

J. MATHISON.
ADDING AND RECORDING MACHINE.

No. 450,814.

Patented Apr. 21, 1891

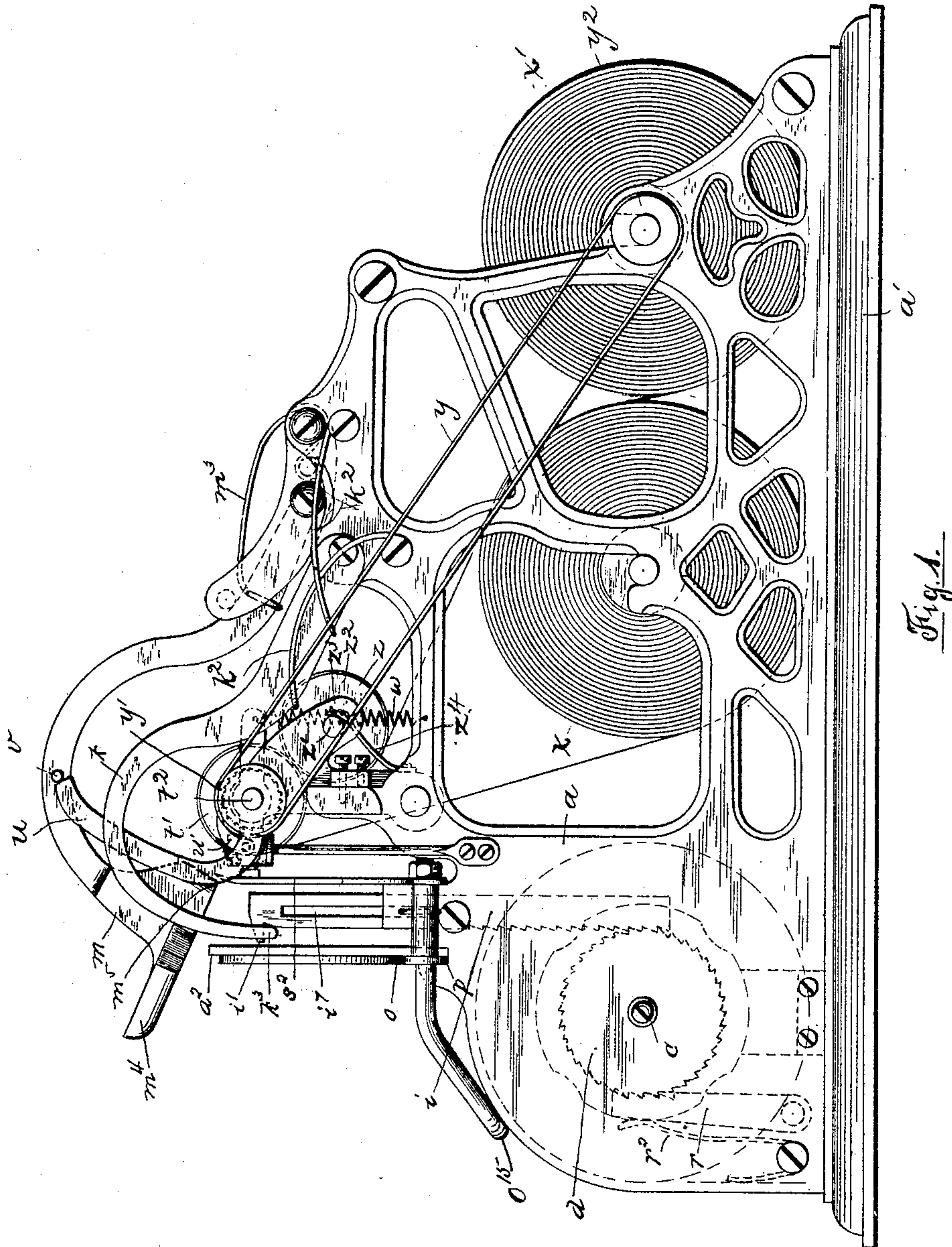


Fig. 1.

