

No. 661,121.

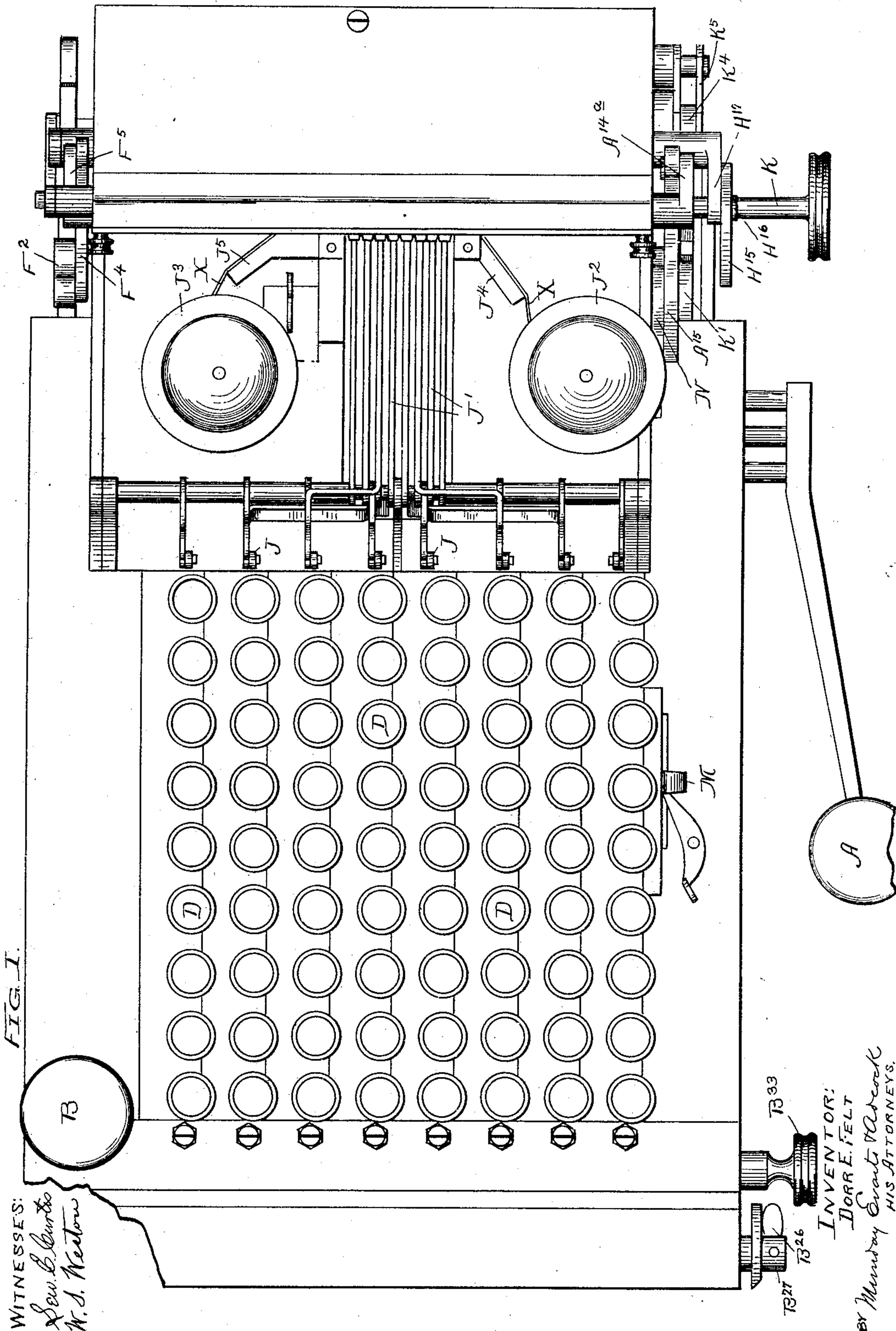
Patented Nov. 6, 1900.

D. E. FELT.  
CALCULATING MACHINE.

(Application filed May 2, 1898.)

(No Model.)

11 Sheets—Sheet 1.



WITNESSES:

Geo. B. Curtis  
W. J. Weston

INVENTOR:  
D. E. FELT

BY Munday, Evans, & Adcock  
HIS ATTORNEYS.

**No. 661,121.**

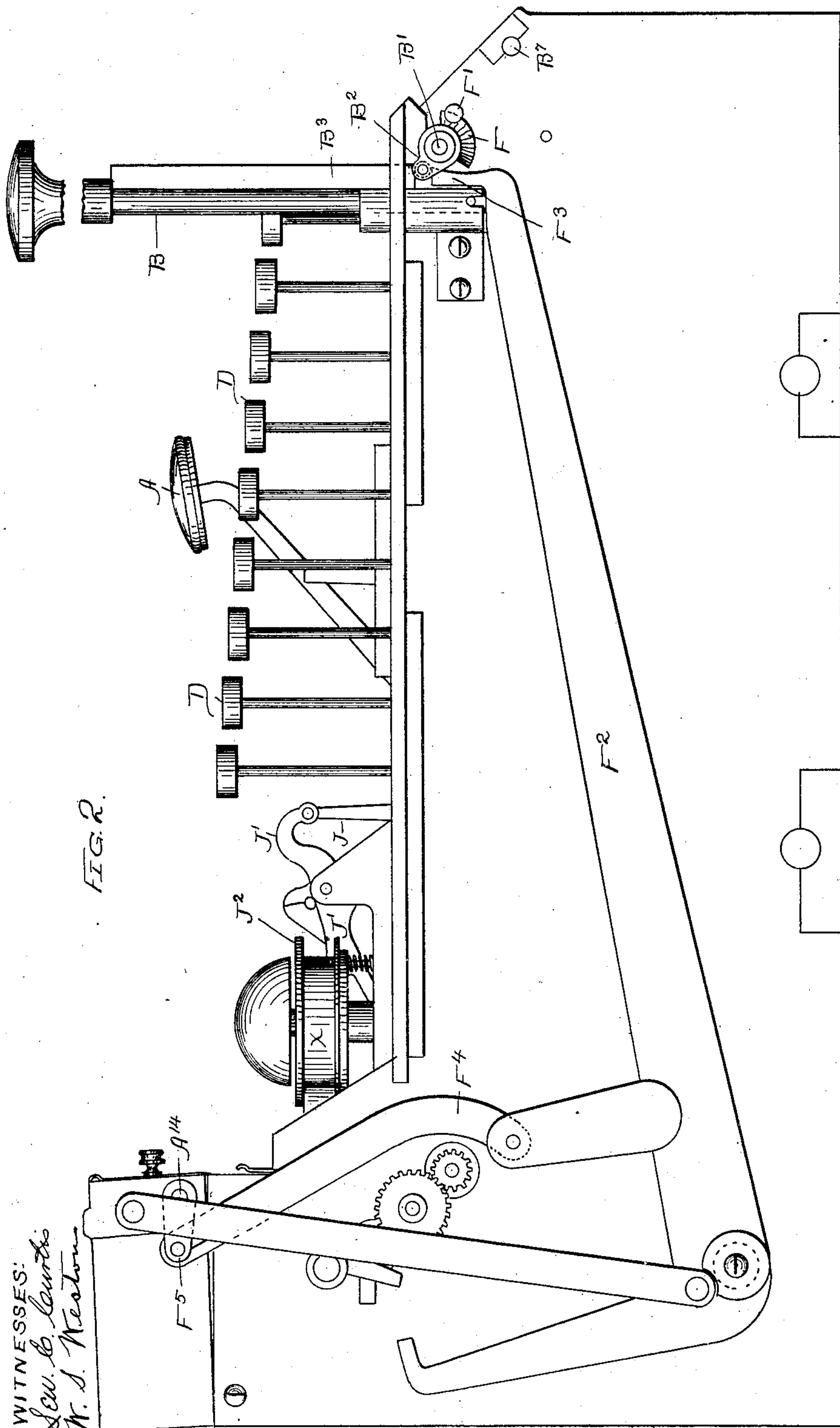
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(No Model.)

**11 Sheets—Sheet 2.**



WITNESSES:

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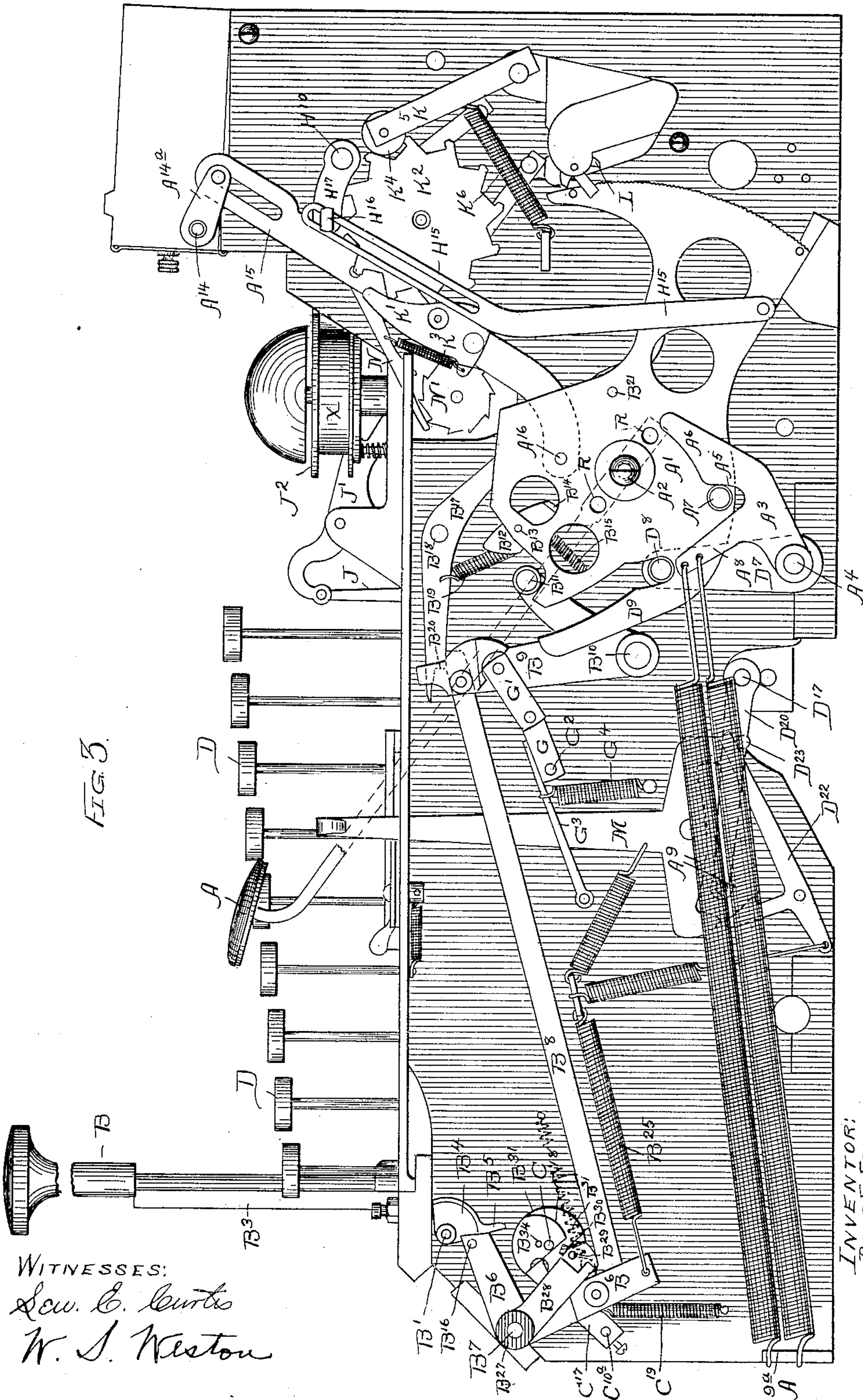


FIG. 3.

WITNESSES:

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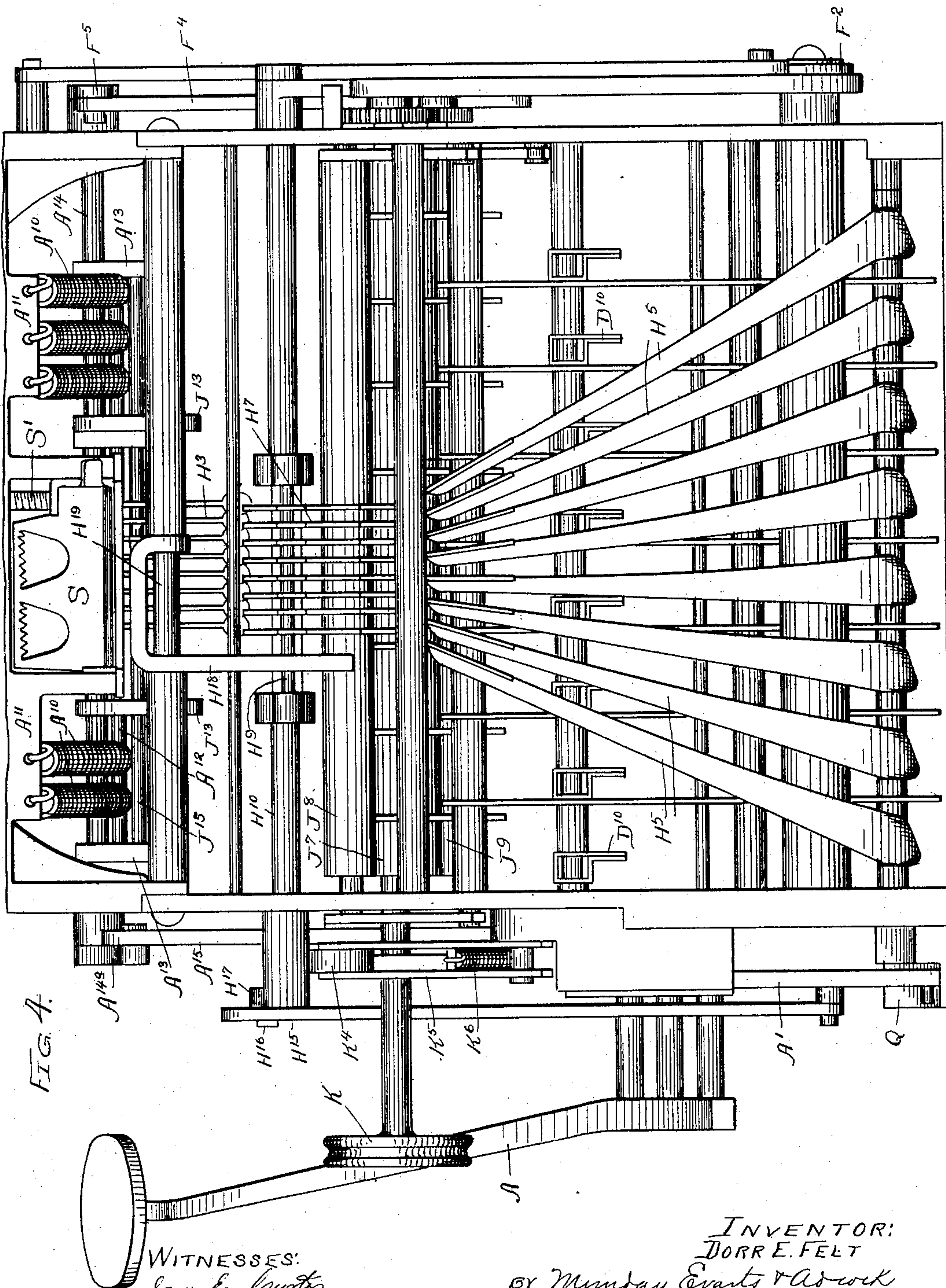


FIG. 4.

