June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

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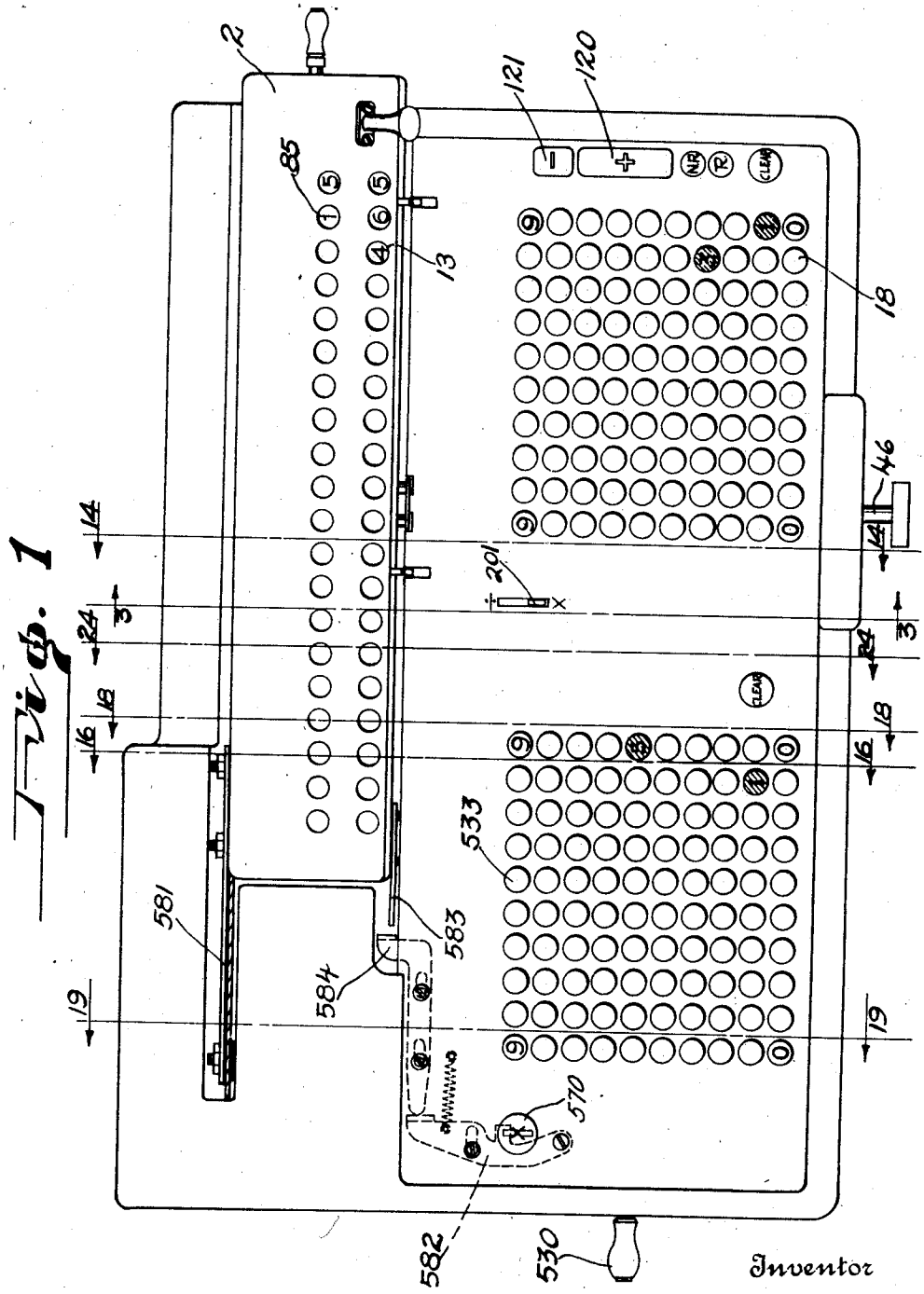


Fig. 1

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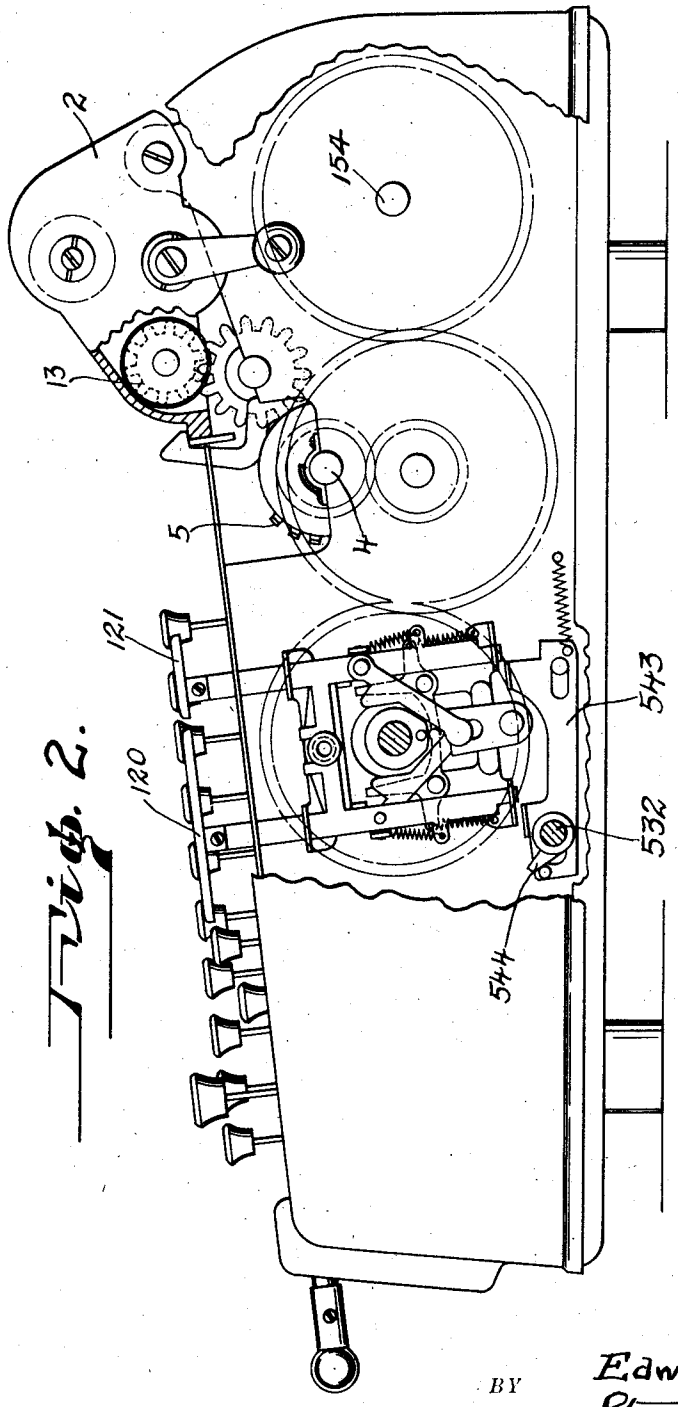


Fig. 2.

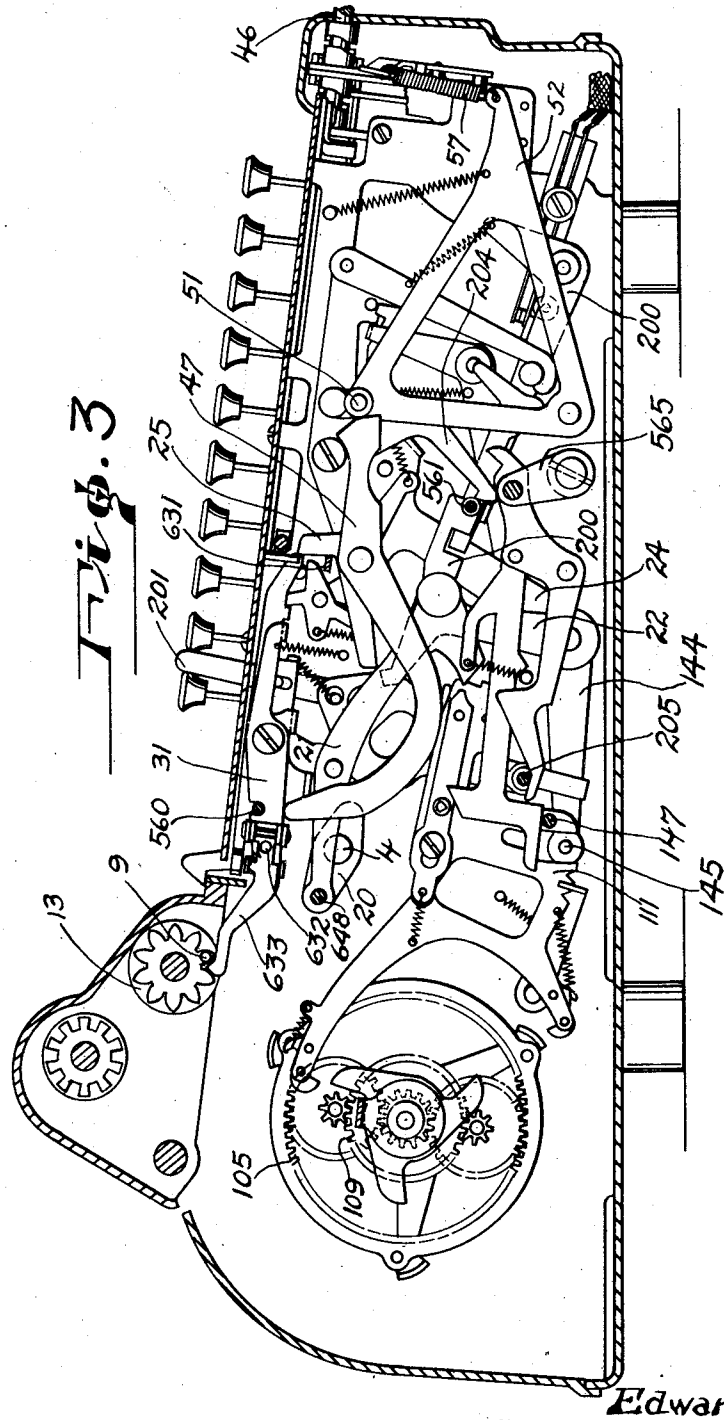
INVENTOR
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CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 3

Fig. 3



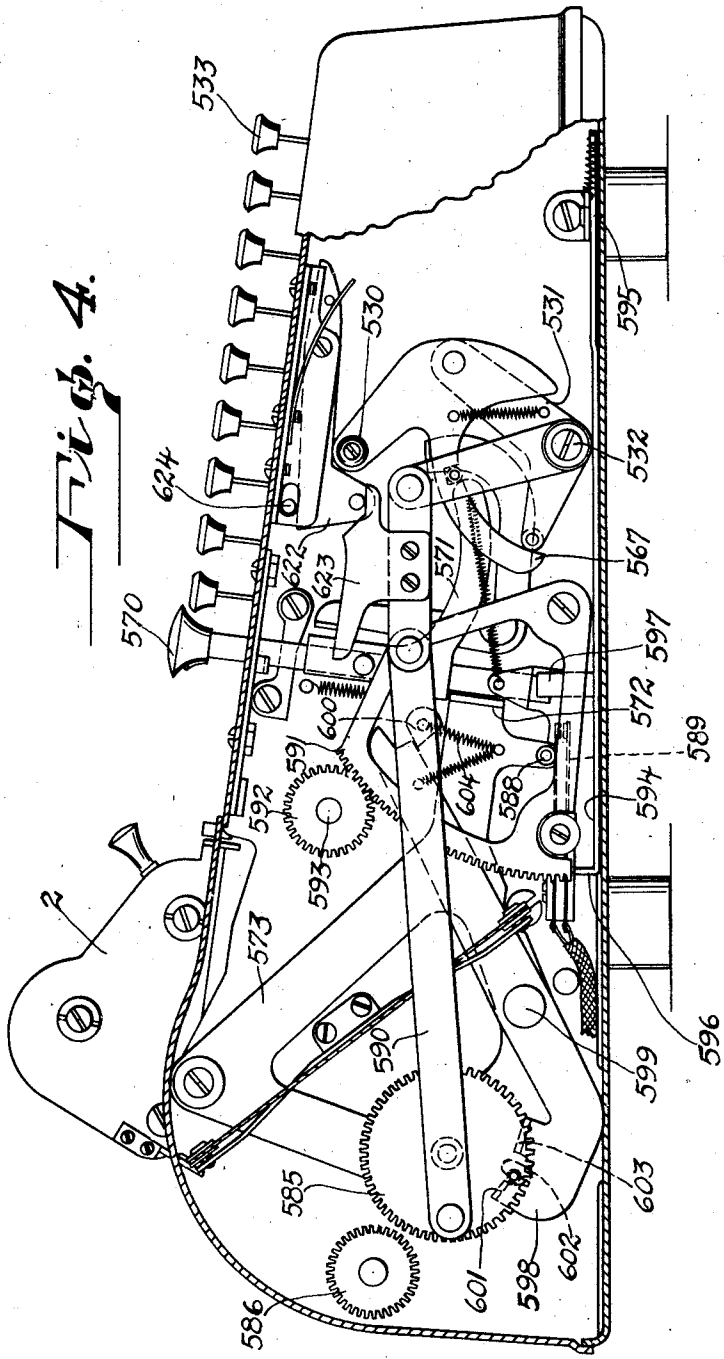
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June 6, 1933. E. C. WALTER 1,912,874

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Filed May 21, 1931 20 Sheets-Sheet 4

Fig. 4.