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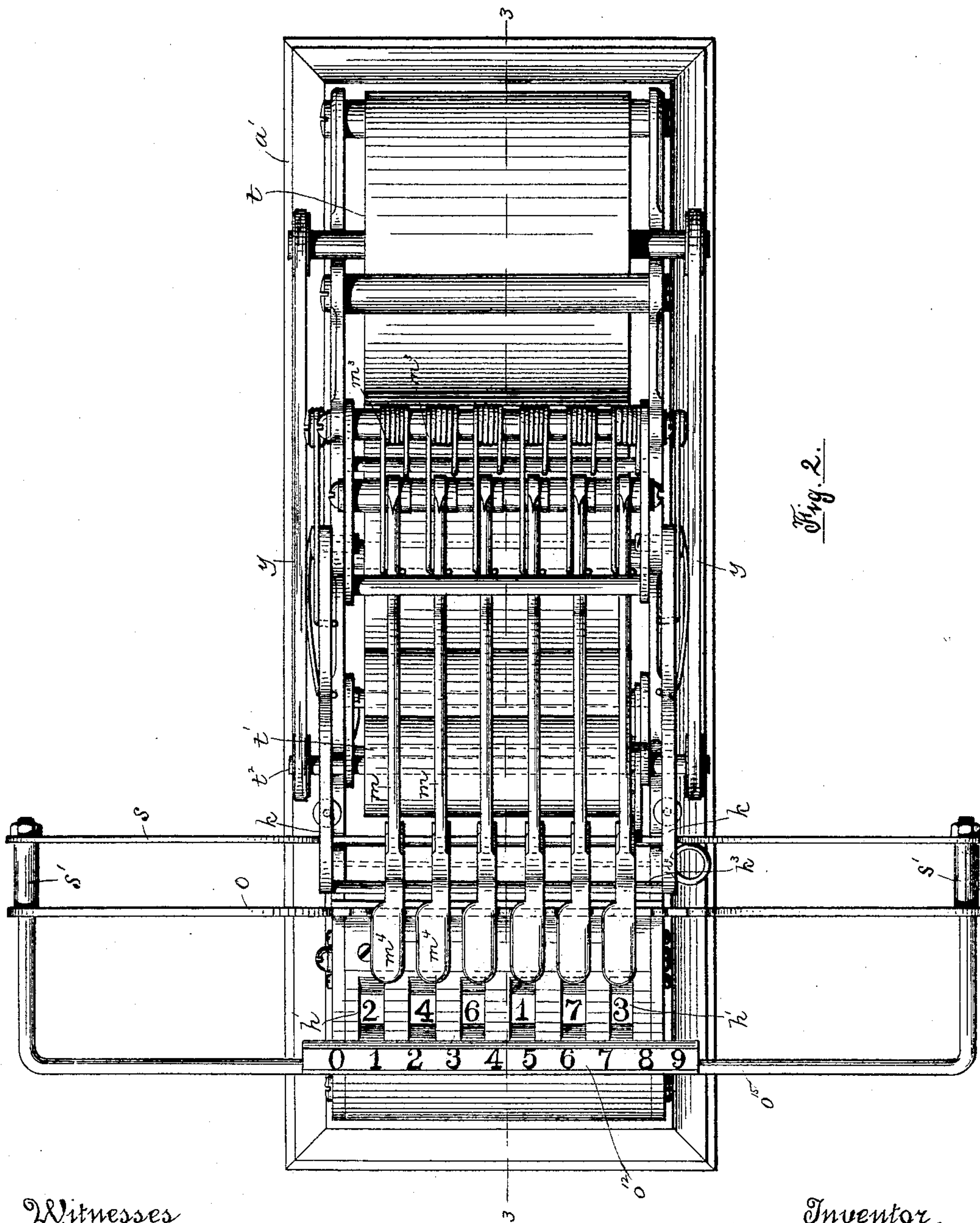
(No Model.)