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11 Sheets—Sheet 5.

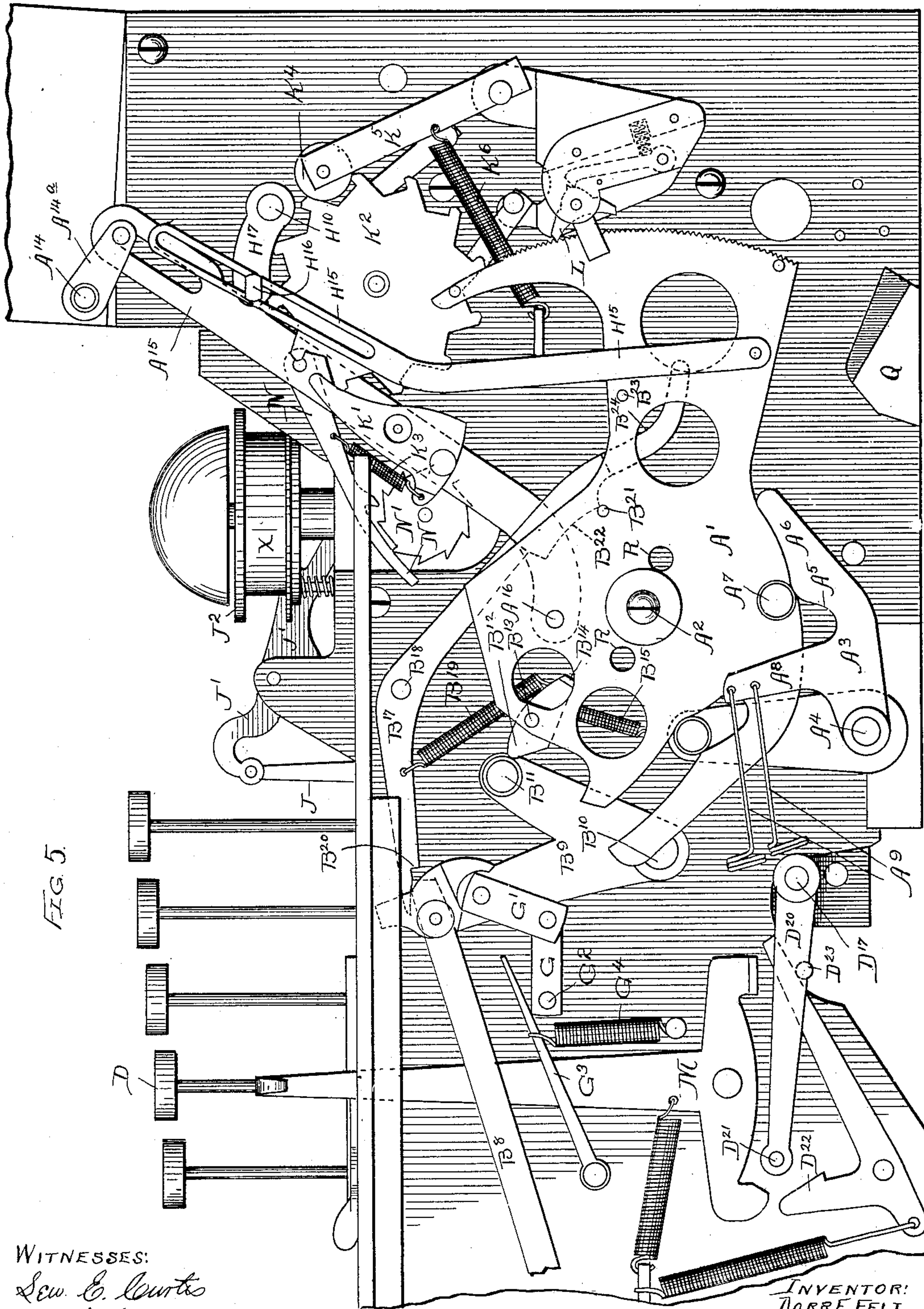


FIG. 5.

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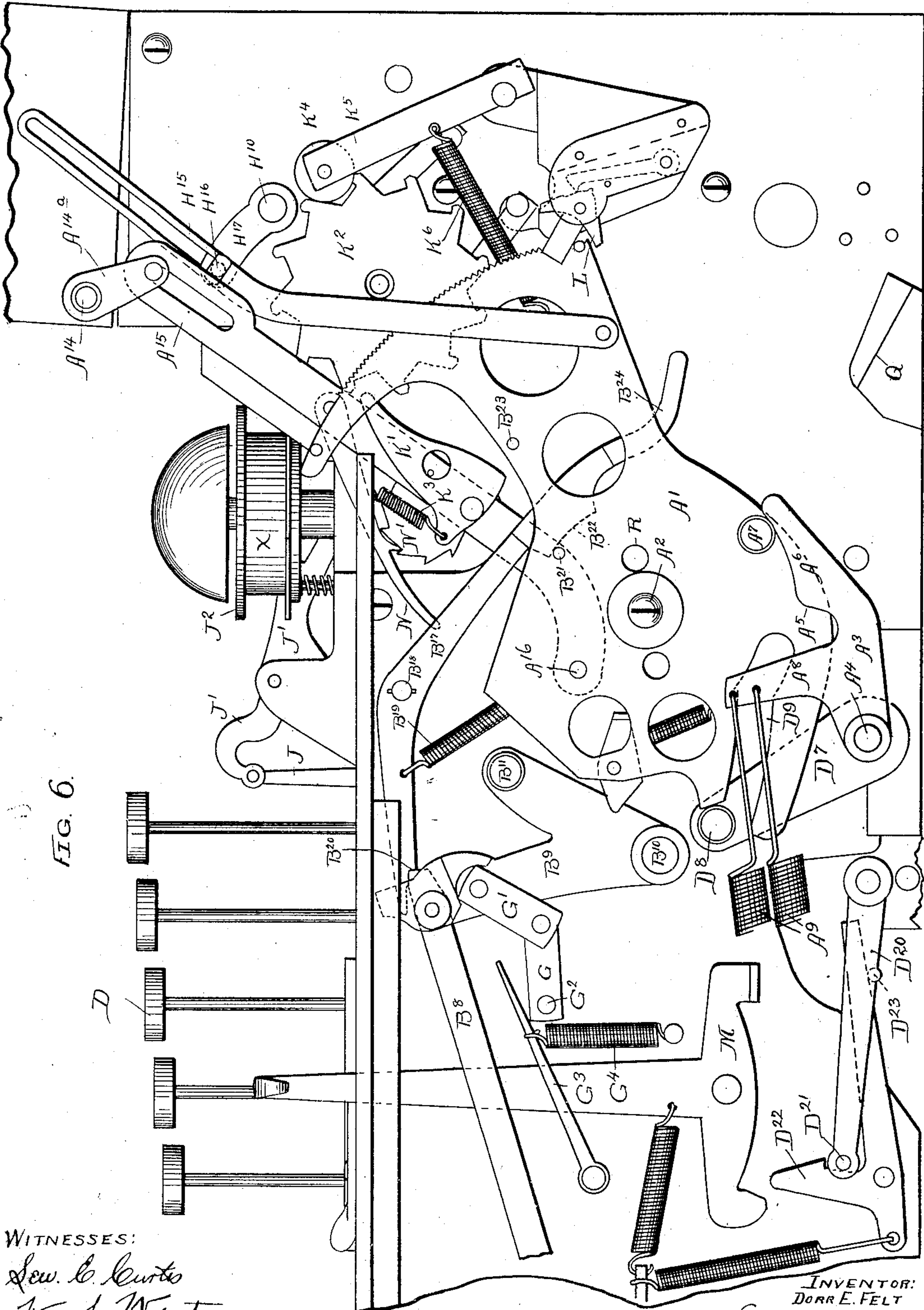


FIG. 6.

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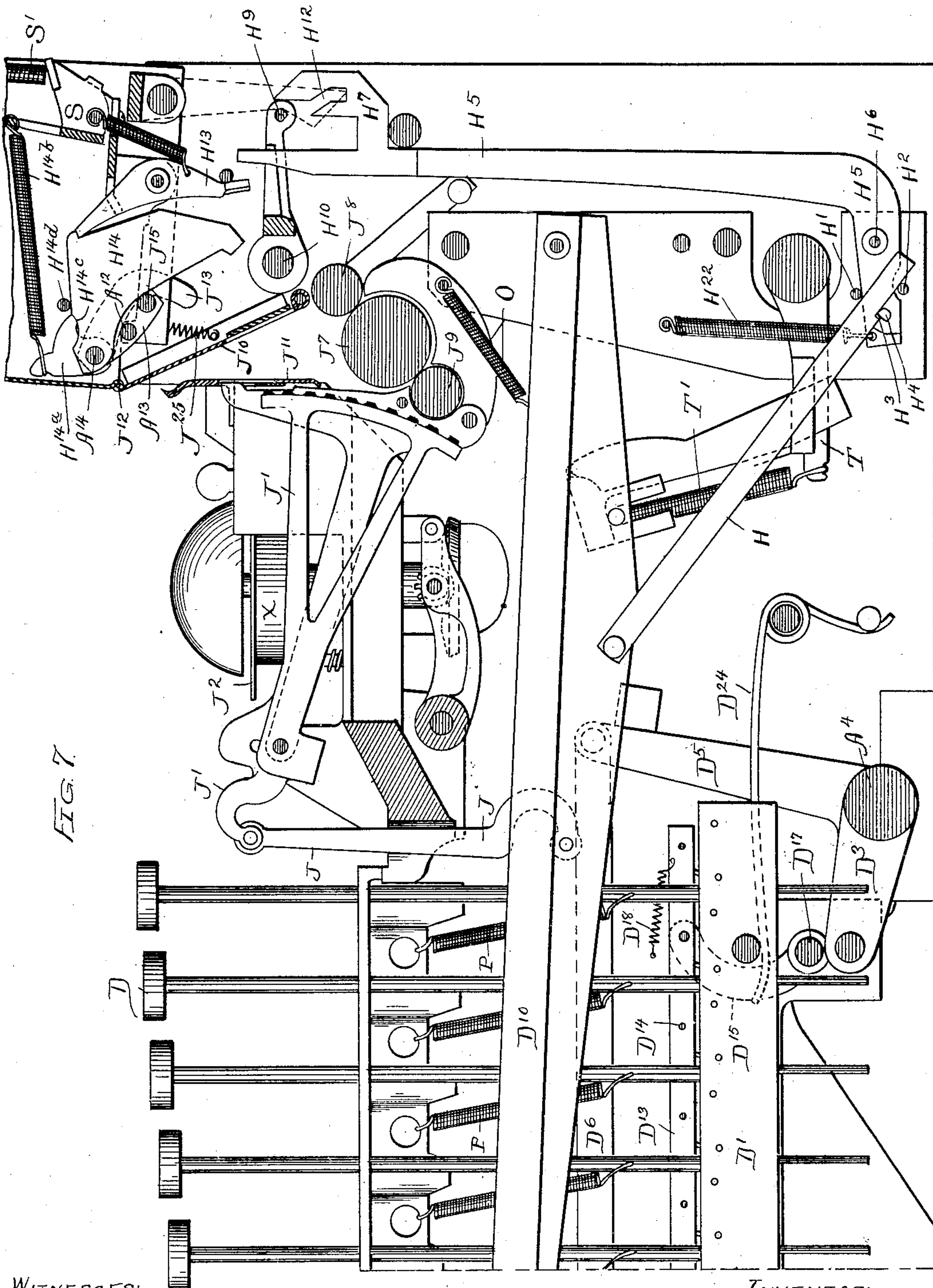


FIG. 7

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FIG. 9.

