D. E. FELT.

CALCULATING MACHINE.

APPLICATION FILED MAR. 4, 1910.

996,009.

Patented June 20, 1911.

4 SHEETS—SHEET 1.

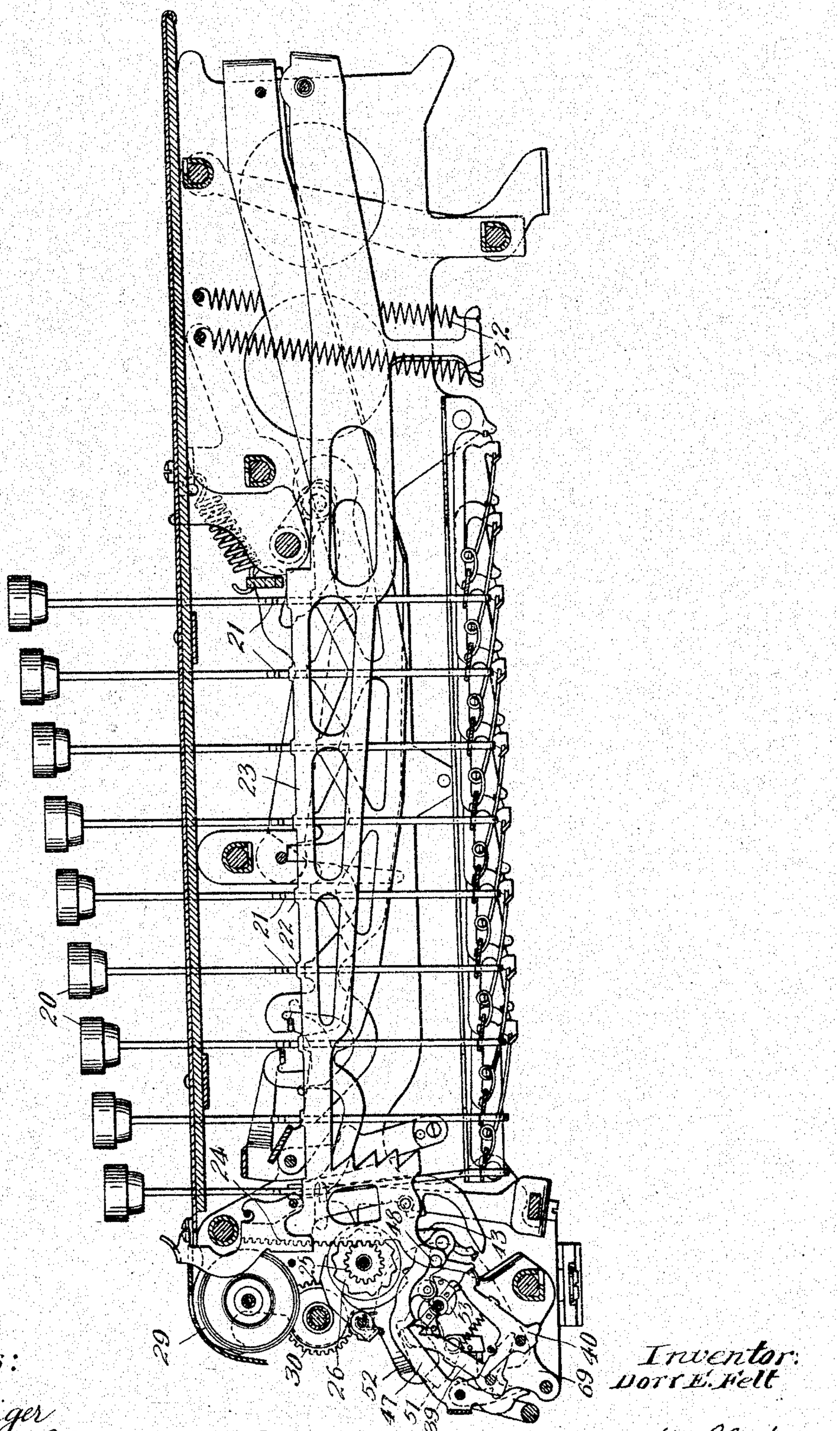

Fig. 1

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4 SHEETS—SHEET 2.

