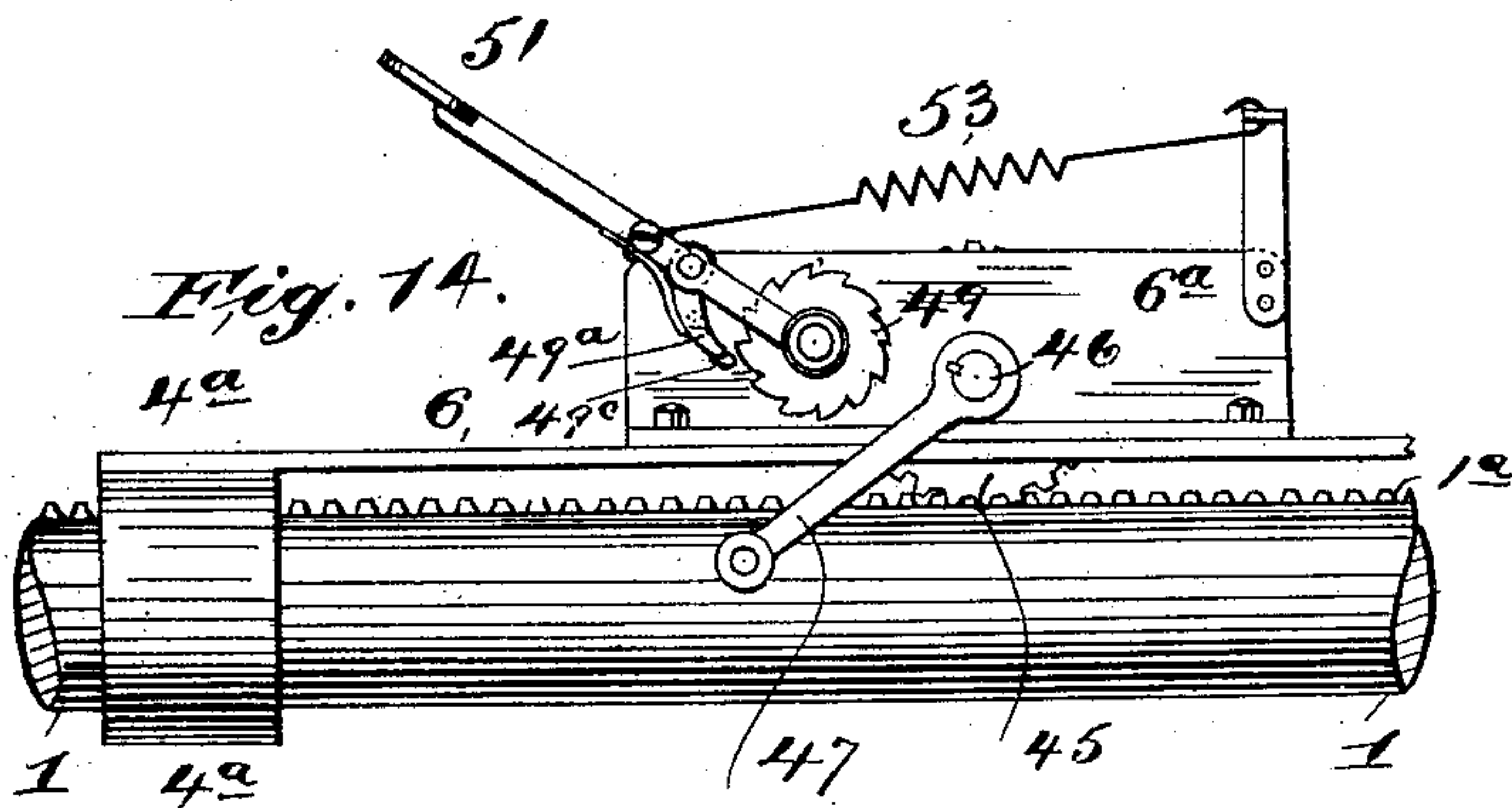


Fig. 14.