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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 5

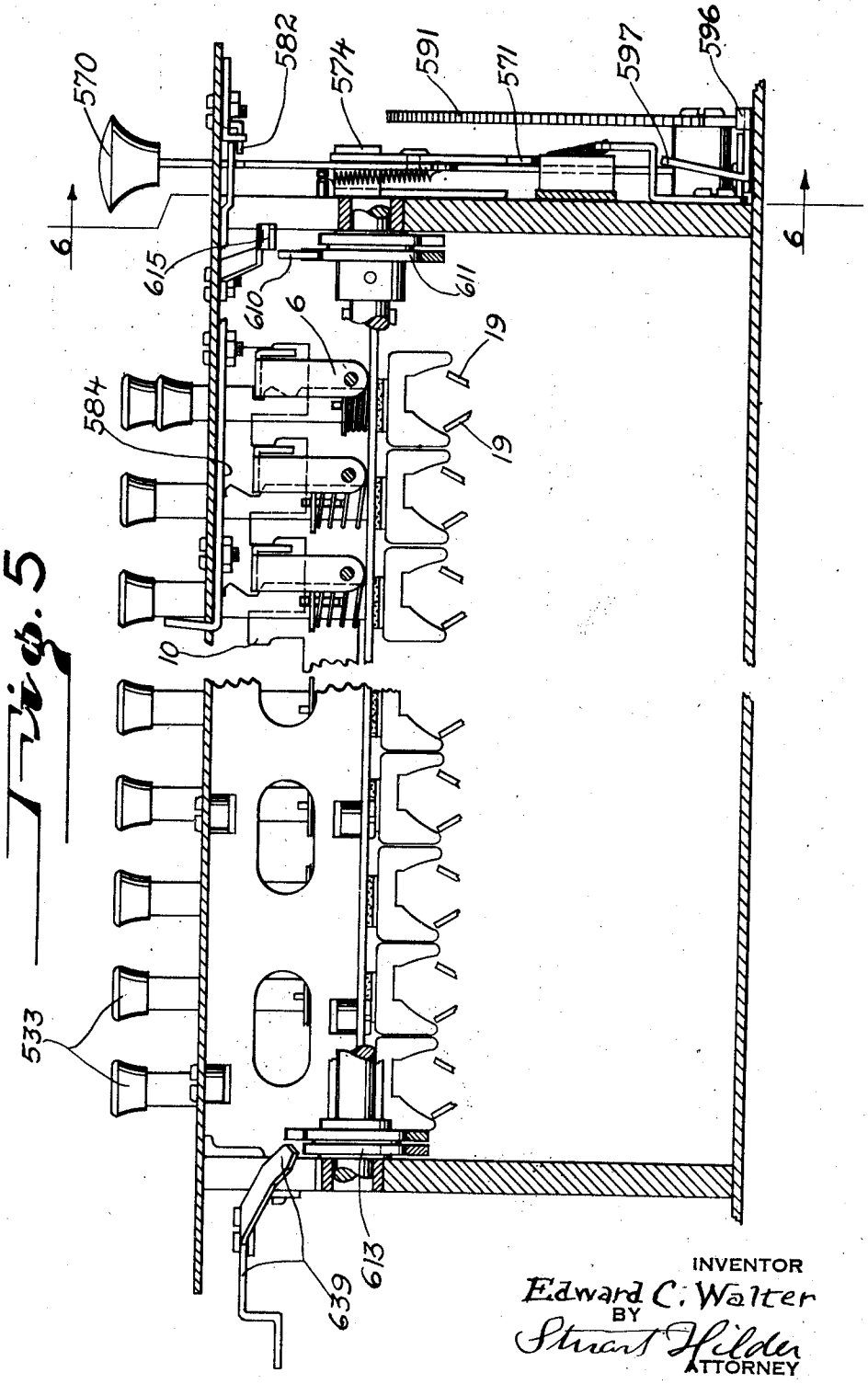


Fig. 5

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 6

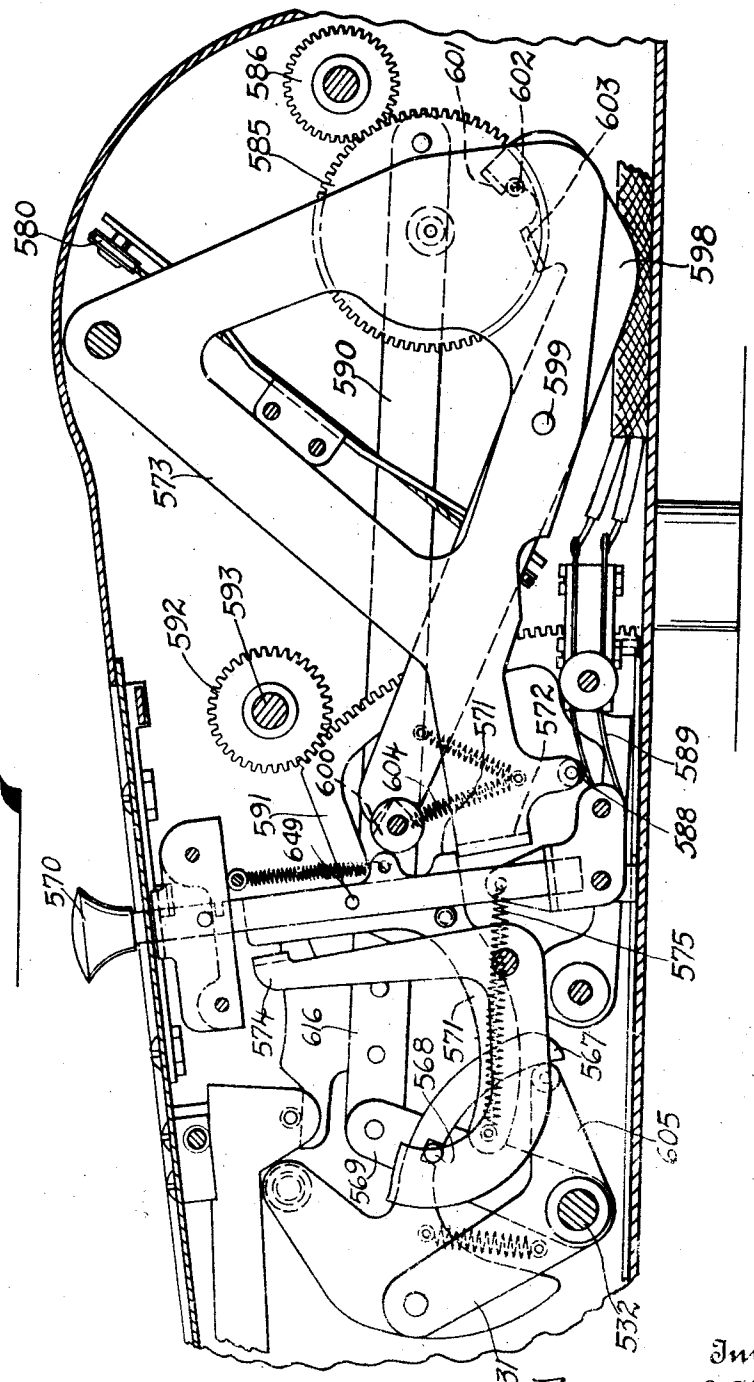


Fig. 6.

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 7

Fig. 7

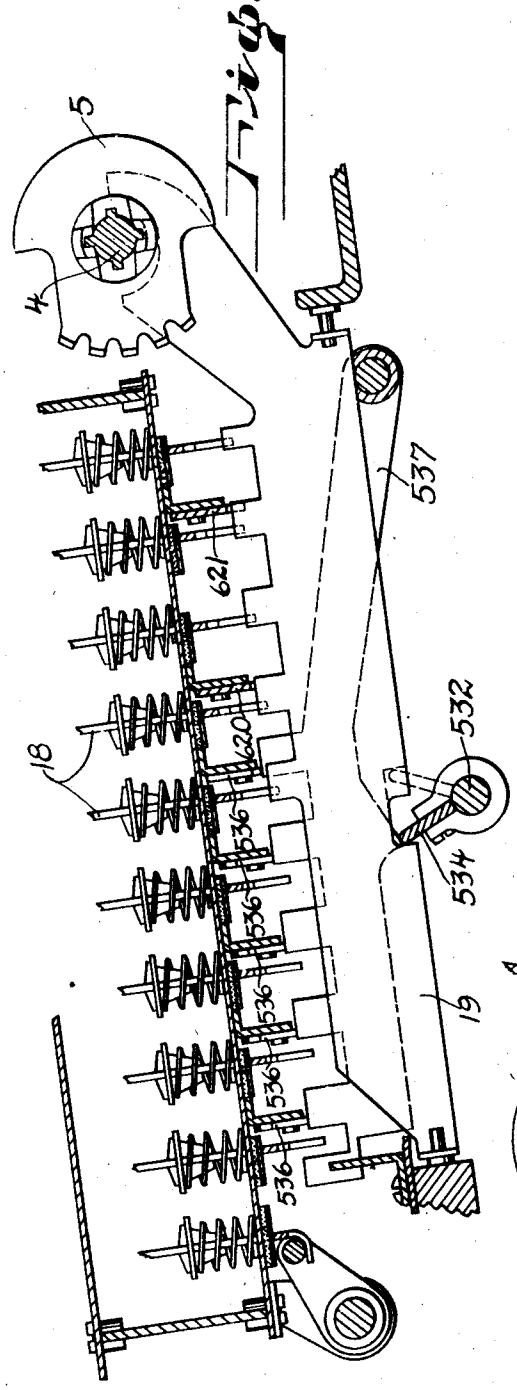
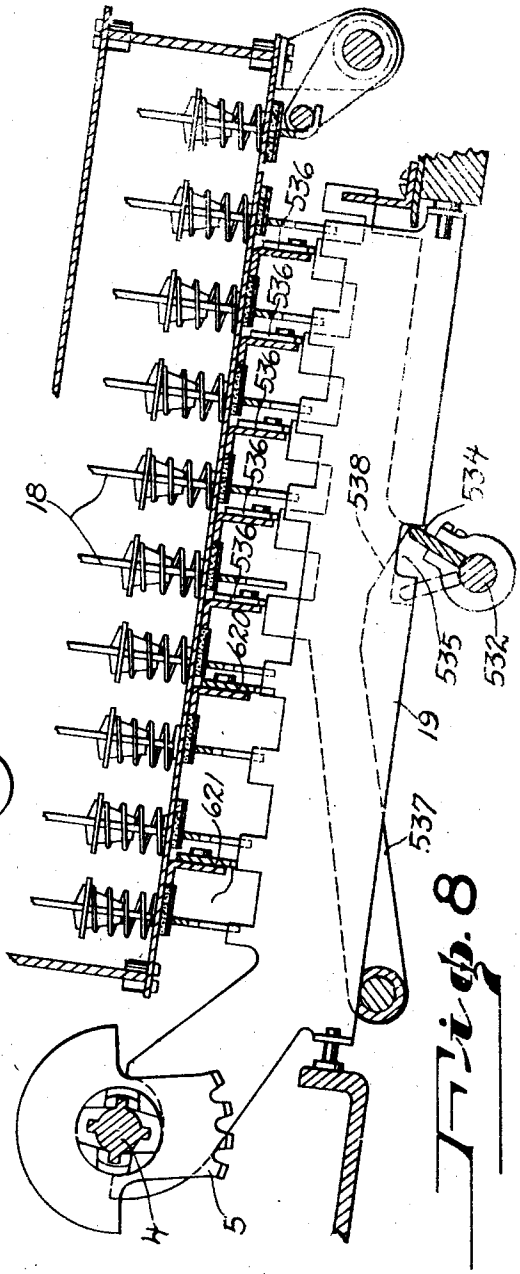


Fig. 8



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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 8