Fig. 2

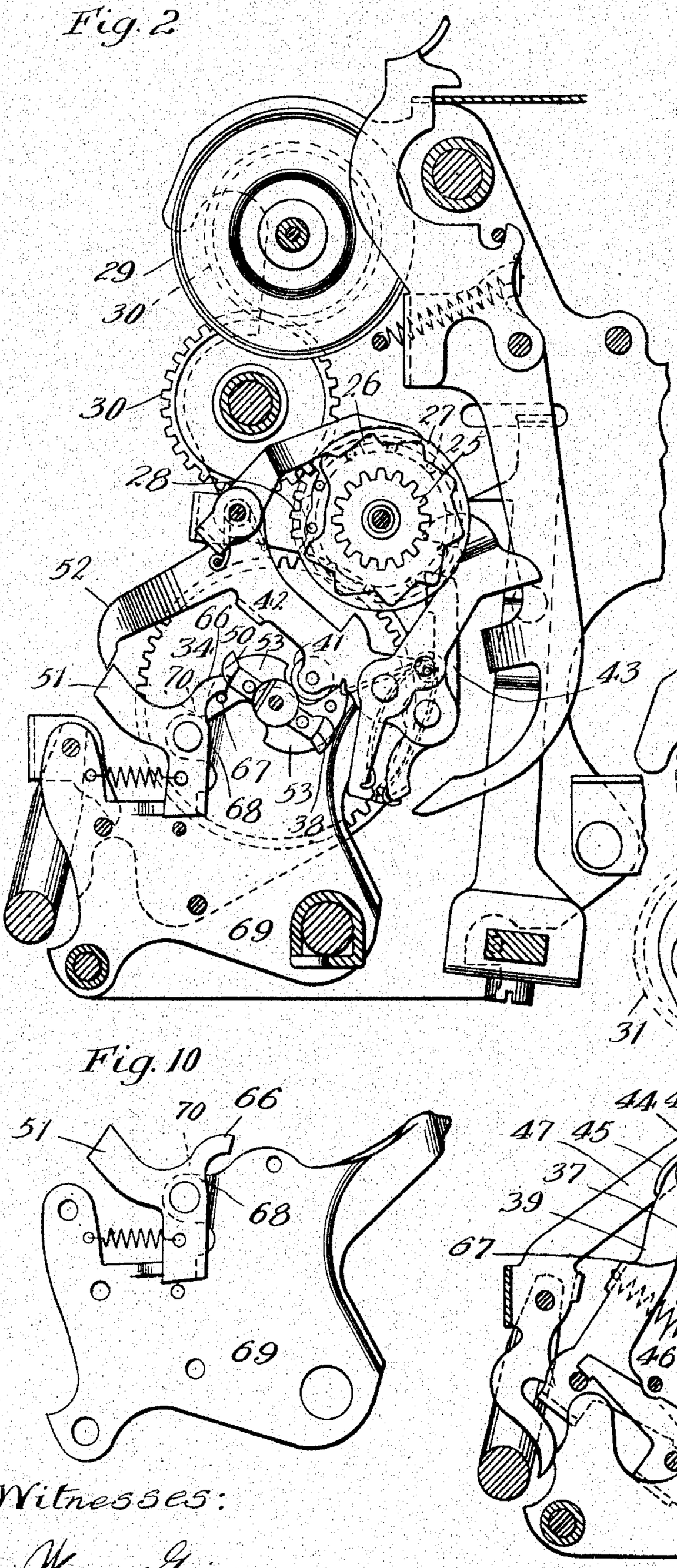

Fig. 3

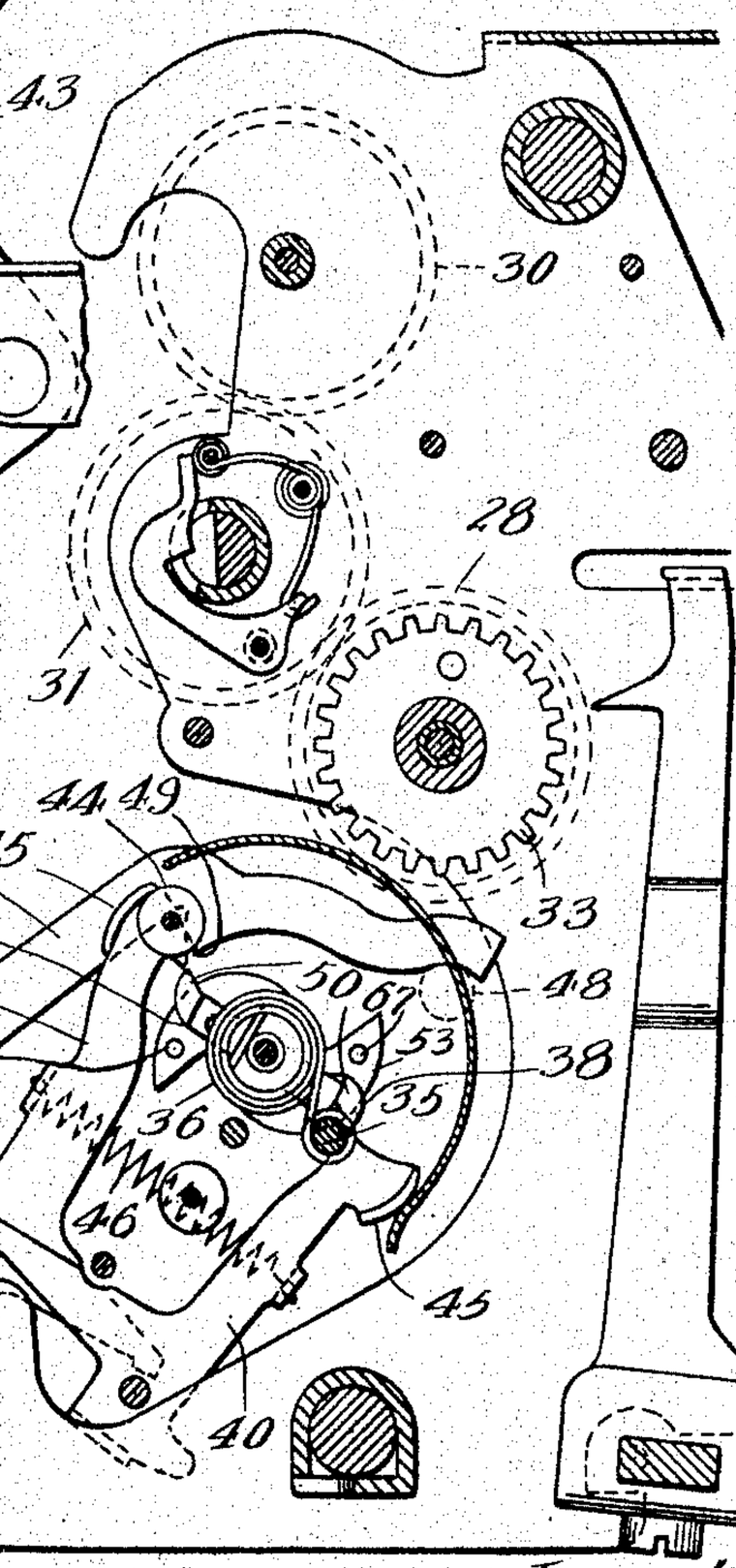

Fig. 10

Witnesses:

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4 SHEETS—SHEET 3.