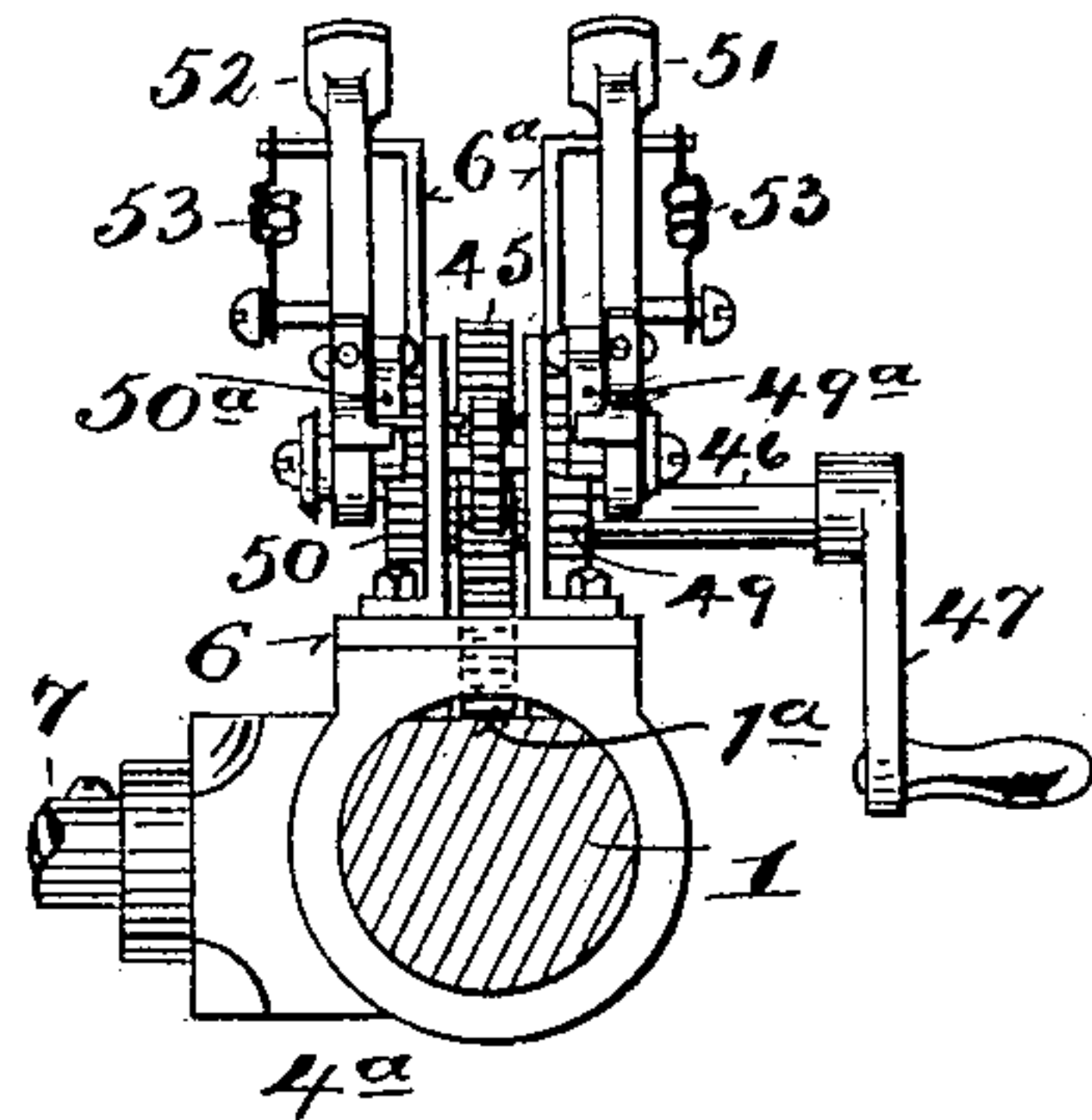


Fig. 15.

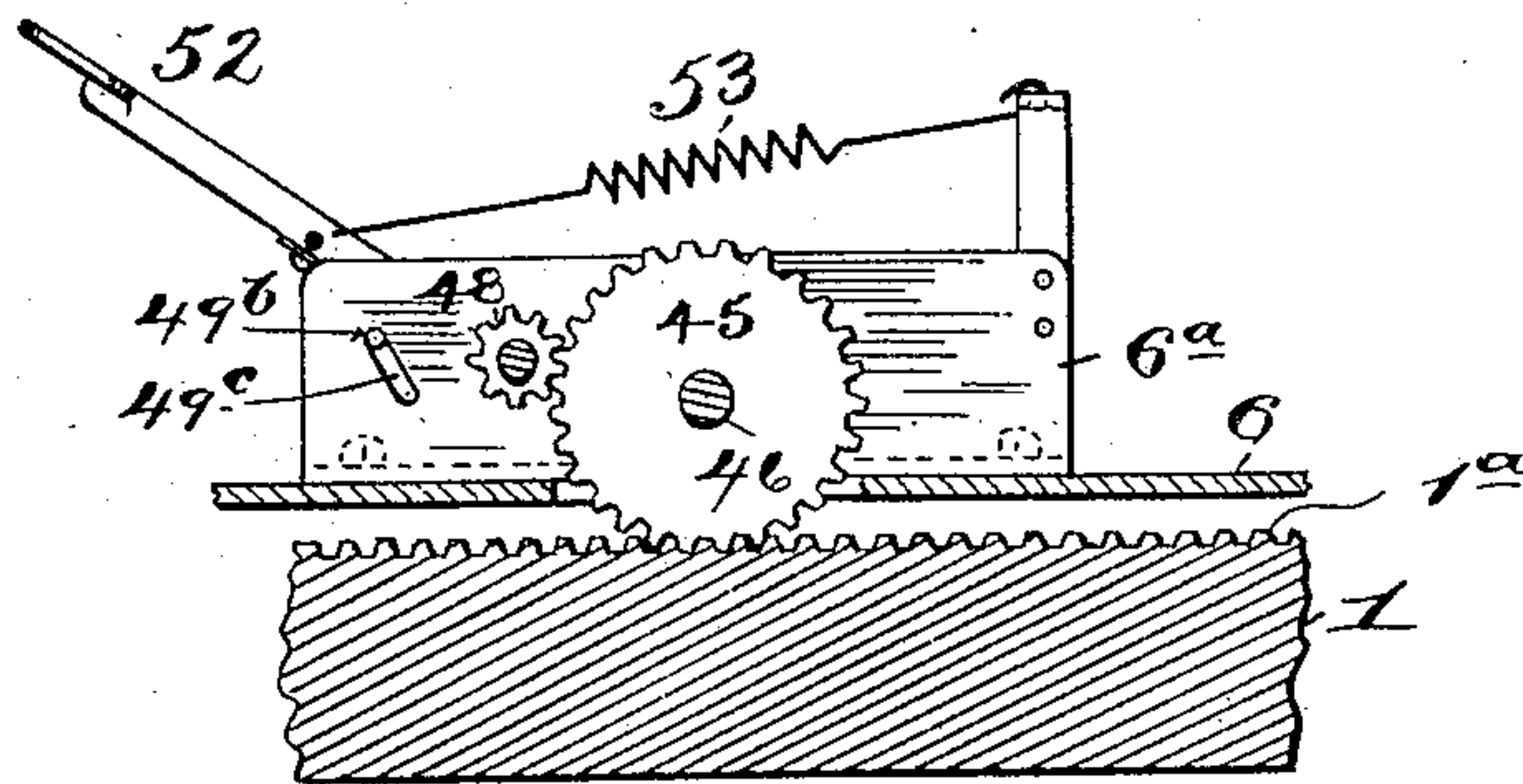


Fig. 16.