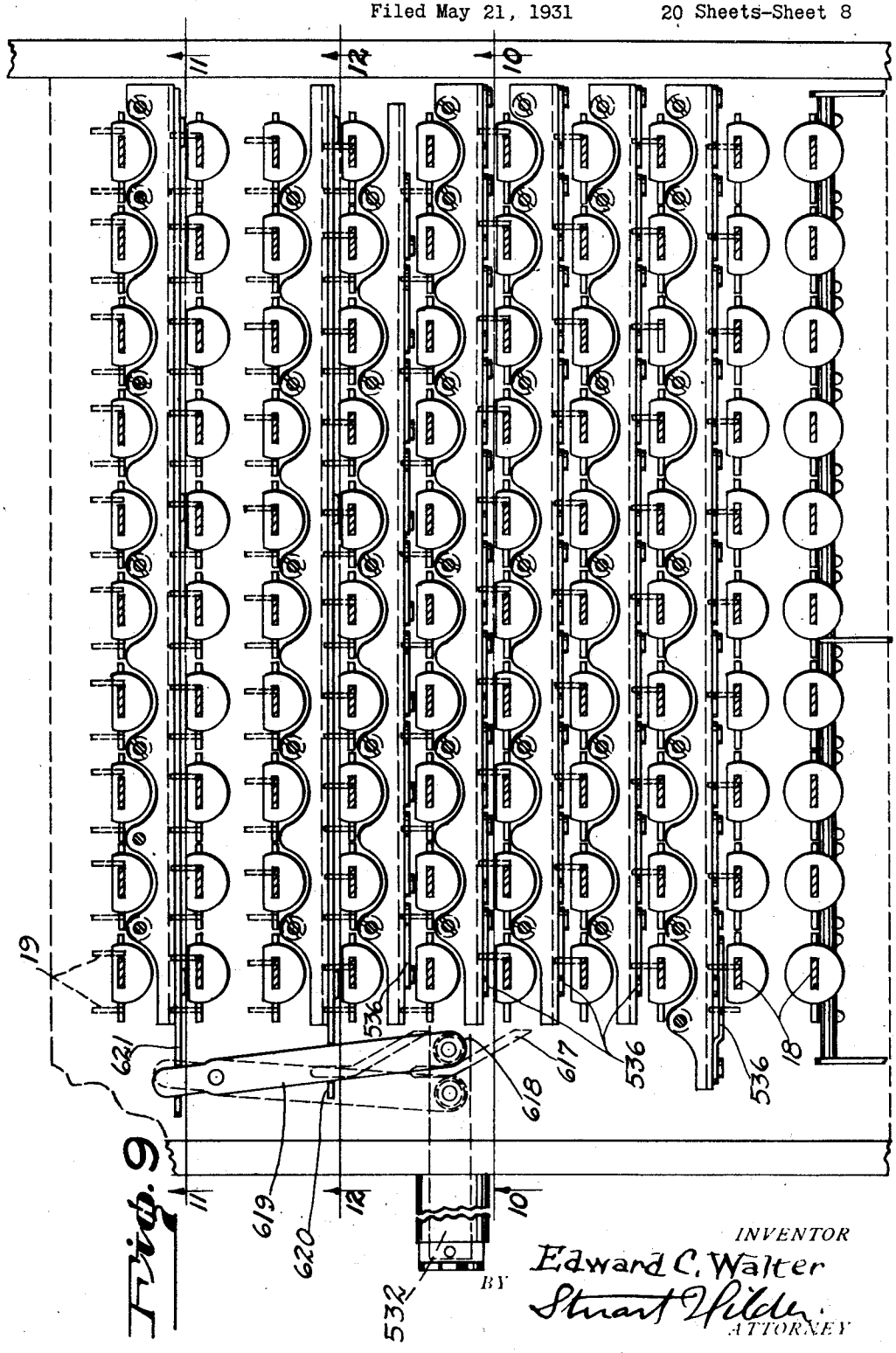


Fig. 9

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 9

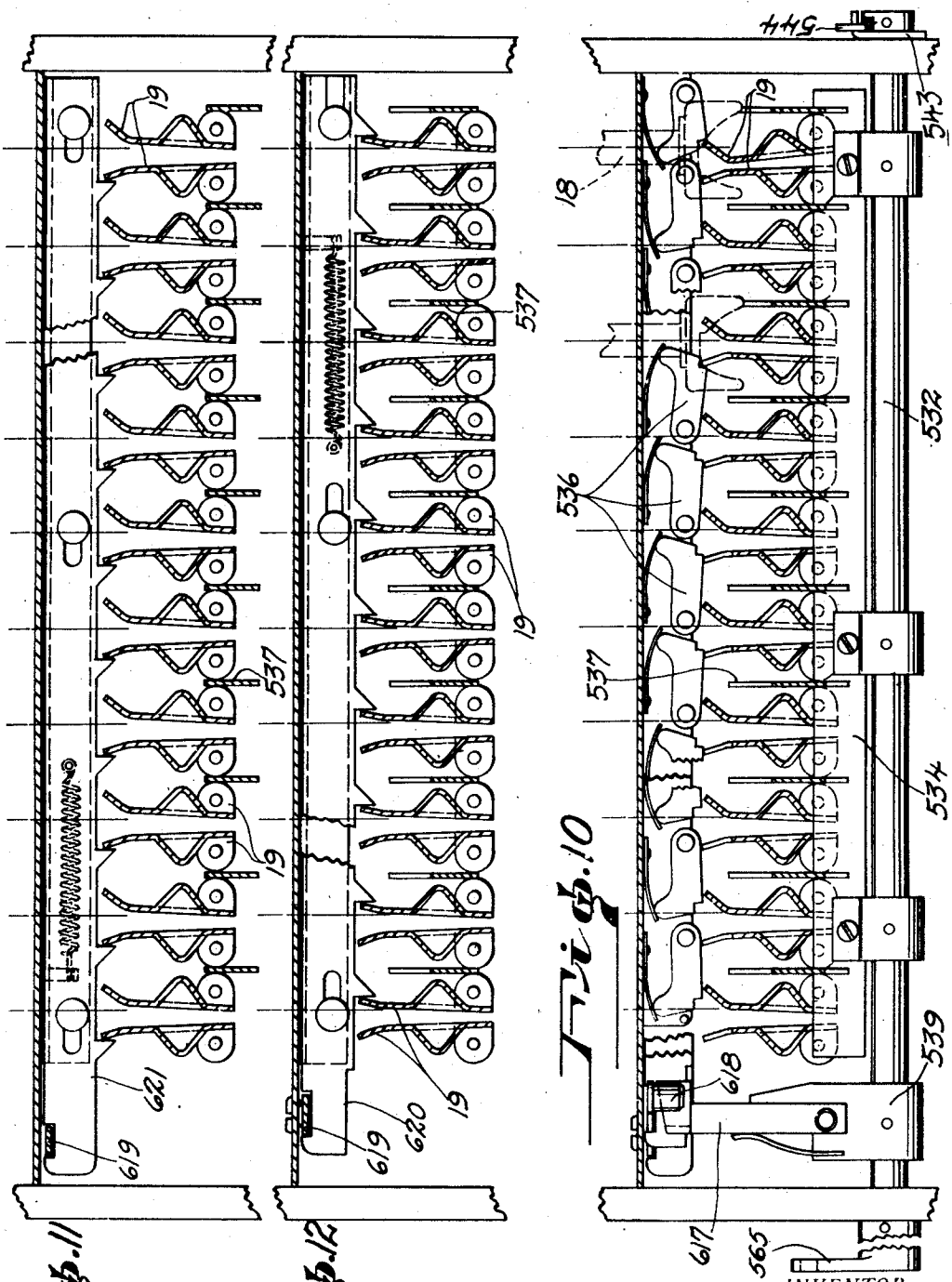


Fig. 10

Fig. 11

Fig. 12

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 10

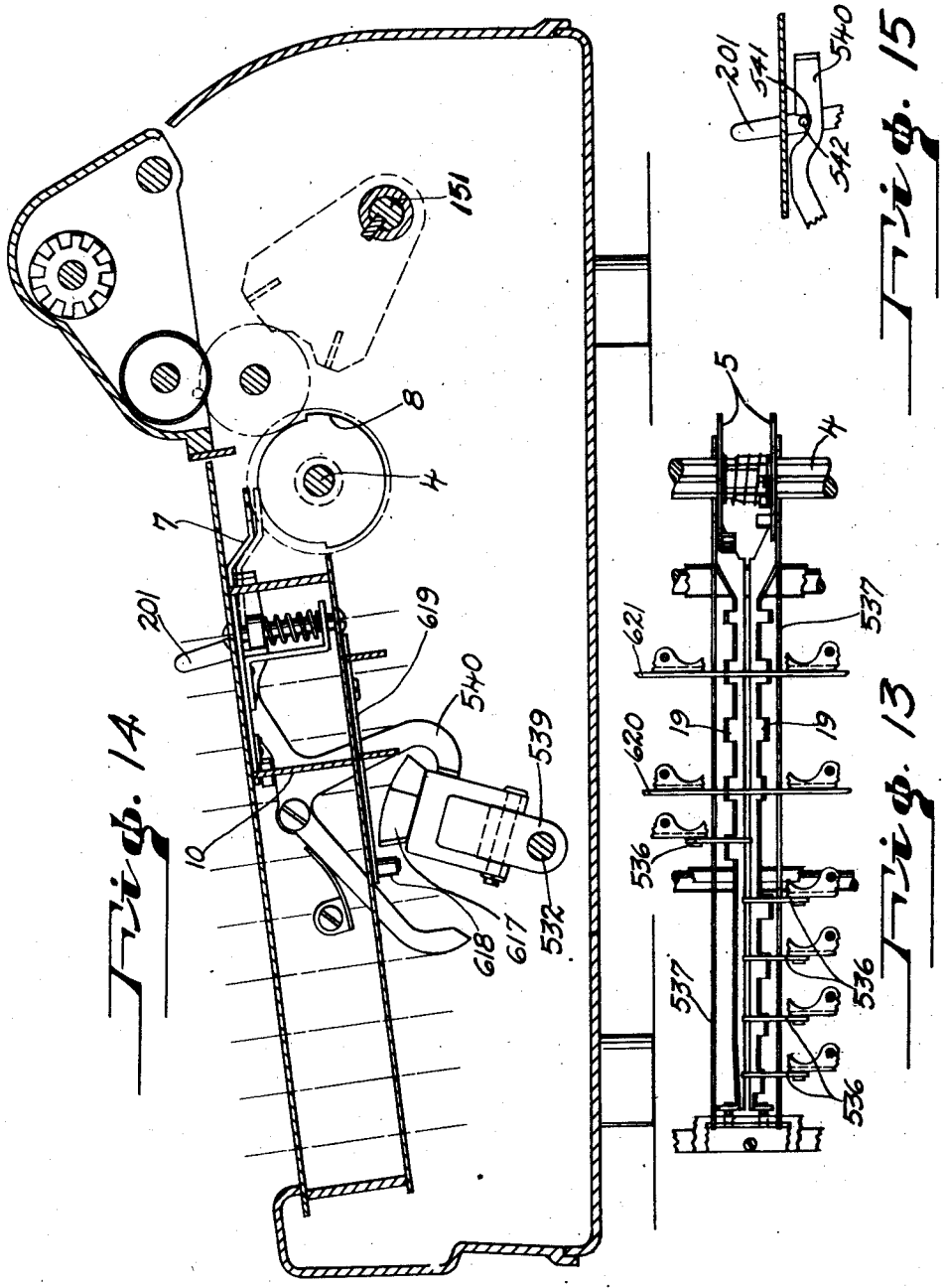


Fig. 14

Fig. 13

Fig. 15

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 11

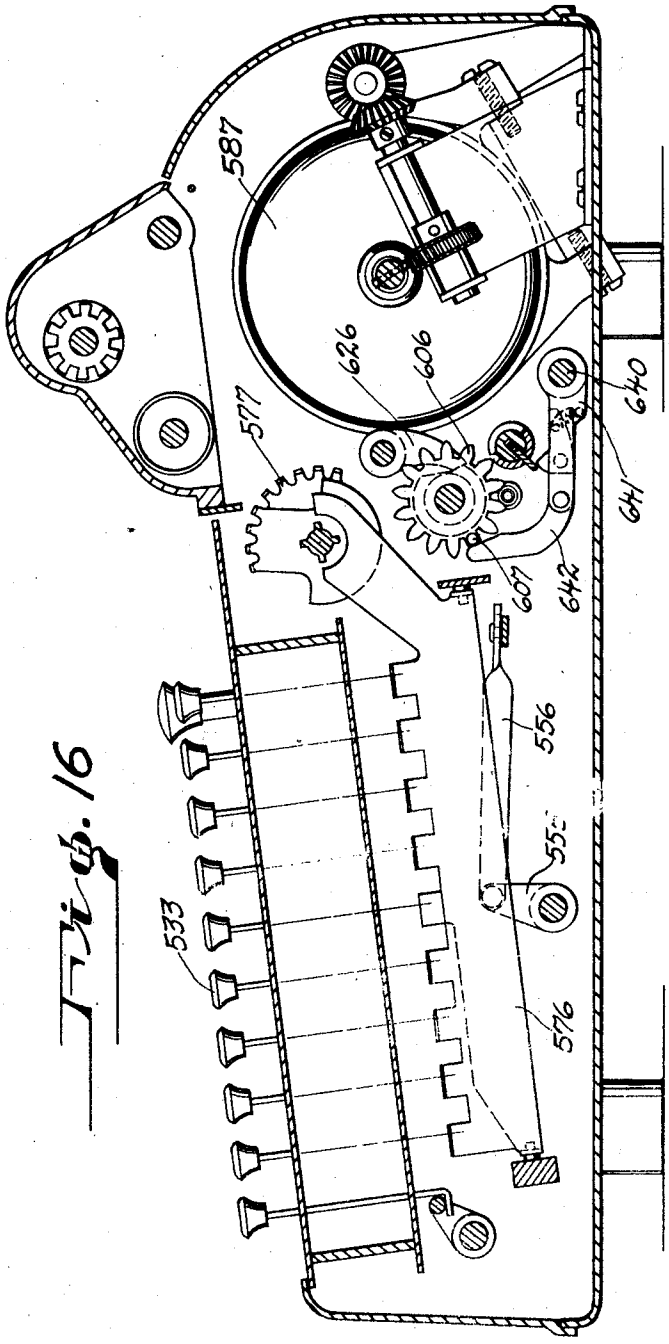


Fig. 16

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 12

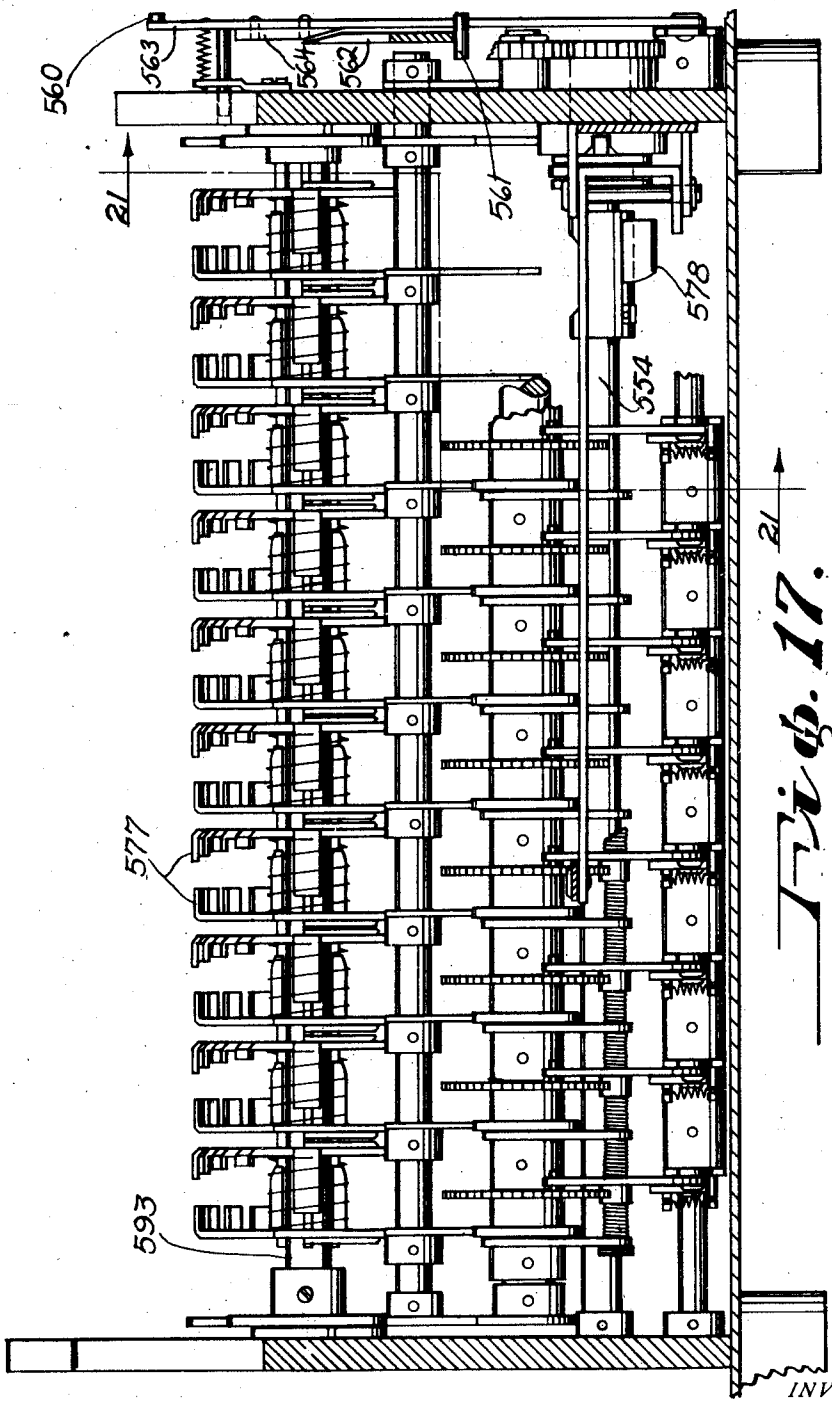


Fig. 17.