Fig. 6

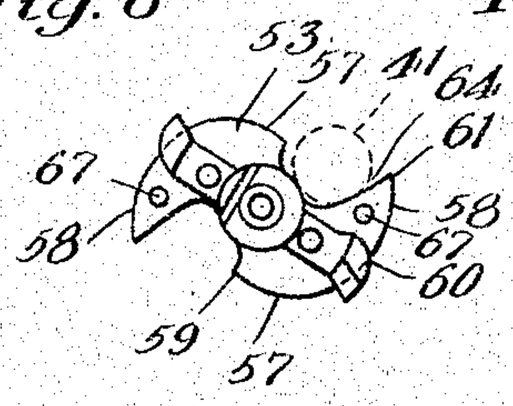


Fig 7

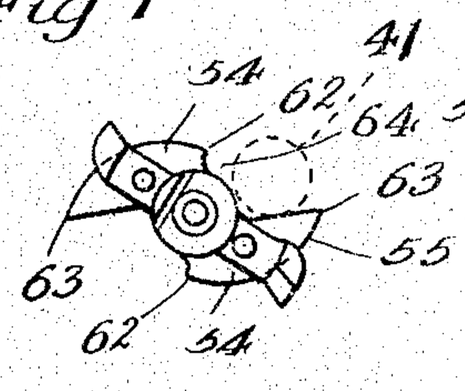


Fig. 8

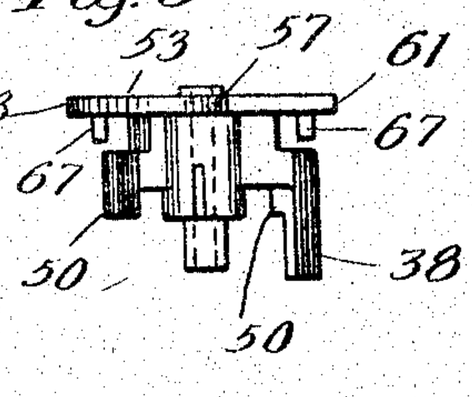


Fig. 1.