WITNESSES:

C. W. Benjamin  
M. Manning.

INVENTOR

H. M. Salyer

BY

Straley, Hasbrouck, Schlueter  
his ATTORNEYS



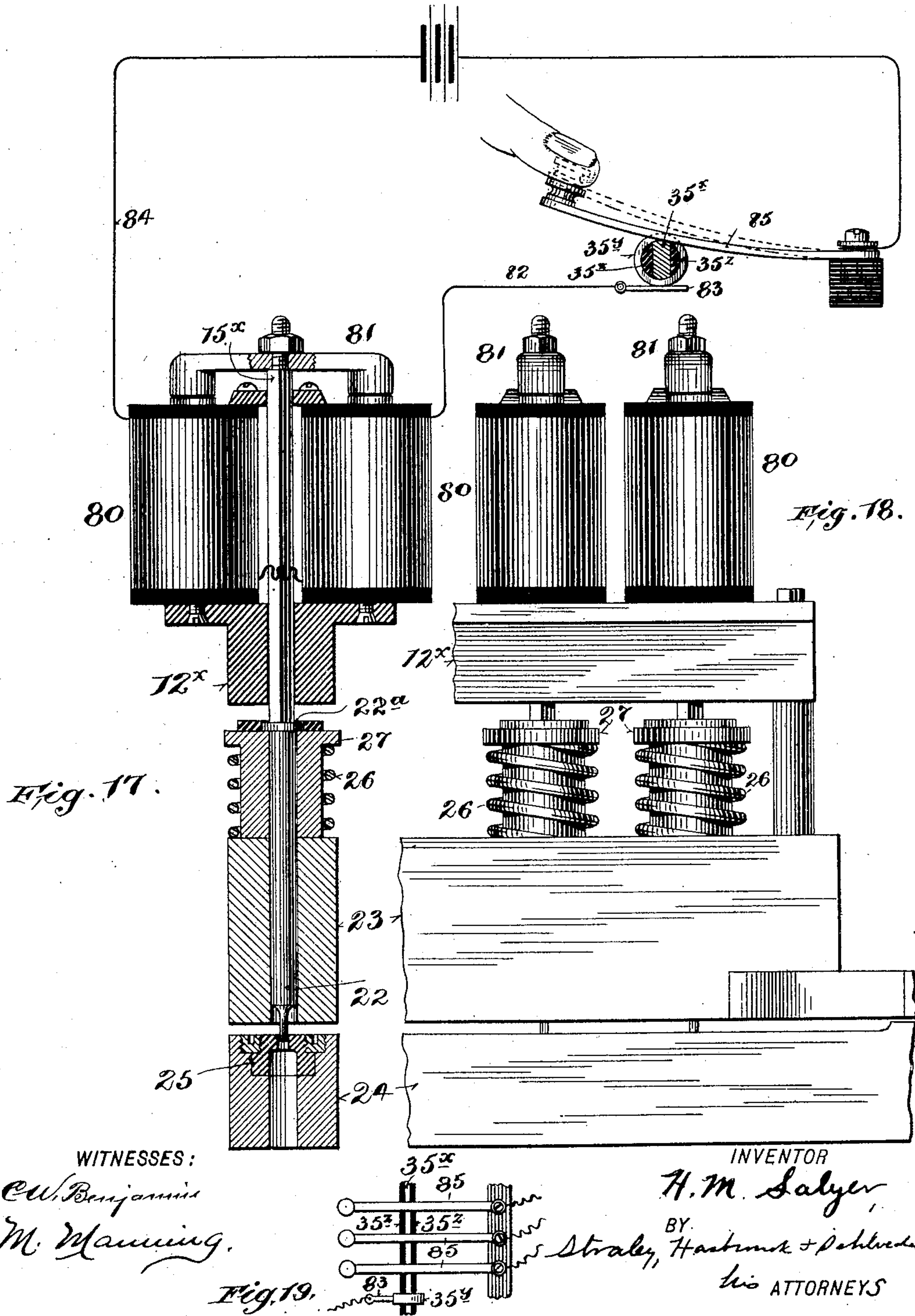
H. M. SALYER.

APPARATUS FOR PERFORATING MUSIC SHEETS.

(Application filed Sept. 25, 1901.)

(No Model.)

5 Sheets—Sheet 5.



WITNESSES:  
*C. W. Benjamin*  
*M. Manning*

Fig. 19.

INVENTOR

*H. M. Salyer*

BY

*Straley, Haskins & Schlueter*  
 ATTORNEYS



# UNITED STATES PATENT OFFICE.

HARRY M. SALYER, OF NEW YORK, N. Y., ASSIGNOR TO JOHN H. LUDWIG  
AND CHARLES A. ERICSSON, OF NEW YORK, N. Y., FIRM OF LUDWIG & CO.

## APPARATUS FOR PERFORATING MUSIC-SHEETS.

SPECIFICATION forming part of Letters Patent No. 702,887, dated June 17, 1902.

Application filed September 25, 1901. Serial No. 76,494. (No model.)

*To all whom it may concern:*

Be it known that I, HARRY M. SALYER, a citizen of the United States, and a resident of New York city, borough of Bronx, State of New York, have invented certain new and useful Improvements in Apparatus for Perforating Music-Sheets, of which the following is a specification.

The object of my invention is to provide an apparatus or machine in which strips or sheets of paper or analogous material for use in self-playing musical instruments may be perforated accurately and expeditiously.

My invention comprises in its organism a plurality of cutting or perforating instruments to act upon the music-strip for making perforations in the strip corresponding to the notes in different octaves, together with the means for causing said instruments to cut slots of more or less length, as the case may require, according to the length of time of the notes to be represented by the perforations in the strip. When the perforated strip is to be used in conjunction with mechanism for automatically-played pianos, I preferably provide cutting instruments for each of a number of octaves—say six—and a cutting instrument to produce slots for accentuation or expression, together with independent mechanism for controlling the operation of each cutting instrument and with means for shifting all of the cutting instruments simultaneously transversely or longitudinally of the strip, whereby several perforations corresponding to similar notes in different octaves may be simultaneously made across the strip in a straight line, as well as any desired single note, and whereby the length of each of such perforations may be varied by the control the operator has over the cutting-instrument-operating mechanism and the shifting mechanism.