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CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 13

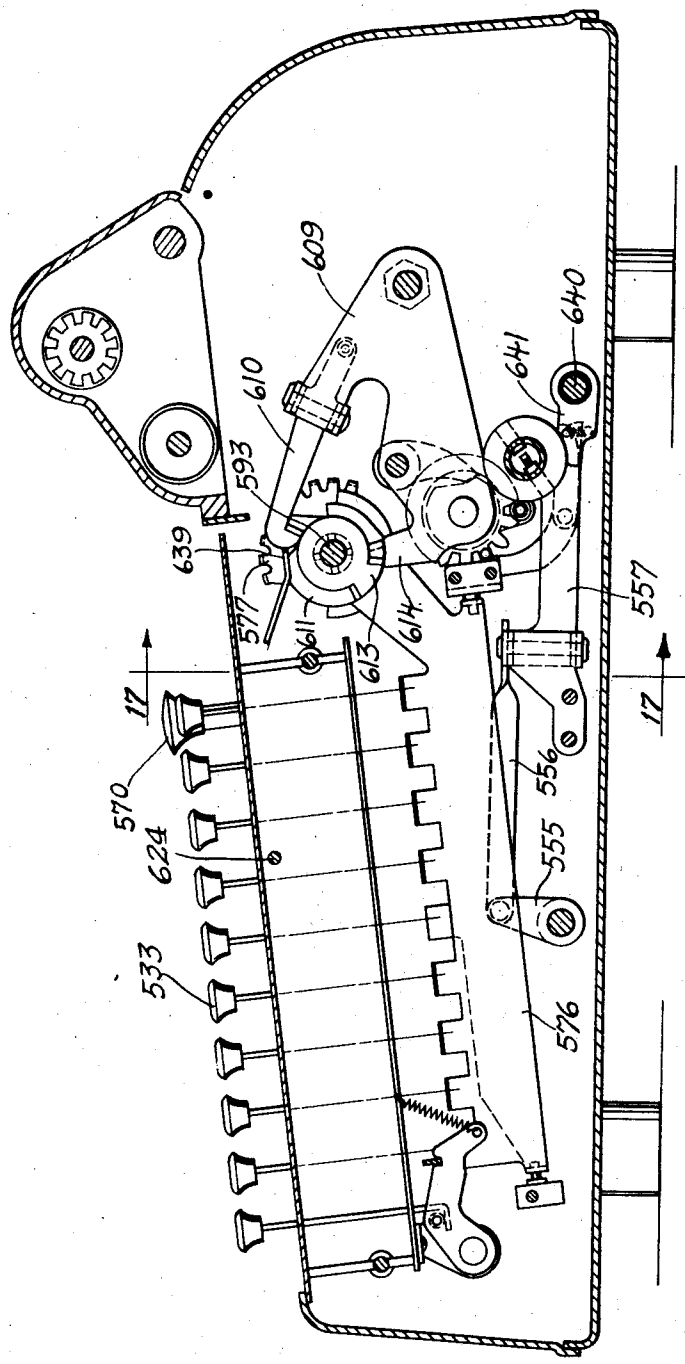


Fig. 18

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 14

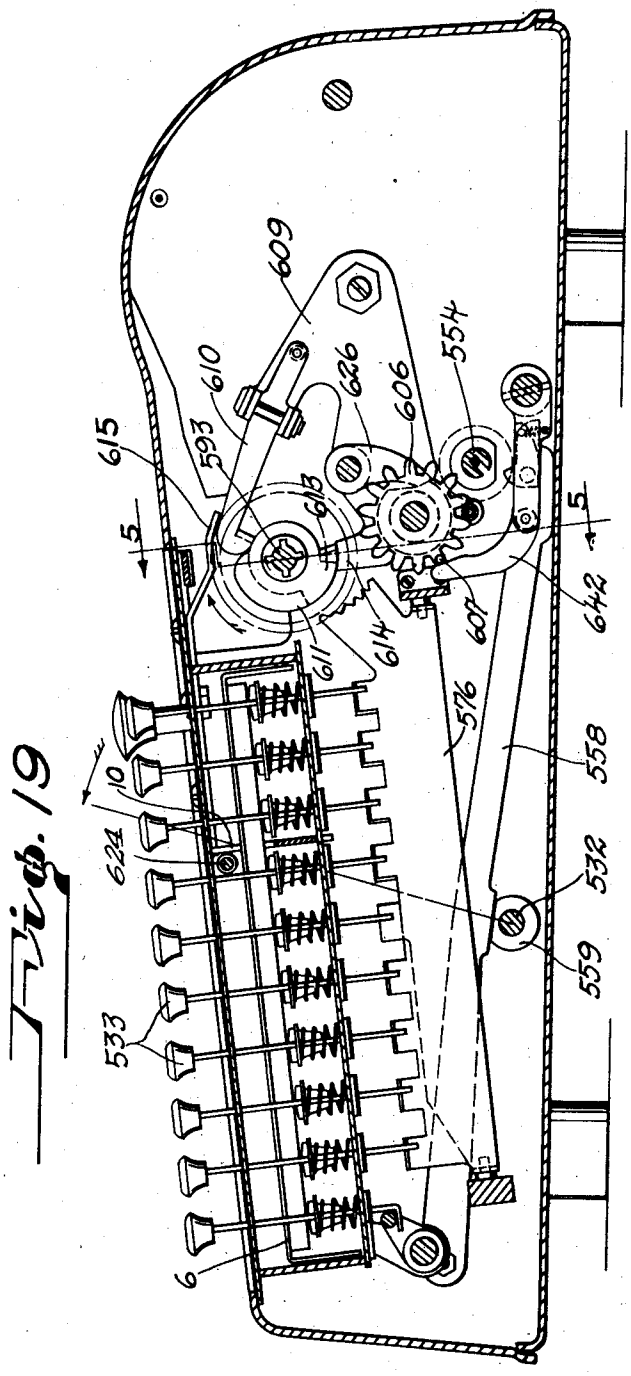


Fig. 19



Fig. 20

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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 15

Fig. 22

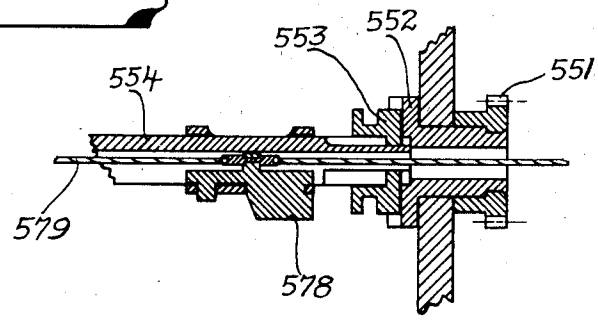
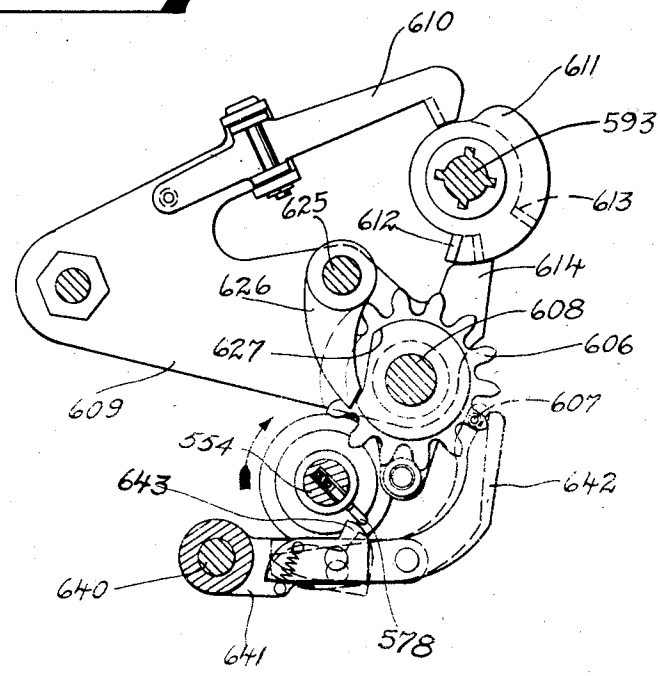


Fig. 21



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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 16