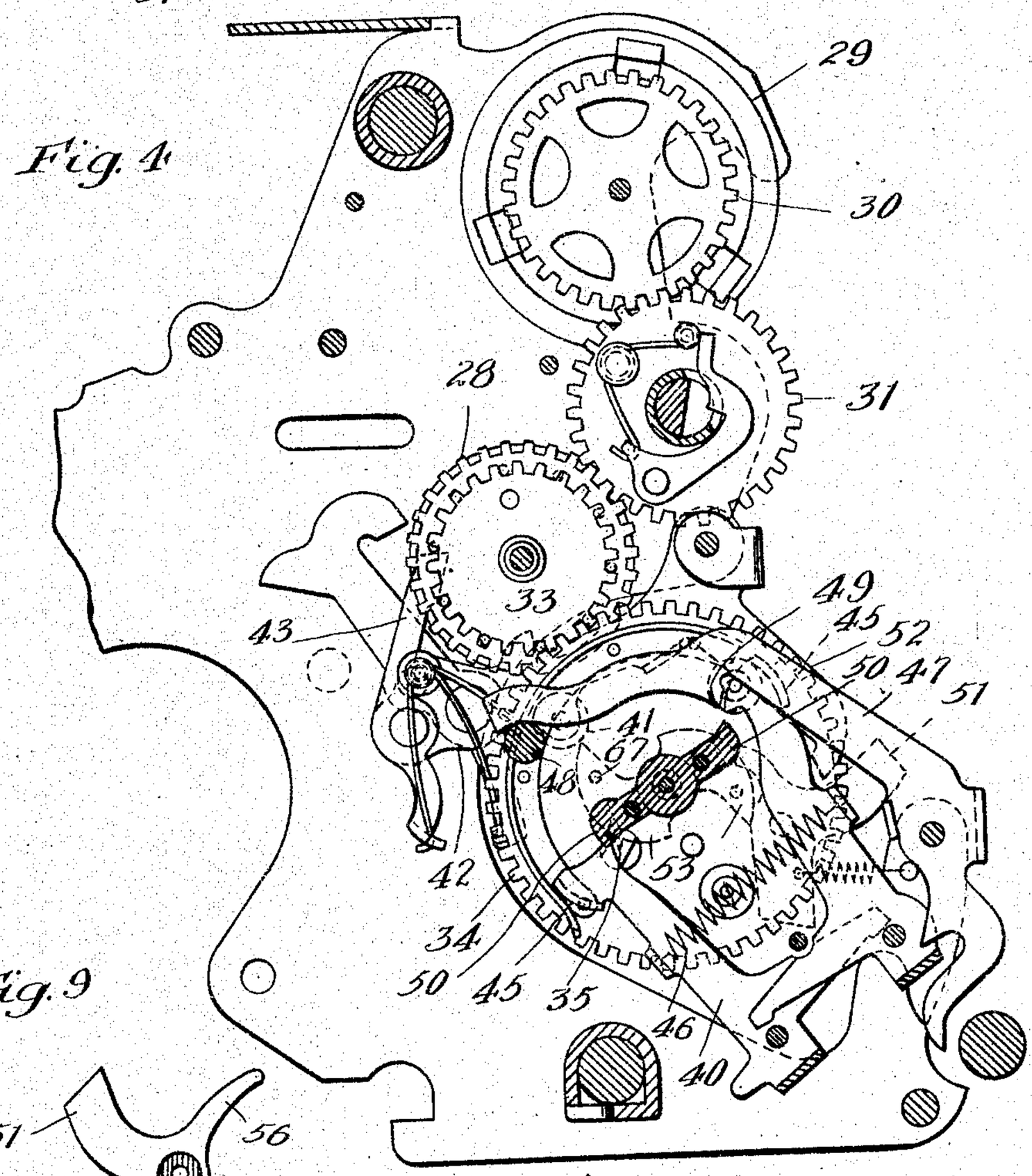
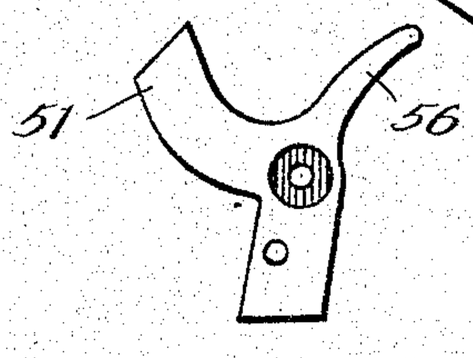


Fig. 9



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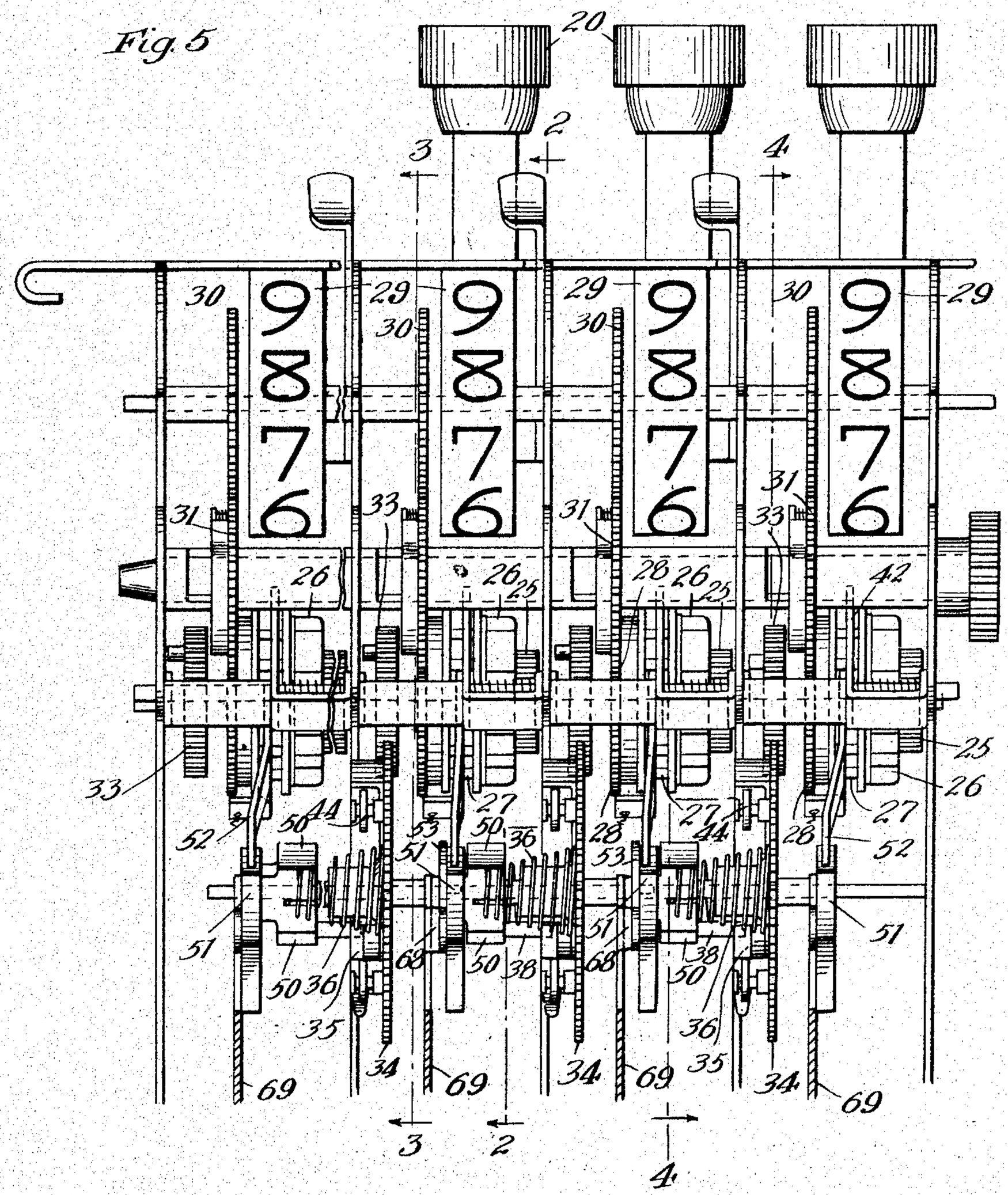
4 SHEETS—SHEET 4.