My invention further contemplates novel details of improvement capable of carrying out my invention in a practical but preferred form that will be more fully hereinafter set forth and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming part hereof, wherein—

Figure 1 is a partly-broken plan view of an apparatus embodying my invention. Fig. 2

is a side elevation thereof, part of the main frame being removed. Fig. 3 is an enlarged detail view, partly in section, of mechanism for operating the cutters or punches. Fig. 4 is a section on the line 4 4 in Fig. 3. Figs. 5, 6, and 7 are the details of the cutting instruments. Fig. 8 is a partly-broken plan view, enlarged, of the device for controlling the motive power of the cutters. Fig. 9 is a detail sectional view of one of the controlling-keys and the connected parts. Fig. 10 is a detail of a part thereof. Fig. 11 is a detail view, enlarged, of means for shifting the cutting instruments transversely of the sheet or strip. Fig. 12 is a detail of a rack used in adjusting the cutting instruments in the longitudinal direction of the strip. Fig. 13 is a detail plan view, enlarged, of devices for shifting the carriage. Fig. 14 is a side view thereof. Fig. 15 is an end view looking from the left in Fig. 14. Fig. 16 is a detail section substantially on the line 16 in Fig. 13. Fig. 17 is a partly-broken sectional detail view showing electrical devices for operating the cutters. Fig. 18 is a view at right angles to Fig. 17, and Fig. 19 is a detail of the circuit-controlling devices.

Similar numerals of reference indicate corresponding parts in the several views.

In the accompanying drawings the numerals 1 and 2 indicate the parallel side bars or ways of a suitable frame which may be constructed in any appropriate manner, and 3 is a strip or sheet of paper or analogous material to be perforated and which is maintained between the side bars 1 2, extends parallel therewith, and is adapted to be drawn lengthwise of the frame. By preference the strip will be wound from and upon rolls supported in the main frame in any suitable manner, but which I have not deemed it necessary to illustrate. The side bars or ways 1 2 support a carriage that is adapted to travel back and forth thereon lengthwise of strip 3, which carriage supports the main operative parts of the machine. The carriage I have shown comprises parallel bars 4, having boxes 4<sup>a</sup>, that slide upon the bars 1 2 and are connected by bars 5 6. In the example shown the bar 6 is longer than the bar 5 and is connected to three boxes 4<sup>a</sup> on the longitudinal bar 1, a



brace 7 connecting two end boxes 4<sup>a</sup>, as shown in Fig. 1. The carriage I have shown may be altered, as it merely exemplifies one form in which it may be made. Upon this carriage  
 5 is mounted an auxiliary frame adapted to be adjusted transversely with respect to the strip 3, and the frame I have shown comprises bars 8 9, (parallel to the bars 5 6,) connected with boxes 10, adapted to slide on the bars 4, the  
 10 boxes 10 being connected together by bars 11; but said frame may be altered in construction as may be found desirable. Means are provided for adjusting the carriage step by step, more or less, as required, along the bars 1 2  
 15 and also for adjusting the auxiliary frame transversely thereof the required distances and holding it in such positions, as will be more fully hereinafter set forth.

The auxiliary frame carries the cutting instruments for perforating the strip 3, and in the example of my invention herein set forth I employ compressed air as the motive power for operating the cutting instruments, and as the several cutting instruments and their operating devices are of substantially the same construction a description of the details of one will suffice for all. The arrangements I have shown for this purpose are as follows:  
 To the auxiliary frame is connected a tube or  
 30 hollow bar 12, which is shown supported above the frame by posts 13, and beneath the tube 12 are cylinders 14 14<sup>a</sup> and their pistons 15, adapted to receive compressed air from the tube 12 and arranged parallel or in a substantially straight line transversely of strip 3,  
 35 as indicated in Fig. 1. The cylinders are in communication with the tube 12 by means of an interposed head 16, having ports 16<sup>a</sup> 16<sup>b</sup>, that communicate with a chamber 17, the port 16<sup>a</sup> leading to the cylinder and the port 16<sup>b</sup> communicating with tube 12. (See Figs. 3 and 4.) I have shown the head 16 connected with tube 12 by means of a stem 16<sup>c</sup>, passing into said tube and held thereto by a  
 45 screw 16<sup>d</sup>. The ports 16<sup>a</sup> 16<sup>b</sup> are controlled by a valve 18, adapted to be operated by differential air-pressure and adapted to reciprocate in chamber 17. The valve 18 is adapted to fit against its seat 18<sup>a</sup> to control the  
 50 passage of air from chamber 17 to the port 16<sup>a</sup>, and yet said valve permits permanent communication between port 16<sup>b</sup> and chamber 17, as by openings 18<sup>c</sup> in said valve, as indicated by the arrow in Fig. 4. The stem  
 55 19 of valve 18 travels transversely in chamber 17 and is of such dimensions as to permit air to circulate around it to reach the ports 16<sup>a</sup>, and said stem has at or near its outer end a valve 19<sup>a</sup>, adapted to fit against a  
 60 seat on the head 16 to normally open the exit to the atmosphere from the port 16<sup>a</sup>. Near the opposite end of said stem 19, at the chamber 17, is a diaphragm 20, shown held in place by a hollow cap 21, secured to said head and  
 65 forming a space or chamber 21<sup>a</sup> between the diaphragm and the cap. The chamber 17 is in communication with chamber 21<sup>a</sup> through

a port 19<sup>b</sup>, leading through stem 19, and the area of said port is preferably controlled by a screw 19<sup>c</sup> passing into said stem. The arrangement is such that the piston 15 will be  
 70 reciprocated through the medium of differential air-pressure controlled in the manner hereinafter explained. The piston 15 operates a cutter or punch 22 for perforating  
 75 the strip 3, and said cutter is shown provided with a head 22<sup>a</sup>, engaged by the piston-rod 15<sup>a</sup>, said cutter being adapted to reciprocate in a bore in a guide or bar 23, carried by the  
 80 auxiliary frame. Beneath the bar 23 is a corresponding bar 24, carrying the die 25, with which the cutter coacts in perforating the strip 3. I have shown the die 25 as sunk in a recess in the bar 24 and held in place by a  
 85 threaded ring or nut 25<sup>a</sup>. The bars 23 and 24 are at such a distance apart as to permit the strip 3 to slide between them, as shown in Figs. 3 and 4. The cutter or punch 22 is  
 shown as adapted to be lifted against the action of piston 15 by a spring 26, which acts  
 90 at one end against the bar 23 and at the other end against the head 22<sup>a</sup>, a bushing 27 being shown surrounding the cutter 22 and within said spring. 28 is a bar carried by the auxiliary frame and adapted as a stop to limit  
 95 the upward movement of the cutter 22. In Figs. 3 and 4 the cutters are shown in position as having descended to perforate the strip 3.

