

05.5-059



UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS.

RECORDING COMPUTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 465,255, dated December 15, 1891.
Application filed November 11, 1890. Serial No. 871,108. (No model.)

Diskrete Mathematik
Universität Bonn

P-615

To all whom it may concern:

Be it known that I, DORR E. FELT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Recording Computing-Machines, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a top or plan view omitting the parts which carry the paper-roll. Fig. 2 is a side elevation, the case being in section. Fig. 3 is a side elevation of the opposite side from that shown in Fig. 2, the case being in section. Fig. 4 is a front elevation, the case being removed. Fig. 5 is a rear elevation, the case being removed. Fig. 6 is a longitudinal section on line 6 6 of Figs. 1, 4, and 5. Fig. 7 is a longitudinal section on line 7 7 of Figs. 1, 4, and 5. Fig. 8 is a longitudinal section on line 8 8 of Figs. 1, 4, and 5. Fig. 9 is a detail, being a section through the paper-roll. Fig. 10 is an enlarged detail, being a front elevation of one numeral-wheel and part of another and the coacting parts between them, showing also the lever 44. Fig. 11 is a section on line 11 11 of Fig. 10. Fig. 12 is a section on line 12 12 of Fig. 10. Fig. 13 is an enlarged detail showing one face of a numeral-wheel. Fig. 14 is an enlarged detail showing the opposite face of a numeral-wheel. Fig. 15 is an enlarged detail showing one face of an actuating-disk. Fig. 16 is an enlarged detail, being a section through a numeral-wheel on line 16 16 of Fig. 13. Fig. 17 is an enlarged detail, being a perspective view of a portion of the device for recording the answer or result of the numbers computed. Fig. 18 is an enlarged detail, being a side elevation of the actuating-bar of the device for returning the numeral-wheels to zero. Fig. 19 is an enlarged detail, being an elevation of the parts shown and a portion of the device for returning the numeral-wheels to zero. Fig. 20 is a view similar to Fig. 18, showing the parts in another position. Fig. 21 is an under side view of the part of the machine shown. Fig. 22 is an enlarged detail view showing the devices which I introduce and their connection with the parts 89, 91, and 86, which constitute all the additional mechanism necessary to cause

the machine to automatically print the zeros. Fig. 23 is a detail showing a portion of the device for moving the ink-ribbon. Fig. 24 is a detail showing a modified form of the devices for resetting the carrying-levers, the parts being in the position which they will occupy after a carrying operation. Fig. 25 is a detail, being an elevation of a portion of the outside of the frame, showing the necessary change in the arrangement of the link 39 to accomplish the change in motion required by the change of construction, as shown in Fig. 24. Fig. 26 is a view similar to Figs. 11 and 24, showing the parts shown in the position they will occupy just prior to the releasing of the carrying-arms.

This invention relates, chiefly, to recording-machines which compute, and the novel features are designed especially as improvements upon recording-machines; but some of these improvements may be used in computing or adding machines.

The leading object of my invention is to provide an improved recording-machine, which will record the answer or result indicated by the numeral-wheels by pressing a knob instead of striking the amount of the answer on the keys.

Another object of my invention is to provide an improved device for returning the numeral-wheels to zero.

Another object of my invention is to record automatically the zeros of the number to the right of the digit which is being recorded.

Another object of my invention is to derive the power to effect the carrying of the tens from the movement of the lever which advances the paper, and thus cause the keys to be depressed with less expenditure of force.

Another object of my invention is to prevent the carrying of tens from any column to the next higher whenever a subtraction is made by means of adding a complementary number, as hereinafter explained.

Further objects will be hereinafter set forth in a description of the device.

I accomplish these various objects and the objects hereinafter set forth, as illustrated in the drawings and as hereinafter described.

Those things which I claim as new will be pointed out in the claims.

Similar figures of reference refer to similar parts throughout the several views of the drawings.

1 indicates the case of the machine, which is made in suitable form and of suitable material to contain the devices, hereinafter described.

2 indicates the frame of the machine, which is made in suitable form to support the various parts, hereinafter set forth.

3 indicates a shaft, upon which a series of numeral-wheels 4 is loosely mounted. Each numeral-wheel 4 is provided on one side with a ratchet-wheel 5, as best shown in Figs. 10, 11, 12, 14, and 16. Each ratchet-wheel 5 is secured to its numeral-wheel 4 by ten pins 6, as shown in Figs. 14 and 16, and each ratchet-wheel 5 is provided with ten teeth.

7 indicates a series of actuating-disks, one for each numeral-wheel 4, mounted upon the shaft 3. Each actuating-disk has secured thereto a spur-pinion 8, as best shown in Figs. 4, 8, 10, 12, and 16. Each actuating-disk 7 is provided with an actuating-pawl 9, adapted to engage with the ratchet-wheel 5 on its numeral-wheel 4. Each pawl 9 is held in contact with its ratchet-wheel by a spring 10.

11 indicates a series of actuating-levers, one for each numeral-wheel 4. Each lever 11 is pivoted at its rear end upon a shaft 12, and at its forward end is provided with a rack 13, as best shown in Fig. 8, adapted to engage with its corresponding spur-pinion 8.

14 indicates several series of keys, as best shown in Figs. 1, 6, and 8, a series for each lever 11. Each series consists of nine keys bearing numerals from one to nine, inclusive, and in addition to the number thus placed upon each key there is also placed upon it another in smaller type, which is equal to the difference between such first-mentioned number and nine. Each key 14 is provided with a return-spring 15, as shown in Fig. 8.

16 indicates a series of stop-levers, one for each actuating-lever 11. Each key 14 of a lever 11 is adapted to engage with the corresponding stop-lever 16 near the end of its downward stroke. Each stop-lever 16 is pivoted near its rear end upon a shaft 17, and at its forward end is connected by a link 18 with a stop-pawl 19, as best shown in Fig. 6. Each stop-pawl 19 is adapted to enter between the pins 6 of its numeral-wheel and stop its numeral-wheel at the end of the stroke of the actuated key 14, and consequently stop its actuating-lever 11. These features are shown and described in Patent No. 441,232, issued to me November 25, 1890, and their construction and operation need not be further described.

20 indicates a series of detaining-pawls, one for each numeral-wheel 4. Each detaining-pawl 20 is provided with a spring 21, adapted and arranged to keep the pawl in engagement with the pins 6 of the numeral-

wheel 4 and prevent backward rotation of said numeral-wheel.

The carrying of the tens from the numeral-wheel of one order to the numeral-wheel of the next higher order is effected by improved mechanism, which I will now describe.

As best shown in Figs. 10, 6, and 11, 28 indicates a series of levers, one for each numeral-wheel 4, except that the numeral-wheel of the highest order need not be provided with one. Each lever is pivoted upon a shaft 23, and each lever is provided with a pawl 27, which is normally pressed to engage the pins 6 of the next higher wheel 4 by a spring 29. Each lever 28 is normally pressed toward its numeral-wheel by a spring 31, as best shown in Figs. 6 and 8.

32 indicates a series of detents, as best shown in Fig. 11, one for each lever 28. Each detent 32 is mounted upon a shaft 33 at one end, and at its other end is adapted to be engaged by a pin 34 (see Fig. 13) on its corresponding numeral-wheel 4. Each detent 32 is provided with a catch 35, as best shown in Fig. 8, adapted to engage with a catch 30 on its corresponding lever 28. The engagement of the catch 35 with the catch 30 holds the lever 28 back against the pressure of the spring 31 until the catch 30 is released, when the spring 31 will cause the lever to move toward the numeral-wheel and the pawl 27 to move its corresponding numeral-wheel one space.

36 indicates a series of links, as best shown in Figs. 6, 8, 11, and 12, one attached to each lever 28. Each link 36 is attached to a rock-shaft 37. The rock-shaft 37 is mounted in suitable bearings in the frame 2 and is provided at its outer end with an arm 38. (See Fig. 2.) The arm 38 is connected by a link 39 with a lever 40, which lever moves the paper and returns the recording-hammers, as hereinafter set forth. The lever 40 is mounted upon a pivot 41, as best shown in Fig. 2, secured in the frame 2, and is provided with a hand-piece 42, by which it can be readily depressed. The lever 40 is provided with a return-spring 43, which is preferably arranged as shown in Fig. 2.

22 indicates a series of stops, one for each numeral-wheel 4. Each stop 22 is provided with a spring 24, adapted and arranged to cause such stop to enter between the pins 6 of its corresponding numeral-wheel 4 to prevent overrotation of said numeral-wheel under the impulse of the carrying-pawls. Each stop 22 is mounted upon the shaft 23, as best shown in Fig. 12, and is provided with a pin 25, adapted to engage with the periphery of its corresponding actuating-disk 7, as shown in Figs. 10 and 12. The periphery of each disk 7 is provided with a notch 26, adapted to receive the pin 25 when the actuating-disk is in its normal position. The periphery of each disk 7 by its engagement with its corresponding pin 25 keeps its stop 22 from locking en-

gagement with its numeral-wheel, except when the pin is in the notch 26, at which time the pawl is permitted to engage with the numeral-wheel, as heretofore set forth.

The operation of the stop 22 is fully shown in Patent No. 371,496, issued to me October 11, 1887.

Each lever 28 is provided with a pin 47, which is adapted to enter an elongated opening 48 in the corresponding stop 22, as best shown in Fig. 12. When the levers 28 are drawn backward, the pins 47 withdraw the stops 22 out of engagement with the pins 6 of the numeral-wheels; but when the levers 28 are released for the purpose of carrying, the stops 22 move into engagement with the numeral-wheels and prevent overrotation.

To prevent the stops 22 from engaging with the numeral-wheels before the numeral-wheels have been rotated far enough to allow the pins 6 to pass the stops 22, each stop 22 is provided with a pawl 49, (see Fig. 12,) which is provided with a point 50, adapted to engage with the shaft 33, and thereby prevent the engagement of the stop 22 with its corresponding numeral-wheel until after the carrying-pawl 27 has moved the numeral-wheel a part of the distance through which it is to be rotated. One end of the spring 24 engages with the pawl 49 and holds it in a normal position. The action of the pawl 49 and spring 24, together with stop 22, is shown and described in my former patent, No. 371,496, dated October 11, 1887.

The lever 40 is to be depressed after the recording of each number for the purpose of shifting the paper, moving the ink-ribbon, and returning the recording-hammers, as herein-after set forth. On each depression of the lever 40, as best shown in Figs. 2, 7, 11, and 12, the levers 28 are drawn backward by means of the links 36, rock-shaft 37, arm 38, and link 39, and said levers 28 are held back against their springs 31 by the engagement with their catches 30 of the catches 35 of the detents 32. The levers 28 and their carrying-pawls 27 are thus held back against the spring until the catch 35 is disengaged from the catch 30, when the lever 28 and its carrying-pawl 27 is driven forward by the impulse of the spring 31, thereby causing the carrying-pawl to move the numeral-wheel of the next higher order one space, thus effecting the carrying of the tens.

As it is necessary to carry the tens from each numeral-wheel to the next higher numeral-wheel but once on recording each number and as the lever 40 is operated after the recording of each number, the carrying levers and pawls will be reset after the recording of each number.

On computing-machines heretofore in common use the operation of subtraction has been accomplished by adding the complement of the subtrahend to the minuend. In practice this is accomplished as follows, and in this explanation I use the word "digit" as meaning any

one of the figures 1 to 9, inclusive, and as not including zero: It will be observed that there are two numbers on each key 14. (See Fig. 1.) The large one represents the power or numeral value of each key, and the small one represents its complement less one. When it is desired to subtract one number from another by means of my improved machine, the operator strikes the minuend on the keys with reference to the large numbers, as in adding, and he then strikes the subtrahend on the keys with reference to the small figures, except that he strikes one less for the extreme right-hand or units digit, and that he omits to strike the 9's of such subtrahend and strikes all of the ciphers to the left of the right-hand digit of the subtrahend, and he strikes as many ciphers to the left of the left-hand digit as the number of places or figures in the minuend exceeds the number of places or figures in the subtrahend. The answer or remainder will be expressed on the numeral-wheels of those orders on which the operation has been performed, and the next higher numeral-wheel will indicate one, which is to be disregarded in reading the answer.