Fig. 5



Witnesses:

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UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS.

CALCULATING-MACHINE.

996,009. Specification of Letters Patent. Patented June 20, 1911.

Application filed March 4, 1910. Serial No. 547,224.

To all whom it may concern:

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

My invention relates to a multiple-order key-driven calculating machine, and more especially to a machine of the general type of the well known "duplex comptometer" in whose manufacture and marketing I have been extensively engaged for some years and whose general character is set forth in several United States patents issued to me, Nos. 762,520 and 762,521, of June 29, 1904, and 767,107 of August 9, 1904, and in my copending application Serial No. 453,271, filed September 16, 1908.

My invention has for an object the still further reduction of resistances and lightening of the key-touch in such key-driven machines, as a result of increasing the efficiency of and reducing the resistances in the automatic carrying-motors that transmit carrying impulses from one to another of the series of key-driven accumulator mechanisms. And the invention has for further objects the effecting of all other improvements in construction or function that may be found to obtain in the mechanism hereinafter described or claimed.

The key-touch in my above mentioned "duplex comptometers" has heretofore been exceedingly light, and greatly lighter than in the non-duplex comptometers manufactured in accordance with my earlier patents such as Nos. 366,945, 371,496, 396,034 and others; but it is always of high importance to lighten the key-touch to the utmost in such machines, because in such key-driven machines the entire power for both the prime actuations and the carrying-impulses of the accumulator mechanisms is derived from the mere finger touches of the operator upon the indexed keys of the keyboard, and furthermore, in the duplexing operation of such machines, the operator may and constantly does depress a large plurality of the key-driven column-actuators simultaneously, transmitting both prime actuations and carrying-impulses to a considerable plurality or even to all of the accumulator mechanisms simultaneously. This condition has developed a necessity for extremely high precision construction in the manufacture of the entirely automatic mechanism of such key-driven calculating machines as compared with the relatively coarse adjustments of, for instance, a lever-driven printing adding-machine in which a hand-lever or power-motor drives the accumulator mechanism instead of mere light finger-touches upon the finger keys. And one of the chief sources of resistance to the movement of the key-driven column-actuators in these machines is the automatic carrying-motors whose stored power, for the carrying-impulses they automatically transmit, must be entirely derived from said key-driven column-actuators.

In the accompanying drawings, forming a part of this specification, and in which like reference numerals indicate like parts in all of the figures, Figure 1 is a longitudinally vertical section through the machine; Fig. 2 is a section through the accumulator mechanisms, at the line 2—2 of Fig. 5; Fig. 3 is a section through the accumulator mechanisms, at the line 3—3 of Fig. 5; Fig. 4 is a section through the accumulator mechanisms at the line 4—4 of Fig. 5, viewed from the left-hand side instead of from the right as in Figs. 2 and 3; Fig. 5 is a front view of the accumulator mechanisms in the three right-hand orders and the extreme left-hand order of the machine, the intermediate orders being broken away, and those members being removed that would conceal the carrying-motor springs and cams; Fig. 6 is a view of the new carrying-cam escapement-member of each of the carrying-motors except that of the highest order, viewed from the right as positioned in the machine, with the dolly-roll of the carrying-lever indicated in dotted lines in its normal resting position at the rear end of one of the recesses between the two opposed carrying-cams constituting the carrying-cam member; Fig. 7 is a similar view of the prior type of carrying-cam escapement-member, with the dolly-roll similarly indicated, in the carrying-motor of highest order, at the left of the machine; Fig. 8 is a further detail view of the same member shown in Fig. 6; Fig. 9 is a detail view of the carrying-lever locking-pawl that coacts with the carrying-cam member shown in Fig. 8, in the highest order; Fig. 10 is a detail of one of the carrying-lever locking-pawls in the other orders, mounted on the front-intersection-plate that bears it.