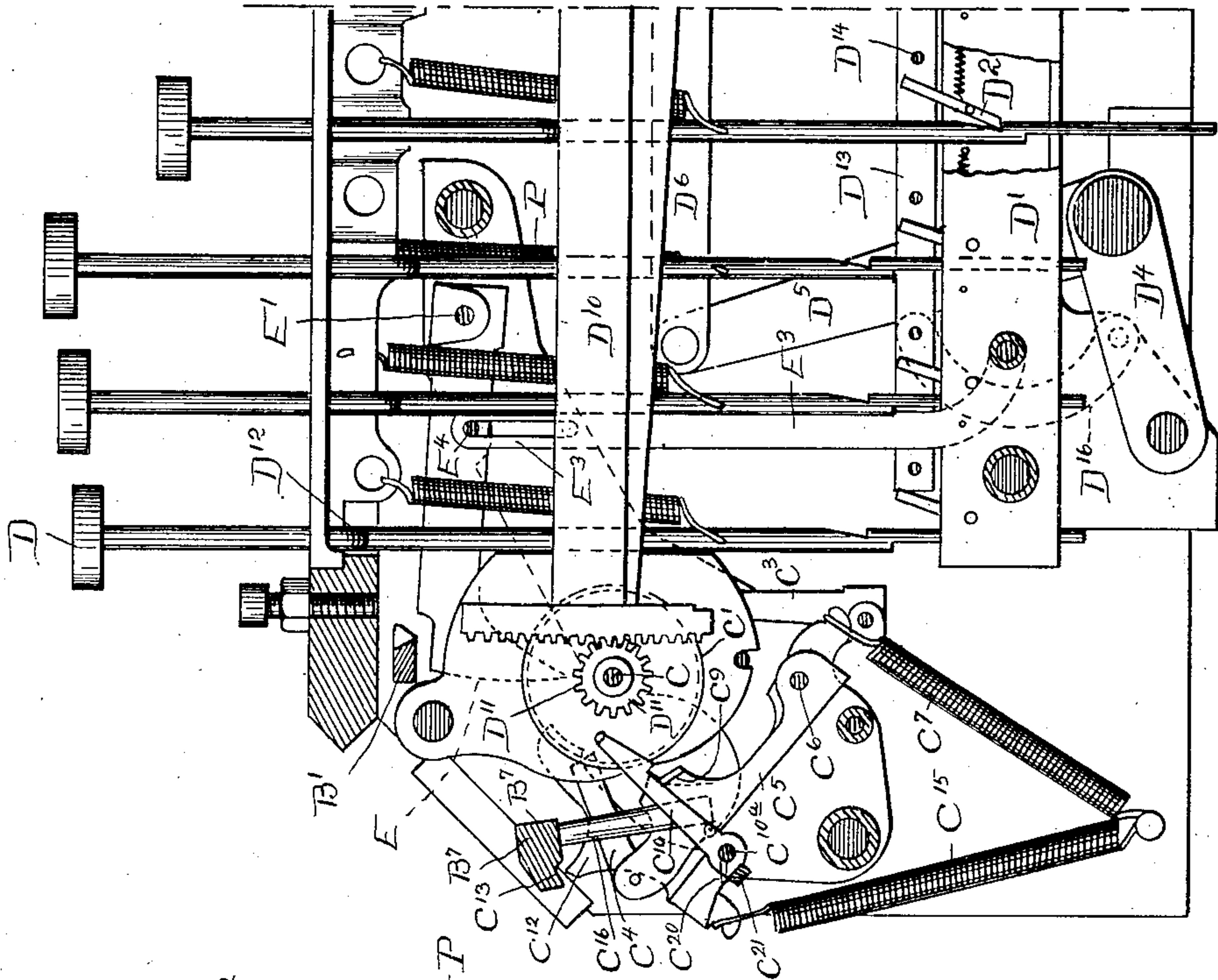
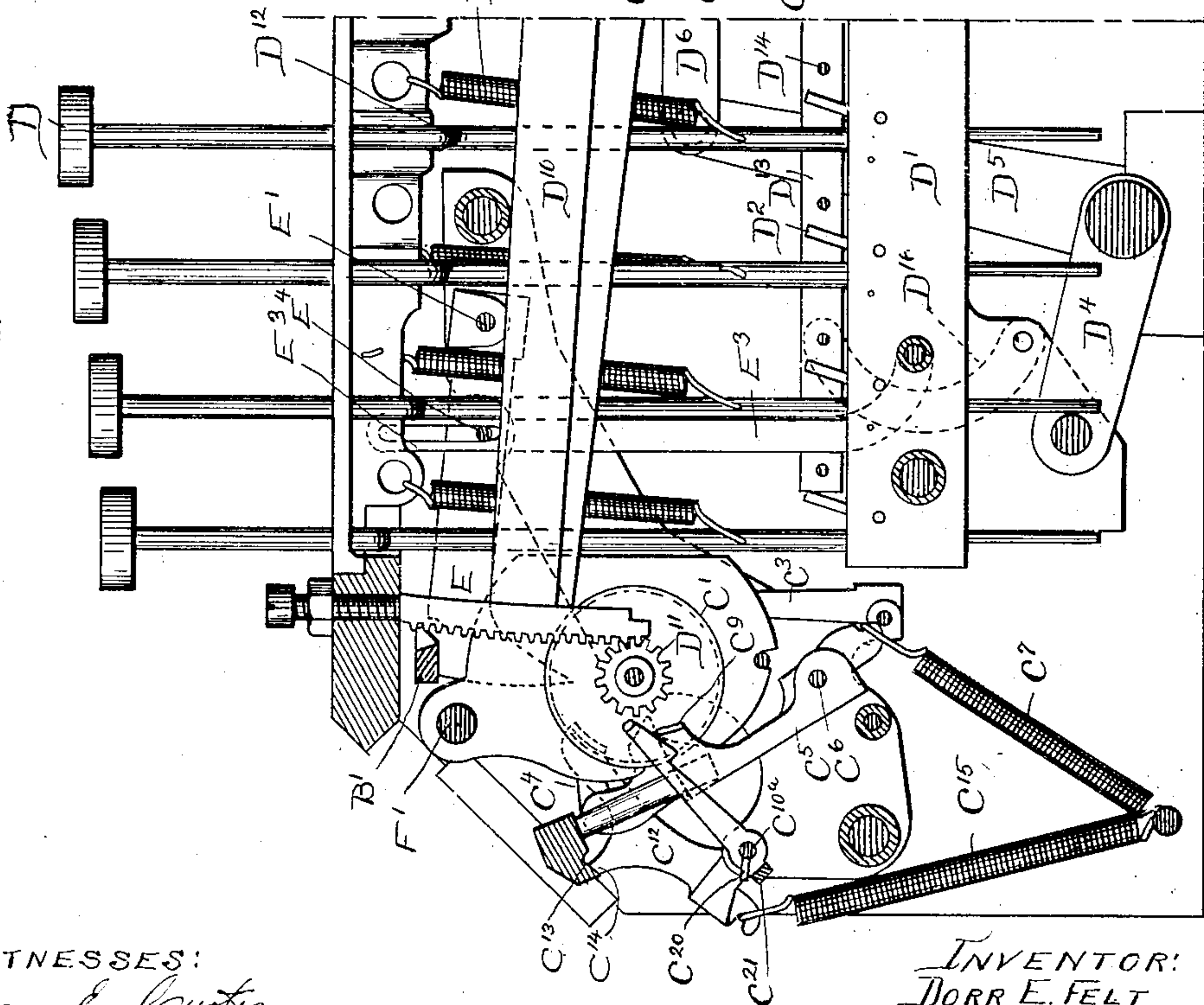


FIG. 8.



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11 Sheets—Sheet 9.

FIG. 11

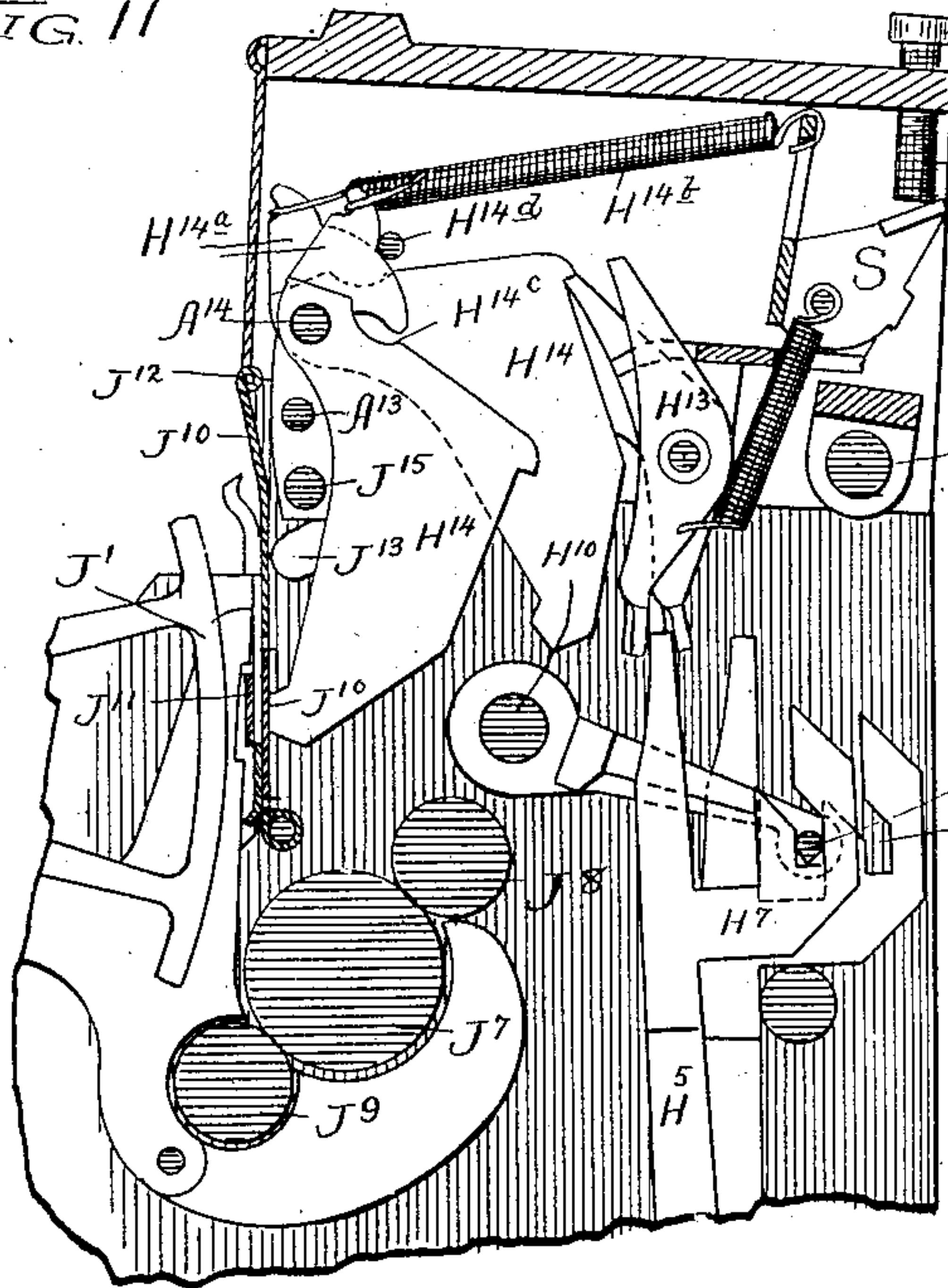


FIG. 12.

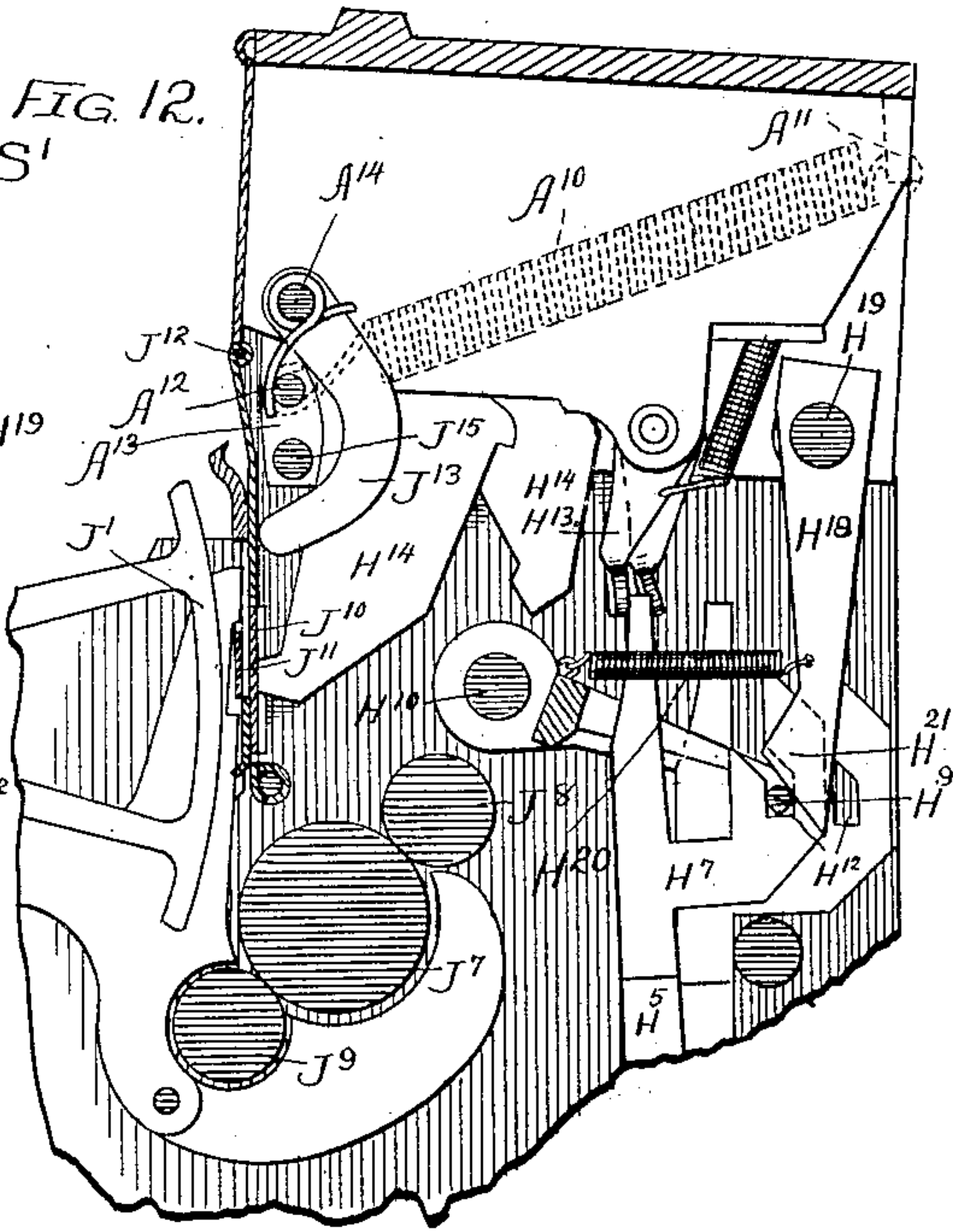
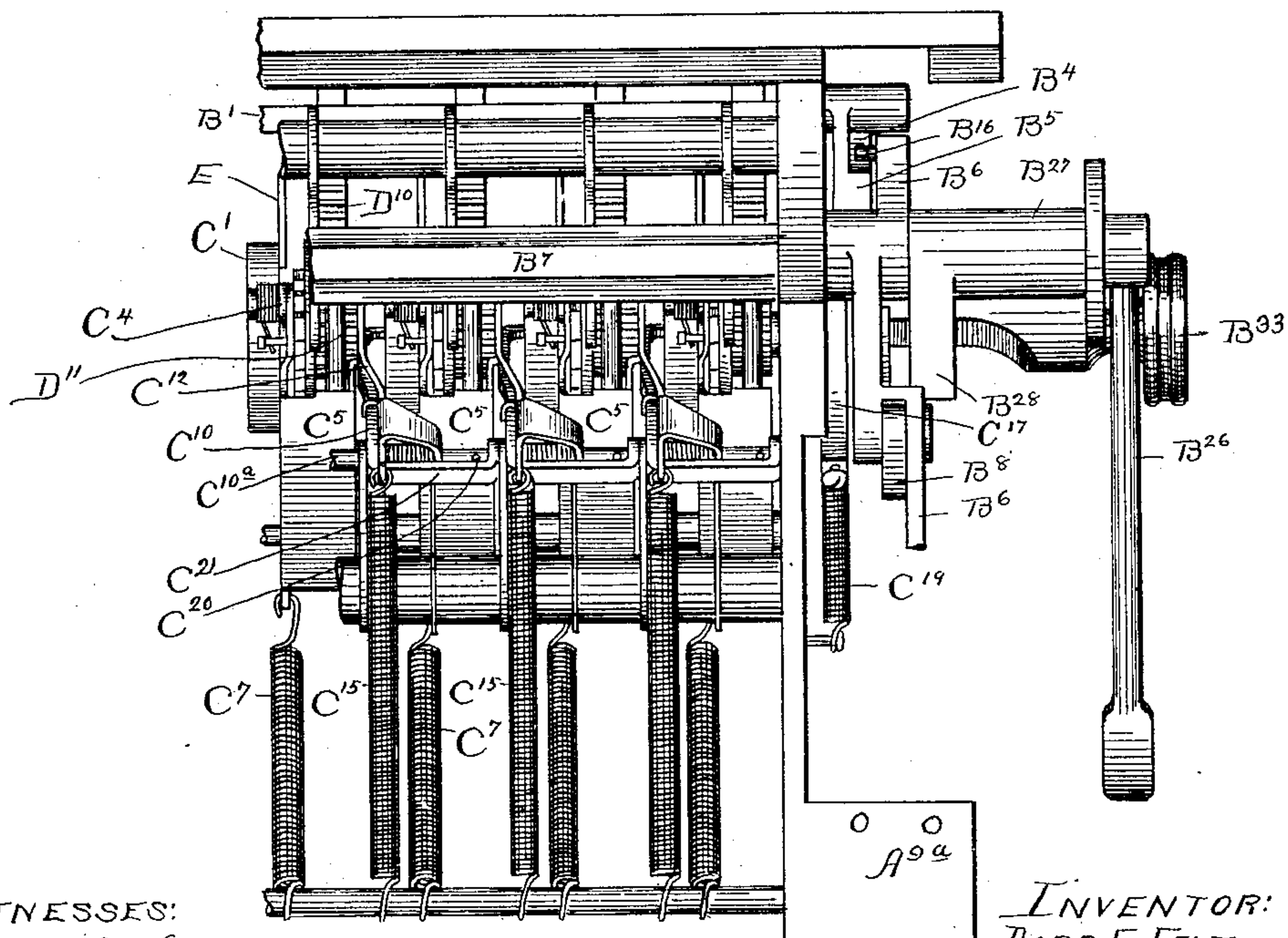