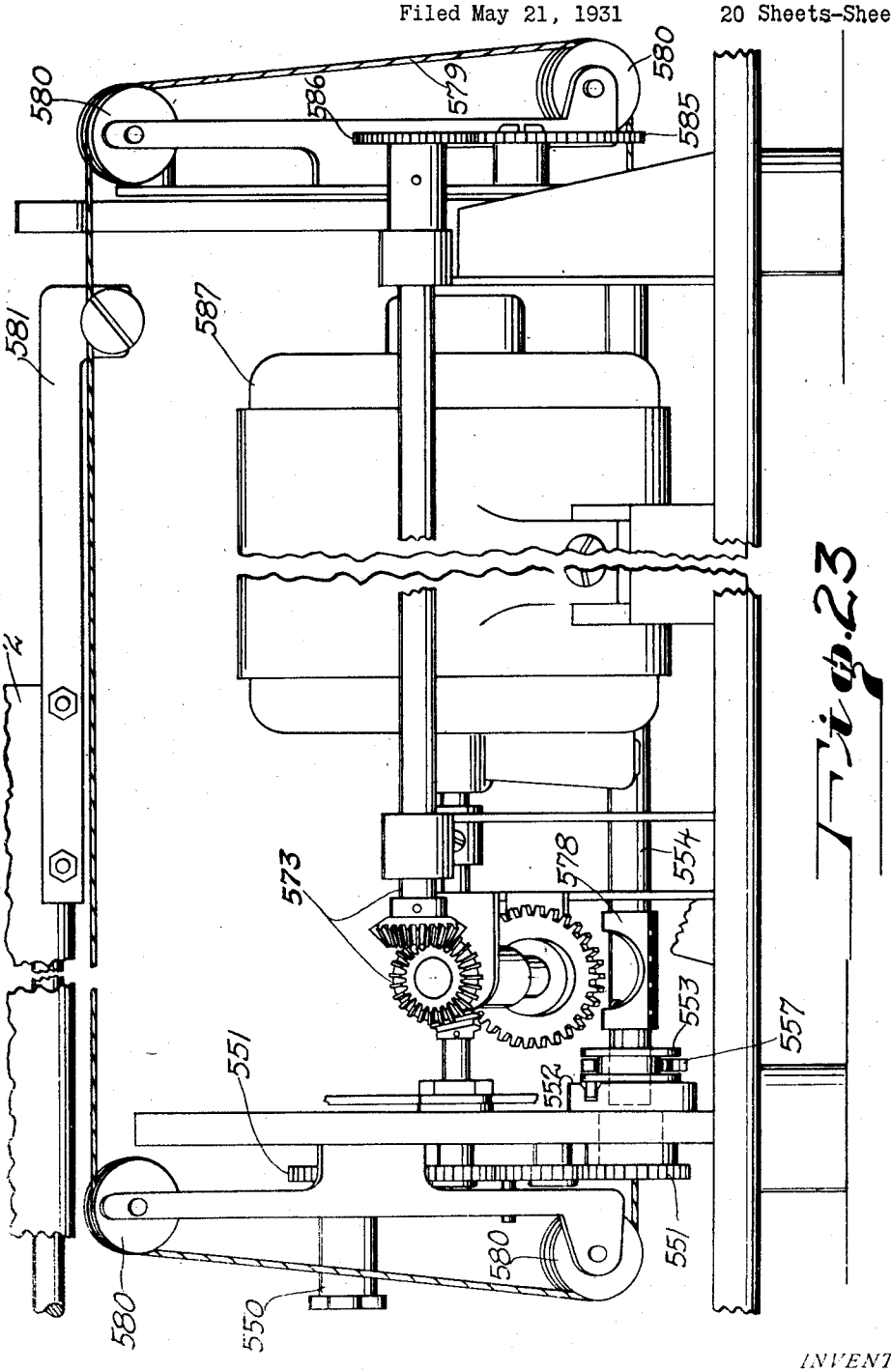


Fig. 23

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CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 17

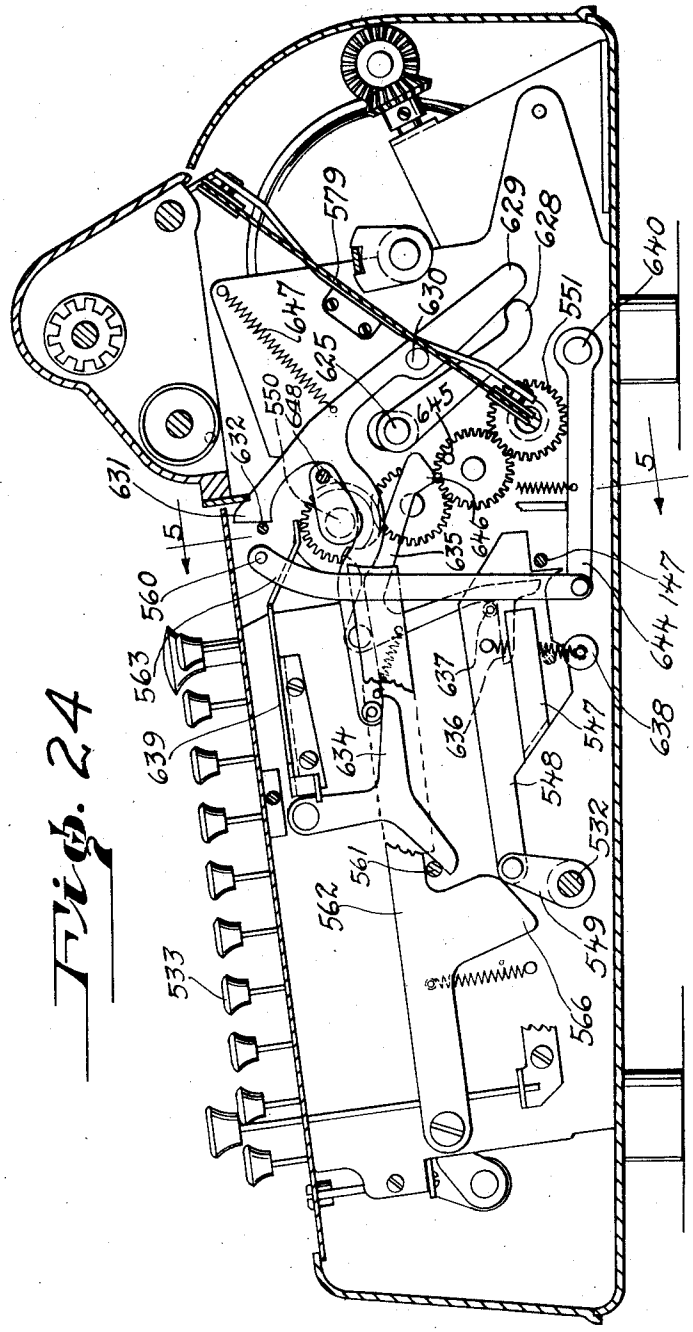


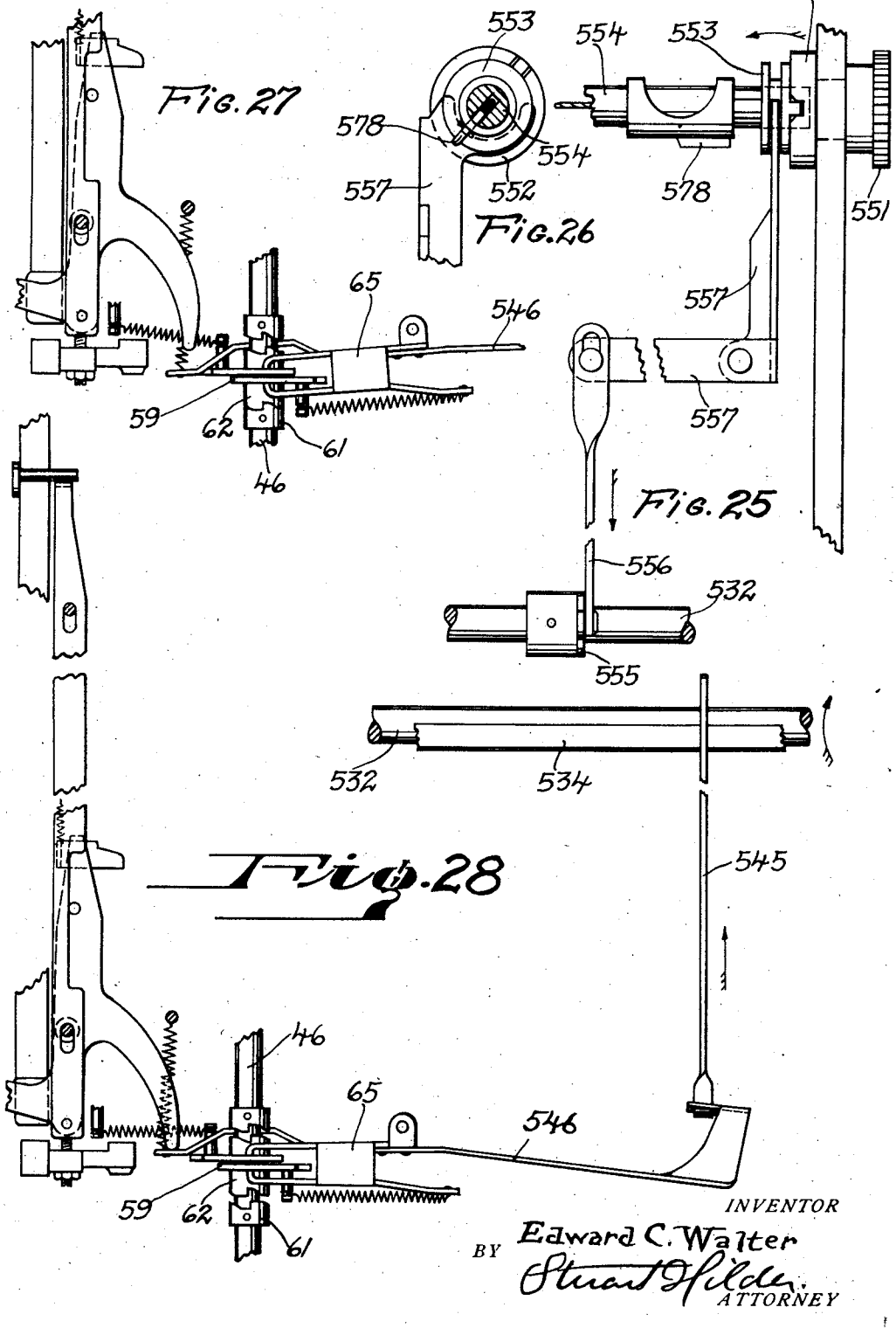
Fig. 24

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CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 18



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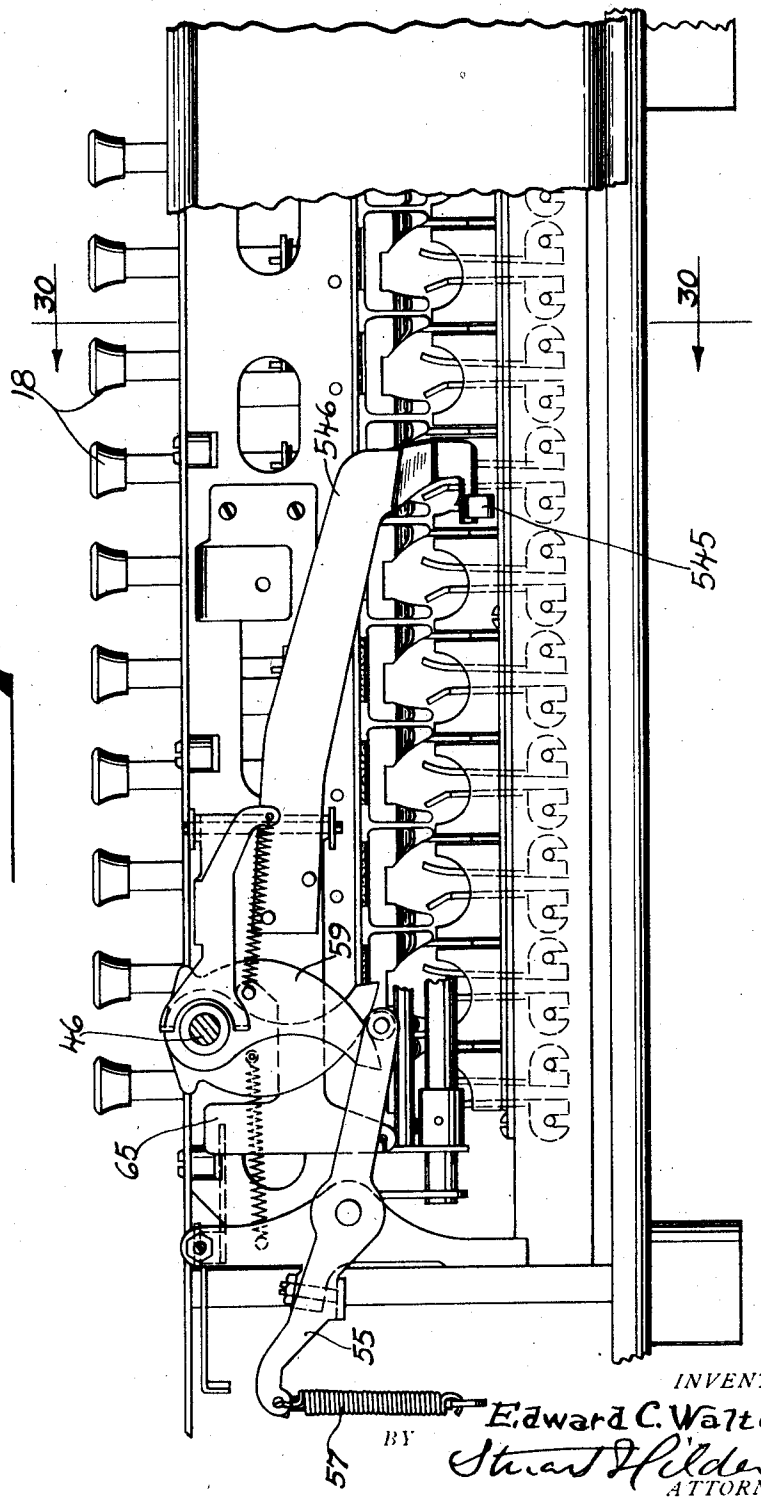
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CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 19

Fig. 29



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June 6, 1933. E. C. WALTER 1,912,874