5 Sheets—Sheet 2.

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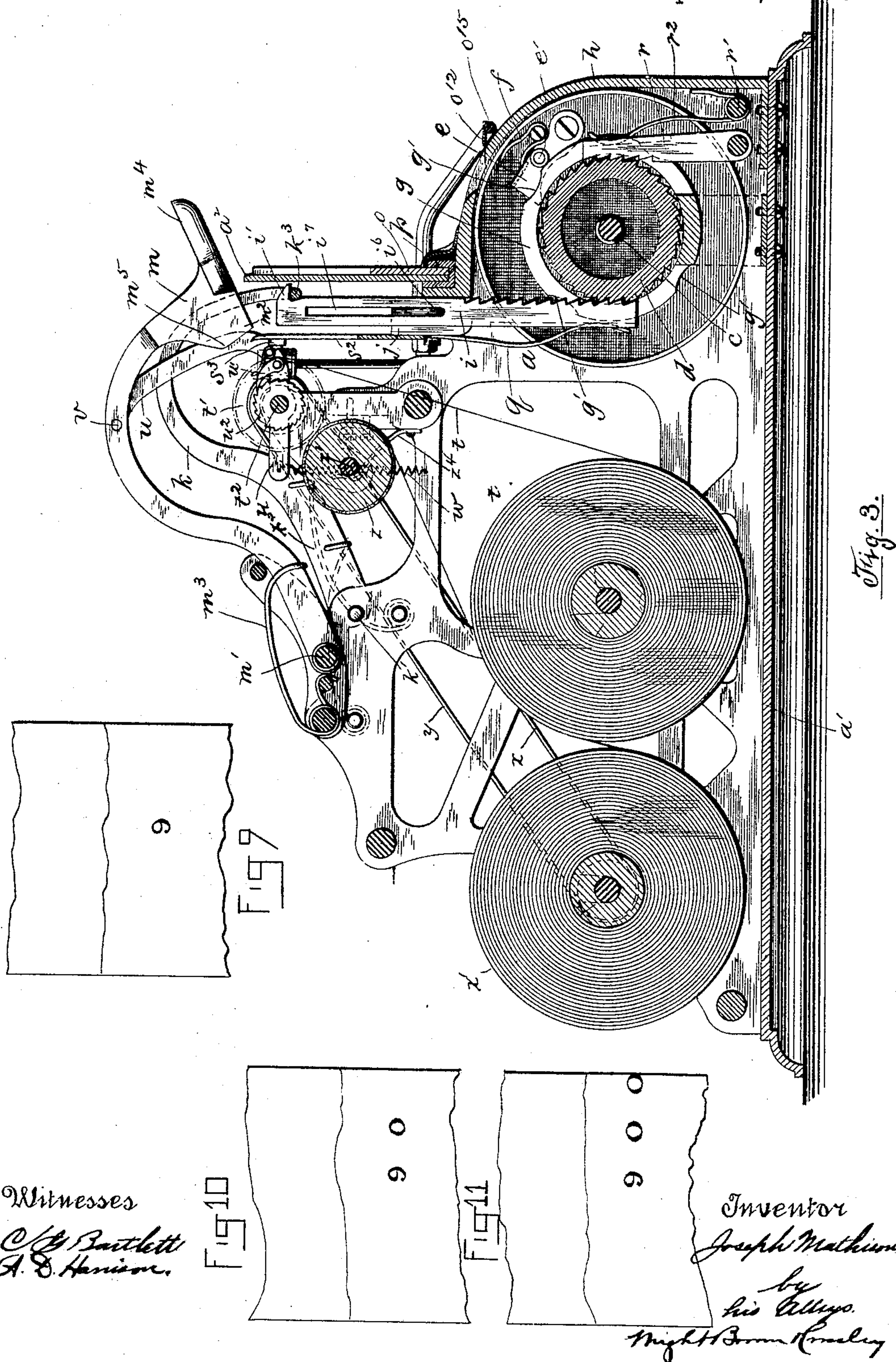
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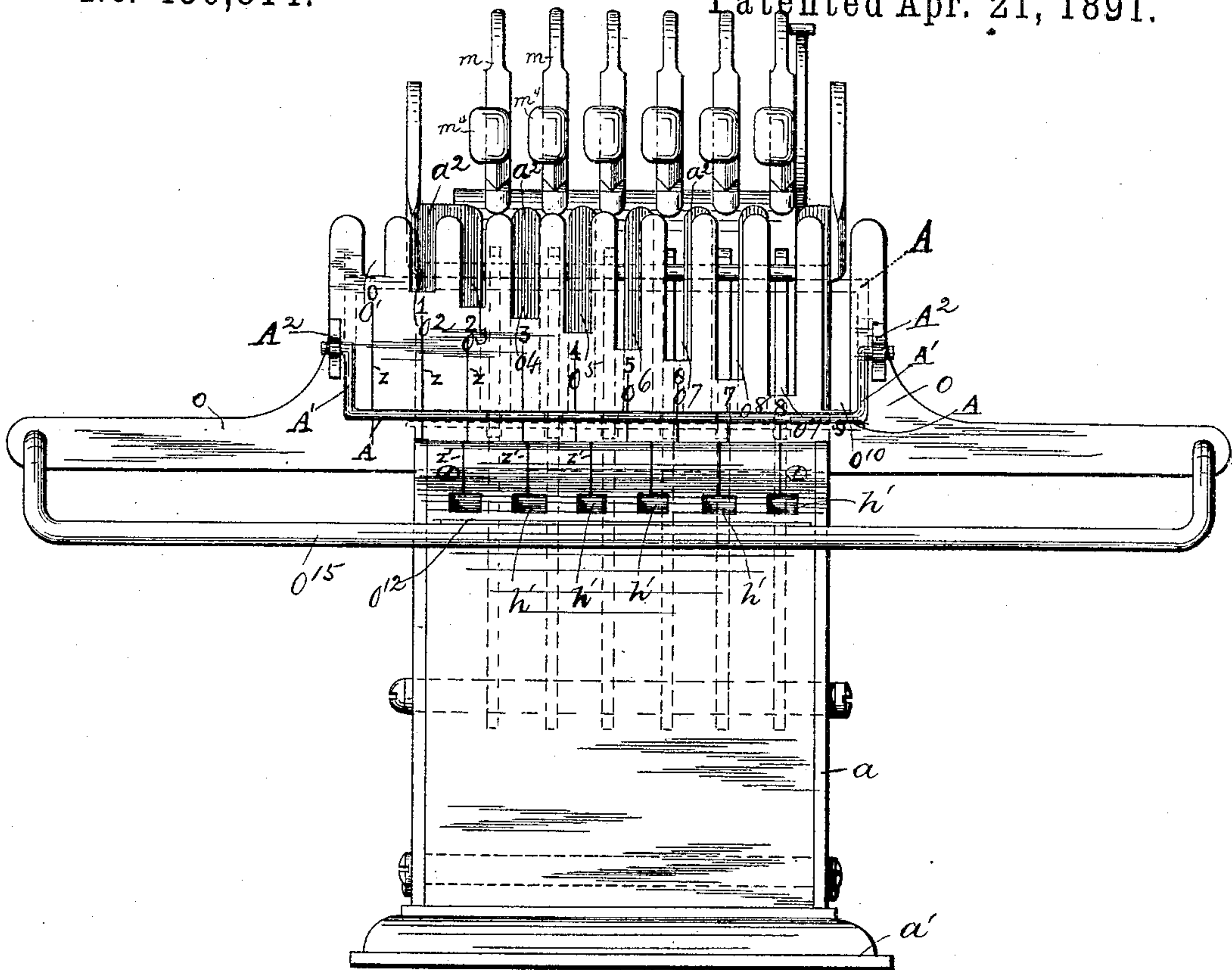


Fig. 4.