As will be seen, the cutters and their operating-cylinders, &c., are arranged in a straight line on the auxiliary frame, extending across the strip 3, and as each cutter is controlled by a separate set of operating devices they may be caused to reciprocate singly or any  
 100 number simultaneously, and thereby two or more perforations may be made simultaneously in the strip 3 in a straight line across the same when necessary and at stated distances apart. The cutters of the cylinders 14 are  
 110 intended to cut slots for notes, six of such cutters being represented to cut slots in the strip 3 for the notes in six octaves, and the cutter of cylinder 14<sup>a</sup> is intended to cut slots in the strip for producing accentuation, expression, &c., of notes; but any desired number of cutters may be employed.

The means I have shown for controlling the operation of the cutters is as follows: The main supply-pipe 12 is maintained in  
 120 connection with a suitable source of compressed air through the medium of a coupling or the like 30, connected with said tube, and with an air compressor or tank in any suitable manner not necessary to be shown.  
 125 From each of the caps 21, and therefore from each of the chambers 21<sup>a</sup>, extends a tube or pipe 31 to a mechanism to be manually controlled for causing the reciprocations of the valve 18 at the proper moments. The details  
 130 of the mechanism I have adopted for this purpose are shown in Figs. 8, 9, and 10 and their relative arrangements in Fig. 1. Each of the tubes 31 leads to a block or the like



32, that is shown secured to a cross-bar 33, which is mounted upon the cross-bar 9 of the auxiliary frame, and the blocks 32 each have a port 32<sup>a</sup>, to which the corresponding pipe 31 leads. (See Fig. 9.) The outlet end 32<sup>b</sup> of the port is controlled by a valve 34, shown in the form of a spring secured on block 32 and having a washer to bear upon said outlet, (see Fig. 9,) whereby when the port 32<sup>a</sup> is closed by its valve the pipe 31 and chamber 21<sup>a</sup> will be filled with air from tube 12 through the port 19<sup>b</sup> in stem 19, and the pressure on opposite sides of diaphragm 20 is thus equalized. Thereupon pressure of the air upon valve 18 will then hold the latter to its seat, preventing the air from chamber 17 from passing into port 16<sup>a</sup> and from escaping through the valve 19<sup>a</sup>, which is now in its open position. When, however, port 32<sup>a</sup> is opened, the pressure in chamber 21<sup>a</sup> and pipe 31 is reduced and the air in chamber 17 acts upon the diaphragm 20 to slide the stem 19, open the valve 18, close the valve 19<sup>a</sup>, and permit air to enter cylinder 14 through port 16<sup>a</sup> to act upon the piston 15, and then when port 32<sup>a</sup> is next closed equal pressure will immediately arise again on diaphragm 20, whereupon valve 18 will immediately close, valve 19<sup>a</sup> will open, and the exhaust from cylinder 14 will occur, the spring 26 pushing the piston back. Thus each time that port 32<sup>a</sup> is opened and closed by its valve 34 the piston 15 in the corresponding cylinder 14 will be reciprocated. It is intended that the cutter 22 shall have a relatively rapid reciprocating motion for perforating the strip 3, and to conveniently permit of such action I have provided means for rapidly operating the valve 34, (during such space of time as the latter may be released,) and to this end I have provided a shaft 35, mounted to rotate in suitable bearings 36, carried by the auxiliary frame. While the shaft can be rotated by any suitable means, I have provided a suitable motor 37, supported by the auxiliary frame, the type of motor shown being adapted to operate by compressed air, and for convenience the motor is shown connected by a pipe 37<sup>a</sup> with the coupling 30, that is connected with the source of compressed air. Said shaft 35 is shown provided with opposite cut-away portions 35<sup>a</sup>, adapted to coact with the valve 34 to operate the latter. (See Figs. 8 and 9.) To normally keep the valve 34 upon its seat and to permit its release when required, I have shown a key-controlled locking device comprising a member 38, pivotally supported upon a rod 39, carried by the auxiliary frame, said member having a hooked end 38<sup>a</sup>, through which shaft 35 passes and upon the tongue 38<sup>b</sup> of which the shaft 35 is adapted to bear, the cut-away parts 35<sup>a</sup> of said shaft being aligned with said tongue. Said tongue is also adapted to bear upon the spring 34, through the influence of the uncut part of the shaft 35. The member 38 is controlled by a key 40, shown pivotally supported upon a rod

41, carried by the auxiliary frame and having one end 40<sup>a</sup> bearing upon the member 38 and the opposite end provided with a finger-piece 40<sup>b</sup>, the key 40 being normally maintained in position to hold down the member 38, and thereby the valve 34, through the medium of a spring, shown in the form of a coil-spring 42, located in a socket in block 32 and pushing a plug 43 against the key 40. (See Fig. 9.) As shown in Fig. 1, the several devices for controlling the cutters are arranged side by side in position conveniently to be manipulated by the operator. The arrangement of the parts is such that when they are in the normal position shown in Fig. 9 the port 32<sup>a</sup> will be closed, and thereby the piston associated therewith will not be operated; but when it is desired to cause a cutter 22 to reciprocate the key 40 associated therewith will be operated to release the member 38, and as the shaft 35 is continuously rotated the spring 34 will be reciprocated owing to the action of the two cut-away parts 35<sup>a</sup> and the uncut part of said shaft, because when a cut-away part passes in line with the finger 38<sup>b</sup> valve 34 will rise and open port 32<sup>a</sup>, and then when the uncut part of the shaft engages said finger said valve will be closed, and so on so long as key 40 is held down, the piston meanwhile reciprocating once for each half-rotation of shaft 35. It will be understood, however, that the shaft 35 may be arranged to cause valve 34 to operate one or more times for each rotation of said shaft if desired.