The operation of subtraction is performed in like manner on my present machine; but in my former machine the 1 carried to the next higher numeral-wheel to the left of the highest numeral-wheel of the subtrahend was removed by adding a 9 to said numeral-wheel and to all other numeral-wheels at the left of it. To save the carrying of the 1 above mentioned and afterward adding the 9's, as above described, I provide the following device:

44 indicates a series of levers, (see Figs. 1 and 4,) one for each carrying-pawl 27. Each lever is mounted upon a stud 45, as shown in Fig. 11, and is provided with a finger-piece, which extends upward to within convenient reach of the operator, as shown in Figs. 1, 4, 7, 10, and 11. Each lever 44 is provided with an arm 46, adapted to engage with the under side of its carrying-pawl 27, as best shown in Figs. 10 and 11, and hold said carrying-pawl from engagement with its numeral-wheel. When the operator makes a subtraction, the lever 44 at the left of the highest column or series of keys in which a key is struck in the subtrahend is pushed backward, which raises the carrying-pawl 27, which carries from said highest series or column of keys to the next column at the left. By this construction and operation the carrying-pawl is held out of operation, so that the complementary number is added and the tens of the highest series are not carried, thereby making a proper subtraction. When the levers 44 are in their normal position, they do not interfere with the operation of the carrying-pawls 27. The shaft 3 is provided with a series of pins or projections 56, one for each numeral-wheel 4, as best shown in Fig. 13. Each numeral-wheel 4 is provided with a pawl 57, located in its face, as shown in Figs. 13 and 16. Each pawl is provided with a spring 58 to press it

outward and a stop 59 to limit its outward movement. Each pawl 57 is arranged and adapted to be engaged by the pin or projection 56 on the shaft 3 when the shaft is rotated in the direction indicated by the arrow in Fig. 13. The arrangement and operation of these parts is fully described in Patent No. 371,496, issued to me October 11, 1887. When the numeral-wheel 4 is rotated forward, as in computing, the spring 58 permits the pawl 57 to pass the pin 56. The shaft 3 is provided with a spur-pinion 60, which is preferably located upon the outer end of said shaft, as shown in Fig. 3.

61 indicates a lever pivoted at its rear end upon a pivot 62, as best shown in Fig. 3. At its forward end the lever 61 is provided with a rack 63, which meshes with the pinion 60.

64 indicates an actuating-bar for the lever 61. This actuating-bar is mounted and can move longitudinally in a vertical bearing 65, as best shown in Figs. 18, 19, and 20. The actuating-bar 64 may be provided with an eye, as shown in Fig. 3, or as shown in Figs. 18 and 19. This bar 64 is connected with the lever 61 by a spring 66, which is attached to the eye in the lower portion of the bar 64 and acts to return the bar 64 to normal position. The bar 64 is provided with a shoulder 67, which is adapted to engage with the edge of or a flange on the lever 61 and depress said lever. When the bar 64 is in its normal position, (shown in Fig. 18,) the shoulder 67 will be elevated a distance above the edge of the lever 61, for purposes which will hereinafter appear. When the lever 61 is moved downward to its lower limit by the bar 64, the rack 63 will rotate the pinion 60 and shaft 3. The rotation of the shaft 3 will, as best shown in Fig. 13, by the engagement of its pins 56 with the spring-pawls 57, rotate the numeral-wheels 4 forwardly. The arrangement of the pins 56 upon the shaft 3 and of the rack 63 in relation to the pinion 60 is such that when the lever 61 and rack 63 reach their lowest position they will have rotated the numeral-wheels into the position which will reveal the zeros at the sight-opening.

In order to automatically move the stops 22 out of engagement with the numeral-wheels to permit said numeral-wheels to be reset to zero, I provide the following device:

68 indicates an engaging plate, which is secured to the bar 64. This plate 68 is provided with an inclined shoulder 69 on its lower edge, as best shown in Fig. 18.

70 indicates a push-rod, which, as best shown in Fig. 7, is at one end loosely connected with an arm 71 on a rock-shaft 72, and at its other end is adapted to engage with the incline 69 of the plate 68, as best shown in Figs. 18 and 19. This rock-shaft 72, as best shown in Figs. 7, 11, and 12, is adapted to engage with a series of projections 73, one upon each stop 22. When the bar 64 is depressed, the push-rod 70 will be moved by its engagement with the incline 69 sufficiently to throw

the stops 22 out of engagement with the numeral-wheels by the engagement of the rock-shaft 72 with their projections 73. This operation takes place prior to the engagement of the shoulder 67 with the lever 61, so that the stops 22 are out of engagement with the numeral-wheels before any of the numeral-wheels begin to be rotated by the shaft 3, as hereinbefore set forth.

The plate 68 is provided with a vertical edge 74 and an inclined face 75, as shown in Fig. 19. When the bar 64 and plate 68 pass downward, as best shown in Figs. 7, 18, and 20, causing the incline 69 to pass beyond the end of the push-rod 70, the engaging end of the rod 70 will engage with the vertical edge 74 of the plate 68, and at about the time the numeral-wheels have been rotated to bring the figure 6 at the sight-opening the end of the rod 70 will arrive at the inclined face 75 of the plate 68 and slip therefrom, which will allow the rod to be drawn backward by a spring 80, which will rock the shaft 72 from engagement with the projections 73 and leave the stops 22 free to engage the numeral-wheels at the proper time. The stops will be held back by the carrying-levers 28, the hook 50 engaging with the shaft 33 until the units numeral wheel, which is about one-fortieth of a rotation in advance of the other numeral-wheels 4, arrives at ten, when the carrying-levers 28 will be released in succession, thereby releasing the stops 22 to stop all the numeral-wheels at zero. The push-rod 70 can spring sidewise sufficiently to allow its engaging end to be passed by the plate 68, as such plate moves up, when the bar 64 returns to its normal position, and the attachment of the spring 80 is such, as shown in Fig. 19, that it will act to bring the end of the rod 70 back under the shoulder 69 of the plate 68, as shown in Figs. 3 and 19, when the bar 64 is returned to its normal position.

81 indicates a series of recording-disks or type-heads, as best shown in Figs. 1 and 8, one for each actuating-lever 11. Each recording-disk or type-head is provided with numerals 0 to 9, both inclusive. Each recording-disk or type-head 81 is mounted upon a shaft 82, and each recording-disk or type-head is connected with its proper actuating-lever by a link 83, which is attached at its upper end to an arm 84 upon the proper type-head, as fully described in Patents No. 441,232, issued to me November 25, 1890, and No. 405,024, issued to me June 11, 1889. Each link is provided with set-nuts 85, as shown in Figs. 1 and 8, by which the position of the recording-disk 81 in relation to the actuating-lever 11 can be adjusted properly, and I so adjust them that when each actuating-lever 11 is in its normal position its corresponding disk will be held in position to print a zero, as and for the purposes hereinafter set forth.

As best shown in Fig. 8, 86 indicates a series of arms secured to or made integral with the rear ends of the series of stop-levers 16;

and serving to release the pawls 89 from locking engagement with the hammers 87, when the levers 16 are depressed, as hereinafter more fully described.

5 87 indicates a series of hammers, one for each recording-disk 81.

88 indicates a series of springs, one for each hammer 87. Each spring 88 acts to throw the hammers against the recording-disks 81 for the purpose of making the record, as herein-
10 after set forth and as fully described in Patent No. 441,233, issued to me November 25, 1890.

89 indicates a series of retaining-pawls, as best shown in Fig. 8, one for each hammer 87.
15 Each hammer 87 is provided with a notch 90, adapted to receive one end of its corresponding pawl 89. The lower end of each pawl 89 is adapted to be engaged by an adjustable projection or screw 91, secured in the upper
20 end of a corresponding arm 86.

92 indicates a series of springs, one for each pawl 89, which act to normally hold the pawls in engagement with the notches 90 in the hammers.

25 As best shown in Fig. 8, when an actuating-lever 11 is depressed by a key 14 its recording-disk 81 is brought into such position that the figure corresponding to the figure on the key struck is raised and held in such a position that it will be struck by the striking-face
30 of the hammer when the hammer is released. At the end of the stroke of the key it depresses the corresponding stop-lever 16, as heretofore set forth, which causes the arm 86, through its projection 91, to release the corre-
35 sponding pawl 89 from engagement with the notch 90 in the corresponding hammer 87. This releases the hammer 87, which is thrown forward by its spring 88, making a record of
40 the figure. After each operation the hammer remains down until it is returned, as hereinafter set forth.

In using my computing-machine the operator writes the figures successively, beginning
45 at the right. When there are zeros or ciphers in the number, such zeros or ciphers have no corresponding key in the several series of keys 14. Each recording-disk has a cipher or zero, which is normally held at the printing-
50 point, as hereinbefore set forth. In order to print these ciphers, I provide each pawl 89 with a pin 93, as best shown in Fig. 22 and in section in Fig. 8, which is adapted to be engaged by a projection or flange 94 on a pawl
55 89, which belongs to the series of the next higher order. All hammers which have not been released at the right of a pawl 89, which releases a hammer in making a record, will be released, thereby printing or recording a
60 cipher in each order in which a figure has not already been printed. For instance, a person wishing to record 5,000 will depress the key 14, having the number 5 thereon in the thousands series—that is, the fourth series, count-
65 ing from the right. The actuation of this key will cause the record to be made as heretofore described, and by the engagement of the flange

94 on the pawl 89 of the thousands series with the pin 93 of the hundreds series (see Fig. 22) the hammer of the hundreds series will be re-
70 leased and record a zero, and the hammers of the tens and units series will in like manner be released and record a zero. The hammers of all the series to the left will be unactuated, because the pin 93 will simply move away
75 from the flange of the pawl at the left.

95 indicates a link, which is connected at one end with the lever 40, as best shown in Fig. 2, and at its other end with an arm 96 on a rock-shaft 97. The rock-shaft 97 is pro-
80 vided with an arm or extension 98, (best shown in Fig. 4,) which is adapted to engage with the hammers 87 and throw said hammers back into position to engage the pawls 89 with the notches 90. By each actuation of
85 the lever 40 the rock-shaft 97 is rocked and the hammers 87 are thrown back in the position shown in Fig. 8 by the engagement of the extension or arm 98 therewith and locked in such position by the pawls 89. This places
90 the hammers in position in readiness for recording a second number. As shown, the hammers 87 are loosely mounted upon the shaft 97.

99 indicates a ratchet-wheel which is mount-
95 ed upon one end of the paper-roller 100. (Best shown in Fig. 5.) The link 95 is provided with a pawl 101, which is held in engagement with the ratchet-wheel 99 by means of a spring 102, as best shown in Fig. 2. Each
100 actuation of the lever 40 causes the pawl 101 to move the ratchet-wheel the space of one tooth.

103 indicates a roll of paper, which is mounted upon a screw-threaded shaft 104,
105 as shown in Figs. 8 and 9. The shaft 104 is provided with two screw-threaded followers 105, which are internally screw-threaded and adapted to be secured in the end of the roll of paper 103, and thereby secure said roll
110 of paper upon said shaft 104. The shaft 104 may be inserted longitudinally in a bearing 106 at one end, as shown in Fig. 9, and its other end may be inserted in a bearing 106, which is provided with a slot to permit such
115 insertion and with a spring-catch 107 to prevent its accidental removal.

108 indicates an arm which is adapted to engage with the roll of paper 103, and is mounted upon a rock-shaft 109, which is pro-
120 vided with a spring 110, as shown in Figs. 8 and 9. The arm 108 may be adjusted upon the shaft 109 by means of a set-screw 111. The paper of the roll 103, as shown in Fig. 8, passes over a pulley 112, thence downward
125 and around the roller 100, thence upward and back of an ink-ribbon 135, which lies between the paper and the type-heads on the recording-disk 81. As shown in Fig. 8, the paper 103 passes between the series of hammers 87
130 and the recording-disks 81. If desired, a rubber platen 114 may be interposed between the paper 103 and the hammers 87.