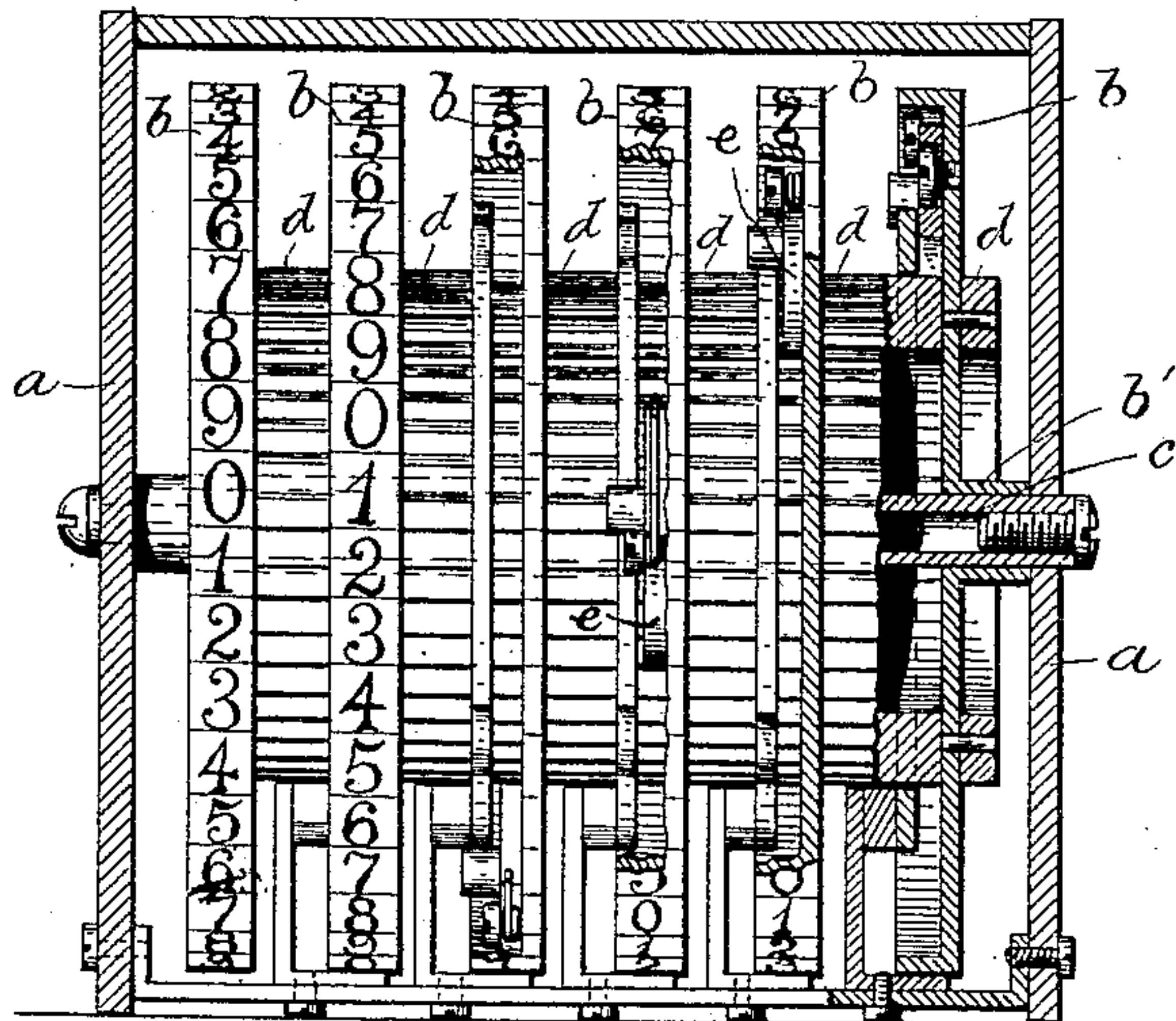


Fig. 5.

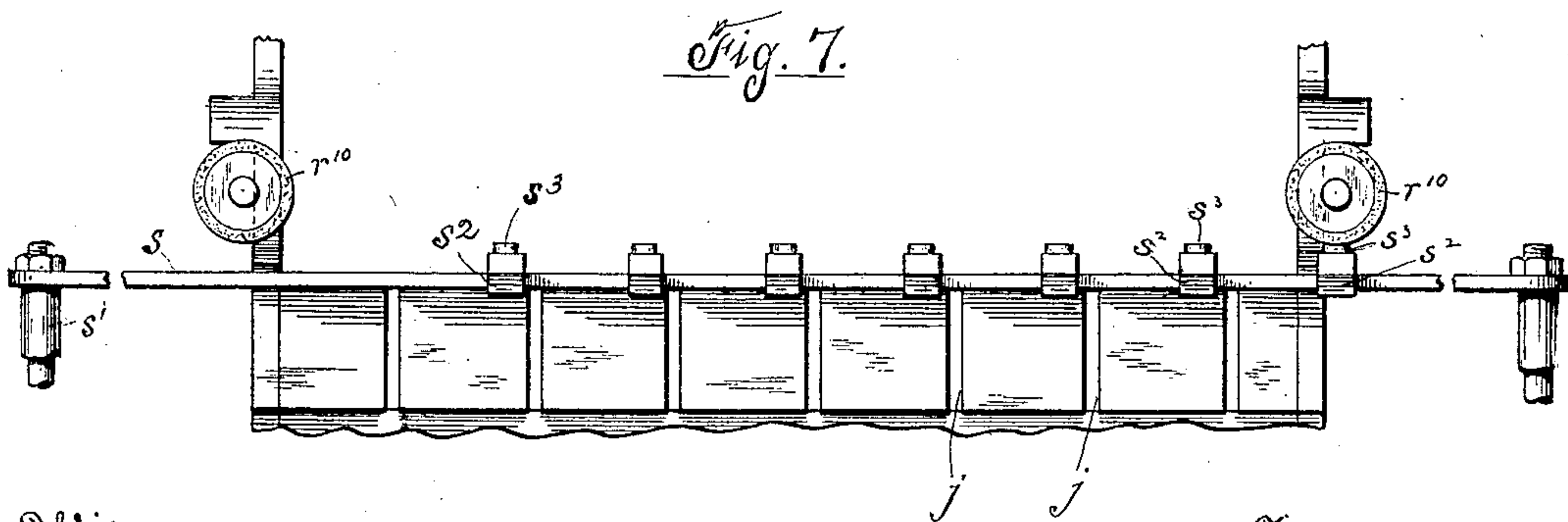
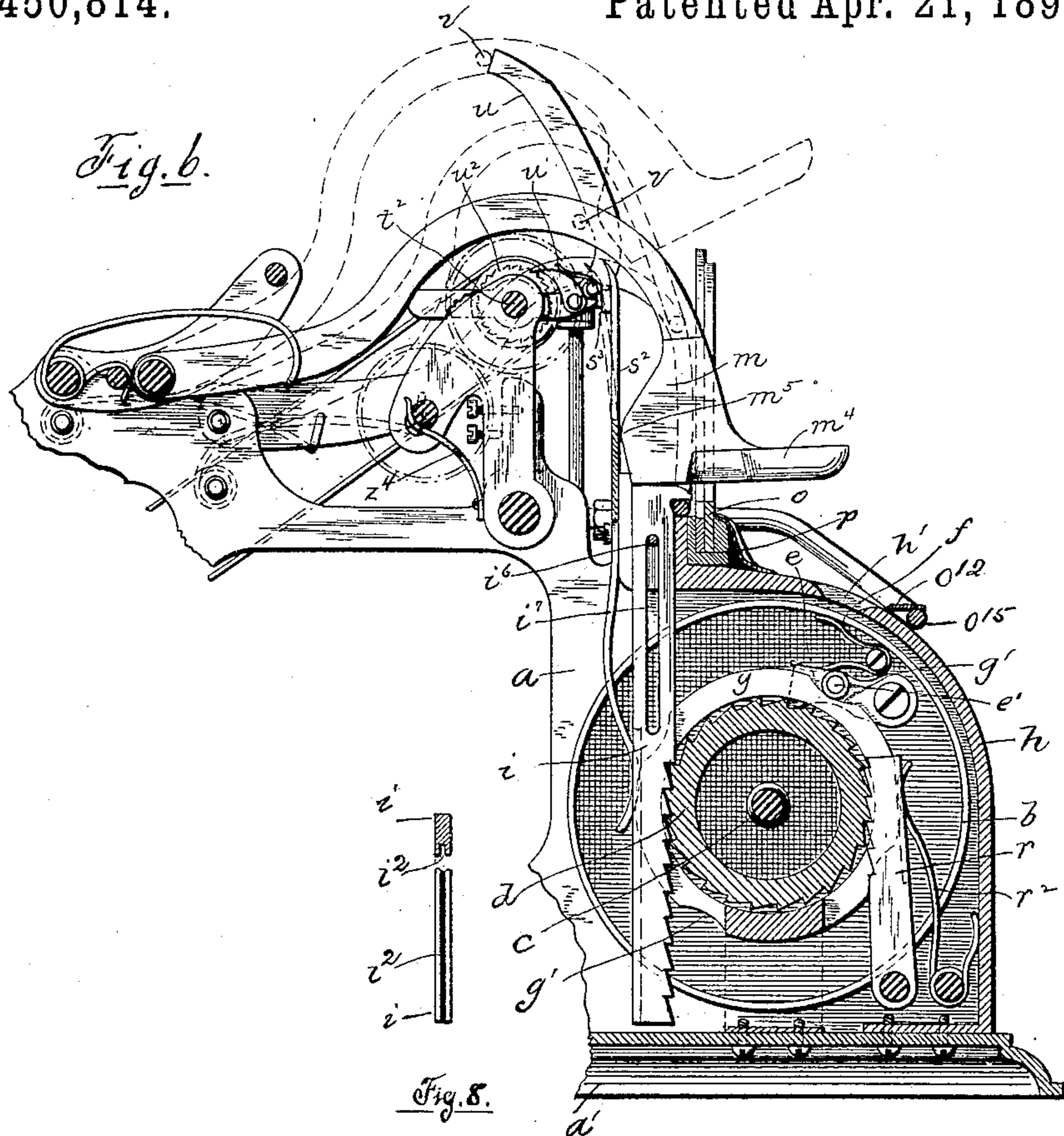
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UNITED STATES PATENT OFFICE.