I have shown convenient means for readily adjusting the carriage the proper distances lengthwise of the strip 3 for producing slots of the desired length and means for adjusting the auxiliary frame and the cutters transversely of said strip for producing the desired note or notes in a proper line across said strip. For the purpose of adjusting the carriage either step by step or for any desired distance I have provided the bar 1 with a rack 1<sup>a</sup>, along which the bearing 4<sup>a</sup> is adapted to travel, a spur-gear 45, in mesh with said rack, being carried by a shaft 46, journaled on the bar 6, as in supports 6<sup>a</sup>, and provided with a handle 47 for rotating it, the gear 45 being in mesh with a pinion 48, journaled in bearings, as on the support 6<sup>a</sup>. (See Fig. 1.) To the pinion 48 ratchet-wheels 49 50, having unequal teeth, are connected and adapted to be operated by pawls 49<sup>a</sup> 50<sup>a</sup>, carried by levers or keys 51 52, pivotally supported by bar 6 and provided with springs 53 to coact therewith. It will be understood that when the keys 51 52 are reciprocated the ratchets and gears will feed the adjustable frame, through the medium of rack 1<sup>a</sup>, step by step along the bars 1 2, and the purpose of having two ratchets is to permit feed of different lengths, according to which ratchet is operated. The keys and ratchets feed the carriage in the direction of the arrow in Fig. 1, and to move the carriage quickly any distance desired in the reverse direction it is merely necessary to rotate the



shaft 46 by the handle 47 reversely to its rotation by the pinion 48 and the ratchet. A single ratchet, pawl, and key may be used, if preferred. The pawls may have a pin 49<sup>b</sup> traveling in a slot 49<sup>c</sup> in support 6<sup>a</sup> to guide the pawl into and out of mesh with its ratchet-wheel. The carriage is provided with an indicator for the purpose of regulating the distance of its adjustment, and for this purpose I have shown a pointer 55, carried by the bar 6 and traveling over a scale 56, carried by the main frame and extending parallel to the strip 3. Divisions on said scale may be suitably arranged and are intended to indicate a suitable division of a whole note of music, it being understood that if a cutter 22 is operating on the strip during the time that the pointer 55 travels over a space between two divisions or lines on the scale 56 a perforation or slot will be cut in the strip corresponding in length to such distance on the scale and that if a longer or shorter perforation or slot is to be cut to represent a longer or shorter note the pointer 55 will travel over more or less divisions or a portion of a division of scale 56, as the case may require.

The means I have shown for adjusting the auxiliary frame transversely of strip 3 are as follows: 60 is a spring-barrel of suitable construction carried by the bar 5 and connected by a strap 61 with the auxiliary frame to move the latter, as toward the right in Fig. 1. The carriage has a rack 62, which is controlled by an escapement or feeding device to permit the auxiliary frame to travel under the influence of the spring-barrel 60 step by step, and for this purpose I have shown a pawl 63, carried by a disk 64, whose shaft 65 is journaled in bearings carried by the auxiliary frame, a key or lever 66, connected with said disk, serving to rock the same, a spring 67, suitably connected with said disk or shaft, serving to act with the key 66. The disk 64 also carries a stop or dog 68, (see Fig. 11,) normally out of engagement with but adapted to engage the rack 62. The pawl 63 and dog 68 are shown as facing in opposite directions, and the arrangement is such that the spring-barrel 60 normally tends to draw the pawl 63 into engagement with rack 62, as indicated in Fig. 1. When the auxiliary frame is to be fed to the right in Fig. 1, the key 66 is depressed, whereupon its dog 68 engages the rack 62 and permits a partial movement of said frame, during which time the pawl 63 is lifted out of the rack and slips over the adjacent tooth, so that when the key 66 is released and returns to its normal position the dog 63 will pass into the space between two teeth and the frame will be drawn the balance of the movement permitted equal to the space between two teeth of rack 62. As a convenient means for quickly drawing the auxiliary frame back or toward the left in Fig. 1 I have provided a rotative member or sleeve 69, which surrounds the bar 1 and is connected with the auxiliary frame by a strip 70, the member 69 having a handle 71 where-

by when said handle is depressed the member 69 will be rotated and will draw the auxiliary frame the desired distance. An indicator or scale is provided to regulate the distance that the auxiliary frame shall be adjusted corresponding to the several notes in an octave. The indicator I have shown comprises a scale 72, carried by the auxiliary frame and having divisions corresponding to the notes in an octave—say from F up to E—as indicated at 73, and a separate scale, as indicated at 74, to correspond to the cylinder 14<sup>a</sup>, whose cutter 22 is intended to perforate the strip 3 for accentuation or expression of notes. Pointers 73<sup>a</sup> and 74<sup>a</sup>, coacting with the scales 73 74, are shown carried by a bar 75, supported by the carriage, as indicated in Fig. 1.

The operation of the machine above set forth may be described as follows: The strip or sheet 3 to be perforated is stretched in the main frame, passing between the bars 23 24, and the carriage is adjusted to the end of the machine. (Indicated at the top of Fig. 1.) If a perforation for a single note is desired, the auxiliary frame is adjusted until the note represented by its scale 73 aligns with the pointer 73<sup>a</sup>—as, for instance, the note E—it being understood that shaft 35 is now continuously rotating. The key 40<sup>b</sup> of the cylinder 14 corresponding to the octave in which such note is represented is next operated, causing the corresponding cutter 22 to reciprocate rapidly through the strip 3, and simultaneously therewith the carriage is caused to move in the direction of the arrow *a* in Fig. 1 by the key 51 or 52 and the cutter that is in operation will produce a slot in the strip 3. The length of the slot will be determined by the distance that the carriage travels and the cutter may be caused to cease cutting either by releasing the key 40<sup>b</sup> or ceasing to operate the key 51, or both. If it had been desired to produce slots in a straight line in the strip 3 for similar notes, as E, in more than one octave instead of the single slot described above, as many keys 40<sup>b</sup> would be operated and held down as correspond to the cutters representing the desired octaves. If such slots are all to be of the same length, the cutters would all be stopped simultaneously; but if the slots so produced simultaneously are to be of varying lengths for notes of different lengths of time the keys 51 or 52 would be operated a sufficient time to produce the longest slot, but the key 40<sup>b</sup>, corresponding to the shortest slot, would in the interim first be released, and then the key for the next shortest slot, and so on until the longest slot has been cut. If several differing notes, as in a chord, are to be produced by slots in a line transverse of strip 3, one or several slots for similar notes will first be produced, as described above with reference to note E, and then with the carriage in the same relation to the strip 3 the auxiliary frame will again be adjusted transversely of the strip to bring the cutters 22 in posi-



tions corresponding to the succeeding notes required, and the keys 40<sup>b</sup> and 51 or 52 will be operated, and so on successively for as many notes as may be required in a chord.