When a key 20 in any given order is depressed, a shoulder 21 on the right-hand side of the stem of said key strikes a corresponding contact point 22 on the upper edge of the column-actuator segment-lever 23 in such order and depresses said lever 23 to the extent requisite to enable the upstroke of the segment-gear on the forward end of the lever to effect such part of a rotation of the corresponding accumulator mechanism as will advance the reading of the numeral wheel an amount equal to the index of the key depressed. During such depression of the column-actuator segment-gear 24, the pinion 25, meshing with said segment-gear and secured to the right-hand face of the internal pinion-ratchet 26 is rotated backward sufficiently to engage the proper internal tooth of said ratchet with the spring pawl mounted on the right-hand face of the accumulator lantern-ratchet 27, so that upon the upstroke of the column-actuator the said pinion 25 and internal ratchet 26, so engaging lantern-ratchet 27, will rotate said lantern-ratchet, and the accumulator-gear 28 secured thereto, sufficiently to add the desired amount to the reading of the numeral wheel 29 whose gear 30 meshes with the intermediate gear 31 that meshes with said accumulator gear 28. The column-actuator is so thrown upward, upon the releasing of the key from the finger of the operator, by the column-actuator springs 32. The rotation of the accumulator gear 28 will to like extent rotate the carrying-pinion 33 that is fast on the same hub with said gear 28; and such rotation of the carrying pinion will rotate to a proportionate, though lesser angular extent the large carrying-motor winding-gear 34 to whose stud 35 is secured the right-hand end of the carrying-motor spring 36. The other end of this motor spring is secured to and constantly tends to rotate forward the carrying-escapement member 37 whose long arm 38, projecting to the right is adapted to engage the rear edge of the flat end of the stud 35 on said winding gear 34, such engagement limiting the extreme extent to which said escapement-member may be rotated forward in angular relation to said gear. This long arm 38 of the escapement member is also adapted to be engaged by first one and then the other of the pair of releasing-detents 39, 40, so that when released by one of said detents, such escapement member can make only one-half of a full rotation before being engaged and checked by the other of said detents; and each such half-rotation of the escapement member gives a corresponding half-rotation of the carrying-cam member that is secured upon the left-hand end of the escapement member and that consists in the pair of opposed cam-arms over which the dolly-roll 41 of the bell-crank carrying-lever 42 rides during the carrying throws imparted to such lever by such cams. Each such 180° throw of one of these carrying-cams, lifts said bell-crank carrying-lever sufficiently to cause the carrying-pawl 43, borne on the rear end of said lever, to throw the lantern-ratchet of the next higher or left-hand accumulator one numeral space, thereby effecting a carrying transfer from the accumulator mechanism of the lower order to such accumulator of the higher order. The said release of the escapement member from first one and then the other of its releasing detents 39, 40 is effected through the lifting of such detents by the dolly-roll 44 that is mounted on the aforesaid carrying-motor winding-gear 34 and adapted to ride under the cam-faced ear 45, projecting laterally from each detent, when the winding-gear rotates into proper angular relation with the detent to be released. In this manner it is provided that while the winding-gear 34 may, by a full rotation, wind into the carrying-motor spring 36 sufficient power to effect two carrying-throws of the carrying-cam member, the alternate engaging and releasing of the escapement member by first one and then the other of the pair of opposed releasing-detents 39, 40, whose connecting spring 46 constantly tends to draw one or the other of them into the path of the long arm of the escapement-member, will restrict each throw of said escapement-member to a half-rotation and so release only one carrying-impulse at a time. And to prevent either carrying-cam, of any carrying-cam member, from effecting a carrying-throw of the coacting carrying-lever at a time when the accumulator of the higher order, impelled by said carrying-lever, is already in motion or about to be moved by the column-actuator that has been or is being depressed by one of the keys in that higher order, there is provided the detaining latch 47 that is normally held lifted by the stud 48, on such column-actuator of the higher order, but that, upon the depression of such column-actuator, and stud, drops into the position where hook-point 49, of said latch 47, is in the path of and intercepts one or the other of the short arms 50, 50 of the escapement-member, so that such escapement-member, and its carrying-cam, if then released from either of the releasing detents, is prevented from making a carrying-throw, and lifting the carrying-lever, until such detaining latch 47 is again lifted by the return to normal of the said column-actuator of the higher order, the order that is to receive the released carrying-throw. In this manner it is provided that keys may be depressed simultaneously, and column-actuator impulses delivered, in two or more adjacent orders, and yet any carrying-impulses released from a lower one of said or-

ders will not be actually delivered to the next higher of said orders until the column-actuator movement of such higher order is completed. This possibility of effecting simultaneously key-driven actuations of a plurality of column-actuators in adjacent orders, is the action that has been hereinbefore referred to as "duplexing". The automatic carrying-motor capable of storing the power for a plurality of carrying-impulses, and the mechanism for successively releasing such impulses and for detaining them until after the therewith interfering column-actuator movements are completed, prevent any of the carrying-transfers from being lost, as they would be if the carrying-lever impelling any accumulator were permitted to make a carrying-throw while such accumulator was already moving in response to its own key-driven column-actuator.