CALCULATING MACHINE

Filed May 21, 1931 20 Sheets-Sheet 20

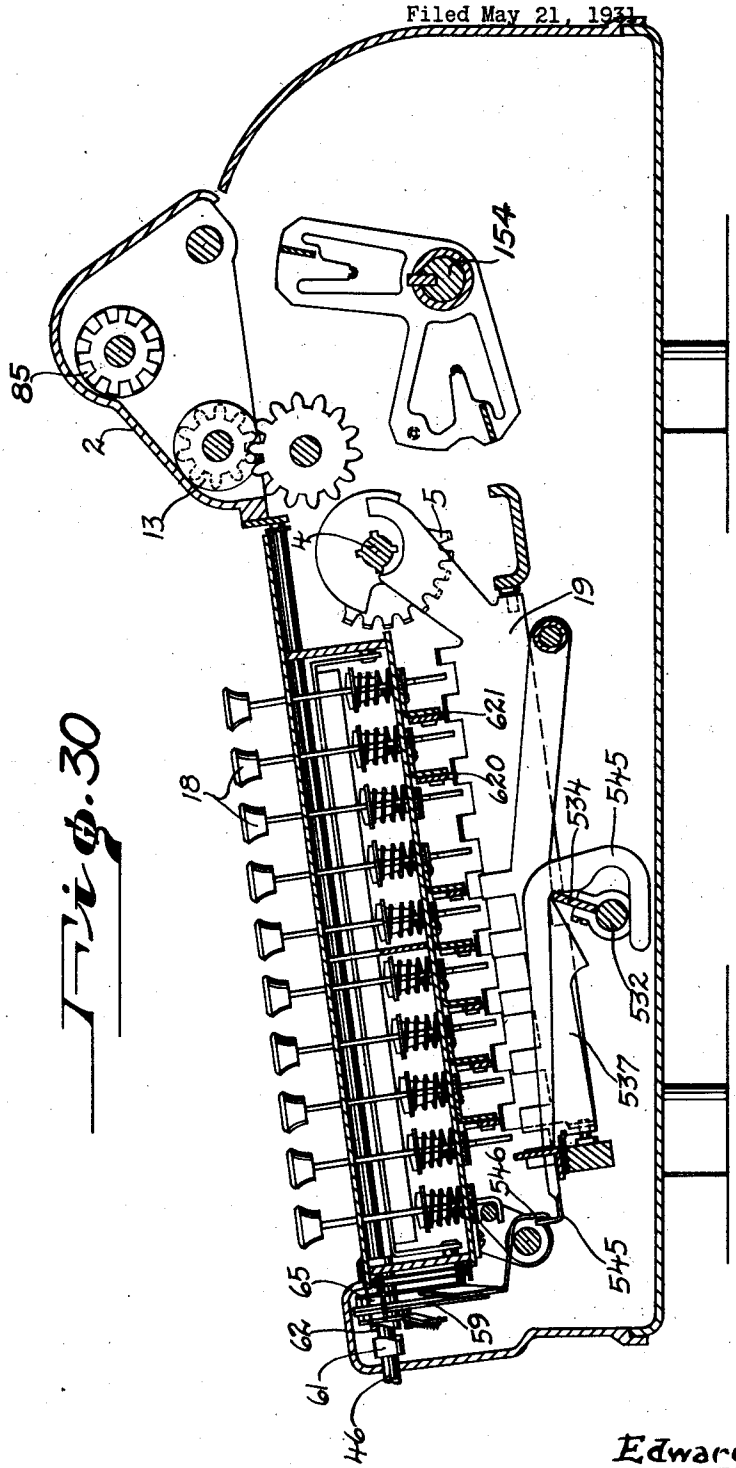


Fig. 30

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Patented June 6, 1933 1,912,874

UNITED STATES PATENT OFFICE

EDWARD C. WALTER, OF ORANGE, NEW JERSEY, ASSIGNOR TO MONROE CALCULATING MACHINE COMPANY, OF ORANGE, NEW JERSEY, A CORPORATION OF DELAWARE

CALCULATING MACHINE

Application filed May 21, 1931. Serial No. 538,941.

The invention relates to calculating machines, and more particularly to machines for performing multiplication.

Broadly, the invention comprises a development of certain features disclosed in the patents to Alexander Rechnitzer #1,189,288, issued July 4, 1916, and entitled Setting and adjusting mechanism of calculating machines, and #1,409,575, issued March 14, 1922, and entitled Calculating machine, in that both factors of a second multiplication problem may be set upon the keys of the machine while the quotient of a first problem is being computed. According to the present invention, however, the mechanism for storing a first multiplier in the machine is associated with a "full" multiplier keyboard, wherein the complete multiplier is set up and the keys are latched in set position. Other novel features will appear from the following description.

The invention consists in the novel construction and combination of parts as set forth in the appended claims.

In the accompanying drawings illustrating the invention:

Fig. 1 is a plan view of a calculating machine constructed in accordance with the invention.

Fig. 2 is a right hand elevation of the machine, with parts broken away.

Fig. 3 is a section, taken on line 3—3 of Fig. 1.

Fig. 4 is a left hand elevation of the machine, with parts broken away.

Fig. 5 is a section, taken on lines 5—5 of Figs. 19 and 24.

Fig. 6 is a section taken on line 6—6 of Fig. 5.

Fig. 7 is a detail section through keyboard 18, looking from the right hand side of the machine.

Fig. 8 is a similar view, looking from the left hand side of the machine.

Fig. 9 is a planar section of keyboard 18, taken just below the lower key supporting plate.

Fig. 10 is a section, taken on line 10—10 of Fig. 9.

Fig. 11 is a section, taken on line 11—11 of Fig. 9.

Fig. 12 is a section, taken on line 12—12 of Fig. 9.

Fig. 13 is a detail plan view of the selector bails and latches of the keyboard 18.

Fig. 14 is a section, taken on line 14—14 of Fig. 1.

Fig. 15 is a detail view of parts hidden in Fig. 14.

Fig. 16 is a section, taken on line 16—16 of Fig. 1.

Fig. 17 is a section, taken on line 17—17 of Fig. 18.

Fig. 18 is a section, taken on line 18—18 of Fig. 1.

Fig. 19 is a section, taken on line 19—19 of Fig. 1.

Fig. 20 is a detail view of parts hidden in Fig. 19.

Fig. 21 is a section, taken on line 21—21 of Fig. 17.

Fig. 22 is a detail section of parts of the multiplier feed.

Fig. 23 is a rear elevation of the right hand portion of the machine, with parts broken away.

Fig. 24 is a section, taken on line 24—24 of Fig. 1.

Fig. 25 is a detail plan view of the multiplier feed clutch and associated parts.

Fig. 26 is a detail end view of parts shown in Fig. 25.

Fig. 27 is a detail plan view of a portion of the carriage shifting mechanism, with the carriage shifting clutch in engaged position.

Fig. 28 is a similar view with the carriage shifting clutch shown in disengaged position.

Fig. 29 is a front elevation of the right hand portion of the machine, with parts broken away.

Fig. 30 is a section, taken on line 30—30 of Fig. 29.

General operation

The invention is shown as applied to a Monroe calculating machine, the essential features of which are disclosed in U. S. patents to George C. Chase, #1,566,650, issued December 22, 1925, entitled Operating means

for calculators, and #1,664,661, issued April 3, 1928, entitled Full-cycle positioning mechanism.

According to these disclosures, amounts set up on the keyboard 18 and thereby upon the differential actuating gears 5, (Fig. 30) are registered upon numeral wheels 13 by the operation of differential gear shaft 4 and shaft 154, whereon the tens carry members are mounted, these shafts being connected by suitable gearing, and driven by an electric motor 587.

A multiplier register is also provided, comprising numeral wheels 85, driven by mechanism adapted to register on said wheels the number of cycles of operation made by the differential actuators 5. Wheels 13 and 85 are mounted in a transversely shiftable carriage, which is employed in the well-known manner in performing operations in multiplication.

The motor 587 (Figs. 16 and 23) is connected with shaft 154 by means of a planetary gear mechanism, (Fig. 3) fully described in Patent 1,566,650, the gear members 105 and 109 normally rotating idly, but adapted to be selectively arrested by means of a reversing clutch lever 111, to drive the third member of the differential, connected with the carry shaft, forwardly or reversely (Fig. 3).

Reversing clutch lever 111 is thrown from neutral into additive or subtractive clutch position by means of add key 120, subtract key 121 or division lever 201, as fully described in the above-mentioned art, and by the multiplier devices forming the subject of the present invention, in the manner hereinafter described.

To bring the actuators to rest at the end of an operation, a crank arm 20 is provided upon shaft 4, said arm having a link connection 21 with a rock lever 22. A normally inactive rock arm 24 is provided with a pivoted stop element 25, located in the plane of and normally held outside of the path of movement of rock lever 22, by contact with the end of a compound trigger 31.

Lifting of the forward end of trigger 31 will release element 25 which, under the action of its spring, will drop into position to engage the rock lever 22 as the latter begins its necessary forward stroke, arm 24 will now move as a unit with rock lever 22, a rearward extension 144 of said arm engaging, by means of pin 145 with a cam portion of reversing clutch lever 111, to bring the latter to neutral or unclutched position.

The numeral wheel actuating means thus freed from the action of the motor will be brought to rest at full cycle position as follows:

Following the action of arm 24 upon lever 111, continued movement of lever 22 and arm 24 will bring the latter into engagement with a fixed stop, secured to the framing of the machine, whereby forward movement of the parts will be rested beyond the full cycle position and the spring of arm 24 will be tensioned. This spring, together with the rebound action of the parts, will return the actuating mechanism to full cycle position, where the movement will be finally checked with the parts locked in such position by means of lock lever 200 engaging the end of link 21 as shown in Fig. 3. Lock lever 200 is raised out of engagement with link 21 by the mechanism associated with the different operation control keys, and will be held in disengaged position by means of a spring latch 204. As arm 24 is rocked forwardly in the stopping operation, a suitable pin thereon will contact with the latch 204 and release the lock lever therefrom.

Automatic carriage shifting means are placed in operative position by the engagement of the clutch hub 62 (Figs. 27, 28 and 30) of a carriage shifting cam 59 with a clutch member 61, fast upon carriage shifting shaft 46. The engagement of these members provides for shifting the numeral wheel carriage 2 to the right upon the completion of a multiplier figure registration.

The carriage shifting mechanism will be operated, upon operation of the full cycle stopping elements, by means of a push rod 47 (Fig. 3) pivoted upon the arm 24, said push rod engaging a roller 51, mounted on bell lever 52. Lever 52 has connection through a flexible element 57 with a carriage shifting lever 55, (Fig. 29) provided at its free end with a roller adapted to operate the carriage shifting cam 59. Thus movement of arm 24, through the connections described, will rotate cam 59 and shaft 46, the latter raising and shifting numeral wheel carriage 2, by means of a crank pin, engaging a rack on the forward edge of the carriage.

All of the above is well known mechanism, and the detailed operation of the parts are not essential to the understanding of the present invention.

Setting for multiplication

In order to couple the multiplier unit of the machine to the general registering mechanism, and to set the machine for performing problems in multiplication, a knob 530, (Fig. 1) located on the left hand side of the machine is pushed to the rear, this knob being connected by a two part lever 531 to rock shaft 532 (Fig. 4). Shaft 532 extends beneath multiplier keyboard 533 and beneath keyboard 18 of the general registering mechanism. Beneath keyboard 18 shaft 532 is provided with a blade 534 engaging between the walls of notches 535 in the lower margins of the selector bails 19 (Figs. 7 and 8), so that as shaft 532 is rocked rearwardly bails 19 will be moved longitudinally upon

their pivot studs to bring the upper cam lugs out of register with the lower ends of the stems of the keys 18. The effect of this arrangement is to provide a keyboard wherein the depression of a key 18 will not adjust the selector bails or the differential actuator gears 5, but will merely place the end of the key-stem in position to cooperate with these parts at a later time.

The bails 19 are provided with latches 536 (Figs. 7 to 10) which operate to store a multiplicand in the selecting mechanism in the manner hereinafter described, the blade 534 of shaft 532 holding the latches 536 in raised position, out of engagement with the bails, by means of the arms 537 when knob 530 stands in its forward position. As shaft 532 is rocked rearwardly blade 534 will move along the cam surfaces 538 of arms 537 permitting the arms to fall and the latches to rest on the cam lugs of the bails. This release of the latches 536 is not immediately effective for any useful purpose, but the movement of knob 530 to the rear will place the latch control mechanism in the proper position for the following operations.

Movement of knob 530 to the rear will disable the keyboard locking means related to keyboard 18, so that the keys may be freely depressed whether the machine is in operation or not, except at the times hereinafter mentioned. This is accomplished by means of a lever 539 (Fig. 14) secured on shaft 532 this lever releasing one arm of a three armed lever 540, in the rearward movement of shaft 532, and engaging a second arm of said lever, to raise the third arm of lever 540 into engagement with the keyboard locking arm 7, and raising the same out of the path of movement of the locking cam 8 mounted on the selector gear shaft 4 of the machine. Locking arm 7 cooperates in well known manner with a key lock bail 6, (Fig. 5) and when in active position locks the bails, and thereby the keys 18 against readjustment during a registering operation

Lever 540 also serves to lock the division lever 201 in inoperative position, by means of a notch 541 in the work arm of lever 540 engaging a pin 542 of the division lever (Fig. 15).

When the machine is set for multiplication the plus and minus bars 120, 121, (Figs. 1 and 2) are locked in inactive position by means of a sliding plate 543 provided with lugs adapted to be positioned beneath the stems of the plus and minus bars. Plate 543 is moved into locking position by means of a tooth 544 on shaft 532, said tooth engaging between projections of the sliding plate. (Figs. 2 and 10).