JOSEPH MATHISON, OF SOMERVILLE, MASSACHUSETTS.

ADDING AND RECORDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 450,814, dated April 21, 1891.

Application filed November 7, 1890. Serial No. 370,715. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH MATHISON, of Somerville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Adding and Recording Machines, of which the following is a specification.

This invention has for its object to provide a simple and efficient adding-machine whereby any desired number of additions may be made by mechanical operations of the operator, the carrying of one denomination to another being performed automatically by the machine.

The invention also has for its object to provide a machine adapted not only to add numbers, but also to make a printed record of the individual numbers or number of the addition.

To these ends the invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a side elevation of a machine embodying my invention. Fig. 2 represents a top plan view of the same. Fig. 3 represents a longitudinal vertical section on the plane of line 3 3, Fig. 2. Fig. 4 represents a front elevation. Fig. 5 represents a front elevation of the series of adding-wheels and a sectional view of the casing containing the same, one of said wheels and a portion of the ratchet of the adjoining wheel being shown in section, while portions of several of the other wheels are shown as broken away. Fig. 6 represents a longitudinal section similar to a portion of Fig. 3, showing the machine at a different stage of its operation. Fig. 7 represents a top view of a portion of the machine. Fig. 8 represents a rear view of a portion of one of the ratchet-bars which operate the adding-wheels and a transverse section of said bar. Figs. 9, 10, and 11 represent views of the record-strip hereinafter referred to.

The same letters of reference indicate the same parts in all the figures.

In the drawings, *a* represents a supporting-frame, which is mounted upon a suitable base *a'*.

b b b represent a series of adding-wheels which are located side by side in a series upon a suitable central rod or support *c*, said

wheels being provided with hubs *b'*, adapted to rotate upon said rod or support *c*, the latter being affixed to the supporting-frame *a* in any suitable manner. To one side of each wheel *b* is affixed a ratchet *d*, each ratchet projecting from one side of the wheel *b*, to which it is affixed and adapted, to be engaged by a pawl *e* on the next wheel. Each wheel has upon its periphery a series of numerals from zero (0) to nine, (9,) inclusive, and said series is repeated a sufficient number of times to enable the wheels and the ratchets to be made of comparatively large diameter, so that their rotation, as hereinafter described, will not involve such an extended movement of the key which effects the rotation of each wheel as would be required if each wheel had only one series of numerals. Each ratchet *d* has a number of teeth corresponding with the number of numerals on the wheel to which it is attached.