5 When all the slots that are required in a straight line across the strip for a chord have been produced by the various cutters, the same steps will be carried on in a new position of the carriage with respect to the strip  
10 3 for succeeding single notes or chords, and so on throughout the length of the strip. The cutter of cylinder 14<sup>a</sup>, which is to produce slots in the strips for accentuation, expression, &c., will preferably be operated after  
15 the note-slots are all cut in the strip by going over the strip separately, although said slots may be produced as the note-slots are being made.

It will be understood that my invention is  
20 not limited to operating the cutters 22 by air pressure or suction, as steam, or electric magnets and their circuits could be utilized. In Figs. 17 and 18 a bar 12<sup>x</sup>, which corresponds as a support to the hollow bar 12 and supported by the auxiliary frame substantially  
25 similarly to said bar 12, carries electromagnets 80, whose armatures 81 operate to push the punchers 22 against the resistance of springs 26, as by means of a rod 15<sup>x</sup>, connected with the armature and bearing upon  
30 the head 22<sup>a</sup>. The magnets of the several cutters have independent circuits and circuit-controlling devices for controlling the operation of each cutter at will. In Fig. 17 the  
35 conductor 82 has a contact 83, and the conductor 84 is connected with a key 85, current being supplied to such circuit in any suitable manner. The circuit of the magnets may be rapidly opened and closed by means of a  
40 shaft 35<sup>x</sup>, corresponding substantially to the shaft 35 and supported and operated by a motor in suitable manner, which shaft is preferably maintained in circuit with contact 83 by means of a ring or annular contact 35<sup>y</sup>, and the several contacts or keys  
45 85 are adapted to be brought into circuit with shaft 35<sup>x</sup>, although normally out of circuit therewith, as shown by dotted lines in Fig. 17. As shown in said figure, the opposite  
50 sides of shaft 35<sup>x</sup> are provided with insulation 35<sup>z</sup>, so as to leave two opposed surfaces of the shaft exposed to the key 85. The keys 85 extend over shaft 35<sup>x</sup> and may be placed side by side, as in Fig. 19, in manner similar to  
55 the keys 40 in Fig. 1. By the arrangement shown as shaft 35<sup>x</sup> rotates the circuit of a magnet of any key 85 will be made and broken twice during each rotation of the shaft, and it will be seen that one or several  
60 keys may be depressed at the same time to cause one or several cutters to operate simultaneously, it being understood that when a key 85 is in contact with shaft 35<sup>x</sup> the circuit will be from 85 through 35<sup>x</sup>, 35<sup>y</sup>, and 83 and  
65 through the circuit and corresponding magnets. The cross-section of shaft 35<sup>x</sup> may be altered or the contacts otherwise arranged to

produce more or less breaks in the circuit of the magnets for each revolution of the shaft, as may be desired. In other respects the operation of the other portions of the invention  
70 will be similar to that before described, it being understood that in both the pneumatic and electrical arrangement for operating the cutters the use of the continuously-rotating  
75 shaft permits the rapid reciprocations of the cutters by the operator merely holding down a key corresponding to the cutter to be operated.

I do not limit my invention to the arrangements and details of parts shown and described, as they may be varied without departing from the spirit of my invention.

Having now described my invention, what I claim is—

1. An apparatus of the character described comprising a plurality of cutting instruments, means for actuating them, means for adjusting said instruments bodily and conjointly  
85 relatively to a strip to be cut, and means for independently controlling the operation of each of said cutting instruments, substantially as described.

2. An apparatus of the character described comprising a plurality of cutting instruments, means for supporting a strip relatively there-  
95 to, means for actuating said instruments, means for adjusting the positions of said instruments and the strip bodily back and forth relatively to each other in the transverse direction of said strip, and means for independently controlling the operation of each of said instruments, substantially as described.

3. An apparatus of the character described comprising a plurality of cutting instruments, means for supporting a strip relatively there-  
105 to, means for actuating said instruments, means for adjusting the positions of said instruments and the strip bodily back and forth relatively to each other in the transverse direction of said strip, means for adjusting the positions of said instruments and the strip  
110 bodily back and forth relatively to each other in the longitudinal direction of said strip, and means for independently controlling the operation of each of said instruments, substantially as described.

4. An apparatus of the character described, comprising a plurality of cutting instruments, means for actuating said instruments, a carriage supporting said instruments, a frame  
120 to which said carriage is adjustably connected, and means for independently controlling the operation of each of said cutters, substantially as described.

5. An apparatus of the character described comprising a plurality of cutting instruments, means for actuating said instruments, a carriage supporting said instruments, a frame  
125 to which said carriage is adjustably connected, means for independently controlling the operation of each of said cutters, and means for adjusting the positions of said carriage and a strip to be operated upon relatively to each



other in the longitudinal direction of said strip, substantially as described.

6. An apparatus of the character described comprising a plurality of cutting instruments, means for operating the same, means for independently controlling the operation of each instrument, means for adjustably supporting said instruments, an indicator, and a scale corresponding to the notes in an octave, whereby said cutting instruments may be adjusted simultaneously into positions corresponding to any note in an octave, substantially as described.

7. An apparatus of the character described comprising a plurality of cutting instruments, means for operating the same, means for independently controlling the operation of each instrument, means for adjustably supporting said instruments, an indicator, and a scale corresponding to the notes in an octave whereby said cutting instruments may be adjusted simultaneously into positions corresponding to any note in an octave, and means for adjusting said cutting instruments in a direction perpendicular to the last-mentioned direction of adjustment, substantially as described.

8. An apparatus of the character described comprising a plurality of cutting instruments arranged at distances apart in a substantially straight line, means for operating the same, means for independently controlling each of said cutters, and means for permitting the simultaneous and coincident adjustment of said cutters in the direction of said line, and means for permitting the simultaneous and coincident adjustment of said cutters in a direction perpendicular to said line, substantially as described.

9. In an apparatus of the character described, a frame, means for adjustably supporting the same, a plurality of cutters carried by said frame, means for operating said cutters, and means carried by said frame for independently controlling the operation of each cutter whereby the cutters and their controlling means may be adjusted simultaneously into different positions, substantially as described.