FIG. 10.



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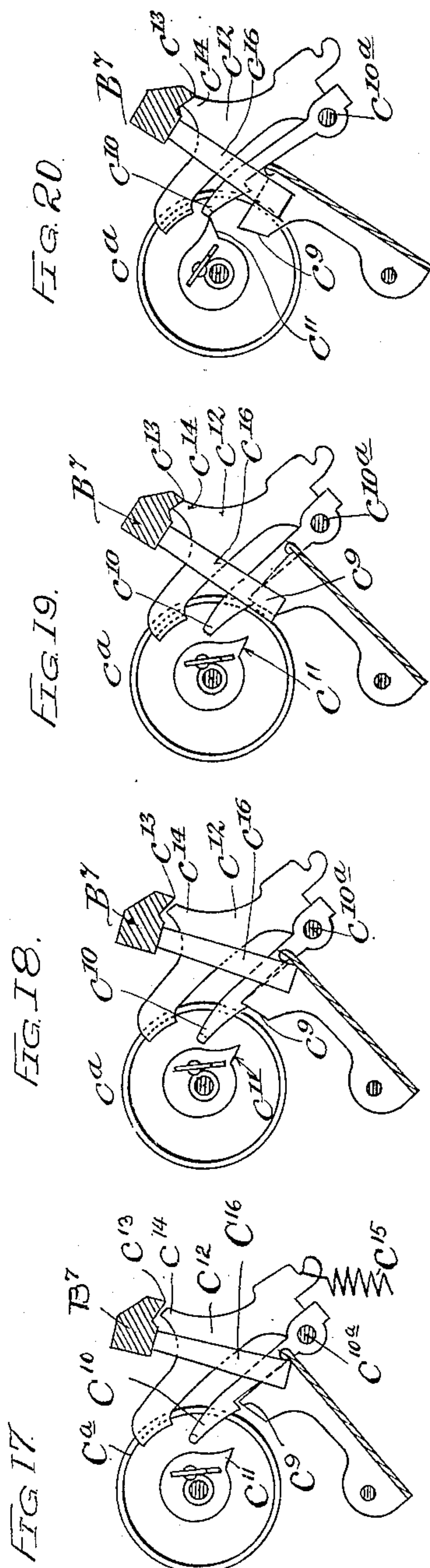
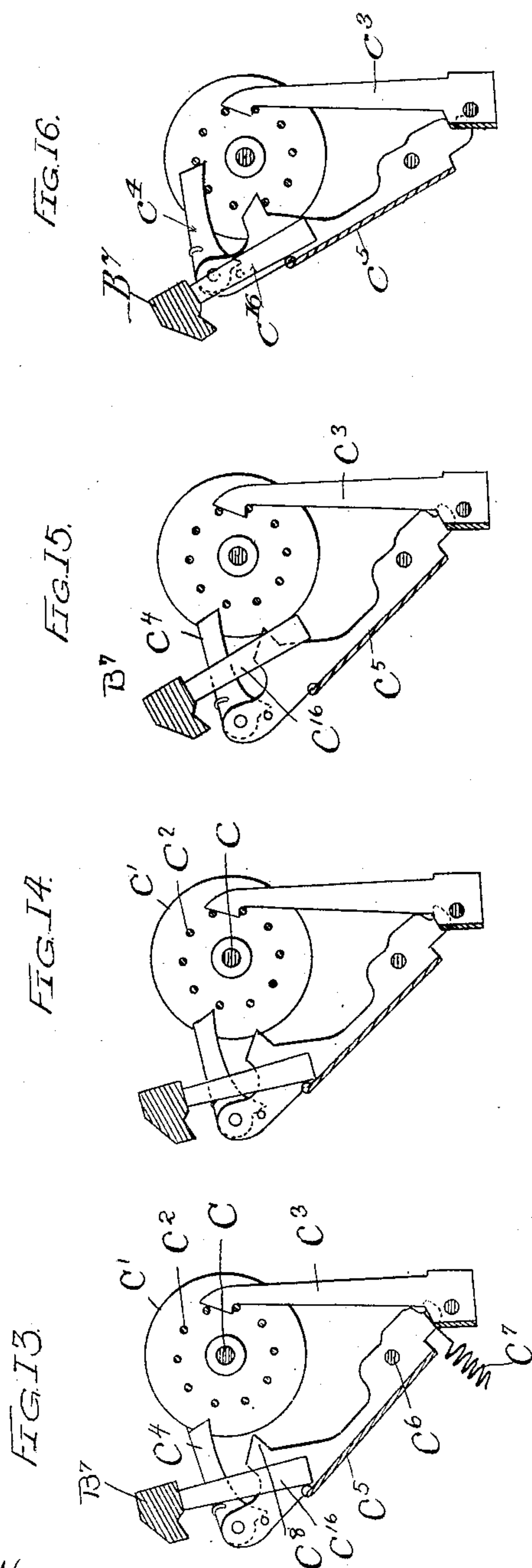
*By Munday Erast & Adcock*  
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CALCULATING MACHINE.

(No Model.)

(Application filed May 2, 1898.)