The pawls *e*, which are pressed inwardly upon the ratchets by springs *f*, Figs. 3 and 6, are prevented from engaging the ratchets, excepting at stated intervals, by means of cam-shaped rings *g*, affixed to the supporting-frame and surrounding the ratchets, there being one ring *g* for each ratchet. Each ring has a series of depressions *g'*, corresponding in number to the number of series of numerals on the adding-wheels, and said depressions are arranged so that they permit the pawls *e* to move inwardly and engage the ratchets after each wheel has made a sufficient rotation to carry one series of its numerals past a given point—that is, as the wheel is on the 9's point. The pawls *e* are provided with rolls *e'*, which bear upon the perimeters of the rings *g*, the pawls being held out of engagement with the ratchets by said rings, as shown in Fig. 3, excepting when the rolls *e'* enter the depressions *g'*, as shown in Fig. 6.

The series of adding-wheels are covered by a fixed plate *h* at one end of the machine, said plate having a series of orifices *h'*, through each of which a portion of one of the adding-wheels is visible. When a wheel has been partially rotated so as to carry all of the characters comprising one of its series of numerals across the orifice *h'*, through which said wheel is visible, the ring *g*, supporting the pawl engaged with said wheel, permits the

said pawl to drop into engagement with the ratchet of the next wheel and give the latter a rotation equal to the distance between one character and the next upon its periphery, so that operation of carrying one to the next higher denomination is automatically effected, the movement of the first-mentioned wheel being effected by a direct manipulation of the operator, as presently described, and representing the addition of a number, while the second movement, effected through the engagement of the ratchet of that wheel with the pawl of the next wheel, represents the carrying of one number to a higher denomination.

Each ratchet d is engaged by a sliding ratchet-bar i , having a series of ratchet-teeth adapted to engage the teeth of the corresponding ratchet d , there being one bar i for each ratchet. Said bars i are adapted to move in vertical guides or slots j , formed in the supporting-frame, and they are normally held elevated by means of a cross-bar k^3 , forming a part of a spring-supported pivoted yoke or frame k , which is pivoted at k' to the supporting-frame, and is held in the raised position (shown in Figs. 1 and 3) by means of springs k^2 k^2 , Fig. 1. The cross-bar k^3 extends across the series of bars i and is engaged with ears i' on the upper ends of said bars. The bars i are depressed by means of a series of keys m , which are mounted side by side on a fixed rod or support m' on the supporting-frame, there being one key for each bar i . Said keys are arranged so that when either of them is depressed a shoulder m^2 on its swinging end strikes the upper end of the corresponding bar i and gives the same a downward movement, the extent of which is determined by a movable plate o , having a series of vertical slots o' , o^2 , o^3 , o^4 , o^5 , o^6 , o^7 , o^8 , o^9 , and o^{10} . Said plate is adapted to be moved endwise in either direction by the hand of the operator in a slot or way p , extending across the frame of the machine above the series of adding-wheels, said way being clearly shown in Figs. 1, 3, and 6. Its slots o' o^2 o^3 o^4 o^5 o^6 o^7 o^8 o^9 o^{10} are of different depths, and each is adapted to be brought by the sliding movement of the plate o into position to receive either of the keys m when said key is depressed, the lower end of the slot constituting a stop which limits the downward movement of the key and determines the extent of the rotary movement of the numbered wheel operated by said key. The slot o^2 has its bottom arranged at such height that a key entering it can move downward far enough only to move the corresponding numbering-wheel through the intermediate ratchet-bar and ratchet a distance equal to the space between one numeral and the next on the periphery of said wheel, so that a movement of any wheel when the slot o^2 is in position to receive its operating-key can be only one step, representing the addition of one to the sum represented by the portion

of said wheel, which is visible through the corresponding orifice h' . When the slot o^3 is in position to receive a key, the downward movement of that key will give the corresponding adding-wheel a two-step movement, representing the addition of two to the number previously indicated by said wheel, and so on, each succeeding slot permitting the depression of a key that enters it to a lower point than the slot next preceding it until the last slot is reached, said slot permitting a nine-step movement, representing the addition of nine to the number previously indicated by said wheels.

The plate o is provided with a series of numbered marks or graduations z z , Fig. 4, which are arranged with relation to the slots o' , o^2 , o^3 , o^4 , o^5 , o^6 , o^7 , o^8 , o^9 , and o^{10} to designate each slot by the number of steps or extent of rotation of an adding-wheel, which it permits. The front plate h is also preferably provided with a series of marks z' z' , (see Fig. 4,) corresponding in number and position to the numbering-wheels and arranged to coincide with the graduations on the plate o , so that the operator may adjust said plate to bring either of its slots into position to receive the key that operates either wheel by bringing the mark on the plate o , accompanying the desired slot, into coincidence with the mark on the plate h , indicating the desired wheel.

The ends of the slots o' o^2 , &c., may be called a "series of graded stops," each serving to stop the wheel-operating movement of a key at a different point from the others, said stops determining the downward movement of each key and enabling the extent of such movement to be varied, as described.

To further increase the convenience of the adjustment of the plate o , I provide said plate with a rod o^{15} , to which is affixed a graduated plate o^{12} , arranged in close proximity to the orifices h' in the plate h , said plate o^{12} having numbered graduations similar to those of the plate o . It will be seen that upon the depression of either key the corresponding ratchet-bar i will be depressed, and by its engagement with the cross-bar k^3 will depress said cross-bar, so that when the key is released the cross-bar, being impelled upwardly by the springs k^2 , will raise the depressed ratchet-bar. No ratchet-bar is affected by the depression of any key except its own. Said bars are retained in position after being raised by the cross-bar k^3 by means of springs q , affixed to the supporting-frame and bearing against the rear edges of each of said bars, said edges each having a groove i^2 , Fig. 8, which receive the springs, the sides of said grooves retaining the springs in engagement with the bars. The springs not only act by friction to hold the bars i in their raised position, but also hold the teeth of the bars in yielding engagement with the teeth of the ratchets d and permit said bars to yield or swing outwardly when rising to the extent re-

quired to permit their teeth to slip over those of the ratchets.