115 indicates a roller which is adapted to

engage with the paper 103^a on one side of the roller 100.

116 indicates a roller which is adapted to engage with the paper on the opposite side of the roller 100, as best seen in Fig. 8 and as best shown in Fig. 2. Each roller 115 116 is mounted upon arms 117, which are drawn together to bring the rollers 115 116 against the paper on the roller 100 by means of a spring 118.

52 indicates a pawl (best shown in Fig. 2) which is provided with a spring 119, adapted to hold the pawl in engagement with the ratchet-wheel 99 and prevent the backward rotation of the ratchet-wheel 99 and the roller 100.

As best shown in Figs. 3 and 5, 120 indicates a spur-wheel upon one end of the shaft of the roller 100, which is engaged by pinions 121 upon the shafts of the rollers 115 116. The engagement of the pinions 121 with the spur-wheel 120 insures the rollers 115 and 116 rotating in unison with the roller 100.

122 indicates a shaft which is supported on arms 126. (Best shown in Figs. 8 and 23.) This shaft at its outer end, as shown in Fig. 2, is provided with a ratchet-wheel 123.

124 indicates a pawl (best shown in Fig. 2) which is pivotally mounted upon the lever 40, and is held in engagement with the ratchet-wheel 123 by a spring 125. Each actuation of the lever 40 causes the pawl 124 to rotate the ratchet-wheel 123 and its shaft 122 the space of one ratchet-tooth. The shaft 122 is mounted in bearings upon arms 126, which are secured to a rock-shaft 127. (See Fig. 8.) To one of the arms 126 is pivotally secured a handle 128. This handle 128 projects through an opening 129 in the frame 2, and is provided with notches 130, adapted to engage with the edge of the opening 129. A spring 131 acts to hold one of the notches 130 in engagement with the edge of the opening 129. By means of the handle 128 the shaft 122 can be raised or lowered, as necessary, for the purposes hereinafter set forth.

Upon the shaft 122 are mounted two beveled pinions 132, as shown in Fig. 23, located so that each may mesh with its corresponding bevel-wheel 133, as hereinafter described.

133 indicates two beveled wheels, one for each pinion 132. Each beveled wheel 133 is secured upon a vertical shaft 134, and each shaft 134 projects upwardly through the frame 2 and is provided with an ink-ribbon spool 135. One beveled wheel 133 is arranged to engage with the lower side of its beveled pinion 132, and the other beveled wheel 133 is arranged to engage with the upper side of its beveled pinion 132. When the shaft 122 is depressed by means of the handle 128, the beveled wheel 133, which engages with the lower side of its pinion 132, will be driven, and when the shaft 122 is raised by means of the handle 128 the beveled wheel 133, which engages with the upper side of its pinion 132, will be driven, thereby driving one or other of the

vertical shafts 134 and rotating its ink-ribbon spool 135.

As best shown in Fig. 8, 136 indicates two guides for the ink-ribbon, which guides bring the ribbon in proper position in front of the recording-disks 81.

137 indicates a rocking frame which is provided with a rod 138, as best shown in Figs. 4 and 8. The platen 114 is carried by this frame. The frame 137 is provided with a spring 139, (best shown in Fig. 7,) which holds the frame in the position shown in Figs. 7 and 8. This frame holds the paper in proper printing position. By means of a handle 140 the lower portion of the frame 137 may be rocked backwardly for the purpose of inserting the paper between the rollers.

141 indicates a number of paper-guides 85 (best shown in Figs. 4 and 5) for assisting in inserting the paper between the roller 115 and the roller 100, as fully shown in Patent No. 441,233.

Beneath the rollers 100, 115, and 116 is a paper-guide 142, (best shown in Fig. 6,) which will guide the paper between the roller 116 and the roller 100 when the paper is first inserted.

The bearings 106 of the shaft 104 are supported in a portion 143 of the case 1, which portion is hinged to the main portion 1 or a hinge 144, as best shown in Figs. 7 and 8. When the hinged portion 143 is in the position shown in Fig. 8, the parts are in position for computing and recording. By turning the hinged portion 143 down into the position shown in Fig. 7 a large number of the parts which are exposed in operation are covered.

I have hereinbefore described a complete device for recording the numbers used in computing with my machine, and I will now describe a device by which the result or sums of the computation may be recorded automatically.

145 indicates an actuating-bar for the result-recording device. (Best shown in Figs. 4 and 17.) This actuating-bar 145 is provided with a hand-piece 146. The actuating-bar in the construction shown, which is the best construction and arrangement known to me, is supported in a vertical bearing 147 near the front portion of the machine (best shown in Figs. 1 and 4) and in convenient reach of the operator.

148 indicates a shaft which is supported in horizontal bearings above the numeral-wheels 4. This shaft is movable longitudinally in its bearings. At its outer end it is provided with a notch 149. (Best shown in Fig. 17.)

150 indicates a cam-disk which is mounted upon a rock-shaft 151, mounted in the frame 2, as best shown in Fig. 3, and, as shown in Figs. 4 and 17, is adapted to enter the notch 149 and move the shaft 148 longitudinally, as shown in Fig. 17. This disk 150 is provided with a pin or projection 152, which is adapted to be engaged by a plate 153, secured to the actuating-bar 145. As shown in Fig. 17, when

this actuating-bar 145 is in its normal position a shoulder 154 of the plate 153 engages with the pin 152. When the actuating-bar is depressed, the shoulder 154 will cause the cam-disk 150 to be rotated by the engagement of said shoulder 154 with the pin 152, and the cam-disk 150 will cause the shaft 148 to be moved longitudinally by the engagement of the cam-disk 150 with said shaft 148 in the notch 149, as best shown in Figs. 4 and 17.

The shaft 148 is provided with a series of plates 155, one for each actuating-disk 7. Each plate 155 (see Fig. 17) is provided with a circular hole 156, slightly larger than the disk 7, the edge of which hole is adapted to engage the rear point 157 of the actuating-pawl 9 of the corresponding actuating-disk 7 when the disk and pawl are rotated. Normally each plate 155 occupies such a position that the point 157 will not be engaged with it; but when the shaft 148 is moved longitudinally each plate 155 is moved over its corresponding actuating-disk 7, and the point 157 of the pawl carried by each actuating-disk 7 will engage the plate 155, and the ratchet-engaging point of the pawl will thereby be held from engagement with its ratchet-wheel 5 when the actuating-disks 7 are rotated, as hereinafter set forth. The downward descent of the actuating-bar 145 and its attached plate 153 depressing the pin 152 rotates the cam-disk 150 sufficiently to move the shaft 148 longitudinally to bring the plates 155 into position to engage with the points 157 of the actuating-pawls 9 and throw such pawls out of engagement with the ratchets 5 when the actuating-disks 7 are rotated, and simultaneously the pin 152 rotates from beneath the end 154 of the plate 153 and slides along the edge 158 of said plate 153, thus retaining all the parts in position to hold the pawls 9 out of engagement with the ratchets 5 until the bar 145 has been depressed a full stroke to print the answer, as hereinafter described. When the bar 145 is released, the parts return to their normal position, as shown in Fig. 17.

The rock-shaft 151, upon which the cam-disk 150 is rigidly mounted, is located above the stop-pawls 19, and when rocked about its center 151^a by the engagement of the shoulder 154 with the pin 152 it engages with all of the stop-pawls 19 (see Fig. 6) and causes such stop-pawls to enter between the pins 6 of their respective numeral-wheels, and thereby lock the several numeral-wheels at the commencement of the stroke of the actuating-bar 145.

The lever 151^b (best shown in Fig. 7) is pivoted on a shaft 151^c, the ends of which are suitably supported in the sides of the frame, and such lever is so placed that its movable end extends under and against the rock-shaft 151 when in its normal position. There is pivotally attached to the lever 151^b near its movable end a push-rod 180, which at its lower end is provided with a slot adapted to receive a pin 181 in the end of the arm 71 on

the rock-shaft 72. The rocking of the rock-shaft 151 about its center 151^a depresses the end of the lever 151^b, and with it the push-rod 180, which depresses the pin 181 and the end of the arm 71 and rocks the shaft 72, and, as best shown in Figs. 6 and 12, the rocking of the shaft 72 by the engagement of the shaft 72 with the points 73 of the detents 22 lifts the detents 22 out of locking engagement with the pins 6 of the numeral-wheels 4, as previously described. The pin 181 passes through a slot in the rod 180, so that the rod 180 will not interfere with the operation of the arm 71 and rock-shaft 72 when operated by the push-rod 70, as hereinbefore set forth.

159 indicates a lever (see Fig. 8) which at its forward end is adapted and arranged to be engaged by the lower end of the actuating-bar 145. The rear end of the lever 159 is secured upon a rock-shaft 160. The rock-shaft 160 is supported in suitable bearings in the lower rear portion of the frame 2. This rock-shaft 160 is provided with a series of arms 161, (best shown in Fig. 8,) one for each actuating-lever 11.

162 indicates a series of hooks, one for each arm 161 and actuating-lever 11. Each actuating-lever 11 is provided with a pin 163, (see Fig. 8,) over which its corresponding hook 162 is hooked. The lower end of each hook 162 passes through and slides in a boss 164 upon its arm 161, and is provided with a shoulder 165, adapted to rest upon the boss 164. Each hook 162 is provided with a spring 166, which is attached at its upper end to the upper portion of the hook and at its lower end to its corresponding arm 161, as shown in Fig. 8. The depression of the lever 159 causes the arms 161 of the rock-shaft 160 to be depressed. The springs 166 will draw the hooks 162 downward, which will cause the actuating-levers 11 to be drawn downward. The racks 13 of the actuating-levers 11 will cause the spur-pinions 8 to be rotated, which will rotate the actuating-disks 7. The actuating-disks 7 on their inner faces are each provided with a pawl 167, (best shown in Fig. 15,) which is pressed outwardly by a spring 168. The adjoining face of each ratchet-wheel 5 is provided with a groove 169, having a shoulder 170, as best shown in Fig. 14. When the actuating-levers 11 are depressed by means of the springs 166, the racks 13 will rotate their pinions 8 until the pawl 167 of each actuating-disk 7 engages with the shoulder 170. The engagement of a pawl 167 with its corresponding shoulder 170 will prevent further rotation of its pinion 8, and consequently the further depression of the actuating-lever 11. The arrangement is such that the pawl 167 will engage with the shoulder 170 at the time when the actuating-lever 11 has been depressed sufficiently to bring the same number upon the corresponding recording-disk 81 to the point of printing, which is shown on the numeral-wheel 4. The further descent of the arms 161 will not move the

actuating-levers 11 downward farther, as they are locked by the pawls 167 engaging the shoulders 170 on the ratchet of the numeral-wheels, which are locked by the pawl 19, as hereinbefore described; but the springs 166 will stretch.

171 indicates a link (best shown in Figs. 6 and 8) which is attached at its lower end to one of the arms 161. At its upper end the link 171 is provided with a slot 172.

173 indicates a swinging frame, which is pivotally mounted upon a shaft 171^a, supported in the frame 2, and is adapted to engage with all of the pawls 89. The frame is provided with a pin 174, (best shown in Fig. 6,) which passes through the slot 172 in the link 171. The link 171 is provided with an adjusting-screw 175, for purposes hereinafter set forth. When the arms 161 are rocked downward, the link 171 will be drawn downward. At the end of the downward stroke of the lever 159, Fig. 3, at which time when all of the recording-disks will have been moved into printing position, as above described, the adjustable screw 175 (see Fig. 6) will engage with the pin 174, and by swinging the frame 173 on its pivot 171^a cause it to engage with the rear portion of the pawls 89, thereby causing the pawls to be moved sufficiently to release the hammers 87. The hammers, when released, will strike the recording-disks and record the totals or result indicated upon the numeral-wheels 4. By the construction just described one device throws the actuating-pawls 9 out of operation. Another arrangement of devices moves the stop-pawls 19 into engagement with the numeral-wheels and locks them in the position they then occupy. Another device draws the actuating-levers downward until they are stopped at the number indicated by the numeral-wheels 4, at which time, of course, the recording-disks are moved into the position to record the numbers shown by their respective numeral-wheels. At or near the completion of the downward stroke of the lever 159 and its actuating-bar 145 the recording-hammers are all released by means of the link 171 and the frame 173, thereby recording the result, as before set forth. When the actuating-bar 145 returns to normal position, the hooks 162 will be raised by the arms 161 through the engagement of the shoulders 165 with the bosses 164, and when in normal position by the engagement of the shoulder 165 with the boss 164 the hooks 162 will be lifted from the pins 163, so that the springs 166 will not interfere with the ordinary operations of my machine, as best shown in Fig. 8.