In order to provide for the automatic shifting of the numeral wheel carriage 2 and of other parts to be hereinafter described during the registration of a product, a carriage shifting clutch is engaged when shaft 532 is rocked. This clutch consists of a ratchet tooth hub member 62 of a carriage shift cam 59 (Figs. 27—30), said hub being carried into engagement with a tooth member 61 on the carriage shifting shaft 46, by means of a link 545 engaged at one end by the blade 534 and at its other end engaging the end of a flexible plate 546 attached to a pivoted frame 65 having shipper connection with the carriage shift cam 59.

In order to insure that the division lever 201 stands in inactive position before the machine is set for multiplication an off-set portion 547 of a plate 548, (Fig. 24) secured to arm 549 of shaft 532, will be carried rearwardly in the movement of said shaft and, if the division lever 201 stands in active position, will contact with a pin 205 (Fig. 3) of said lever and force the parts into inactive position. This action will occur before the locking of the division lever by means of lever 540, as previously described.

The automatic control of the number of cycles of registering operation to be performed in each ordinal position of the numeral wheel carriage 2 is governed by the multiplier storage devices in the left hand unit of the machine. The multiplier having been stored in these devices, it is necessary to connect the multiplier mechanism with a portion of the general registering mechanism which operates in cycle with the numeral wheel actuators. Therefore, a stud shaft 550 has a crank connection 648 (Figs. 3 and 24) with the crank arm 20 of actuator shaft 4. Train of gears 551 connect shaft 550 with a hub 552 (Figs. 23—26). A clutch member 553, splined to the multiplier feed shaft 554 is adapted for movement upon said shaft into clutching engagement with hub 552. For engaging this clutch an arm 555 on shaft 532 has a link 556 operating the bell crank lever 557, one arm of which is provided with a yoke engaging clutch member 553. When clutch 553 is disengaged shaft 554 is locked in normal position by means of an arm 558 (Fig. 20) pivoted upon the left hand framing of the machine, and engaged intermediately of its length by a cam 559, mounted upon shaft 532. As shaft 532 is rocked and the clutch 553 brought into engagement, cam 559 will permit arm 558 to fall away from a flat surface on shaft 554, leaving the shaft free to rotate at the completion of each partial product registration.

At the conclusion of each multiplier figure operation the registering mechanism is brought temporarily to rest while the carriage is being shifted to the next ordinal place. The stopping of the registering mechanism is governed by the operation of a tripping pin 560 (Fig. 24) hereinafter more fully described. This pin must remain in operative position until the conclusion of the

multiplying operation, at which time it is necessary to disable the tripping pin in order to bring the machine to rest. Therefore, means (as follows) are connected to the locking lever 200 of the registering mechanism for governing the position of the trip pin (Fig. 3), this lock lever being controlled by means hereinafter described so that it will remain in inactive position throughout a multiplying operation, and will fall into locking position at the conclusion thereof. Lever 200 (Figs. 3, 17 and 24) is provided with a pin 561 lying beneath a plate 562, pivoted to the framing of the machine to the right of the multiplier keyboard (Fig. 24) and extending at its free end into contact with an arm 563 in which the pin 560 is fixed. When plate 562 is held in raised position the end thereof will be in register with a cam portion 564 (Fig. 17) of arm 563, and will act to hold arm 563 slightly to the right, with pin 560 overlying the trigger 31 of the stopping means. Plate 562 is allowed to move with pin 561, when the machine is set for multiplication, by the rocking of shaft 532 a crank arm 565 of said shaft moving away from a cam projection 566 of the plate, and allowing said plate to fall upon the pin. (Figs. 3 and 24).

As will be apparent from the following description, certain of the mechanisms operated by shaft 532 should be reciprocated by movement of the shaft to and from its forward rock position upon the performance of each problem in multiplication. Therefore, lever 531 is provided with a latch arm 567 (Figs. 4 and 6) having a notch adapted to drop into register with a pin 568 mounted on a rock arm 569, which arm is reciprocated by motor drive means hereinafter described. When knob 530 is manually set to its forward position pressure upon the knob will lift latch 567 and release shaft 532 from rock arm 569.

The multiplier setting means should also set devices into position whereby the multiplier key 570 will be rendered operable. The operative member of key 570 consists of a dog 571 (Figs. 4 and 6) pivoted to the keystem at 649 and cooperating with a lug 572 on rocker frame 573, as hereinafter described. When knob 530 is in its forward position dog 571 is held out of line with lug 572 by means of a bell crank lever 574, one arm of which engages dog 571, and the other arm of which is provided with a lug riding upon the upper surface of latch arm 567. As the notch of this arm drops over the pin the arm will move downward sufficiently to allow the bell crank lever 574 to drop away from dog 571 the dog now being pulled by spring 575 into position overlying lug 572.

Setting of the factors

The multiplicand keys are set to represent the desired multiplicand value, this operation, as previously stated, serving merely to position the bottoms of the keystems so that they will later effect setting of the multiplicand bails.

This keyboard is shown as provided with the well known repeat—non-repeat mechanism, which may be set by appropriate keys either to automatically clear the setting from the keyboard during each cycle of operation, or to disable this automatic clearing mechanism so that the setting of the keyboard will remain therein until cleared out by the usual clear key or the zero keys of the individual columns. It may be noted that in this machine a single multiplication may be effected irrespective of whether the mechanism is set for repeat or non-repeat operation, since the amounts first entered in the keyboard 18 are thereafter stored in the differential actuator gears, this storage being independent of the further manipulation of the keys. However, if full advantage is to be taken of the operation for setting up a second multiplicand while the machine is registering under the control of a first multiplicand, the repeat key should be depressed, so that when the keys 18 are set to represent the second multiplicand they will remain in set position, ready for the second operation of the machine.

The multiplier is set in the keys 533, these keys serving to position the bails 576 and thereby differential actuating gears 577 (Figs. 17–19) to represent the desired multiplier value. These bails and gears are of the well known Monroe type, illustrated in the patents hereinbefore referred to, and needing no further special description.

Both keyboards 18 and 533, are of the "flexible" type, whereby, by well known means, the depression of a digit key will effect the restoration of any previously depressed key in the same column. While no repeat—non-repeat keys are shown in connection with keyboard 533 (Fig. 1), it will be apparent that the same mechanism may be employed for controlling the keys of both keyboards, or that separate repeat—non-repeat mechanism might be provided for keyboard 533.

Entering the factors

When a multiplication operation is to be started the numeral wheel carriage 2 should be positoned to the extreme left, from which position it is advanced step by step toward the right during the operation of the machine. The amount stored in the gears of the multiplier mechanism also controls the number of cycles of operation in successive columns of the multiplier mechanism, beginning at the right hand column and continuing successively in the columns to the left thereof. In order to govern this action the feeding finger 578 (Figs. 17 and 23) is

splined upon shaft 554, along which shaft it is movable by operation of an endless cable 579, attached to the feeding finger and leading therefrom in both directions through the keyway of shaft 554, over rollers 580 and connected to an extension 581 of the carriage 2. The points of connection of cable 579 to the feeding finger and to the carriage are so positioned that when the carriage is in extreme left hand position the feeding finger will be in extreme right hand position and that movement of the carriage toward the right will move the feeding finger toward the left, from column to column.

The multiplier key 570 is normally locked in raised position by means of a spring latch 582, (Figs. 1 and 5) engaging a notch of the keystem. As the carriage 2 is moved into the proper starting position a finger 583 on the forward edge of the carriage will engage a push rod 584, which rod engages at its further end with latch 582. Thus, when the carriage is moved into extreme left hand position the multiplier key will be unlocked and, if knob 530 is in rearward position, the key may be depressed to initiate a multiplying operation.

The depression of multiplier key 570 will, by means of the previously described dog 571, rock frame 573 to engage a gear 585, carried thereon, into mesh with a gear 586, in driving connection with motor 587 (Figs. 4—6, 16, 23). Rocking frame 573 is provided with a roller 588 of insulating material, which in the rocking of the frame is moved downwardly to effect the contact of a switch 589 interposed in the motor circuit. The lead to this switch is in parallel with a second lead which is extended to a switch governed by the locking lever 200 (Fig. 3), as shown in the patents previously referred to, so that closing of either of these switches will complete the circuit through the motor and start the motor and drive shafts in operation. The gear 585 (Figs. 4, 6 and 16—19) is connected by a rod 590 with a segment 591, linked to arm 569 said segment meshing with a gear 592 on the shaft 593 of the multiplier differential actuator gears 577. Therefore, a rotation of gear 585 will reciprocate segment 591 and oscillate gears 577 back and forth, through their zone of active movement.

In order to prevent rocking of segment 591, closing of switch 589 and engagement of gears 585 and 586 by the manual movement of the knob 530 to the rear in setting the machine for multiplication a stopping member 594 (Fig. 4) is pivoted to the framing of the machine at 595, said member having a lug 596 underlying segment 591, so that the segment, connecting rod 590 and frame 573 cannot be rocked so long as member 594 remains in the position described. Member 594 is provided with a cam lug 597 lying in the path of movement of the multiplier keystem (Figs. 4 and 5) so that when key 570 is depressed member 594 is moved to one side and lug 596 is carried out of the path of movement of segment 591.

Means are provided whereby the driving mechanism just described will be given a single cycle of operation, and will be thereafter brought to rest, irrespective of the length of time that finger pressure is maintained on key 570. This means comprises a latch lever 598 fulcrumed on frame 573 at 599 (Figs. 4 and 6), the forward end of said lever normally resting on a tooth 600, on the frame of the machine. As rocker frame 573 is moved, lever 598 will be carried rearwardly, until the forward end thereof drops from contact with tooth 600. This movement of the latching lever will bring a laterally bent lug 601 on the rearward end of said lever out of the path of a pin 602 fixed in the gear 585, a second lug 603 of lever 598 being at the same time raised into the path of movement of pin 602. As gear 585 completes a cycle of movement, pin 602 will contact with lug 603 and depress the rear end of lever 598, bringing lug 601 into the path of movement of said pin and raising the forward end of lever 598 out of contact with tooth 600, so that frame 573 will be free to swing forward, under the influence of a spring 604. This tripping of latch lever 598 cannot be prevented by holding key 570 depressed, because the excursion of segment 591 has carried therewith lever 531, said lever being provided with an arm 605 having a pin underlying the forward arm of dog 571. Thus after lever 531 is carried forwardly arm 605 will move dog 571 out of engagement with lug 572, allowing frame 573 to rise slightly so that dog 571 cannot again engage over lug 572 until the key is released.

In the oscillation of the differential actuator gears 577, (Figs. 16 and 18) amounts set on said gears will be transferred to storage gears 606, rotating the controlling pin 607 of said gears a number of spaces out of normal position corresponding to the amounts set up on the corresponding actuator gear. The shaft 608 of gear 606 is mounted in a rocking frame 609 (Figs. 18 and 21), said frame having finger 610 pivoted thereto and extending forwardly to cooperate with cam 611 fast upon shaft 593. As shaft 593 oscillates, cams 611, through fingers 610, will raise rocking frame 609 and bring storage gears 606 into the path of movement of the differential actuator gears 577. As shaft 593 reaches its extreme oscillated position, completing the transfer of the multiplier to the storage gears, fingers 610 will fall to the low points of cam 611, allowing the storage gears 606 to fall away from the path of movement of the actuator gears. As shaft 593 begins to oscillate in the opposite direction finger 610 will be moved pivotally by engagement of the free end of said fingers

with a bevel portion 612 of cams 611, so that during the return movement of the actuator gears the storage gears will remain in lowered position. At the end of the return movement, fingers 610 will be released from contact with the lateral face of the raised portions of cam 611 and will be moved by suitable springs into their normal relation to said cams. Normally the storage gears 606 are held positively in their disengaged position with relation to the actuator gears by means of an arcuate tooth 613, rigidly attached to shaft 593, said tooth, in the normal position of the shaft, contacting with an extension 614 of the frame 609. In the oscillation of shaft 593 above described tooth 613 will be carried out of register with extension 614, to allow for the movements described.

It has been shown that the factors of a second problem can be entered in keyboards 18 and 533 during the computation of a previously set problem. During the time, however, that a factor set in one of the keyboards is being entered in the storage devices, the keyboard setting must remain unchanged, and for this, means are provided for locking the amounts in the keyboards during this time, and for thereafter unlocking the keyboards. The keyboard locking means are of well known type, consisting of locking bails 6 (Fig. 5) normally held in notches of the keystems by suitable springs. When a key is depressed or released, bails 6 must be cammed out of engaging position with the key notch, and when the keys are to be locked in adjusted position the bails 6 are engaged by a sliding plate 10, one of said plates being slidably mounted in each keyboard.

The plate 10 of the keyboard 533 (Figs. 5 and 19), is held in locking position by an intermediately fulcrumed lever 615, the forward arm of said lever engaging plate 10 and the rearward arm lying to one side of and just above the finger 610 at the left hand side of keyboard 533, when said finger rests in its normal position. As finger 610 is lifted by cam 611 during the storing operation, this finger will rise into the path of movement of the end of lever 615, so that with the parts in this position lever 615, slide 10 and the locking bails 6 cannot be moved, either by the keys or by the key releasing means. After the entry of the selected amounts in the storage gears, plate 609, in falling away, will move finger 610 out of the path of movement of lever 615, and the multiplier keys with their bails and actuator gears will be unlocked, ready for the reception of a new multiplier setting.

During the operation of the multiplier storage mechanism above described, the multiplicand set up on the keys 18 will also be stored in the selector bails 19 and differential actuator gears 5 of the right hand unit of the machine.