11 Sheets—Sheet 10.



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FIG. 21

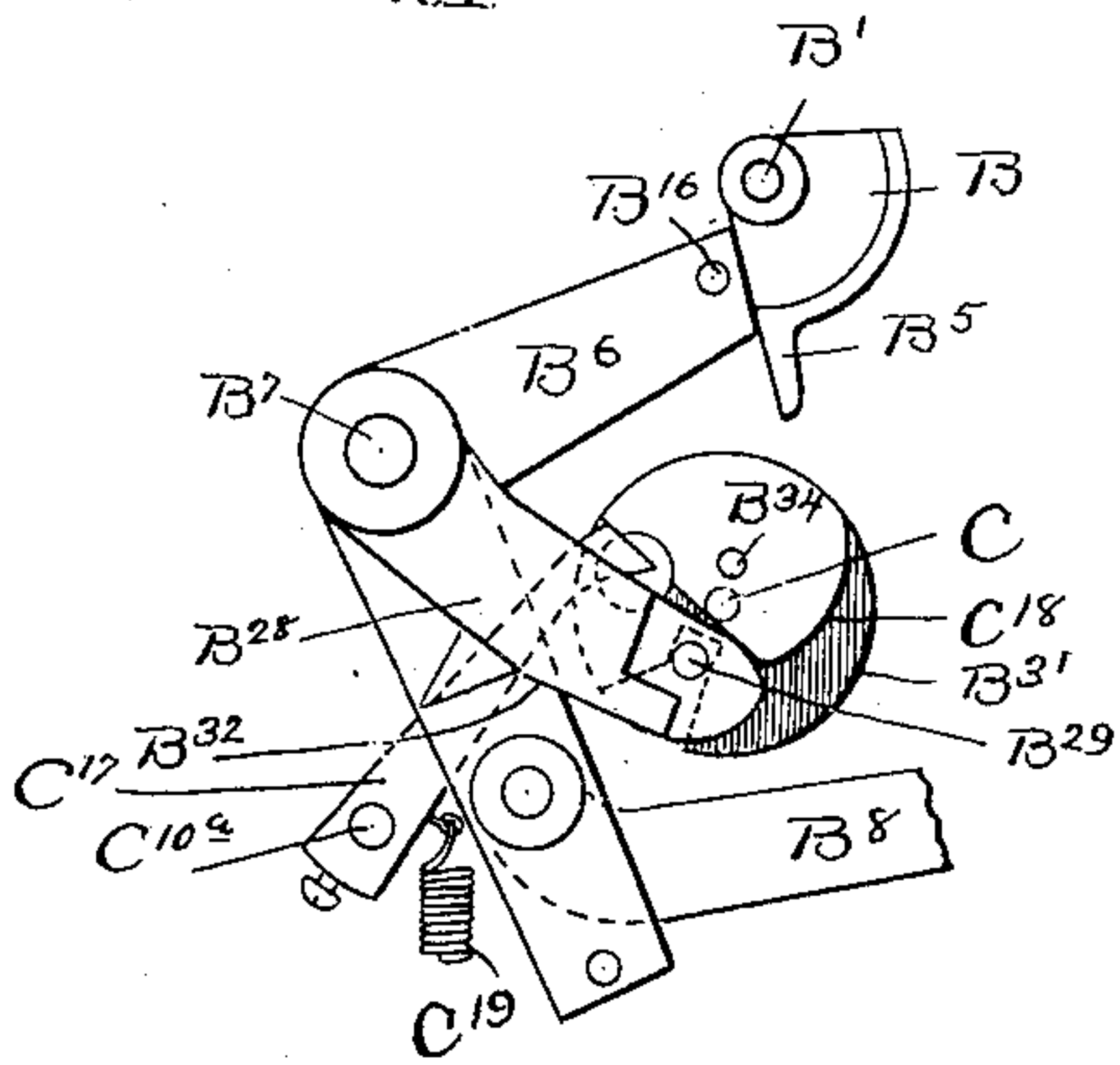


FIG. 22

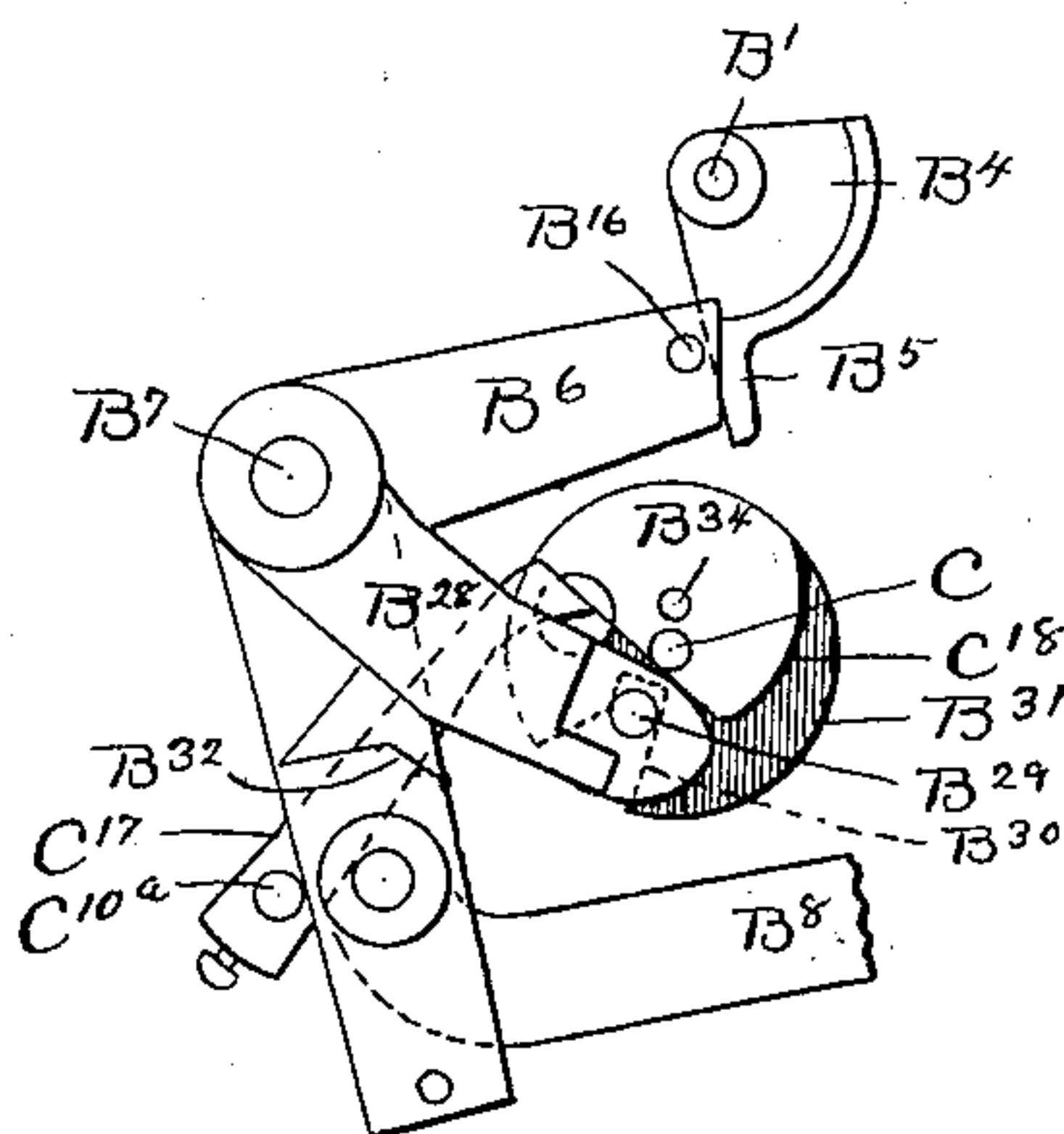


FIG. 23

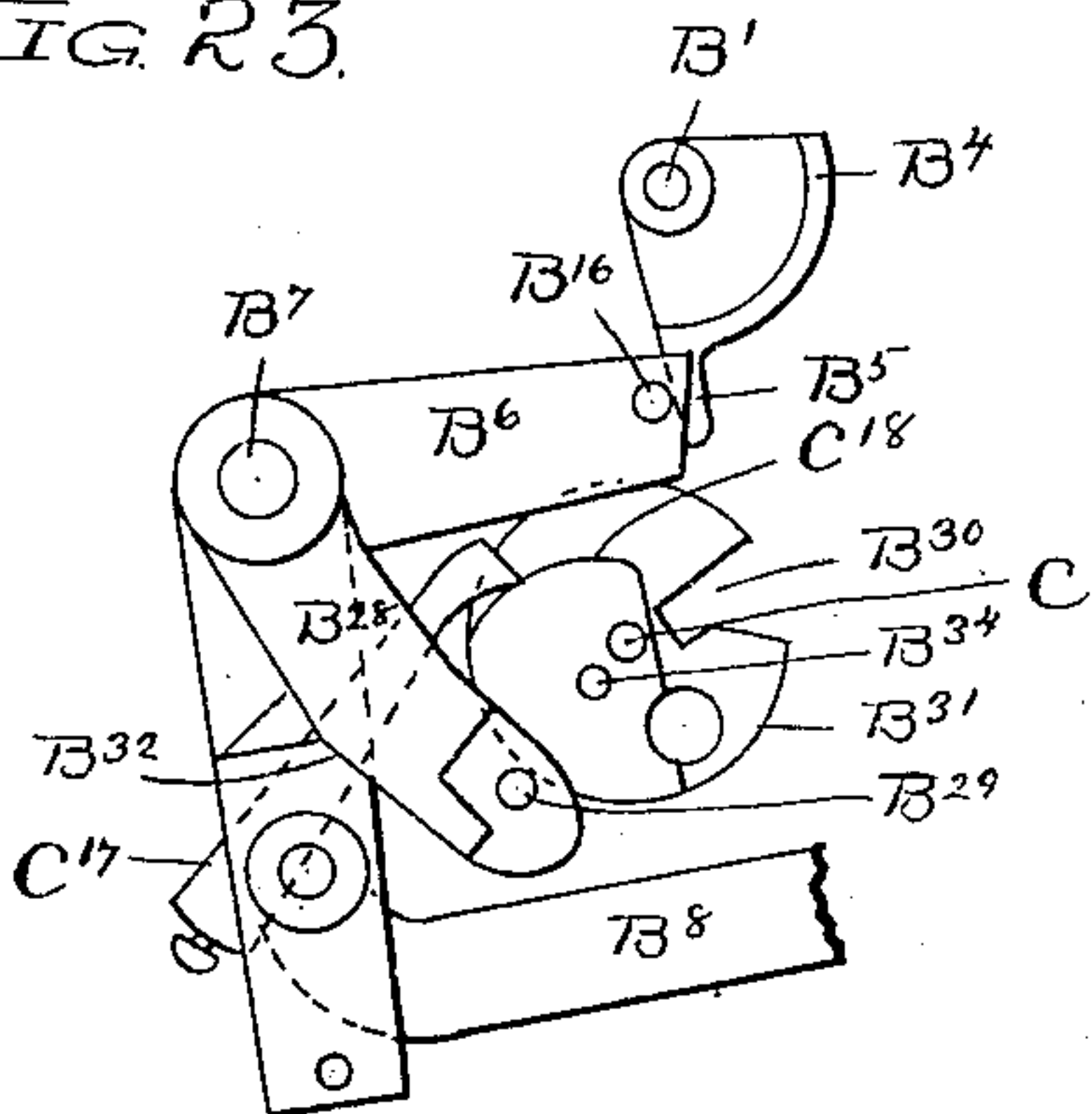


FIG. 27

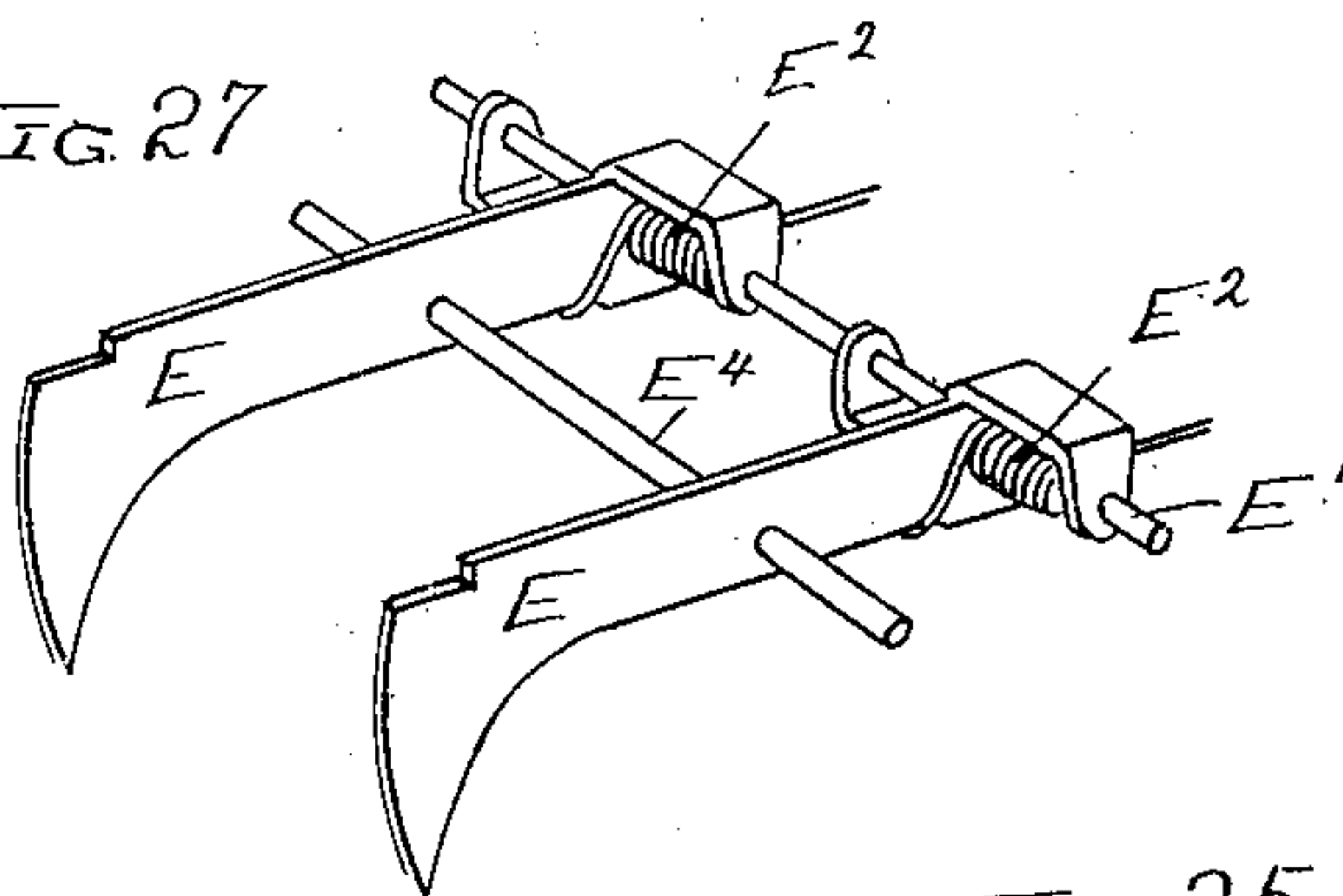


FIG. 25

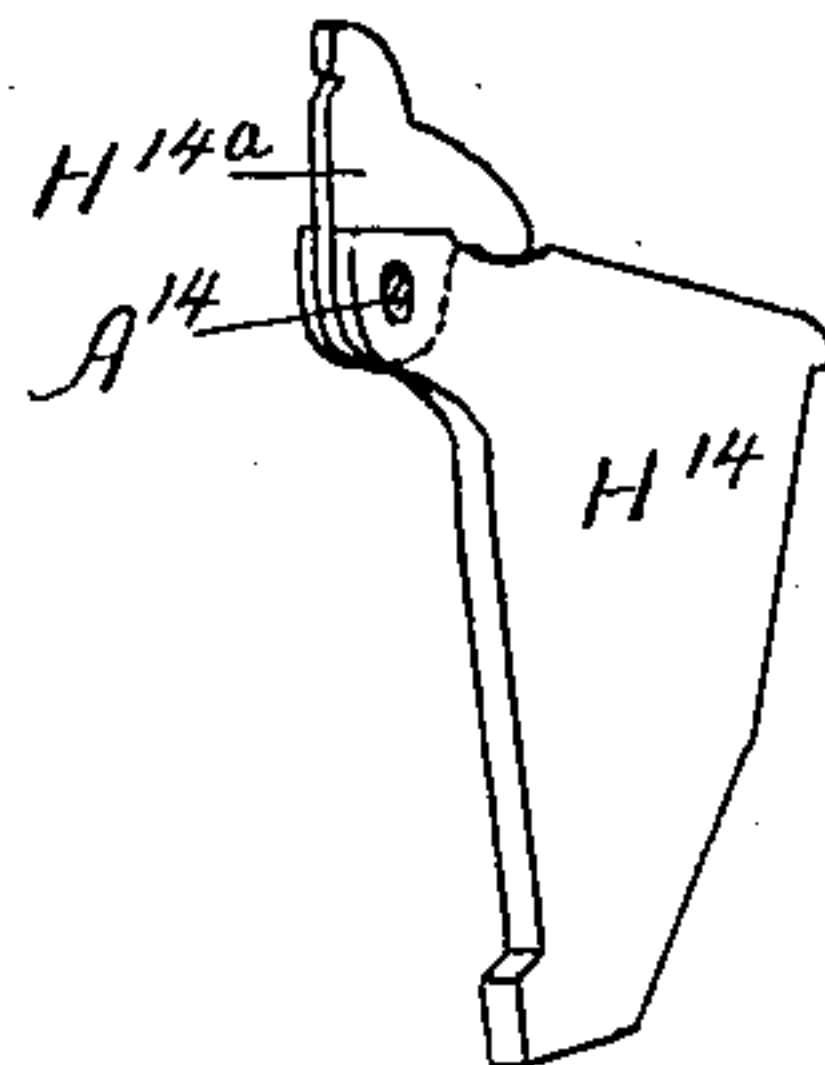


FIG. 24

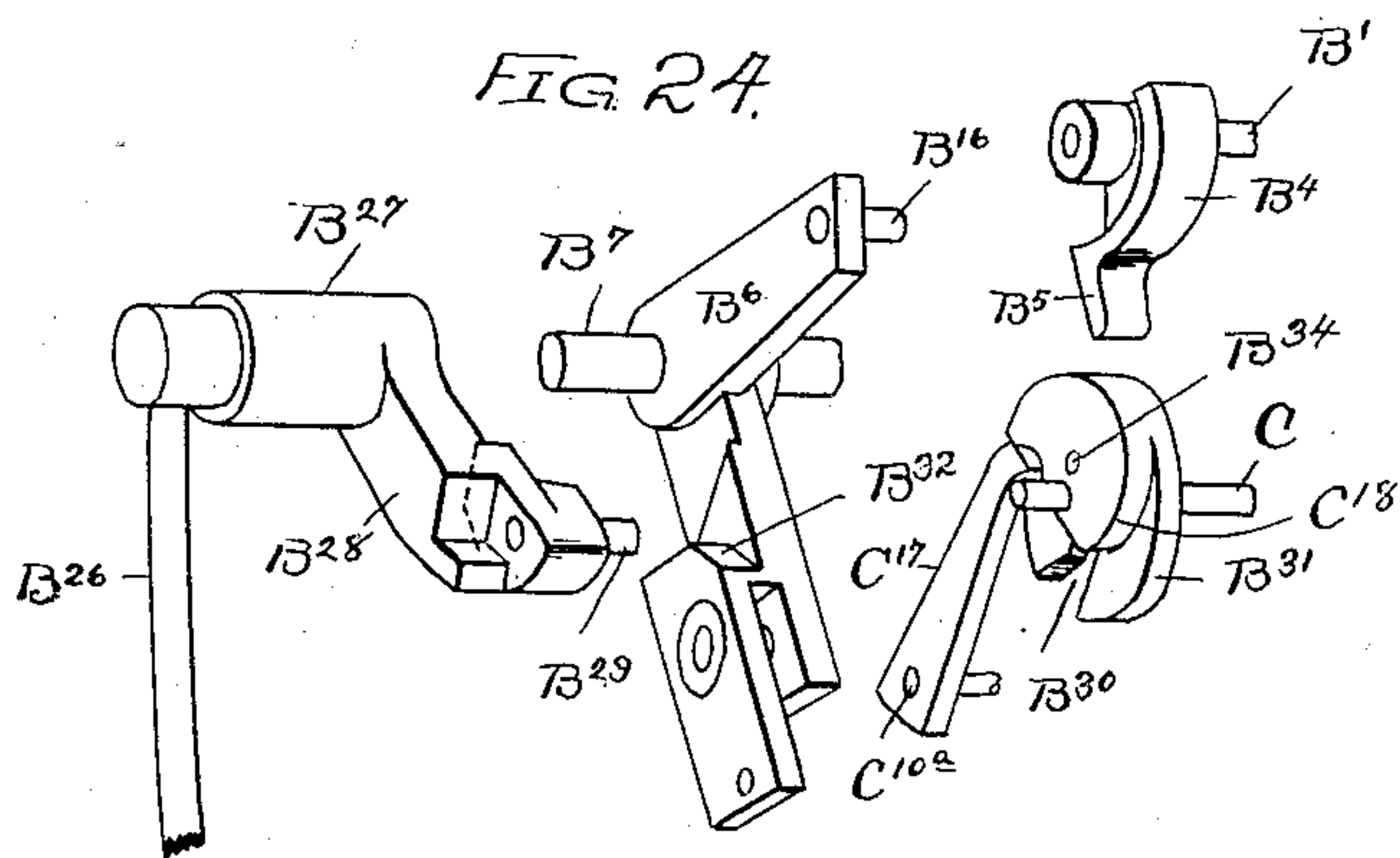
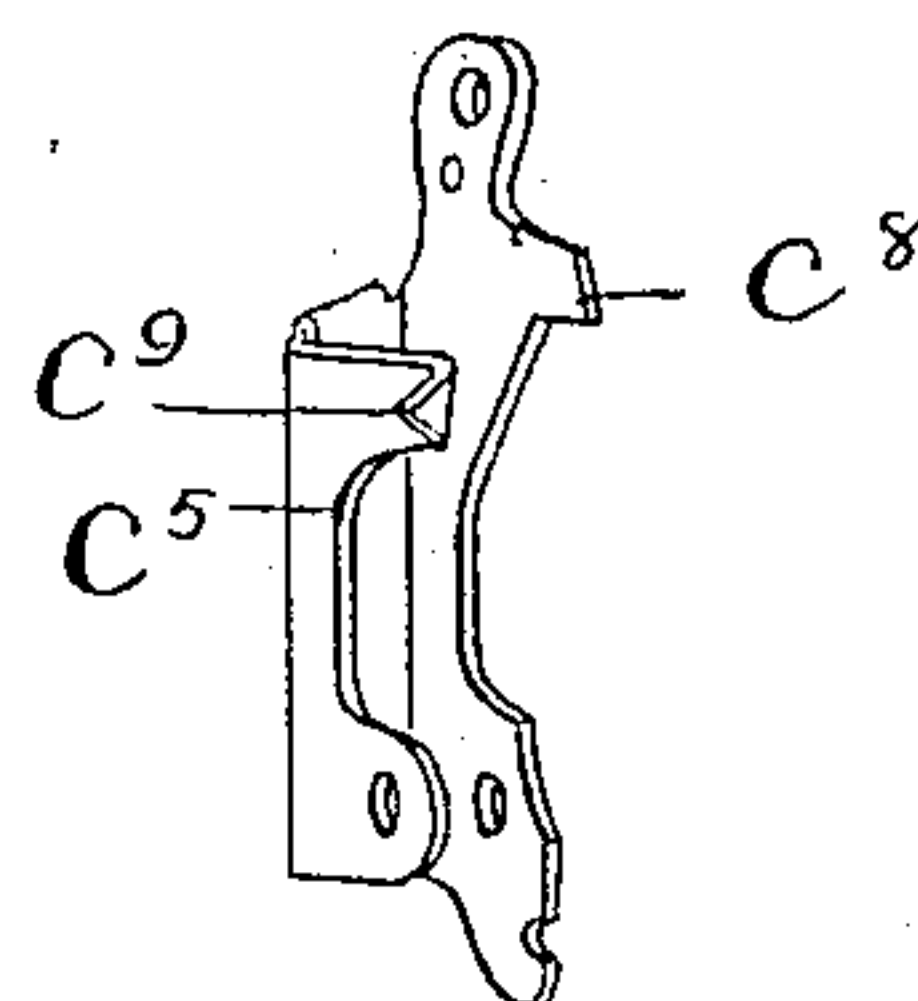


FIG. 26



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# UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS.

## CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 661,121, dated November 6, 1900.

Application filed May 2, 1898. Serial No. 679,461. (No model.)

*To all whom it may concern:*

Be it known that I, DORR E. FELT, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Calculating-Machines, of which the following is a specification.

This invention relates to certain improvements in printing and calculating machines, a type of which is shown in the patent to me, No. 568,021, of September 22, 1896, and is designed to simplify and otherwise improve their construction.

In the accompanying drawings, in which my improvements are fully illustrated, I show at Figure 1 a plan, at Fig. 2 an elevation of the side of the machine upon which the answer-printing lever is located, and at Fig. 3 an elevation, partly in section, of the opposite side of the machine, the main actuating-lever being shown in broken lines. Fig. 4 is an enlarged rear elevation. Figs. 5 and 6 are partial side elevations showing the parts in different positions. Fig. 7 is a partial longitudinal vertical section. Figs. 8 and 9 are partial longitudinal vertical sections showing parts not given in Fig. 7 and also showing the parts in different positions. Fig. 10 is a partial front elevation. Figs. 11 and 12 are partial longitudinal vertical sections showing the printing mechanism. Figs. 13 to 16, inclusive, are detail sectional views showing one of the numeral-wheels with the different positions of its carrying mechanism. Figs. 17 to 20, inclusive, are similar views looking in the opposite direction and showing also the brake. Figs. 21, 22, and 23 are detail views of the interlocking mechanism employed for purposes hereinafter explained. Fig. 24 is a detail perspective of the parts of said interlocking mechanism. Fig. 25 is a detail perspective of the printing-hammer. Fig. 26 is a detail view of the carrying-lever; and Fig. 27 is a perspective view of the stop-levers.

Referring to the drawings, A represents the main operating-lever, serving as the means both of actuating the numeral-wheels in the adding operations and of causing the printing of the numbers added. It is attached to a cam A', which I term the "main" cam, because it is through the medium of this cam

that the lever A accomplishes its various functions. The cam is pivoted at A<sup>2</sup>, so it may turn when power is applied to the lever. It is moved in one direction by the lever and returned to its normal position by spring-power, as now to be explained.

At A<sup>3</sup> is a lever loosely pivoted on the end of a shaft A<sup>4</sup> and having a notch at A<sup>5</sup> and an arm A<sup>6</sup>. The cam carries a stud A<sup>7</sup>, which when the cam is in its normal position lies in the notch of the lever, as at Fig. 3, but which swings the lever and moves out of the notch and onto the arm A<sup>6</sup> soon after the cam begins its movement with lever A, as at Fig. 5. Attached to another arm A<sup>8</sup> of the lever are one or more springs A<sup>9</sup>, secured to a stationary side projection A<sup>9a</sup> and acting upon the lever in a direction contrary to the movement imparted thereto by the cam. These springs are overcome by the hand-lever at the commencement of its stroke, and as the cam and lever near the end of their return movement where there is most resistance to the return of the cam the springs exert considerable power upon them and insure the completion of that movement, but they have no influence upon the cam while the stud A<sup>7</sup> is riding on the arm A<sup>6</sup>, because their strain is then borne by the axis A<sup>2</sup>. They also receive all the distention to which they are subject at the start of the movement of lever A<sup>3</sup> and do not become greatly distended at any time. It will thus be seen that the springs A<sup>9</sup> are intended mainly to actuate the lever and cam during the latter part of their return movements and to hold them in their normal positions. The initial and also the main part of the return movements of the main lever and cam are caused by springs A<sup>10</sup>, Figs. 4 and 12, stationarily attached at A<sup>11</sup> at one end and with their moving ends secured to a cross-bar A<sup>12</sup>, seated at its ends in arms A<sup>13</sup>, secured upon a cross-shaft A<sup>14</sup>, said shaft being rocked with each stroke of the main lever, as will be understood from Figs. 3 and 6, by means of a crank-arm A<sup>14a</sup> and a connecting-bar A<sup>15</sup>, pivotally joined to the main cam at A<sup>16</sup> and to the crank A<sup>14a</sup>. The springs A<sup>9</sup> reinforce or supplement spring A<sup>10</sup> in the concluding part only of the return stroke of the main cam and lever; but by reason of the means employed to keep them out of action



until the stroke is nearly complete and to lessen the distention imparted to them the shock, noise, and vibration occasioned at the end of the stroke are much less than has been the case heretofore.

To avoid any possibility of actuating either the main lever or the answer-printing or totalizing plunger B before the other of them has completely finished its stroke, I provide suitable interlocking mechanism adapted to automatically hold each of them stationary after the commencement of a stroke by the other until the latter fully completes its stroke and returns to its normal position. This interlocking mechanism is preferably constructed as follows: In front of the machine is a rock-shaft B', having at one end a projecting arm B<sup>2</sup>, which has a lateral stud standing under the feather B<sup>3</sup> of the plunger, as seen at Fig. 2, so that when the latter is pushed down by the operator a rocking movement will be imparted to the shaft. At the other end the shaft carries a grooved cam B<sup>4</sup>, (best shown at Figs. 10 and 21 to 24,) having also a downwardly-projecting point B<sup>5</sup>. Adjacent to this cam is an elbow-lever B<sup>6</sup>, (also shown in said figures,) attached to the shaft B<sup>7</sup> and connected by a rod B<sup>8</sup> to a bell-crank lever B<sup>9</sup> (shown at Figs. 3, 5, and 6) and pivoted at B<sup>10</sup>, and also having a lateral stud B<sup>11</sup>, lying in the path of a latch B<sup>12</sup>, pivoted at B<sup>13</sup> to the cam and carrying a stop B<sup>14</sup>, entering an opening in the cam and acting to limit the movement of the latch upon its pivot in one direction. A spring B<sup>15</sup> draws the latch to its normal position. The elbow-lever B<sup>6</sup> has a laterally-projecting pin B<sup>16</sup>, which in one position of the lever enters the groove of the cam B<sup>4</sup> and in another position of the lever encounters the point B<sup>5</sup>.