A 3-armed locking-pawl normally locks each carrying-lever from displacement, the forwardly extending arm 51 of such pawl being positioned to intercept any downward movement of the forwardly extended arm 52 of the coacting carrying-lever; but just before the carrying-lever is to make a carrying-throw, this pawl is thrown out of such intercepting position by reason of the lifting of a rearwardly extended arm, of such 3-armed pawl, by that cam-arm of the carrying-cam member over which the dolly-roll of the carrying-lever is about to ride. Such is, in brief outline, the manner in which prime-actuations and carrying-impulses are imparted to the accumulator mechanisms in the duplex comptometers of my first above mentioned patents and co-pending application. It will also be understood that these actuating mechanisms are associated with various stop-mechanisms, set forth in my said other patents, to limit the movements imparted to the accumulator-mechanisms by the prime actuations and carrying-impulses; and all of these stop-mechanisms, themselves requiring to be variously moved into and out of their several stop-positions, impose additional resistance to the movements of the carrying-devices and to the prime actuations of the accumulators and so themselves absorb a certain proportion of the power imparted to the keys by the finger-touches of the operator.

As has been stated, the actuation of the accumulators, involving winding of the carrying-motors, is effected by the upstrokes of the column-actuators that have been depressed by their respective keys, such upstrokes being accomplished by the retraction of the column-actuator springs 32 that are stretched when the corresponding column-actuators are depressed by the depression of their keys. These column-actuator springs must therefore be of such strength that their retraction will impart to the corresponding column-actuators all of the power required to do the work imposed upon such column-actuators; and the resistance offered by these column-actuator springs is the main resistance to be overcome in depressing the keys that depress the column-actuators, so that a substantial lessening of the work imposed upon the column-actuators will substantially lighten the key-touch by permitting the employment of substantially lighter column-actuator springs. And the present invention permits such employment of substantially lighter column-actuator springs, by substantially reducing the work imposed upon the column-actuators, such reduction of work being effected in the automatic carrying-motors whose winding absorbs a great proportion of the power transmitted from the column-actuators. This reduction of the power required to wind the carrying-motors is directly effected by the use of very much lighter carrying-springs 36 than have been employed in my earlier "duplex comptometers"; and the employment of such substantially lighter carrying-springs is made possible by a new organization of the carrying-cam members and the carrying-lever locking-pawls in all of the carrying mechanisms below the one at the extreme left of the machine—the earlier form of cam and of pawl being employed at said extreme left-hand position because it is desirable to there impose some increased resistance to compensate for the fact that no carrying-motor is wound by the accumulator impelled by the carrying-cam of highest order and the resistances to the movement of such cam need to be equalized with those of the lower orders so as to equalize the adjustments across the entire series of carrying-mechanisms. This prior form of cam member and of locking-pawl, retained at the highest order of the machine, are illustrated in respectively Figs. 7 and 9, thus affording a direct comparison with the form and operation of the new carrying-cam member and carrying-lever locking-pawl employed in the other carrying-mechanisms of the machine. The new carrying-cams 53 are the result of long and tedious experimentation, and the efficiency attained by them will be better understood after their construction and contour has been specifically described.

The cam-face of the prior type of cam 54 was produced by a single circular curve 55, continuous from the low point to the high point of the cam and struck from a single center, and lifted the dolly-roll 41, of the carrying-lever, at a substantially uniform rate throughout the angular throw of the cam, the cam exerting substantially the same lifting pressure against the dolly-roll at the beginning of such throw as toward the end