During the operation of recording the result or the total, which is indicated by the numeral-wheels, the numeral-wheels are held stationary by the stop-pawls 19, as hereinbefore described, and when the parts are returned to their normal position the result or

number indicated by the numeral-wheels as a total will be unchanged.

To avoid having the engagement of the pawls 167 with the shoulders 170 interfere with the correct rotation and stopping of the numeral-wheels 4 when actuated by the keys 14, it is found necessary to set the pawl 167 so that it will nearly but not quite engage with the shoulder 170 when the pawl 9 is in engagement with the ratchet with which it engages when the zero is at the sight-opening.

When the printing of a number is effected by the depression of the keys 14, the position of the recording-disks 81 is determined by the limit to which the lever 11 is pushed downward, and the downward motion of the lever 11 is limited by the engagement of the pawl 9 with the ratchet on its numeral-wheel, (when the numeral-wheel is positively stopped in its rotation by the pawl 19,) and as the position of the recording-disks when the printing of the answer is effected by the depression of the bar 145 is determined by the limit of the downward stroke of the lever 11, which is in this case limited by the engagement of the pawl 167 with the shoulder 170, and as the engagement of the pawl 167 with the shoulder 170 (for any particular number) takes place a little later than the engagement of the pawl 9 would take place with the ratchet on the numeral-wheel for the same number, it will be evident that the levers 11 will be allowed to descend a little lower, and the recording-disks 81 will stand a little higher when the printing of the answer is effected by the depression of the bar 145 than is the case when the printing of each figure is effected by the depression of the keys. To insure the hammers striking squarely on the proper numbers on the recording-disks it is necessary that some compensation be made for this difference in position of the recording-disks. I accomplish this result as follows: By means of the lock-nuts 85 (best shown in Fig. 8) the recording-disks 81 are so adjusted that the hammers 87, as they are released by the depression of the keys, will strike squarely upon the proper numbers on the recording-disks, when the push-rod 145 and lever 159 are in their normal position; but when the printing of the answer is effected by means of the push-rod 145 and lever 159 the hammers are raised to a proper alignment with the changed position of the recording-disks by the following means: I accomplish this result as follows: The shaft 97, upon which the hammers 87 are mounted, is mounted in a portion 176 of the frame 2, (see Figs. 4 and 6,) which is hinged at its rear end to the main portion of the frame 2 by a pivot 176^a. (Best shown in Figs. 3 and 7.) A link 177 is pivotally attached at its lower end to the lever 159 on a pivot 178, as best shown in Fig. 3. At its upper end the link 177 is attached to the portion 176 of the frame by a

pivot 179. When the lever 159 is depressed, the link 177 will cause the portion 176, which carries the hammers, to be raised sufficiently to cause the hammers to strike the recording-disks 81 at the proper point and record the total in proper alignment. By depressing the lever 40 the paper is automatically moved up for the purpose of making a second record by the devices before described, and the hammers 87 are at the same time automatically set for a second operation by devices already described, and the carrying-levers 28 are also automatically set by devices already described. This lever 40 is to be depressed after each record of an entire number made by the keys 14 and after each record of the results shown by the numeral-wheels by the operation of the actuating-bar 145 and the parts operated thereby.

It will be observed in the devices employed for recording the sums or totals that before any of the recording parts are put into operation the numeral-wheels are locked in a stationary position by the stop-pawls 19, and that the numeral-wheels are held in their locked position until after the recording devices return to their normal position. It will also be observed that the recording devices record the amounts indicated by the numeral-wheels, because the recording-disks are permitted to move up to the point which brings the figure on each recording-disk which corresponds to the figure which appears at the sight-opening of its numeral-wheel (in its locked position) in line to be struck by its corresponding hammer.

From the foregoing it results that the numeral-wheels are not moved, and that after the recording devices are returned to normal position after recording the number indicated by the numeral-wheel the numeral-wheels indicate the original sum. This permits the operator to continue his work, adding other numbers to this sum. It also permits him to subtract numbers from this sum and to perform various operations which are necessary to the convenient application of my improved computing-machine to many commercial uses and which need not here be fully set forth.

In Figs. 24, 25, and 26 I have shown a modified form of the carrying devices. The only change from the form previously described is in the employment of an arm 23^a on the lower portion of each of the carrying-levers 28, which arm is adapted to be engaged by the rock-shaft 37 for moving the carrying-levers 28 back into their restrained position. The arms 28^a and the links 39 each form means for retracting the levers 28 by the rock-shaft 37.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with a series of numeral-wheels and actuating mechanism therefor, of a series of separate carrying devices, each provided with an actuating-spring 31, detaining mechanism for said carrying devices, a device for releasing said carrying devices, and mechanism for retracting said carrying devices

against their actuating-springs, whereby the carrying is effected by power not derived from the actuating mechanism, substantially as and for the purpose specified.

2. The combination, with a series of numeral-wheels and actuating mechanism therefor, of a series of carrying-levers 28, carrying-pawls 75 carried by said levers, actuating-springs 31, detaining-pawls 32, and pins 34, carried by the numeral-wheels, substantially as and for the purpose specified.

3. The combination, with numeral-wheels, 80 actuating mechanism for said numeral-wheels, and recording devices operated from said numeral-wheel-actuating mechanism, of a series of separate carrying devices, each provided with an actuating-spring, devices for detaining 85 said carrying devices, devices for resetting the recording mechanism for a second operation, and devices for retracting and setting said carrying devices automatically and simultaneously with the resetting recording 90 devices, substantially as and for the purpose specified.

4. The combination, with numeral-wheels and actuating mechanism therefor, of carrying-pawls 27, carrying-levers 28, having 95 catches 30, actuating-springs 31, detaining-pawls 32, pins 34, carried by the numeral-wheels and adapted to engage said detaining-pawls 32, and devices for retracting said carrying-levers 28, substantially as and for the 100 purpose specified.

5. The combination, with numeral-wheels 4 and actuating mechanism therefor, of carrying-pawls 27, levers 28, having catches 30, detaining-pawls 32, adapted to engage said 105 catches, pins 34, carried by said numeral-wheels, rock-shaft 37, means for retracting said levers 28 by said rock-shaft, arm 38 on said rock-shaft, link 39, and lever 40, substantially as and for the purpose specified. 110

6. The combination, with numeral-wheels and actuating mechanism therefor, of spring-actuated carrying-levers, devices for detaining said carrying-levers, and devices for releasing said carrying-levers to carry the tens, 115 substantially as and for the purpose specified.

7. The combination, with numeral-wheels, actuating devices therefor, carrying-pawls, and devices for actuating said carrying-pawls to carry the tens, of a device for preventing 120 the operation of the carrying-pawls, whereby the operation of subtraction is accomplished, substantially as specified.

8. The combination, with numeral-wheels 4, actuating mechanism therefor, and carrying-pawls 27, of levers 44, having arms 46, substantially as and for the purpose specified. 125

9. The combination, with a shaft 3, having pins 56, numeral-wheels loosely mounted on said shaft 3, and pawls 57 on said numeral- 130 wheels, of devices for rotating said shaft, stops for said numeral-wheels, and devices for automatically throwing said stops out of engagement, operated from the devices rotating

said shaft, substantially as and for the purpose specified.

10. The combination, with a shaft 3, having pins 56, pinion 60, lever 61, having rack 63, and actuating-bar 64, of stops for said numeral-wheels, shaft 72, adapted to engage with said stops, and devices for rocking said shaft from the actuating-bar 64, substantially as and for the purpose specified.

11. The combination, with numeral-wheels 4, carrying-pawls, and actuating mechanism, of movable stops which prevent overrotation of all the numeral-wheels and mechanism which automatically moves the stops from engagement with all the numeral-wheels and resets the latter, substantially as described.

12. The combination, with numeral-wheels 4, having pawls 57, shaft 3, having pins 56, and locking-pawls for the numeral-wheels, of a pinion 60 on said shaft 3, lever 61, having rack 63, actuating-bar 64, having plate 68, shaft 72, and push-rod 70, adapted to engage with said plate 68, substantially as and for the purpose specified.

13. The combination, with numeral-wheels, of an actuating-bar 64, devices for resetting said numeral-wheels to zero, operated by said bar 64, stops and devices for throwing said stops out of engagement, operated by a rod 70, a plate 68 on said bar 60, having a shoulder 69, a straight edge 74, and an inclined portion 79, and a spring 80, substantially as and for the purpose specified.

14. The combination, with recording devices and actuating mechanism therefor, of hammers 87, springs 88 for said hammers, detaining devices for said hammers, separate devices for releasing each hammer from the actuating mechanism, of its recording-disk, and devices for releasing all hammers to the right of the one released, whereby the zeros are recorded automatically, substantially as and for the purpose specified.

15. The combination, with recording-disks 81 and actuating mechanism therefor, of hammers 87 and pawls 89, having flanges 94, and pins 93, substantially as and for the purpose specified.

16. The combination, with a computing device consisting of a series of numeral-wheels and operating mechanism and a recording mechanism adapted to be operated simultaneously with said computing mechanism, of devices for locking said numeral-wheels in the position which they occupy at the end of a computation, and devices for operating said recording mechanism controlled by said locked numeral-wheels to record the result indicated by the numeral-wheels in their locked position, substantially as specified.

17. The combination, with numeral-wheels, of devices for locking said numeral-wheels and recording mechanism for recording the answer or result indicated by said numeral-

wheels in their locked position, substantially as specified.

18. The combination, with computing devices and recording devices operating therewith, of actuating-levers 11, devices for throwing the computing devices out of operation and locking the numeral-wheels of the computing devices, and devices for operating the levers 11 and causing the recording devices to be thereby operated and record the amount indicated by the numeral-wheels of the computing devices, substantially as and for the purpose specified.

19. The combination, with numeral-wheels 4, actuating-disks 7, and pawls 9, of devices for throwing said actuating-pawls out of operation with the ratchet of the numeral-wheels, so as to allow the disks to rotate to their proper positions when the answer is being printed, substantially as and for the purpose specified.

20. The combination, with numeral-wheels 4, disks 7, and pawls 9, of shaft 148, plates 155, having holes 156, adapted to receive the pawls 9, and devices for moving said shaft and plates longitudinally, substantially as and for the purposes specified.

21. The combination, with numeral-wheels 4, disks 7, and levers 11, of stop-pawls 19 for said numeral-wheels, grooves 169 in said numeral-wheels having shoulders 170, and spring-pawls 167 on said disks 7, whereby said disks are permitted to be rotated in recording totals to the points to which said numeral-wheels have been rotated in computing, substantially as and for the purpose specified.

22. The combination, with levers 11, having pins 163, of a lever 159, rock-shaft 160, arms 161, hooks 162, and springs 166, substantially as and for the purpose specified.

23. The combination, with the levers 11, having pins 163, of a lever 159, rock-shaft 160, having arms 161, said arms being provided with bosses 164, hooks 162, having shoulders 165, and springs 166, substantially as and for the purpose specified.

24. The combination, with recording-disks 81, hammers 87 therefor, springs 88, devices for retaining said hammers, and actuating-levers 11 for said recording-disks, of levers 159, devices for depressing the actuating-levers from said levers 159, frame 173, and link 171, substantially as and for the purpose specified.

25. The combination, with a frame 2 and recording-disks 81, of hammers 87, a shaft 97, portion 176 of the frame hinged to the main portion of the frame 2, link 177, and lever 159, substantially as and for the purpose specified.

DORR E. FELT.

Witnesses:

HARRY T. JONES,
JOHN L. JACKSON.