Each key m is provided with an independent raising-spring m^3 , whereby it is raised when released by the operator's finger. Each key is provided with a projection or finger-piece m^4 at its front end to form a convenient bearing for the operator's finger in depressing the key.

Backward rotation of the adding-wheels by the pressure of the ratchet-bars i against them when said bars are rising is prevented by stop-pawls r , Figs. 3 and 6, pivoted at r' to the supporting-frame and pressed by springs r^2 against the ratchets d , said stop-pawls having teeth formed to prevent the rotation of the ratchets in one direction.

The operation of the portions of the machine above described is as follows: Suppose the adding-wheels already indicate a number, to which it is desired to add another number—as, for example nineteen, (19.) The operator first adjusts the slide o by moving it endwise by hand in the way p , so that the slot permitting the one-step movement of any key will be under the key which actuates the tens-wheel. The said key is then depressed by the finger of the operator as far as the slot will permit, thus giving a one-step movement to the tens-wheel, and adding one (1) to the number already indicated by said wheel. The operator then moves the slide o until the slot which permits a nine-step movement of any wheel comes under the key which operates the wheel representing units, and then depresses said key with result similar to that above described. When the rotation of any wheel represents the addition of a number, which, with the number already indicated, equals or exceeds ten, (10,) the wheel representing the next higher denomination is automatically moved one step, thus automatically effecting the operation of carrying one in the manner already described. It will be seen, therefore, that the operator has only to exercise the slight care required in adjusting the slide in order to perform the desired operations in addition, the simplicity of the operation being such that an operator can readily acquire high speed in the operation of the machine.

To enable a record to be kept of all the movements or manipulations of the machine, I provide a recording apparatus, next described.

s represents a bar or plate affixed to the slide o by means of studs s' s' and provided with a series of upwardly-projecting spring-arms s^2 , to the upper ends of which are affixed printing characters s^3 . There are ten arms s^2 , and the printing characters thereon extend from zero (0) to nine (9) consecutively. The arms s^2 and printing characters s^3 correspond in number and position to the slots o' o^2 o^3 o^4 o^5 o^6 o^7 o^8 o^9 o^{10} in the slide o , and when either slot is adjusted to position to receive a given operating-key m the corresponding printing character will be in position to be pressed by

a cam-shaped surface m^5 on the same key against a strip t of paper, which is supported by an impression-roll t' , mounted on a shaft t^2 , which is journaled in bearings on the frame of the machine. The cam m^5 of each key m is arranged to strike the upper end of the type-carrying arm s^2 , which may be in position to be acted on by said key, and deflects said arm, thus moving the type or printing character s^3 thereon backwardly against the paper strip t , as indicated by dotted lines in Fig. 6.

The impression-roll t' may be rotated to feed the paper along from time to time by means of a lever u , which is hung to oscillate freely upon the impression-roll shaft t^2 and carries a pawl u' , engaging a ratchet u^2 upon said shaft. The upper end of said lever is arranged to be moved by contact with a stud v on the key m at one end of the series, there being but one key that has a stud, and whenever said key is depressed its stud v moves the lever u in the direction required to depress or retract the pawl u' , causing the latter to slip on the teeth of the ratchet u^2 . When the said key is released and raised, a spring w , connected at one end to the lever u and at the other end to the frame of the machine, gives said lever a movement in the opposite direction and causes the pawl u' to partially rotate the impression-roll t' . It will be seen that whenever the key having the stud v is depressed the paper strip is moved along into position to receive another line of impressions from the characters s^3 . It will also be seen that the amount added by the depression of every key is recorded or printed on the strip t , each key in its descent operating the printing character which has the same value or represents the same number as the slot which receives the key, so that in the example above given of the operation of the machine—viz., the addition of nineteen (19) to the sum previously indicated by the adding-wheels—the depression of the tens-wheel into the slot a one-step movement of the key will print one (1) on the strip t , while the depression of the units-key will print nine (9) at a different point from the other, so that the value of each impression on the strip will be indicated by its position, all numbers indicating units being nearest one edge of the strip, while tens are printed at a point farther from said edge, and so on.

The paper strip t is unwound by the described operation from a spool x and wound upon another spool x' . Said spools are journaled in bearings in the frame of the machine, as shown in Fig. 1. The spool x' is rotated to wind up the strip by a belt y , connecting a pulley y' on the shaft t^2 with a pulley y^2 on the shaft of the spool x' .

z represents a pressure-roll, the shaft z' of which is journaled in slots z^2 in fixed ears z^3 , and is acted on by springs z^4 , which press the roll z toward the impression-roll t' , so that the paper strip which passes between the

rolls z and t' is held in sufficiently close contact with the impression-roll to be fed or moved forward by the described rotary movements thereof.

5 The ratchet-bars i are connected with the frame of the machine by means of a rod i^6 , passing through vertical slots i^7 in said bars, said rod and slots permitting the necessary movements of the bars i and preventing their
10 removal from the machine.

It will be observed by reference to Fig. 4 that the slots o' o^2 o^3 , &c., are so arranged that but one of them can coincide with a key m at a time, so that when one slot is in position to receive a key all the other slots are
15 out of line with all the other keys. Hence only one key can be depressed at a time, that key being the one which the slot was adjusted to receive. Errors in adding and recording
20 by the selection of the wrong key by the operator are thus prevented.

The keys are guided in their movements and prevented from being sprung or deflected sidewise by fixed vertical tongues a^2 behind
25 the plate or slide o , said tongues being affixed to the supporting-frame and separated by spaces or slots wide enough to receive the keys without permitting them to move laterally. The keys are thus kept in operative
30 relation to the ratchet-bars and printing characters, so that they cannot fail to operate said parts when depressed.