10. In an apparatus of the character described, a frame, means for adjustably supporting the same, a plurality of cutters carried by said frame, means for operating said cutters, means carried by said frame for independently controlling the operation of each cutter whereby the cutters and their controlling means may be adjusted simultaneously into different positions, a carriage supporting said frame, and means for adjustably supporting said carriage to permit it to move in a direction perpendicular to the above-mentioned adjustment of said frame, substantially as described.

11. An apparatus of the character described comprising a plurality of cutters, a cylinder and piston for each cutter, means for supplying said cylinders with a propulsive medium,

a valve for each cylinder to control the admission of the propulsive medium thereto, and a key-controlled device associated with each valve for controlling the operation thereof, a frame carrying said cylinders and cutters, and means for adjustably supporting said frame to permit the same to be adjusted in directions perpendicular to each other, substantially as described.

12. An apparatus of the character described comprising a plurality of cutters, a cylinder and piston for each cutter, a valve for each cylinder, a diaphragm connected with each valve having a chamber on the side opposite the valve, and a key-controlled valve connected with said chamber for regulating the operations of the first-mentioned valve by differential pressure on the diaphragm, substantially as described.

13. An apparatus of the character described comprising a plurality of cutters, a cylinder and piston for each cutter, a valve for each cylinder, means for operating said valve, an auxiliary valve to control said means, a continuously-operative member for actuating the second-mentioned valve, and a key to control the operation of said valve, substantially as described.

14. An apparatus of the character described comprising a plurality of cutters, a cylinder and piston for each cutter, a valve for each cylinder, a diaphragm connected with said valve having a chamber on the side opposite the valve, a pipe connected with each chamber, a valve to control the outlet of each pipe, a continuously-operative member to actuate said valve, and a key for each valve to control its operation by said member, substantially as described.

15. An apparatus of the character described comprising a plurality of cutters, a cylinder and piston for each cutter, a valve for each cylinder, a diaphragm connected with each valve having a chamber on the side opposite the valve, a pipe connected with each chamber, a valve to control the outlet of each pipe, a continuously-operative shaft having actuating portions for each valve, a member acting upon the valve to be operated by each of said portions of the shaft, and a key to control each of said members, substantially as described.

16. The combination of a cutter, a cylinder and piston, a head for said cylinder having ports, a valve to control said ports, a diaphragm connected with said valve and having a chamber on the side opposite the valve, a pipe extending from said chamber, a valve to control the outlet of said pipe, a continuously-operative member to control said valve, and a key to control the operation of said valve by said member, substantially as described.

17. The combination of a cutter, a cylinder and piston, a head for said cylinder having ports, a valve to control said ports, a diaphragm connected with said valve and hav-



ing a chamber on the side opposite the valve, a pipe extending from said chamber, a valve to control the outlet of said pipe, a continuously-rotative shaft having actuating portions, a member to be operated by said shaft to act on the valve, and a key to control said member, substantially as described.

18. The combination of a cutter, a cylinder and piston, a head for said cylinder having ports, a valve to control said ports, a diaphragm connected with said valve and having a chamber on the side opposite the valve, a pipe extending from said chamber, a valve to control the outlet of said pipe, a continuously-rotative shaft having correspondingly depressed and raised portions, a member having a hook-like end provided with a finger to be acted upon by the shaft and to act on the valve, and a key to control said member, substantially as described.

19. An apparatus of the character described comprising a frame, a bar carried thereby over which a strip to be perforated may pass, a cutter carried by said frame, means for operating the cutter, key-controlled devices for controlling the punch-operating mechanism, a frame carrying said cylinders and cutters, and means for adjustably supporting said frame to permit the same to be adjusted in directions perpendicular to each other, substantially as described.

20. An apparatus of the character described comprising a carriage, means for supporting the same, a frame adjustably carried by said carriage, cutters carried by said frame, means for operating said cutters, a spring, and an escapement for adjusting said frame, substantially as described.

21. An apparatus of the character described comprising a carriage, means for supporting the same, a frame adjustably carried by said carriage, cutters carried by said frame, means for operating said cutters, a spring and escapement for adjusting said frame, and means for advancing said carriage step by step, substantially as described.

22. The combination of a frame, means for adjustably supporting the same, a spring connected with said frame for moving it in one direction, and an escapement comprising a rack, an oscillatory member having a pawl and a dog to engage the rack, means for maintaining the dog out of engagement with the rack and the pawl normally in engagement therewith, and means for operating said pawl and dog whereby the carriage may be fed step by step, substantially as described.

23. The combination of a frame, means for adjustably supporting the same, a spring connected with said frame for moving it in one

direction, and an escapement comprising a rack, an oscillatory member having a pawl and a dog to engage the rack, means for maintaining the dog out of engagement with the rack and the pawl normally in engagement therewith, means for operating said pawl and dog whereby the carriage may be fed step by step, and a rotative member connected with said frame for drawing the same against the tension of the spring, substantially as described.

24. In an apparatus of the character described a plurality of cutters, an adjustable frame supporting the same, a carriage supporting said frame, means for controlling the operation of said cutters independently, means for adjusting said carriage step by step, a scale, and an indicator for use in determining the adjustment of the carriage, substantially as described.

25. An apparatus of the character described comprising a frame, a plurality of cutters carried thereby, cylinders and pistons for operating said cutters, a tube connected with said cylinders, means for supplying said tube with a propulsive medium, means for independently controlling the supply of propulsive medium from said tube to each cylinder and including therein a rotative shaft for actuating said means, and a motor carried by said frame for operating said shaft, substantially as described.

26. The combination of a tube, a valve to control its outlet, a rotative member to actuate said valve, and means to control the operation of said valve by said member, substantially as described.

27. The combination of a tube, a valve to control its outlet, means to reciprocate said valve, and a key acting with the valve to normally hold it closed and arranged to release the valve when operated, substantially as described.

28. The combination of a tube, a valve to control its outlet, a shaft having means to actuate said valve, a member to hold the valve closed when released by the shaft, and a key to control said member, substantially as described.

29. The combination of a tube, a block having a port to which the tube leads, a valve to control said port, a member to act on the valve, a shaft to actuate said member, and a key to control said member, substantially as described.

HARRY M. SALYER.

Witnesses:

T. F. BOURNE,  
M. MANNING.