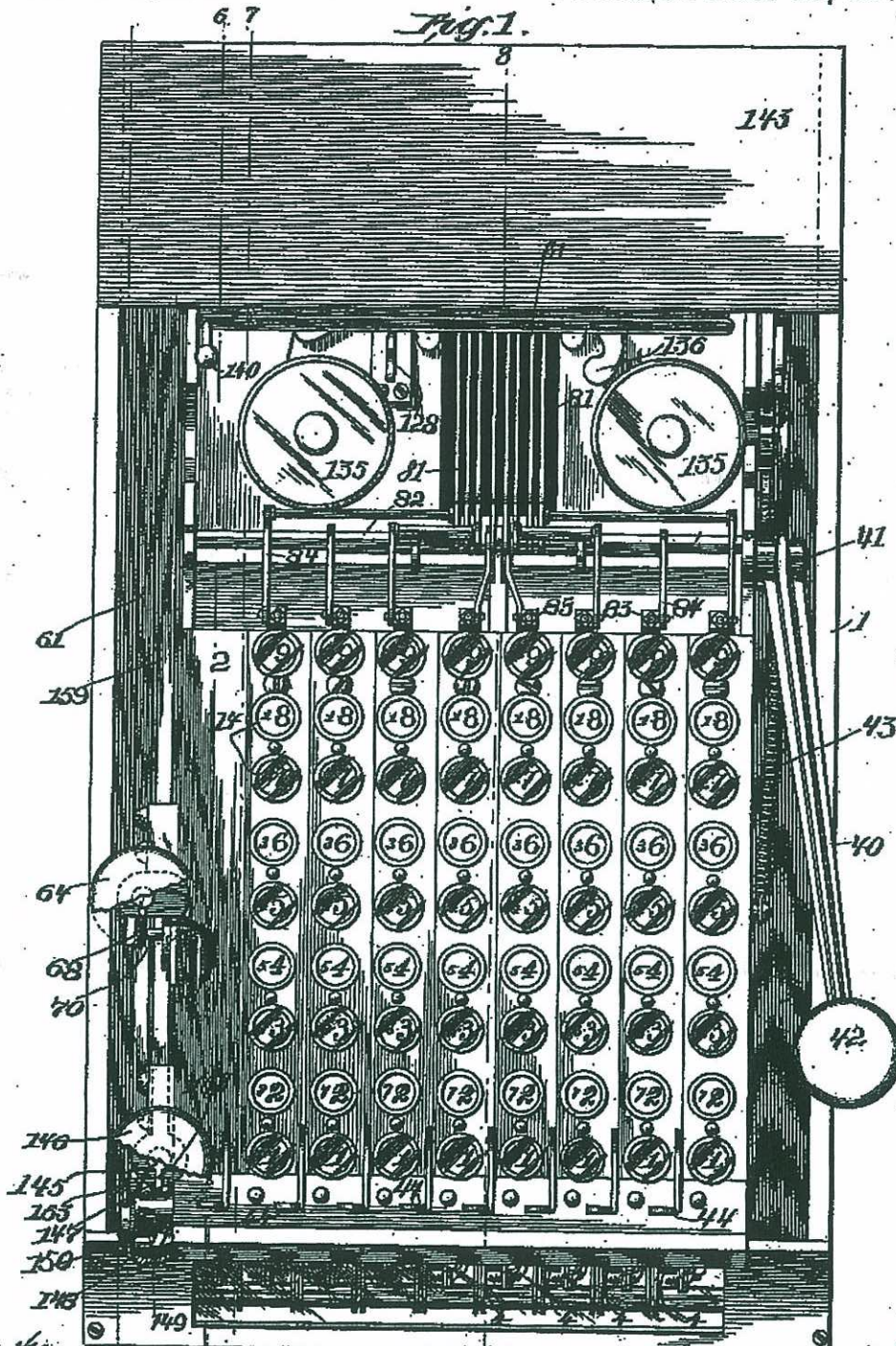
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12 Sheets—Sheet 1.

D. E. FELT.
RECORDING COMPUTING MACHINE.

No. 465,255.

Patented Dec. 15, 1891.



Witnesses:
John L. Jackson.
Frank C. Blanchard.

Inventor:
D. E. Felt
by Bond, Adams & Jones
Attys.

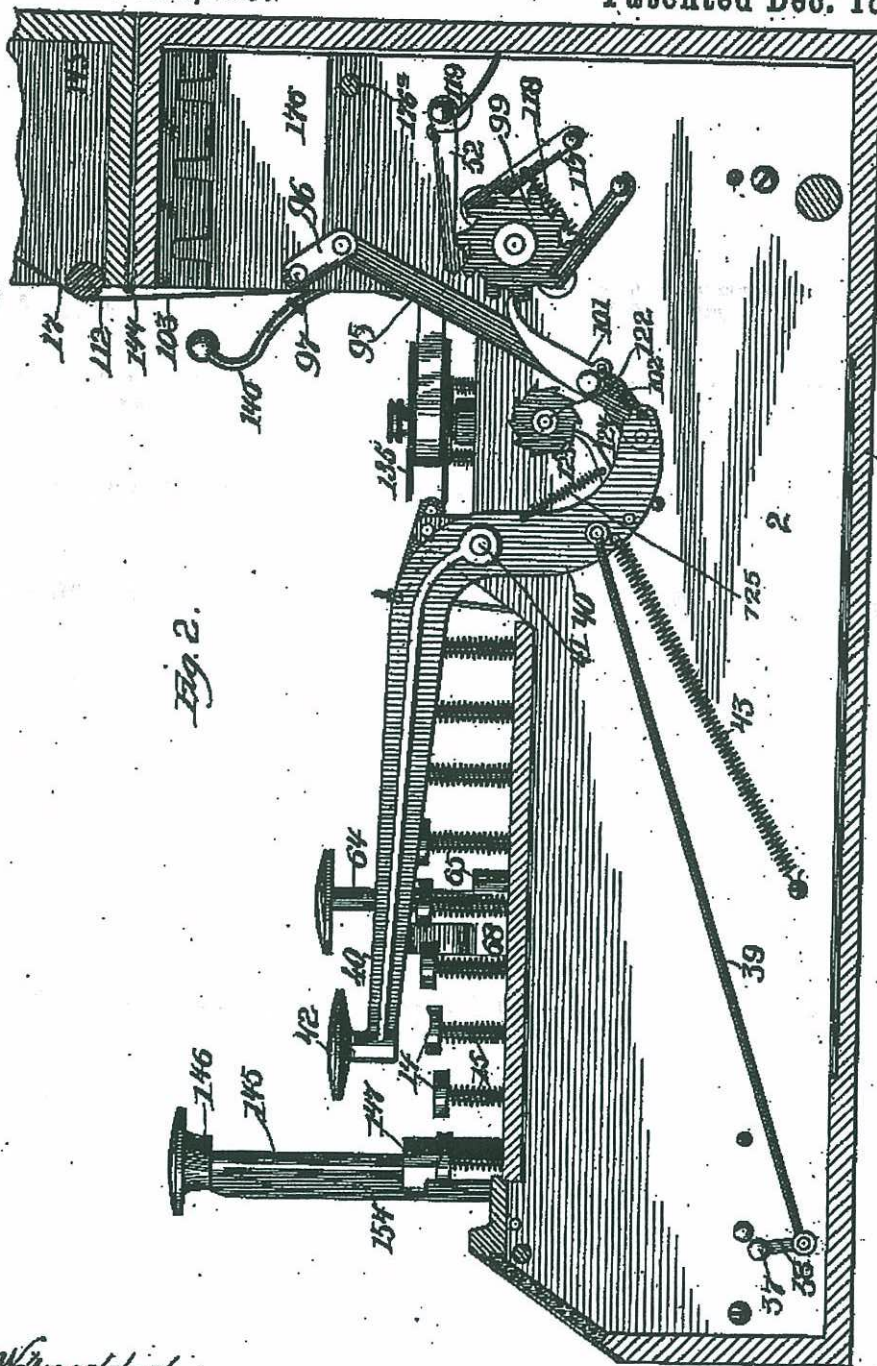
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12 Sheets—Sheet 2.

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Frank E. Blanchard

Inventor:
Dorr E. Felt
by Bond, Adams & Jones
Attys.

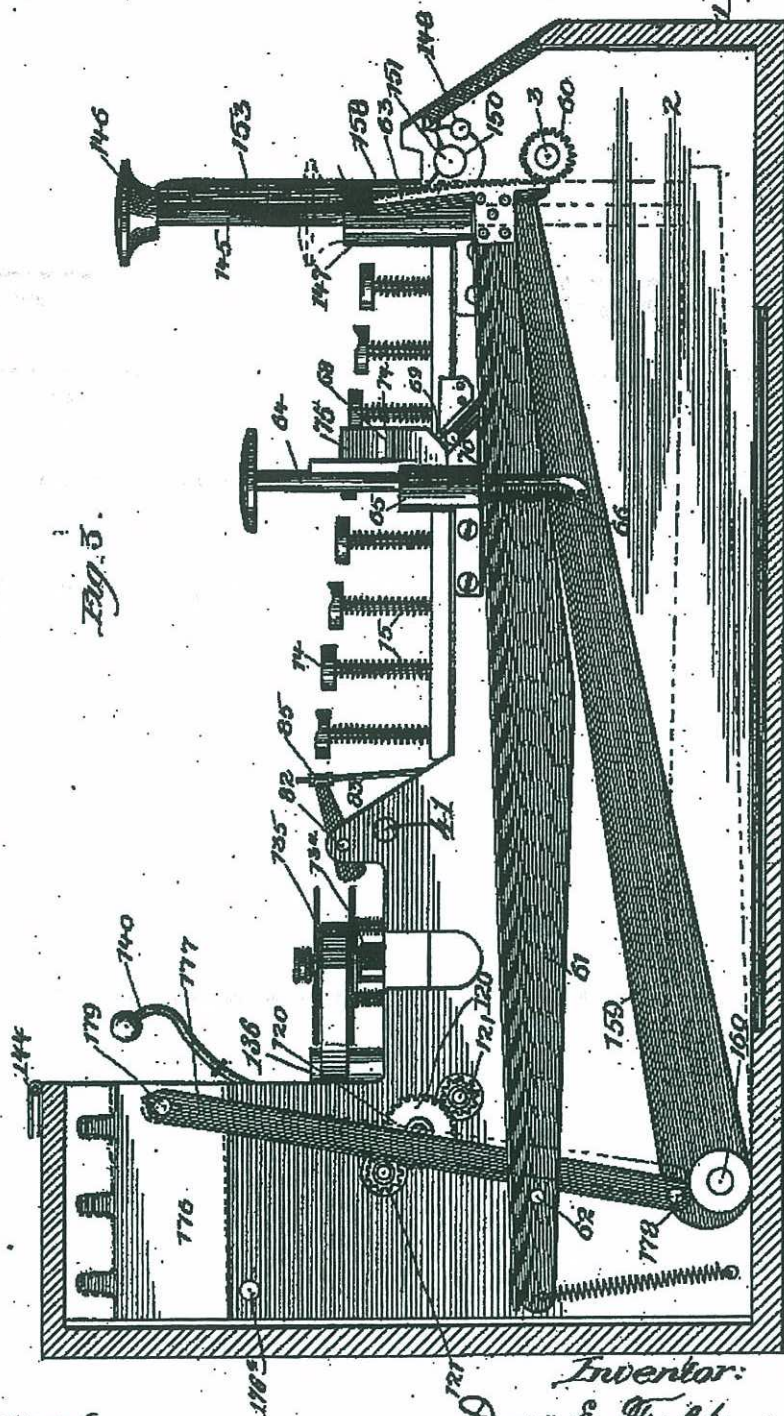
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12 Sheets—Sheet 3.

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Patented Dec. 15, 1891.



Witnesses:
John L. Jackson.
Frank C. Blanchard.