It will be seen that each wheel representing a denomination higher than units is
35 adapted to be rotated to any extent without affecting the wheels representing a lower denomination or denominations, the described carrying connections between the wheels being adapted to impart the carrying motion
40 only to a wheel or wheels of a higher denomination. Hence the addition of any number or numbers of the higher denominations can be effected without movement of the wheels representing lower denominations. Thus if
45 it is desired to add nine hundred to the amount already indicated by the wheels the wheel representing hundreds may be given a nine-step movement, which will effect the desired addition without moving the two lower
50 wheels representing units and tens.

The printing character representing zero (0) is operated by the movement of a key m into the shortest slot o' . Said slot is of such length that it does not permit a key entering
55 it to move the corresponding wheel-operating ratchet-bar. Hence the zero characters may be imprinted on the record-sheet to complete the record of the addition of nine hundred by the depression of the tens and units keys into
60 the slot o' without movement of the tens and units wheels. Figs. 9, 10, and 11 show a part of the record-sheet after each of the above-described operations required to print 900, Fig. 9 showing the strip after the 9 has been
65 printed by the hundreds-key, Fig. 10 after the 0 has been printed by the tens-key, and

Fig. 11 after the 0 has been again printed by the units-key.

The movement of the units-key m , required to print zero, although not sufficient to rotate
70 the corresponding adding-wheel, is sufficient to move the lever u and retract the pawl u' , as above described, so that the upward movement of said units-key after printing zero, as well as after printing any other character, is
75 accompanied by the described feeding movement of the impression-roll.

In case it is desired to print any or all of the numbers upon the record-strip without operating the adding-wheels the slots o^2 o^3 o^4 ,
80 &c., may be obstructed by a movable stop, which is adapted to extend across said slots at the same height as the lower end of the slot o' , so that each key can move down far enough to operate a printing character, but
85 no farther. I have shown said stop in Fig. 4 as a wire rod A , having bent ends $A' A'$, which are hung in bearings A^2 on the slide o . When said rod is in the position shown in full lines in Fig. 4, it is inoperative; but
90 when turned up, as shown in dotted lines in said figure, it is on a level with the lower end of the slot o , and extends across all the other slots in the slide o , so that no key can be depressed lower than said bar.

If desired, the wheel b at the right-hand
95 end of the series may indicate fractions.

I claim—

1. The combination, substantially as here-
inbefore set forth, of a series of independ-
100 ently-revoluble adding-wheels, a corresponding series of independently-movable keys, connections between said keys and wheels through which the movement of any key turns the corresponding wheel a distance gov-
105 erned by the extent of movement of the key, and an adjustable series of graded stops arranged so that either stop of the series can be adjusted to co-operate with either key of the series and determine the wheel-operating
110 movement thereof.

2. The combination, substantially as here-
inbefore set forth, of a series of operating-
keys therefor, operative connections between
said keys and wheels, and a transverse slide
115 having a series of slots of different depths, each adapted to receive either of said keys, the ends of said slots constituting a series of graded stops, whereby the extent of movement of either key may be determined.
120

3. The combination, substantially as here-
inbefore set forth, of a series of adding-
wheels, a series of operating-keys therefor,
operative connections between said keys and
wheels, a slide movable transversely of the
125 keys and provided with a graded series of key-stops and with a graduated scale or series of marks corresponding with said stops, and a fixed scale or series of marks, whereby the required position of the series of stops to
130 bring any stop into operative relation with a given key may be determined.

4. The combination, substantially as here-
inbefore set forth, of a series of adding-wheels,
a casing or plate over said wheels, having a
series of orifices through which portions of
5 the wheels are visible, a series of keys oper-
atively connected with said wheels, and a
slide provided with a graduated scale or se-
ries of marks arranged adjacent to the said
orifices in the casing, as set forth.

10 5. The combination of a supporting-frame,
an impression-roll therein, a series of printing
characters secured to a slide which is mov-
able lengthwise of the impression-roll, each
character being arranged to be pressed against
15 a strip of paper on said roll, and a series of
keys, each adapted to move in a direction at
right angles to the direction in which the said
slide and the series of printing characters are
movable, each key being adapted to operate
20 a printing character when depressed or moved
across said path, the adjustability of the se-
ries of characters enabling either character
to be brought into position to be operated by
any key, as set forth.

25 6. The combination of a series of adding-
wheels, a corresponding series of keys, connec-
tions between said keys and wheels, whereby
the depression of any key is caused to turn
the corresponding wheel, a movable slide hav-
ing a graduated series of stops adapted to
30 determine the wheel-operating movement of
either key, a series of printing characters car-
ried by said slide and arranged to be oper-
ated as desired by said keys, and a sheet-
35 supporting roll or bed against which the print-

ing characters are pressed by the action of
the keys, as set forth.

7. The combination of the supporting-frame,
the series of adding-wheels therein, the series
of keys operatively connected with said wheels, 40
as described, whereby the depression of each
key is caused to partly rotate the correspond-
ing wheel, the slide movable in a guide or
way crosswise of the supporting-frame and
provided with a series of graded key-stops, a 45
bar s, affixed to said slide and provided with
flexible arms, each having a printing charac-
ter, and a series of cams on the keys adapted
to move the said arms when the keys are de-
pressed, as set forth.

8. The combination of the series of operat-
ing-keys, the slide o, having a graded series
of stops adapted to determine the downward
movements of the keys, the printing charac-
ters adapted to be operated by said keys dur- 55
ing the commencement of their downward
movement, the adding-wheels adapted to be
operated by the keys at a later point in their
downward movement, and a movable stop
whereby the downward movement of the keys 60
may be limited to that part which operates
the printing characters, as set forth.

In testimony whereof I have signed my
name to this specification, in the presence of
two subscribing witnesses, this 31st day of 65
October, A. D. 1890.

JOSEPH MATHISON.

Witnesses:

C. F. BROWN,

A. D. HARRISON.