With the construction above detailed the operation will be seen to be that when the main lever is depressed the latch B<sup>12</sup> encounters the stud B<sup>11</sup> and rocks the bell-crank B<sup>9</sup>, thereby imparting such movement to lever B<sup>6</sup> as will carry the pin B<sup>16</sup> from the position shown at Fig. 21 to that of Fig. 22 and in front of the cam projection B<sup>5</sup>, thereby locking the cam B<sup>4</sup>, so that its shaft cannot be rocked by the plunger B. This locking action is maintained until the main lever and cam have returned to their normal positions by employing devices to hold the lever B<sup>6</sup> in the position just described. These devices may consist of a catch-lever B<sup>17</sup>, (see Figs. 3, 5, and 6,) which is pivoted between its ends, as at B<sup>18</sup>, and which is rocked from its normal position, (given at Fig. 3,) in which it rides on the end of rod B<sup>8</sup>, by a spring B<sup>19</sup> to its locking engagement with the end of rod B<sup>8</sup> as soon as the latter has moved far enough toward the front of the machine to allow the catch to drop and present its shoulder B<sup>20</sup> to the end of the rod. The catch is shown as thus engaging the rod at Fig. 6; but the bell-crank B<sup>9</sup> is preferably moved a little beyond the extent necessary to bring about engagement between these

parts, as seen at Fig. 5. The main cam carries a pin B<sup>21</sup>, which soon after the cam begins to turn moves under the widened part B<sup>22</sup> of the catch and holds the catch positively in engagement with the rod during all the remainder of the downstroke of the main lever and during the major part of its return movement and until another pin B<sup>23</sup>, also carried by the main cam, comes against the rear end B<sup>24</sup> of the catch and forces the catch to release the rod. Upon the release in this manner of the rod the spring B<sup>25</sup>, acting upon the elbow-lever B<sup>6</sup>, returns that lever to the position shown at Fig. 21 and in so doing also carries lever B<sup>9</sup> back to its starting-point, so that the lock against movement by the plunger is now withdrawn and all the parts are ready for another operation. As the main cam returns to its normal position the latch B<sup>12</sup> yields sufficiently to permit it to pass the stud B<sup>11</sup> without imparting any movement to the stud or its carrying-lever B<sup>9</sup>, and this movement of the cam precedes in point of time the release of levers B<sup>6</sup> and B<sup>9</sup>.

The locking of the main lever during the operations of the answer-plunger is effected by the mechanism above described as follows: As already noted, the lever B<sup>6</sup> carries a laterally-projecting pin B<sup>16</sup>, which in addition to its engagement with the point B<sup>5</sup> of the cam B<sup>4</sup> is also adapted to enter the groove of said cam when the latter turns with shaft B'. After the pin has thus entered the groove of the cam it will be obvious that the lever B<sup>6</sup> cannot move, inasmuch as the impulses imparted to it by the main lever are calculated to carry the pin B<sup>16</sup> downward, and any such movement will now be prevented by the outer side of the cam-groove.

The interlocking mechanism described also assists in locking the answer-plunger during the operation of cancellation or setting the numeral-wheels at zero. For this purpose a hand-lever B<sup>26</sup>, (shown at Figs. 1, 10, and 24,) the hub B<sup>27</sup> whereof is journaled on B<sup>7</sup>, is provided, and projecting from this same hub is an arm B<sup>28</sup>, (shown at B<sup>24</sup>.) This arm has a laterally-projecting pin B<sup>29</sup>, which enters a slot B<sup>30</sup> in a disk B<sup>31</sup>, fast upon the end of the numeral-wheel shaft C. In its normal position (given at Figs. 1 and 21) this pin is in the slot and locks the numeral-wheel shaft against rotation. The arm B<sup>28</sup> laps over the lower limb of lever B<sup>6</sup>, bearing on it at B<sup>32</sup>, so that when the lever B<sup>26</sup> is actuated by the operator pulling the lower end of the lever toward the front of the machine, preparatory to a canceling operation, the lever B<sup>6</sup> will move with the arm B<sup>28</sup>, and thus carry the pin B<sup>29</sup> in front of the point B<sup>5</sup> of cam B<sup>4</sup> and cause the locking of the answer-plunger. The operator now retains the lever B<sup>26</sup> in the position to which it has just been moved for a limited time, and the movement described as given to the arm B<sup>28</sup> carries the pin B<sup>29</sup> out of the slot B<sup>30</sup>, so that the numeral-wheel shaft is released and free to be turned to any needed extent by



the knob B<sup>33</sup>, Fig. 1, which is attached to shaft C, and also has a pin located eccentrically so it may enter the opening B<sup>34</sup> in disk B<sup>31</sup>. After the cancellation is complete and upon the release of the lever B<sup>26</sup> the parts return to their normal positions under the power of spring B<sup>25</sup>. It will also be seen that the depression of the plunger B, rocking of shaft B', and moving of cam B<sup>4</sup>, so as to bring the groove of the latter over the pin B<sup>16</sup>, thus locking lever B<sup>6</sup> against movement, as before described, prevent also the operating of arm B<sup>28</sup>, carrying the pin B<sup>29</sup>, so that through said pin B<sup>29</sup> and its engagement with the slot B<sup>30</sup> the disk B<sup>31</sup> and shaft C are also locked against being turned by the knob B<sup>33</sup>. Were it not for the interlocking action of the pin B<sup>16</sup> and the cam B<sup>4</sup>, having the groove and point B<sup>5</sup>, a novice in the use of the machine might undertake to operate the plunger and main lever or the plunger and the canceling-knob simultaneously, and thus strain the vital parts of the machine.