Inventor:
Dorr E. Felt
by Baird, Adams & Jones
Attys

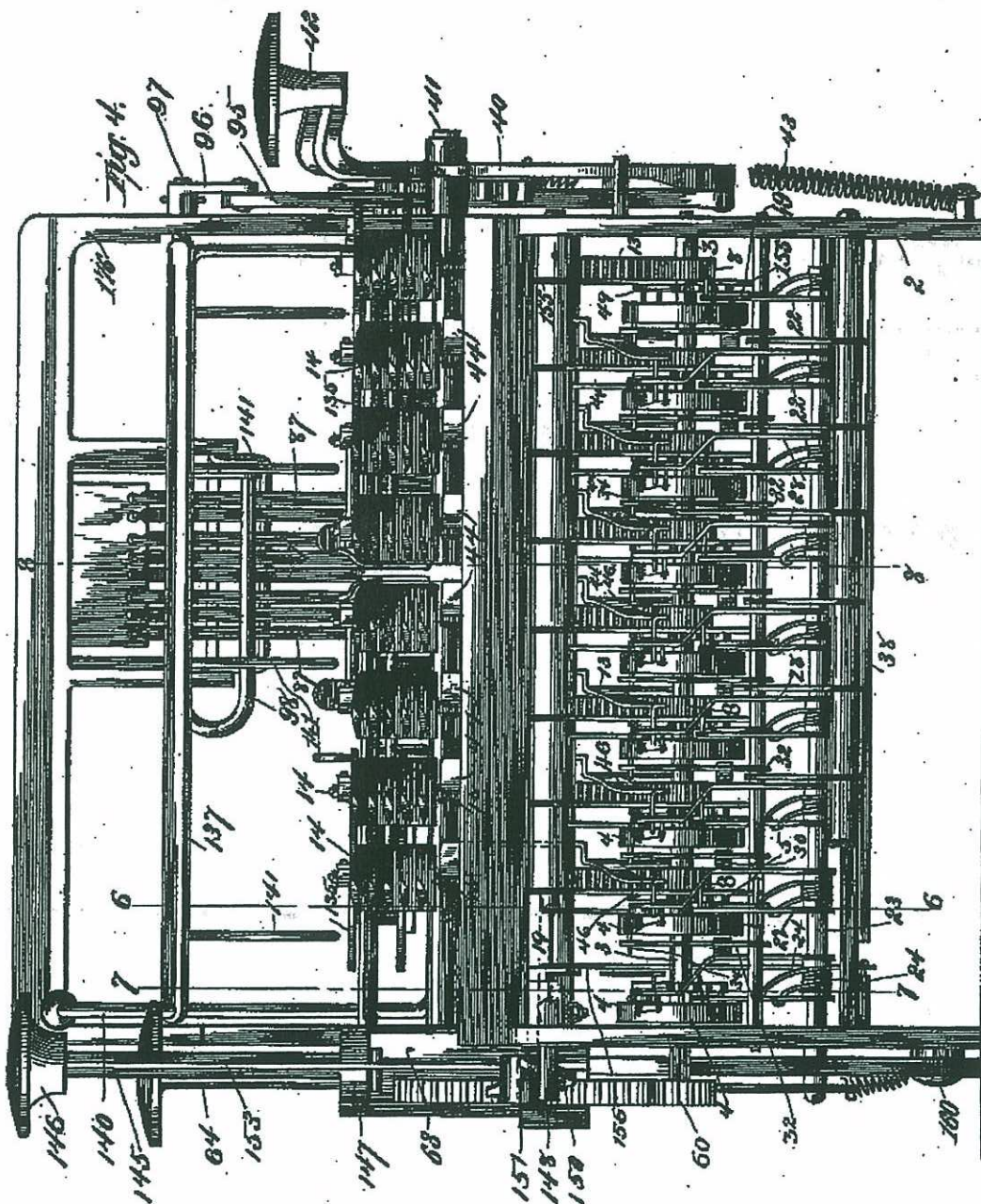
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12 Sheets—Sheet 4.

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Frank S. Blanchard

Inventor:
Dorr E. Felt
by Bond, Adams & Jones
Attys.

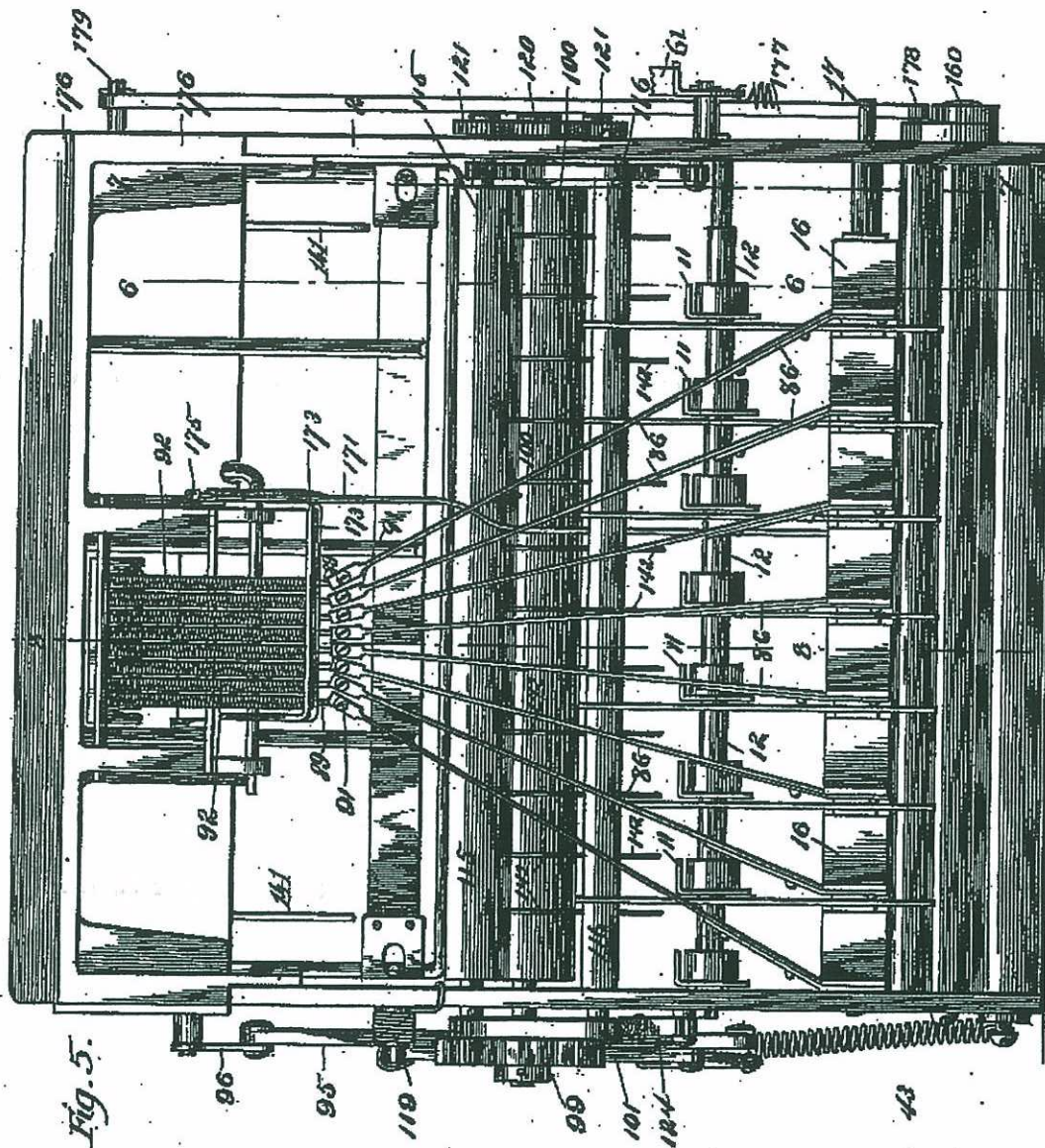
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Witnesses:
John L. Jackson.
Frank S. Blanchard.

Inventor:
D. E. Felt
by Bond, Adams & Jones
Attys.

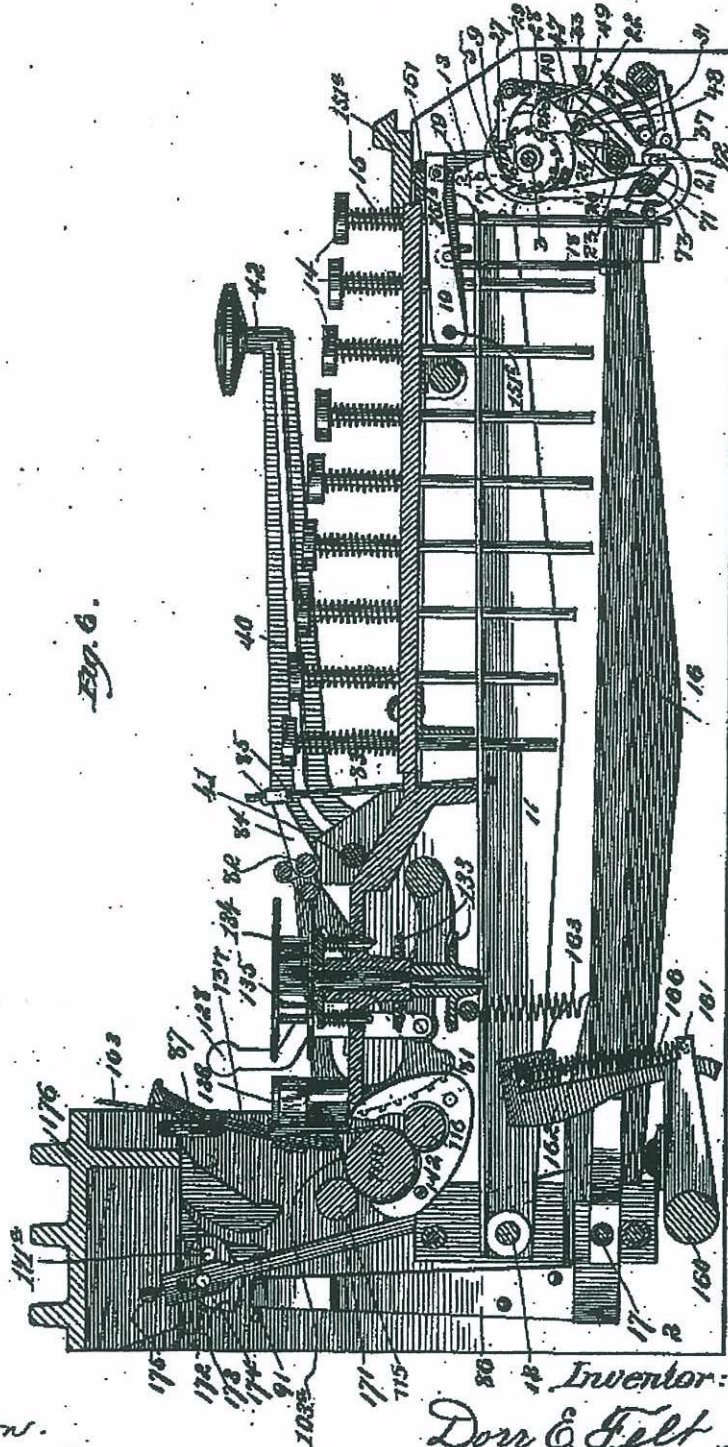
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12 Sheets—Sheet 6.

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Patented Dec. 15, 1891.



Witnesses:

John L. Jackson.
Frank S. Blanchard

Inventor:

Dorr E. Felt
by Bond, Adams & Jones
Attys

(No Model.)