This is accomplished by the rocking of shaft 532, which, as above stated, has been connected through arm 569 and a link 616 with the segment 591. During the forward movement of shaft 532 by this driving connection the finger 534, previously mentioned, will move to the position shown in full lines, Figs. 7 and 8, from the dotted line positions, thereby by engagement with cam surface 538, lifting arms 537 and latches 536, so that the bails 19 are freed from the latches. At the same time the bails 19 are moved from their position out of register with the bottoms of the keystems, into registering position, having been rocked into position to avoid contact with the lower cams of the keys by means of a "pincher" mechanism. This pincher mechanism (Figs. 9—12 and 14) comprises a cam 617, pivotally mounted upon the lever 539, said cam contacting with a roller 618 mounted on an arm 619 intermediately pivoted to the keyboard plate. At one side of the pivot, arm 619 is engaged by a slide 620, and at the other side of the pivot by a slide 621, movement of arm 619 thus moving these slides in opposite directions. Slides 620 and 621 are provided with teeth engaging alternate bails 19, so that upon forward rocking of shaft 532 each pair of bails 19 will be pinched together into a position lying in the place of the notches between the lateral cams of the keystems (Fig. 5). At the end of the forward movement of lever 539 roller 618 will leave cam 617, and suitable restoring springs will move the bails apart from each other until they are arrested by contact with the cams of the keystems, thus taking set positions in accordance with the setting of the keys in the different columns.

In the return movement of shaft 532 blade 534 will allow arms 537 to fall, permitting the latches 536 to engage the cam lugs of the bails 19. The left hand bail 19 of each pair has only one active position, this representing a value of five, and only one latch is provided for each of these bails. The right hand bail 19 of each pair has, however, four different active positions, representing values of one, two, three and four and four latches are provided for each of these bails, cooperating with cam lugs which are offset from the longitudinal axis of the bail to different extents. Thus if the 1—4 bail is held by a depressed key in position for registering one, the latch 536 cooperating with a one value lug will drop behind said lug and hold the setting. If two, three or four has been set on the bail the corresponding one of the other three latches 536 will operate in a similar manner.

It will be noted from Figs. 7 and 8 that there is lost motion in the connection between blade 534 and the bails 19, so that the latches 536 will be dropped into active position before blade 534 will contact with and move the

bails 19, and move the lugs thereof out of register with the keystems. In the rearward movement of lever 539 (Figs. 10 and 14) roller 618 will engage in rear of cam 617 and will move said cam aside on its pivot, so that the pinching mechanism may be idle during the return stroke of the parts.

In this position of the parts latches 536 will hold bails 19 and actuator gears 5 in position to represent the value which has previously been set into the keys.

During the above described operation of storing the multiplicand in the machine, the keys 18 will be locked against readjustment by means of a blocking plate 622 (Fig. 4), movable by means of a cam 623 secured upon the link 616 into position across the end of a rod 624 extending beneath keyboard 533 and into contact with the previously described key locking arm 7, or optionally into contact with the locking plate 10 of the keyboard 18. Thus, rod 624, plate 10 of the multiplicand keyboard and the locking bails 6 engaged by said plate will be held against lateral displacement during the entire oscillatory movement of shaft 532 by the motor means previously described. It is to be noted that cam 623 is attached to the motor driven means, and will not be displaced by manual operation of knob 530.

Product registration

As soon as one of the storage gears 606 is displaced from normal position by an actuator gear 577, means will be operated for setting the machine in motion to register the product. A shaft 625 is mounted in frame 609 (Figs. 21 and 24) and upon said shaft is rigidly mounted a series of fingers 626, each finger cooperating with a cam 627 attached to a storage gear 606. Thus movement of any of the storage gears from normal position will cam one of the fingers 626 and rock the shaft 625 in clockwise direction as viewed in Fig. 21 and counter-clockwise as viewed in Fig. 24. On the right hand end of shaft 625 is an arm 628 contacting with one arm of a lever 629 intermediately fulcrumed at 630.

Lever 629 is provided with a finger 631 engaging a pin 632 of a pivoted extension 633 of trigger 31 (Fig. 3). This extension 633 carries the well known tooth cooperating with the pin 9 of a selected one of the numeral wheels 13 to stop the machine in division operations when an overcarry occurs in the numeral wheels. The finger 631 above described acts to move extension 633 pivotally so that the tooth will be held out of the path of movement of the pin 9 of the numeral wheel during a multiplier operation.

The forward arm of lever 629 engages a rocker 634, which rocker in the movement of the lever is brought into contact with the pin 561 of stop lever 200 previously described and lifts the lock lever out of locking position, thus freeing the actuators 5 for operation by the motor drive, and closing the switches operated from said lock lever, to complete the second circuit through the motor.

The main clutch of the machine is thrown into operation following the movement of lever 629 by means of the previously described plate 548 (Fig. 24). As lever 629 is rocked a bell crank lever 635 fulcrumed upon lever 629, will be lowered, and a spur 636 of said bell crank lever, engaging a pin 637 of plate 548, will, in its downward movement allow plate 548 to fall at its rearward end. Plate 548 is now reciprocated in the movement of shaft 532, the rearward end of said plate contacting in its return movement with a pin 147 projecting from the clutch yoke 111 (Fig. 3), and throwing said yoke into additive clutch position. As plate 548 completes its rearward or return movement it will be cammed upward by engagement with a stud 638 of the frame, so as to leave the clutch yoke 111 free to be moved out of and into clutching position during the registration of the product.

Means are provided for insuring that the stopping element 25 (Fig. 3) is latched out of operating position before the machine is started, this means comprising a bell crank lever 639 fulcrumed to the frame of the machine at the right hand side of keyboard 533. The rearward arm of bell crank lever 639 lies in the path of movement of the arcuate tooth 613 previously described (Figs. 5, 18 and 24), the other arm of said bell crank lever lying in front of the upper arm of element 25. In the oscillation of shaft 593 tooth 613 will rock lever 639 and move element 25 to allow trigger 31 to drop behind and hold said element in inoperative position.

The machine has now been started in operation, each cycle of the actuators 5 registering the multiplicand once in the numeral wheels 13, and each cycle of operation also setting one of the storage gears 606 one step backward toward normal position. When the storage gear being operated returns to normal position, means will be operated whereby the registering operation is interrupted, the numeral wheel carriage 2 shifted one place to the right, and the feeding finger 578 (Fig. 25) shifted one space to the left, to engage the next adjacent storage gear.

For this purpose a shaft 640, (Figs. 16, 18, 19 and 24) parallel to the shaft 554, is provided with a series of arms 641, each arm having pivoted thereto a feeler 642 adapted to be engaged by the pin 607 of the related storage gear. At the opposite side of its pivot, feeler 642 carrier a pawl 643 (Fig. 21), movable with the feeler into and out of the path of movement of the feeding finger 578.

When any of the storage gears stand out of their normal position the related feelers 642 stand in rocked position, with the pawls 643 out of the path of movement of the feed finger as shown in dotted lines Fig. 21. When a storage gear 606 is moved by the feeding finger 578 back to its normal position the pin 607 of said gear will contact with the feeler 642 and rock the same, to bring the pawl 643 thereof into the path of movement of feeding finger 578, as shown in full lines Fig. 21. Continued rotation of shaft 554 will carry the feeding finger against pawl 643, and, the other end of feeler 642 being held by pin 607, arm 641 and shaft 640 will be rocked slightly in a clockwise direction, as shown in Fig. 21 and counter-clockwise as shown in Fig. 24. The arm 563 previously described as carrying the pin 560, is supported on the end of an arm 644, fixed upon shaft 640, so that as shaft 640 is rocked pin 560 will be given a slight downward movement, sufficient to trip the trigger 31 and release the stopping and carriage shifting mechanism of the machine.

During the stopping and carriage shifting movement the actuator shaft 4, and consequently the train of gearing 551 is rotated beyond full cycle position, brought to a stop, and returned through full cycle position, all as previously described. During this movement the reverse rotation of shaft 554 will carry the feed finger 578 against pawl 643, said pawl yielding and allowing the finger to pass beyond it without entailing any movement of shaft 640 and the parts associated therewith.

In order to reengage the clutch yoke 111, which has been thrown into neutral position in the well known manner during the operation just described, a pin 645 (Fig. 24) is provided on one of the gears 551, said pin cooperating with one of the arms of bell crank lever 635. In the lowered position of bell crank lever 635, assumed so long as there is a value stored in the gears 606, a cam toth 646 of bell crank lever 635 lies in the path of movement of pin 645. Fig. 24 illustrates the full cycle position of the parts, pin 645 in additive operation moving in a clockwise direction. As the parts rebound in the interruption of the operation and swing through full cycle position, pin 645 will contact with cam tooth 646 and rock bell crank 635 bringing the other arm of said bell crank against pin 147 of clutch yoke 111 and moving said yoke back into additive clutch position.

It will later be shown that when all of the storage gears 606 have been brought to normal position the machine will be brought to rest, but should the feeding finger 578 be brought in line with a storage gear 606 which stands at zero and representing a naught in the multiplier preceding other digit figures thereof, the machine will be kept in operation and the carriage will be shifted to the next column by the operation of the devices already described. The feeding finger 578 is set to the next column when it stands approximately in the position shown in Fig. 21, from this position it will then be rotated in a clockwise direction, thus contacting with the pawl 643 before it has rotated into contact with the gear 606. This, as previously described, will result in a rocking movement of shaft 640 and the tripping of trigger 31. This tripping before the actuators 5 have passed into their zone of active movement operating to interrupt the actuation and to shift the carriage, without effecting any registration upon the numeral wheels, as previously described.

Upon movement of the last of the storage gears 606 to normal position, shaft 625 (Fig. 24) will be allowed to rock back to normal, carrying therewith arm 628, and allowing lever 629 to be retracted by its spring 647, carrying bell crank lever 646 out of the path of movement of pin 645, so that the clutch yoke 111 will not be reengaged, and the machine will be left at rest. Restoration of lever 629 also releases rocker 634 and stop lever 200, so that the stop lever falls and locks the actuators 5 in full cycle position and breaks the electric circuit through the motor.

The carriage 2 need not have a fixed starting position in multiplication. If a multiplier contained naughts on the right hand side, the latch 584 (Fig. 1) could be operated by the fingers to release the starting key 570 and the carriage could be positioned to start operating on the right hand multiplier digit.

I claim:

1. In a calculating machine having means for automatically registering the product of two factors; means for entering said factors in the machine, including keys whereon a plural figure multiplier may be set, storage devices for retaining said multiplier, multiplicand registering means normally disconnected from said devices, means for transferring a completely set multiplier from said keys to said storage devices and having an additional movement to free said devices from control of the keys, means for connecting said devices with said registering means, and means for registering a product under control of said devices, said transferring, connecting and product registering means being operatively interconnected and adapted for automatic sequential operation.

2. In a motor driven calculating machine having means for automatically registering the product of two factors; means for entering said factors in the machine, including keys whereon a plural figure multiplier may be set, storage devices for retaining said multiplier, multiplicand registering means and means for transferring a completely set

multiplier from said keys to said storage devices and for automatically initiating a product registering operation, including a clutch between said motor and said transfer means, a clutch between said motor and the registering means, and means for engaging said clutches alternately.

3. In a motor driven calculating machine having means for registering results according to two or more of the four rules of arithmetic, including control devices, motor keys, selective connections between said keys and said devices, and means for automatically registering the product of two factors; means manually operable to set the operation control devices for multiplication, means for locking the motor keys in inoperative position, and means operable by said setting means to release the lock of a given motor key and to engage the locks of the other motor keys.

4. In a motor driven calculating machine having means for automatically registering the product of two factors; means for entering said factors in the machine including settable keys, means for automatically locking said keys in set position during a registering operation, storage devices, and means for transferring a set factor from said keys to said storage devices and having an additional movement to free said devices from control of the keys, and means for disabling said locking means and thereupon initiating a registering operation.

5. In a calculating machine having means for registering the product of two factors and including registration control devices; means for entering said factors in the machine including settable keys, shiftable spring retracted storage members differentially settable by said keys, latches for holding said storage members in set position, means for shifting said latched storage members to release the same from the control of said keys, means for setting said registration control devices in accordance with the setting of said members, means for readjusting the storage members into cooperating relation to said keys, and means for moving the latches out of restraining engagement with said members.

6. In a calculating machine having means for registering the product of two factors, including actuators, differential selectors therefor and a keyboard normally connected with said selectors; automatic multiplier mechanism, a settable coupling for connecting and disconnecting the multiplier mechanism from the actuators, normally inactive multiplicand storage means adapted to retain a key setting in said selectors, and means operable to engage said coupling, to throw the storage means into action and to release said selectors from control of the keys.

7. In a calculating machine having means for registering the product of two factors, including differentially settable multiplicand mechanism and a numeral wheel carriage laterally shiftable with relation thereto; automatic multiplier mechanism including a plurality of denominational banks of keys, a series of denominational multiplier control elements related each to a bank of keys, a shiftable denomination selecting element cooperating with said control elements, and connections between said selecting element and the numeral wheel carriage, adapted to advance said selecting element from one control element to the next in a direction opposite to that of the carriage movement.

Signed at Orange, in the county of Essex and State of New Jersey, this 16th day of May, A. D. 1931.

EDWARD C. WALTER.