The numeral-wheels are shown at C', Figs. 13 to 20. Each is provided on one side with equally-spaced pins or teeth C<sup>2</sup>, as shown at Figs. 13 to 16, with which a pivoted spring-catch C<sup>3</sup>, adapted to prevent backward rotation, engages. Said teeth are also engaged by the pawl C<sup>4</sup>, carried and actuated by the carrying-lever C<sup>5</sup>, pivoted at C<sup>6</sup> and receiving motion from a spring C<sup>7</sup>, Fig. 8. This lever is formed by bending a flat plate of metal into U form, as seen at Fig. 26, the bent-up vertical sides affording bearings for the pivot C<sup>6</sup> and also for the attachment of the pawl C<sup>4</sup>. I also form on one of these bent-up sides the stop projection C<sup>8</sup>, which moves into engagement with the pins C<sup>2</sup> when the carrying-lever actuates the wheel (see Figs. 15 and 16) and prevents overrotation. One point of the bent-up side of lever C<sup>5</sup> is also bent laterally, so as to form a stop C<sup>9</sup>, which engages the spring-latch C<sup>10</sup>. This latch by means of this engagement acts to hold the carrying-lever back from its operative position during the intervals between the carrying operations and until the cam C<sup>11</sup>, attached to the numeral-wheel, strikes the upper end of the catch and releases the lever, so it may yield to spring C<sup>7</sup>. The lever C<sup>5</sup> is forced back as hereinafter described. For each numeral-wheel there is also provided a brake-lever C<sup>12</sup>, pivoted on the same cross-shaft C<sup>10a</sup> as the latch C<sup>10</sup>. It bears against the inner surface of the rim C<sup>a</sup> of the wheel, and its normal position is indicated at Figs. 19 and 20. When the main hand-lever operates and causes the rocking of lever B<sup>6</sup>, the latter rocks also the angular shaft B<sup>7</sup>, upon the end of which said lever B<sup>6</sup> is supported, and this shaft is provided with a shoulder C<sup>13</sup> on its under surface, which engages the point C<sup>14</sup> upon the brake. In its normal position the shaft bears against the brake, as seen at said figures, and keeps the latter out of action; but when said shaft is rocked it moves away

from the brake and allows the latter to bear against the wheel in obedience to its spring C<sup>15</sup>, so that the brake is in operation to steady the wheel during the time the wheel is usually actuated by power from the main hand-lever.

In the canceling operation I also provide means for positioning all the carrying-levers at a uniform distance from and quite close to the numeral-wheels, so that they will have a very short distance to move before engaging the wheels and will actuate the latter in their proper successive order. I have been led to introduce this feature, because at the time of the canceling operations some of the levers are apt to be in their outermost positions (shown at Fig. 13) and others in intermediate positions—as, for instance, that shown at Fig. 15. When in the outer positions, they have a considerable distance to move before engaging the wheels, and such movement delays their action somewhat as compared to such carrying-levers as are in the intermediate position, so that they are liable to operate the wheels out of their proper order. This positioning of the levers is brought about as follows: When the operator moves lever B<sup>26</sup> preparatory to canceling, he moves it far enough at least to carry the arms C<sup>16</sup>, extending down from shaft B<sup>7</sup>, to a position intermediate of the positions given at Figs. 13 and 16, and which will allow all the carrying-levers when released to move up against said arms and into close proximity to their operative positions. This movement of the lever B<sup>26</sup> should also be sufficient to carry the pin B<sup>29</sup> out of slot B<sup>30</sup>, so that as soon as the operator turns the numeral-wheel shaft said pin will ride on the edge of the disk B<sup>31</sup>. The disk will now by its engagement with the pin and through the medium of the intervening mechanism control the arms C<sup>16</sup> and retain them in the intermediate position above described even if the operator should release lever B<sup>26</sup>. The latches C<sup>10</sup> of such of the carrying-levers as at the time may be back in their normal positions are now released, as follows: Upon the end of shaft C<sup>10a</sup> is an arm C<sup>17</sup>, adapted to rock the same. The free end of this arm rides upon the edge of a cam C<sup>18</sup>, carried by the disk B<sup>31</sup>, and is held to the same by a spring C<sup>19</sup>. The shaft C<sup>10a</sup> carries transverse pins C<sup>20</sup>, bearing upon the portion C<sup>21</sup> of the latches C<sup>10</sup> which extends in front of said shaft. The cam allows the arm to remain normal during about half its revolution and rocks the shaft shortly before the numeral-wheels are moved into the zero position, and such rocking causes the release of all the latches which are in action at the time, so that the carrying-levers of such latches may then swing up against the arms C<sup>16</sup> (which are now in the intermediate position described) and into advantageous positions for operation. At the conclusion of the cancellation the slot B<sup>30</sup> is presented to the pin B<sup>29</sup>, which under the power of spring B<sup>25</sup> is forced into the same, thereby allowing the rocking



of shaft B<sup>7</sup> sufficiently to carry the arms C<sup>16</sup> back to the position of Fig. 16 and permitting the carrying-levers to act. The carrying-lever after it has acted on the wheel will  
 5 be brought back to its normal position by the arm C<sup>16</sup> and shaft B<sup>7</sup> and into position to be again engaged by the latch C<sup>10</sup> at the next following rocking of said shaft.

The operating of the rock-shaft B<sup>7</sup>, by which  
 10 the carrying-levers are controlled in my present invention, is devolved upon the lever B<sup>9</sup> and latch B<sup>12</sup>, carried by the main cam and the catch-lever B<sup>17</sup>. I deem this mechanism much better for the purpose than that de-  
 15 scribed in my Patent No. 568,021 because it is much more easily adjusted and is less likely to get out of adjustment. It also insures a uniform quick action by the carrying-levers under all conditions, whereas in the patented  
 20 construction they would sometimes move slowly and sometimes quickly, depending upon the varying speed of the main lever in returning to its normal position.

The keys are shown at D, Fig. 9, and the  
 25 channel-bars of the vibrating frame, to which the keys are coupled by the latches D<sup>2</sup>, are shown at D'. The vibrating frame is supported on and actuated by cranks D<sup>3</sup> and D<sup>4</sup>, receiving motion from shaft A<sup>4</sup> and connected  
 30 together upon one side of the machine by cranks D<sup>5</sup> and bar D<sup>6</sup>. The shaft A<sup>4</sup> is rocked by power from the cam A', it having an arm D<sup>7</sup>, provided with a pin D<sup>8</sup>, working in the slot D<sup>9</sup> of the cam. The keys pass through  
 35 or in proximity to the segment-levers D<sup>10</sup>, which mesh with pinions D<sup>11</sup>, and thereby actuate the numeral-wheels and engage the same by means of the graduated shoulders D<sup>12</sup>, formed in the stems of the keys. The bars  
 40 and cross-wires of the frame for releasing the keys from the latches of the vibrating frame are shown at D<sup>13</sup> and D<sup>14</sup>, the arms upon which said frame moves horizontally in the perform-  
 45 ance of its releasing function at D<sup>15</sup> and D<sup>16</sup>, the shaft carrying said arms D<sup>15</sup> at D<sup>17</sup>, the retracting-spring at D<sup>18</sup>, the crank-arm rock-  
 50 ing said shaft D<sup>17</sup> at D<sup>20</sup>, the pin on said crank-arm at D<sup>21</sup>, the spring-latch which encounters said pin when the vibrating and releasing  
 55 frames move down at D<sup>22</sup>, and at D<sup>23</sup> the pin carried by the crank-arm D<sup>20</sup> and normally holding the latch out of operation, as at Fig. 5, the acting position of the latch being shown  
 60 at Fig. 6. In the latter position the latch serves as the frames move upward to detain the end of crank-arm D<sup>20</sup>, and thus causes the rocking of shaft D<sup>17</sup> and the horizontal releasing action by the releasing-frame. The construction shown of these parts does not differ  
 65 materially from that given in my Patent No. 568,021. One of the springs for lifting the vibrating frame is shown at D<sup>24</sup>.

With each numeral-wheel a stop-lever E (shown at Figs. 8 and 9 and also at Fig. 27) is  
 65 provided. They are pivoted at E', are normally held out of action by springs E<sup>2</sup>, and are attached to the vibrating frame by two or

more slotted bars E<sup>3</sup> and cross-rod E<sup>4</sup>. In Fig. 8 the lever shown is in its normal position, and in Fig. 9 it is shown as in action. In  
 70 my said patent the stop-levers were independent of each other and each was retracted solely by the power of its own spring; but I now unite them by means of the cross-rod E<sup>4</sup>,  
 75 which passes through all of them, and thus avoid any danger of any one sticking in its return action, because all the springs E<sup>2</sup> act  
 80 upon the united series of levers at the same time and unusual friction on any one would not hold a stop against the united action of  
 85 all the springs. The stop-levers E are operated when the plunger B is brought into use, one purpose of their employment being to hold the wheels stationary during the print-  
 90 ing of the answers, and they are depressed by power from the plunger as follows: The shaft B', already mentioned, extends across the machine and is angular in cross-section,  
 95 as seen at Fig. 8, and also arranged directly over the ends of the stop-levers. From its shape and location it is adapted when rocked by the answer-plunger to force the series  
 100 of stop-levers into action. The stop-levers are also thrown into action by the vibrating frame at the conclusion of the downward stroke of the frame, as will be under-  
 105 stood from Fig. 9, and they are thus enabled to hold the wheels stationary during the printing operations taking place with each stroke of the main lever. Of course they do  
 110 not assume control of the wheels until after the latter have been actuated by the segment and carrying levers. The shaft B' also carries a cam F at the plunger side of the ma-  
 115 chine, (see Fig. 2,) whose office it is to impart a slight longitudinal motion to a shaft F'. This shaft is identical in construction and function with the shaft K<sup>8</sup> of my said patent and needs no further description here. To  
 120 overcome the friction upon shafts B' and F', which may tend to obstruct their return to normal position, I find it desirable to provide the lever F<sup>2</sup>, which is depressed by the  
 125 plunger and is returned by spring-power, with an upward extension F<sup>3</sup>, setting close under the arm B<sup>2</sup> or its lateral stud. This extension carries the retracting power of the lever F<sup>2</sup> to the arm B<sup>2</sup> and insures a positive return of the shafts B' and F' to their starting  
 130 positions.

In the machine of my Patent No. 568,021 the return stroke of the main lever was attended with some noise, which while slight was nevertheless sometimes objectionable. I find much of this can be overcome by lim-  
 135 iting the return stroke of lever B<sup>9</sup> by means of a toggle G G', attached to said lever at one end and to a stationary point G<sup>2</sup> at the other end, the toggle being adapted to prevent actual contact between its stud B<sup>11</sup> and the  
 140 main cam at the end of the return stroke. The toggle is kept with its center joint below the dead-center by a lever G<sup>3</sup> and spring G<sup>4</sup>.

Each segment-lever carries a bar or lever



H, (shown at Fig. 7,) extending downwardly and rearwardly and pivotally united to the segment-lever. At its lower end it passes between guides H' H<sup>2</sup>. A shoulder H<sup>3</sup> on the under side of the bar engages with a stud H<sup>4</sup>, carried upon the lower end of an elbow-lever H<sup>5</sup>, pivoted at H<sup>6</sup>. The descent of the segment-lever causes a limited rocking of lever H<sup>5</sup>, (the engagement between the stud H<sup>4</sup> and lever H<sup>5</sup> being quickly broken,) which carries its upper end inward. The lever H<sup>5</sup> has an elbow-like projection H<sup>7</sup>, the upper point of which engages the cross-bar of a swinging frame H<sup>9</sup>, secured to a rock-shaft H<sup>10</sup>. The downward motion of frame H<sup>9</sup> carries its cross-bar into the inclined slot H<sup>12</sup> of the elbow projection, and this causes the upper extremity of the lever to bear against the pawl H<sup>13</sup> of the printing-hammer H<sup>14</sup> corresponding to the segment-lever. The movement of the frame H<sup>9</sup> is received from the main cam through the medium of a slotted lever H<sup>15</sup>, a pin H<sup>16</sup> working in the slot and attached to a crank H<sup>17</sup> upon the shaft H<sup>10</sup>. In order to hold the swinging frame H<sup>9</sup> stationary in its lower position until the proper time arrives for it to move up, and thus avoid the creation of undesirable friction between the bar H and its guides, such as might be caused if the lever H<sup>5</sup> began to move prematurely, I employ a detent H<sup>18</sup>, mounted upon a rock-shaft H<sup>19</sup> and held toward the swinging frame by a spring H<sup>20</sup>. The detent has a triangular projection H<sup>21</sup>, which sets over the frame H<sup>9</sup> when in its lower position and yieldingly holds the frame down; but its sloping side does not absolutely prevent the frame from rising at the proper time. The detent yields when the frame moves down, as will be readily understood. The slotted lever H<sup>15</sup> is adapted to act upon the crank H<sup>17</sup> at each end of its stroke. The lever H<sup>5</sup> returns to its starting position under the power of spring H<sup>22</sup>.

The segment-levers are each connected by bent rods J to pivoted type-heads J', which are presented in front of the hammers H<sup>14</sup>, the position of the type-heads being determined, as in my previous patent, by the extent of the depression given the segment-levers. The ink-ribbon X is controlled by the spools J<sup>2</sup> J<sup>3</sup> and guides J<sup>4</sup> and J<sup>5</sup> and moves horizontally past the printing-center, and the paper upon which the numbers added and the answers are recorded or printed moves vertically past said center, being fed by rolls J<sup>7</sup>, J<sup>8</sup>, and J<sup>9</sup> and guided by guides J<sup>10</sup> and J<sup>11</sup>.

The hammers are different from those of the patent, each being now made with the head H<sup>14a</sup> separate from the rest or main body of the hammer. My object in this feature is to soften the blow against the type and allow the hammer to drop back a little from the paper immediately after striking, the head being actuated by the spring H<sup>14b</sup> and being hinged to the same shaft A<sup>14</sup> which supports the body portion of the hammers and being also adapted to bear upon the body at H<sup>14c</sup>,

and thus to give the body the impulse or motion necessary to carry it against the type, but being itself arrested by a stop-rod H<sup>14d</sup>, extending transversely of the series of hammers, before the hammer reaches the paper.