12 Sheets—Sheet 7.

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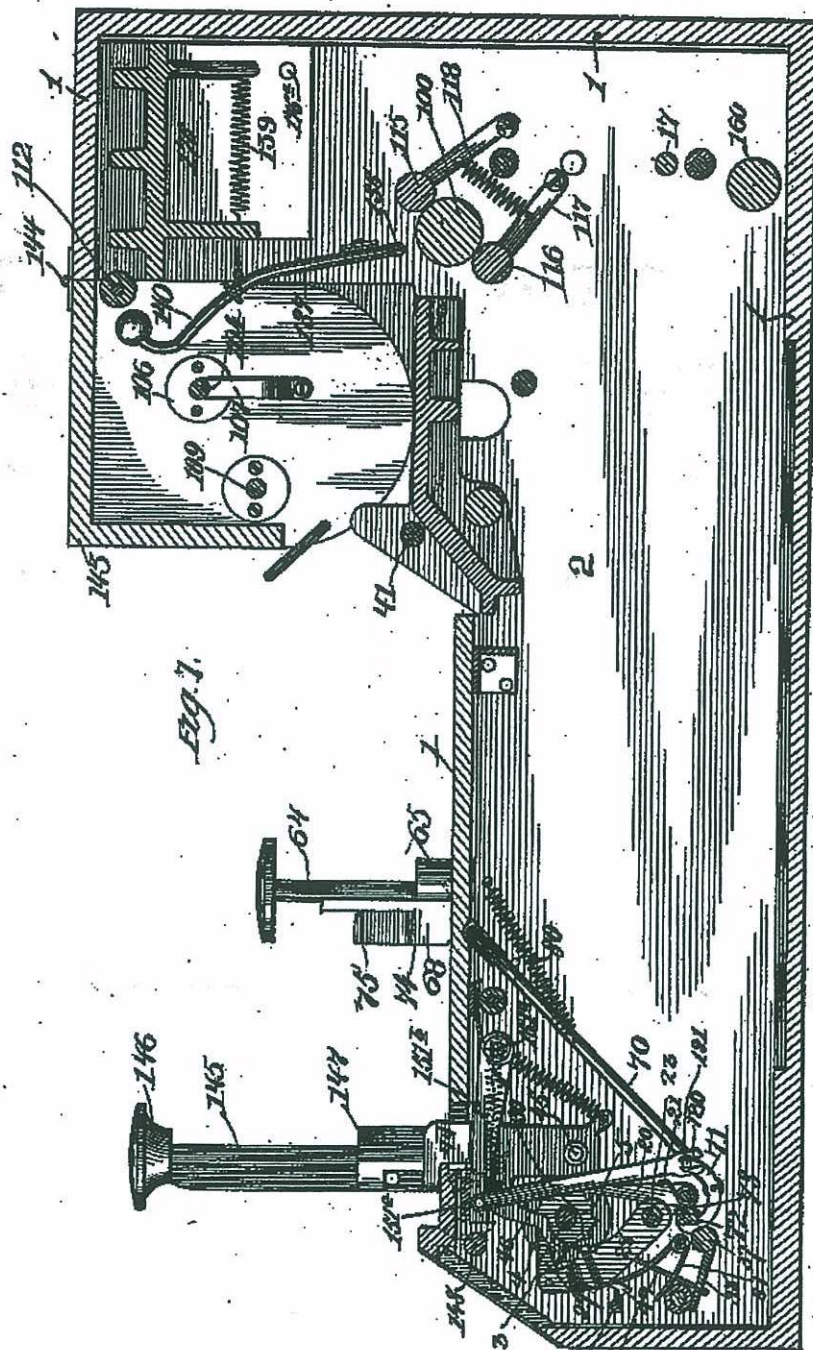


Fig. 1.

Witnesses:
John L. Jackson.
Frank C. Blanchard

Inventor:
Dorr E. Felt
by Bond, Adams & Jones
Attys.

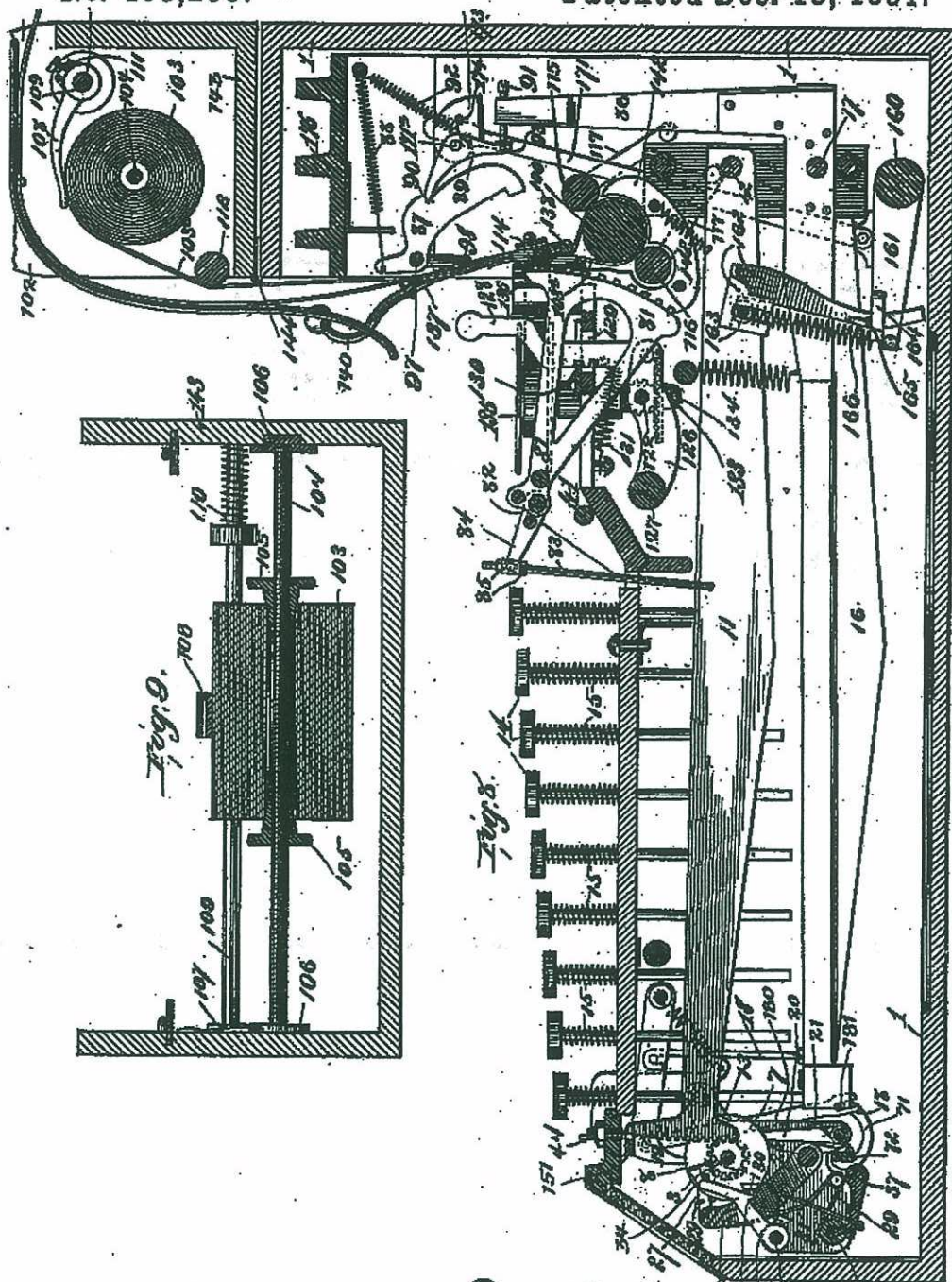
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Patented Dec. 15, 1891.



Witnesses:
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Frank S. Blanchard

Don E. Felt
by Bond, Adams & Jones
Attys.

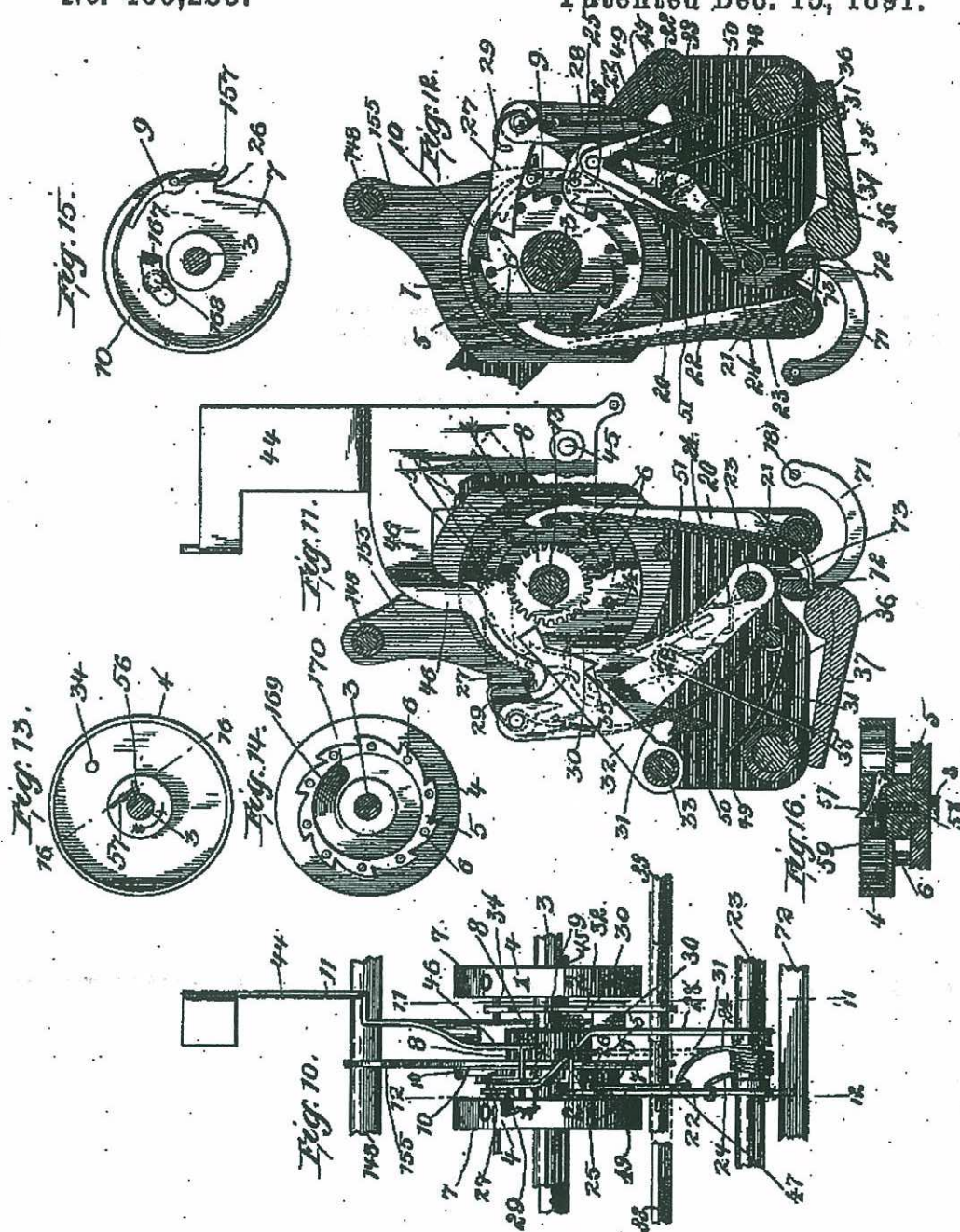
(No Model.)

12 Sheets—Sheet 9.

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Patented Dec. 15, 1891.



Witnesses:
John L. Jackson.
Frank S. Blanchard

Inventor:
Dorr E. Felt
by Bond, Adams & Jones
Attys.

(No Model.)

12 Sheets—Sheet 10.

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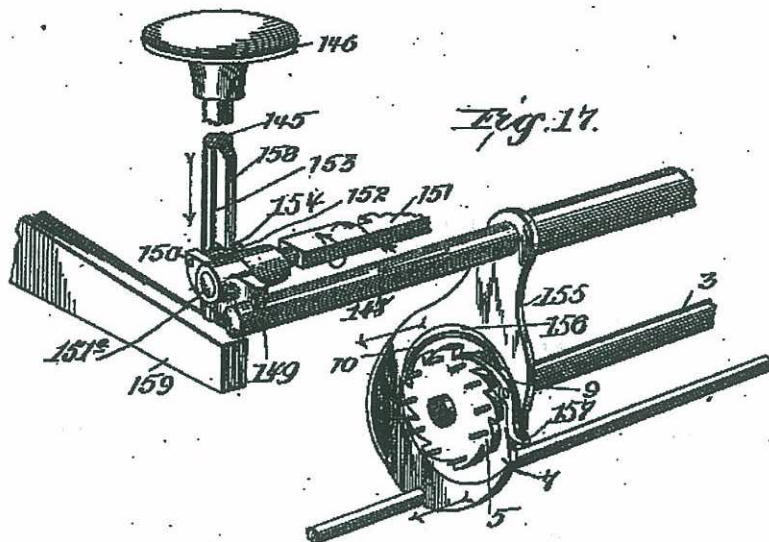


Fig. 17.

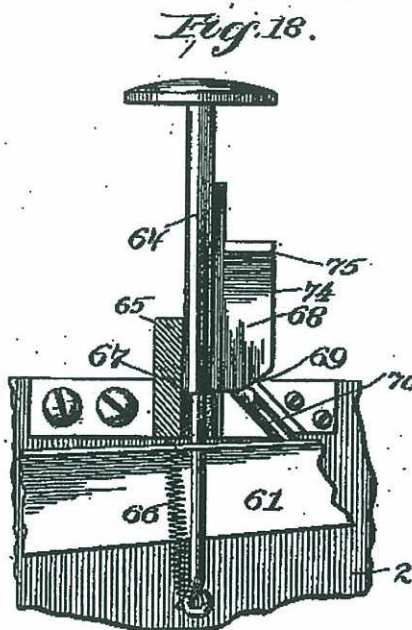


Fig. 18.

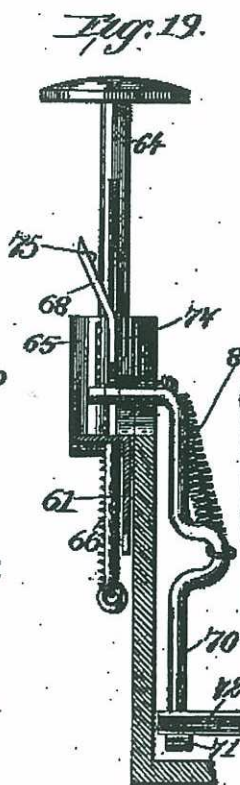


Fig. 19.

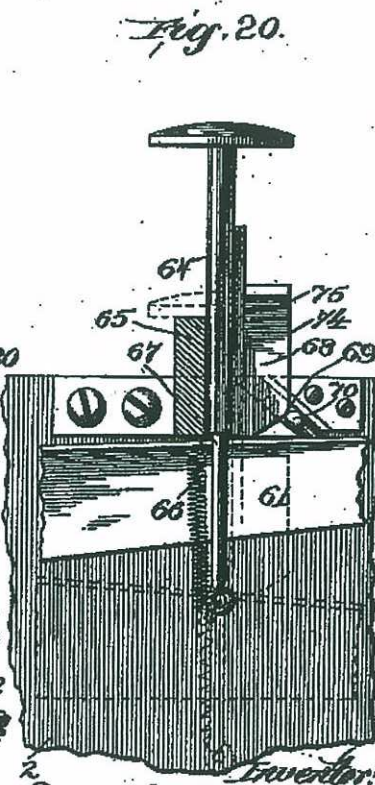


Fig. 20.

Witnesses:
John L. Jackson
Frank S. Blanchard

Inventor:
D. E. Felt
by Bond, Adams & Jones
Attys.

(No Model.)

12 Sheets—Sheet 11.

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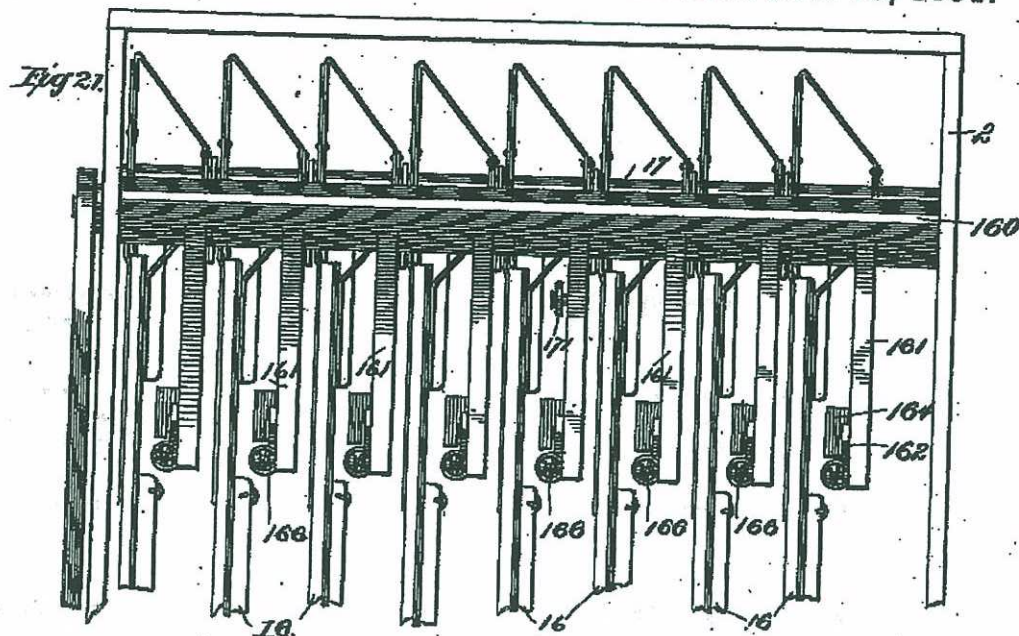


Fig. 22.

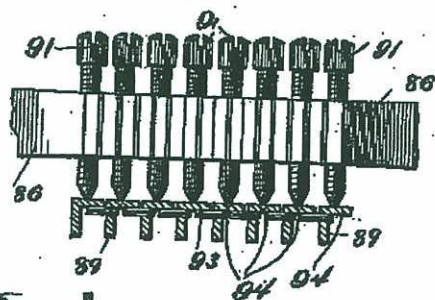
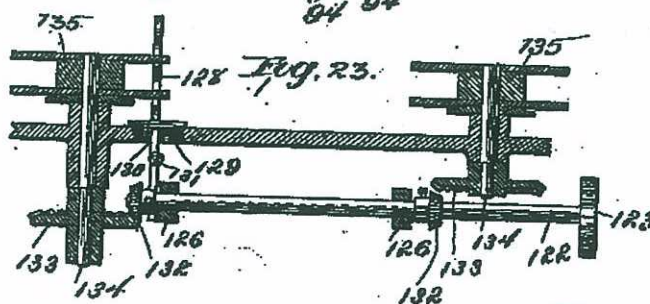


Fig. 23.



Witnesses.

John L. Jackson.
Frank J. Blanchard.

Inventor:

Dorr E. Felt
By Bond, Adams & Jones
Attys.

(No Model.)

12 Sheets—Sheet 11.

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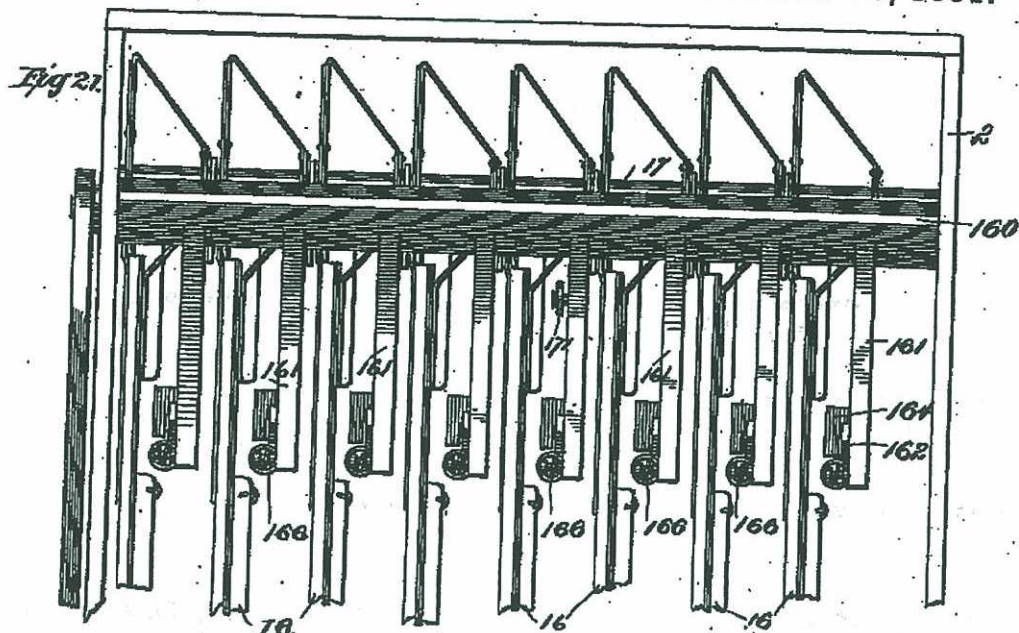
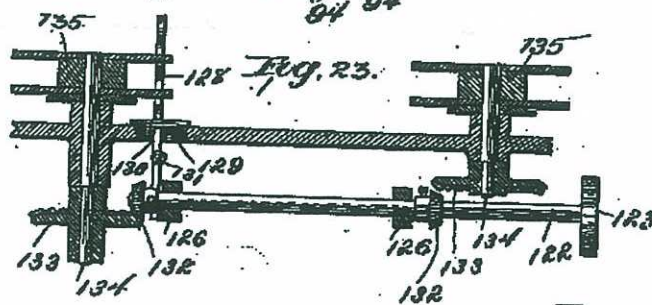
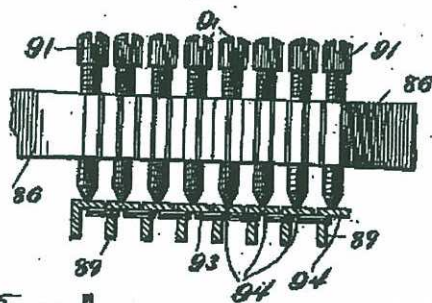


Fig. 22.



Witnesses:

John L. Jackson
Frank J. Blanchard

Inventor:

Dorr E. Felt
By Bond, Adams & Jones
Attys.

(No Model.)

12 Sheets—Sheet 12.

D. E. FELT.
RECORDING COMPUTING MACHINE.

No. 465,255.

Patented Dec. 15, 1891.

Fig. 24.

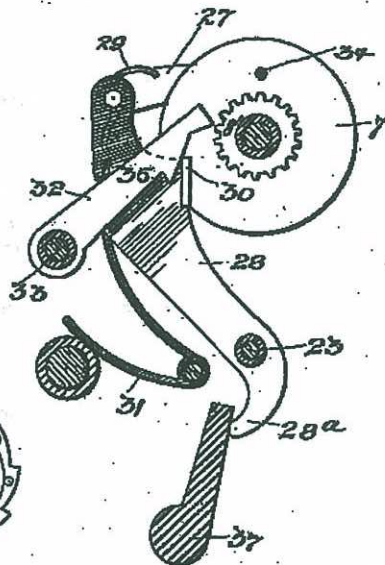


Fig. 26.

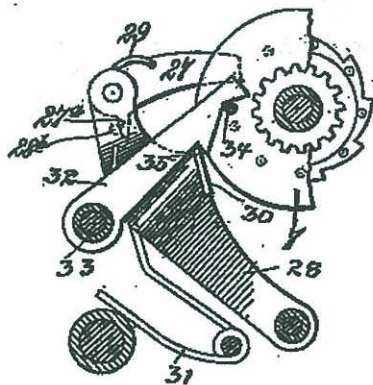
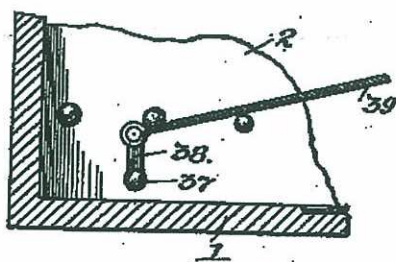


Fig. 25.



Witnesses:

John L. Jackson.
Frank J. Blanchard

Inventor:

Dorr E. Felt
by Bond, Adams & Jones
Attys.