The center paper-roll J<sup>7</sup> is adapted to be actuated by hand when necessary through the medium of the thumb device K, and it is also actuated automatically by means of the pawl K', pivoted upon the slotted lever A<sup>15</sup> and a ratchet-wheel K<sup>2</sup>, borne upon the journal of said roll. A spring K<sup>3</sup> tends to force the acting end of the pawl against the wheel at all times. This pawl at each movement of the main cam carries the wheel one notch in the direction required for feeding the paper, and it is adapted to feed in that direction only. It is released at the conclusion of each operation upon the wheel by the contact of the tooth next following the one last engaged with the under surface of the pawl. As shown, this under surface is rounded or curved, so that when the pawl is in its normal position (shown at Fig. 3) said under surface forms an arc substantially concentric with the ratchet, and consequently the ratchet-teeth can move along this under surface so long as the pawl is in that position without engaging the pawl and without affecting it in any respect except detaining it from fresh engagement. By this construction the ratchet is left free to be turned in either direction by the hand device K until the next actuation of lever A<sup>15</sup> occurs, when the position of the pawl will be changed, so that it will then engage the ratchet during the first part of the upward movement of the lever.

In order to insure perfect uniformity in the intermittent movements of the ratchet-wheel, as well as for the purpose of holding it and the roll stationary between movements and for preventing overrotation, I apply to the wheel a dolly-roll K<sup>4</sup>, supported in a swinging frame K<sup>5</sup> and impelled toward the ratchet-wheel by the spring K<sup>6</sup>. This roll is of such dimension as enables it to center itself in the spaces between the teeth of the wheel, and it bears against the wheel with such force as to insure a correct positioning of the wheel at the conclusion of each movement in case it has turned too far or not far enough. This dolly-roll does not prevent backward movements of the ratchet, as its large diameter enables it to ride readily out of the tooth-spaces.

The paper-guide J<sup>10</sup> is hinged, as shown at J<sup>12</sup>, and is swung by means of the spring-arms J<sup>13</sup>, hinged upon the shaft A<sup>14</sup>, against the paper at the proper time to clamp and hold the paper and insure the latter being in proper position to secure a good impression. The normal position of both the guide and the spring-arms is shown at Fig. 7, the arms being held out of action by the swinging bar J<sup>15</sup>, whose main function is the lifting of the hammers after printing. The bar J<sup>15</sup> is supported in arms A<sup>13</sup>, which are fast to shaft A<sup>14</sup>



and controlled by the springs  $A^{10}$  in one direction and in the other direction by the crank  $A^{14a}$  and connecting-bar  $A^{15}$  upon one side of the machine and by the lever  $F^4$ , joined to the plunger-lever  $F^2$ , and the crank  $F^5$  upon the other side of the machine, and the bar is moved out of the way of the hammer in all the printing operations before the latter are released by their pawls, and this allows the spring-arms just mentioned to act upon the paper seasonably in advance of the printing. The guide is moved back after each printing operation by a suitable spring  $J^{25}$ , Fig. 7.

In addition to the features above described the drawings show a number of other features, such as the double-pointed pawl  $L$ , acting on the serrated or toothed edge of the main cam and acting to prevent partial strokes of the main lever, the inverted-T-shaped lever  $M$ , corresponding in function to the lever  $E$  of my said patent and adapted when moved one way to release the keys and when moved to its limit in the other direction and locked to cause the repeating of the number represented by the set-keys, the pawl  $N$ , attached to lever  $A^{15}$ , and the ratchet  $N'$ , connected to the ink-ribbon spools and serving to actuate the latter through proper intervening mechanism;  $O$ , the springs for lifting the segment-levers;  $P$ , the springs for lifting the keys;  $Q$ , the stop for limiting the return stroke of the main lever and cam;  $R$ , the openings in the main cam, whereat the main lever is attached thereto;  $S$ , the adjustable frame whereby the tension of the hammer-springs is regulated,  $S'$ , the screw for effecting the adjustments thereof,  $T$ , the arms, and  $T'$  the springs for operating the segment-levers at the time of printing the answers; but none of these devices or mechanisms are independently new, but are fully described in my previous patent, and consequently I do not elaborate the description thereof.

While I have described the parts  $A^7$ ,  $B^{11}$ , and  $D^8$  as studs, it will be understood that for the avoidance of friction they are all surrounded by freely-revolving rolls and are what many machinists call "dolly-rolls."

I claim—

1. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, and a reinforcing-spring acting on the lever, during the concluding portion only of the strokes, substantially as specified.

2. In a printing and calculating machine, a hand-lever for actuating the calculating and printing mechanisms, in combination with said mechanisms, a spring for actuating the lever in its return strokes, and a reinforcing-spring acting on the lever during the concluding portion only of the strokes, substantially as specified.

3. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the le-

ver during the concluding portion only of the strokes, and means for holding said reinforcing-spring out of action during the initial part of the strokes, substantially as specified.

4. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever during the concluding portion only of the strokes, and means for limiting the distention of said reinforcing-spring, substantially as specified.

5. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever, during the concluding portion only of the strokes, and a lever  $A^3$  to which the reinforcing-spring is attached, and which serves to hold the same out of action during the initial part of the strokes, substantially as specified.

6. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever during the concluding portion only of the strokes, a pivoted lever  $A^3$  having an arm  $A^6$  controlling said reinforcing-spring, the cam  $A'$ , and pin  $A^7$ , substantially as specified.

7. The combination with the main lever and a lever  $B^6$  actuated thereby and having a pin  $B^{16}$ , of the answer-printing plunger, and the cam actuated by the plunger and engaging said pin, substantially as specified.

8. The combination with the main lever and a lever  $B^6$  actuated thereby and having a pin  $B^{16}$ , of the answer-printing plunger, and the cam  $B^4$  having a groove receiving said pin and a point  $B^5$  engaging the pin, substantially as specified.

9. The combination with the main lever and the answer-printing plunger, of the cam  $B^4$  constructed essentially as described and controlling the plunger, and a device engaging with said cam and controlling the main lever, substantially as specified.

10. The combination with the main lever and answer-printing plunger, of cam  $B^4$  controlling the plunger and lever  $B^6$  controlling the main lever, and means for locking the lever  $B^6$  in engagement with the cam, substantially as specified.

11. The combination with the main lever and answer-printing plunger, of cam  $B^4$  controlling the plunger and lever  $B^6$  controlling the main lever, and catch-lever  $B^{17}$  for locking the lever  $B^6$  in engagement with the cam, substantially as specified.

12. The combination with the main lever and answer-printing plunger, of cam  $B^4$  controlling the plunger and lever  $B^6$  controlling the main lever, and a device for locking the lever  $B^6$  in engagement with the cam, such device being released at the end of the return stroke of the main lever, substantially as specified.



13. The combination with the main lever and answer-printing plunger, of cam B<sup>4</sup> controlling the plunger and lever B<sup>6</sup> controlling the main lever, and a device for locking the lever B<sup>6</sup> in engagement with the cam, such device being released by the power actuating the main lever in its return stroke, substantially as specified.

14. The combination with the main lever and answer-printing plunger, of cam B<sup>4</sup> controlling the plunger, and lever B<sup>6</sup> controlling the lever; and the spring catch-lever B<sup>17</sup> for locking lever B<sup>6</sup> and released by the main cam, substantially as specified.

15. The combination with the answer-printing mechanism and means for setting the numeral-wheels, of a device for controlling said mechanism, a device engaging said controlling device, and means for holding said last-mentioned device in engagement with said controlling device during the setting operation, substantially as specified.

16. The combination with the answer-printing mechanism and means for setting the numeral-wheels, of the cam B<sup>4</sup> controlling said mechanism, the lever B<sup>6</sup> engaging with said cam, and means for holding said lever in engagement with the cam during the setting operation consisting of the arm B<sup>28</sup> controlling said lever B<sup>6</sup>, the pin B<sup>29</sup> and slotted disk B<sup>31</sup> on the numeral-wheel shaft, substantially as specified.

17. The combination with the numeral-wheel shaft and means for actuating the latter, of the slotted disk B<sup>31</sup>, the hand-lever B<sup>26</sup> having arm B<sup>28</sup> and pin B<sup>29</sup>, the latter normally in the slot of the disk and adapted to be moved out of the slot and to ride on the edge of the disk during cancellation, substantially as specified.

18. The combination with the normally-locked numeral-wheel shaft, the answer-printing mechanism and means for locking the latter during the operation of the former, of means for releasing the lock upon the shaft, and means for actuating the shaft, substantially as specified.

19. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, the bent-up sides forming bearings and one of them also forming the stop projection C<sup>8</sup>, substantially as specified.

20. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the stop projection C<sup>8</sup> formed upon one of the bent-up sides, substantially as specified.

21. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the latch-stop C<sup>9</sup> formed upon one of the bent-up sides, substantially as specified.

22. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the stop projection C<sup>8</sup> and latch-stop C<sup>9</sup> formed upon its bent-up sides, substantially as specified.

23. The combination with the numeral-wheels of spring brake-levers bearing against

the inner surface of the wheel-rims, the angular rocking shaft serving to hold the levers normally out of action, and means for rocking said shaft at proper times so as to release the levers, substantially as specified.

24. The combination with the numeral-wheels of spring brake-levers, bearing against the inner surface of the wheel-rims, the angular rocking shaft acting normally to hold the levers out of action, means for rocking said shaft, and means for retaining the shaft in the releasing position, substantially as specified.

25. In a calculating-machine, the combination with the carrying levers and their detaining-latches, of the rock-shaft acting to release said latches, the cam C<sup>18</sup> upon the numeral-wheel shaft, and the arm C<sup>17</sup> attached to the rock-shaft and riding on said cam, substantially as specified.

26. The combination with the numeral-wheels and means for actuating them in cancelling, of the carrying-levers, the latches controlling the carrying-levers, the rock-shaft for releasing the latches, the cam C<sup>18</sup> on the numeral-wheel shaft, and the arm C<sup>17</sup> attached to the rock-shaft and riding on said cam, substantially as specified.

27. The combination with the carrying-levers of the rock-shaft B<sup>7</sup>, the arms carried by said shaft and controlling the positions of the levers, and means for operating said shaft, substantially as specified.

28. The combination with the answer-printing plunger and the lever F<sup>2</sup>, having an upward extension F<sup>3</sup>, of the shaft B<sup>1</sup> having arm B<sup>2</sup> receiving impulses in both directions from the plunger and lever, substantially as specified.

29. The combination with the shafts B<sup>1</sup> and F<sup>1</sup>, of the answer-printing plunger, the arm B<sup>2</sup>, cam F and lever F<sup>2</sup>, having extension F<sup>3</sup>, substantially as specified.

30. The combination with the numeral-wheels, of stop-levers E, one for each wheel, springs for lifting said levers, and a cross-rod E<sup>4</sup> tying the levers together, substantially as specified.

31. The combination with the main cam, and lever B<sup>9</sup>, of the toggle for controlling said lever and preventing noisy contact with the main cam, substantially as specified.

32. The combination with the main cam, of the lever B<sup>9</sup> returned to its normal position by spring-power, and the toggle for limiting the return movement of said lever, substantially as specified.

33. The combination with the main cam, of the lever B<sup>9</sup> returned to its normal position by spring-power, the toggle for limiting the return movement of said lever, and a spring G acting to keep said toggle in acting position, substantially as specified.

34. The combination with the swinging frame H<sup>9</sup>, the lever H<sup>5</sup>, and the devices actuating said lever, of a spring-detent acting on said frame, substantially as specified.



35. The combination with the swinging frame H<sup>9</sup>, the lever H<sup>5</sup> controlled by said frame, the lever H receiving motion from the segment-lever, and giving motion to lever H<sup>5</sup>, and the guides between which said lever H moves, of the detent H<sup>18</sup>, substantially as specified.

36. The combination with the levers H<sup>5</sup>, and the swinging frame H<sup>9</sup>, of a detent acting to prevent premature movement of said levers, such detent having a triangular projection which adapts it to yield and allow the frame to move at proper times, substantially as specified.

37. The calculating-machine, having type and hammers for impressing the paper against the type, said hammers having hinged heads made separate from the bodies, actuating-springs attached to the heads, and means for arresting the heads before the hammers can make the impressions, substantially as specified.

38. In a machine for printing numbers, the combination with the type, of swinging hammers having their heads made separate from their bodies, springs attached to the heads and through them actuating the bodies, and means for arresting the heads before the making of the impressions, substantially as specified.

39. In a machine for printing numbers, the combination with the type, of swinging hammers composed of hinged heads and hinged bodies, the actuating-springs being attached to the heads and the heads adapted to actuate the bodies, and means for arresting the heads before the completion of the stroke, substantially as specified.

40. In a machine for printing numbers, a printing-hammer made in two parts and hinged together, one part receiving the actuating power and imparting it to the other, and being itself arrested before the making of the impression, substantially as specified.

41. In a machine for printing numbers, a

printing-hammer consisting of a head and a body made separate and hinged upon the same shaft, the head bearing upon the body and receiving the power for making the impression and imparting it to the body, and means for arresting the head, substantially as specified.

42. The combination with the paper-roll and its ratchet, of a pawl for actuating the ratchet, said pawl being shaped to ride idly on the ratchet when in its normal position and to engage when moved from its normal position, substantially as specified.

43. The combination with the paper-roll and its ratchet, of a pawl for actuating said ratchet, and a movable support for the pawl, the pawl engaging the ratchet when the support moves from its normal position, and at other times riding idly thereon, substantially as specified.

44. The combination with the carrying-levers and the rock-shaft for controlling them, of means for rocking said shaft consisting of a lever connected to the shaft, a latch operating said lever, and an oscillating device carrying the latch, substantially as specified.

45. The combination with the carrying-levers and the rock-shaft for controlling them, of means for rocking said shaft consisting of a lever connected to the shaft, a latch operating said lever, the cam carrying the latch, and means for temporarily locking lever B<sup>9</sup> in the position to which it is moved by said stud, substantially as specified.

46. The combination with the carrying-levers and rock-shaft controlling the same, of mechanism for rocking said shaft, and means for holding the shaft in the position to which it is moved by the rocking mechanism, substantially as specified.

DORR E. FELT.

Witnesses:

EDW. S. EVARTS,  
LEWIS E. CURTIS.