of such throw; and the rearwardly extending arm 56, of the prior form of 3-armed locking-pawl for the carrying-lever, rode over such cam-face just ahead of the dolly-roll 41, thereby causing the said pawl to be thrown forward out of its locking relation to the carrying-lever, leaving the carrying-lever free to make the carrying movement as the dolly-roll 41 is lifted by the said cam. But the cam-face contour of the new cam 53 is produced by two confluent circular curves, 57, 58, struck from two differently distant centers, the curve 57, of the lesser radius, extending upward from the low point 59, of the cam, and become confluent, at about the point 60, with the curve 58, of greater radius, that extends on to the high point, 61, of the cam, so that the dolly-roll 41 is lifted suddenly and with maximum rapidity during its traverse of curve 57, at the initial part of cam's angular throw, when the full tension of the impelling-motor is exerted, and then is further lifted but very gradually during the traverse of the further curve 58, when the tension of the impelling motor is partly spent; and to permit the abrupt initial gradient and yet render the final gradient as gradual as possible, the low point, 59, of the cam is displaced a considerable angular distance, relative to the cam's axial radii, rearward of the angular position of the low point 62 of the prior type of cam, 54, and the high point 61 is extended a considerable angular distance forward, relatively to the position of the high point 63 of said prior type of cam, thereby greatly restricting the width of the recesses 64 into which dolly-roll 41 drops when it rides off the high point 61; and such restricting of said recesses 64, as compared with the recesses in the prior type of cam-member, greatly reduces the length of the idle movement of dolly-roll 41 along the bottom of such recess at the beginning of the cam-member's carrying-throw and before the dolly-roll mounts the low point 59 of the opposed cam 53, and this reduced idle movement both necessitates and makes possible the tripping of the new off-set arm 66 of the 3-armed locking-pawl by a mere instantaneous touch of the new trip-stud 67 laterally fixed in the right-hand side of each new cam 53, it being necessary that said tripping occur during but not before said idle movement of dolly-roll 41, in order that the locking-pawl may free the carrying-lever before dolly-roll 41 lifts said lever but may hold said lever locked during the normal resting position of dolly-roll 41 at the rear end of the bottom of one or the other of the two diametrically opposed recesses in the carrying-cam member; and such instantaneous trip-stud tripping of the locking-pawl relieves the new cam 53 of the frictional resistance imposed upon the prior cam 54 by the riding of the arm 56, of the prior form of pawl, upon the cam-face of said cam 54, such riding of the arm upon the cam-face being an action that would also be too slow to be accommodated by the reduced idle movement of dolly-roll 41 in the restricted recess 64. To so displace toward the right the rearwardly extending arm of the 3-armed pawl that it may be engaged and tripped by the lateral trip-stud of the cam instead of riding over the face of the cam, it has been necessary to off-set to the right the tongue 68, of the front-intersection plate 69, on which each such pawl is pivotally mounted; and yet to avoid so far laterally displacing said pawl as to bring its forwardly extended locking-arm out of alinement with the coacting carrying-lever, it has been found necessary that the arm to be tripped by the new cam's trip-stud should itself be off-set to the right by being considerably recessed, at 70, on its left-hand side, to clear the path of the cam-face of the cam. This trip-arm of the pawl has also been especially designed to permit its substantially frictionless and instantaneous tripping engagement by the trip-stud on the cam. The great difficulty of developing such cam-action as that here considered is evident not only from the complexity of functions of the automatic mechanism but also from the further facts that, in actual practice, the entire lift of dolly-roll 41 by the cams of each cam-member is only about eleven-sixty-fourths of an inch and occupies so slight a fraction of a second, even in the case of my prior duplex comptometers, that the eye is unable to detect the cam's movement except as an almost imperceptible flash of light, and in order to withstand the service these cam-members are made of hardened steel of the highest grade, although their greatest dimension, from high point to high point of the two opposed cams of the cam-member, is only nine-sixteenths of an inch, the straight distance from high point to low point of each cam 53 being only about three-eighths of an inch. The highest known methods of precision workmanship have been required to produce a working sample of these members, even after their invention and designing, and to develop the special tools necessary to the manufacture of such members in the interchangeable uniformity required to insure proper functioning and save all adjusting and fitting of parts.

The special action of the new cam members,—exerting their maximum lifting pressure at the initial part of their throw when the full tension of the impelling-motor is exerted, and then further lifting the carrying-lever at a greatly reduced and diminishing rate during the latter part of the throw, when the tension of the impelling-motor is partly spent,—is especially efficient in con-

junction with the particular form of carrying-motor spring 36 that has been used in my more recent duplex comptometers but differs from the triple-concentric-coil carrying-motor spring shown in the drawings of my before mentioned Patents Nos. 762,520 and 762,521. The said triple-concentric-coil motor-spring was exceedingly efficient, as particularly explained in my said Patent 762,521, but the later form adopted for this motor-spring, and shown in the drawings accompanying the present specification, the spring 36, is not only a simpler form but is also still more efficient; for while both forms of spring effectively store and discharge the power for a plurality of carryings, as required by the action of "duplexing" automatic carrying-mechanism, the triple-concentric-coil spring exerted a substantially uniform tension throughout each throw of a carrying-cam, while the later form of spring, the simple conically helical spring 36, exerts much its greatest tension at the initial part of each carrying-throw, just when such greatest tension is needed to start the moving parts from rest. The new type of cam is therefore not only adapted to give high efficiency to either form of spring but is also peculiarly adapted to utilize the special efficiency of the conically helical spring 36, a spring having the special action just above stated. Although springs of this latter form were used in my duplex comptometers prior to the introduction into them of the new cams and pawls, and are illustrated in the drawings of my copending application hereinabove mentioned, the said springs so used and illustrated have been greatly heavier than the springs 36, the substantial lightening of these springs, for the purpose hereinabove set forth, being made possible by the new cams and pawls, as has been explained.

The substantial lightening of the carrying-motor springs has also made possible a lightening of the spring 46 that joins and draws toward each other the two carrying-motor releasing-detents 39, 40, and the lightening of this spring 46 reduces the pressure of the ears of these detents upon the dolly-roll 44, of the winding gear 34, that lifts them, thereby still further reducing the resistances to the movement of such winding-gear and so still further contributing to the lightening of the key-touch. Furthermore, the substantial lightening of the carrying-motor springs lessens, and in fact almost eliminates, the possibility of jamming or locking a carrying-mechanism by the accumulated tension put upon a carrying-motor winding-gear by such accidentally or intentionally improper manipulation as holding a key depressed and making many useless repeated strokes with a key or keys of lower order. Such accumulated tension upon a carrying-gear causes the stud 35, which normally limits the forward rotation of said gear, to impinge and press unduly against the rear edge of the long arm of the escapement-member that is engaged by the undercut hook of the carrying-motor detaining-latch, so that said latch will be firmly held in depressed position, and itself hold depressed the column-actuator that normally lifts it, thereby jamming or locking the mechanism until said latch is freed by some sudden shock or movement of coacting parts. But the lightening of the carrying-springs through which such accumulated tension would be transmitted to the winding gear of the thus locked carrying-mechanism, minimizes the possibility of so accumulating sufficient tension to press the escapement-member into a locking grip upon the under-cut hook of the detaining latch. This locking action, and means for releasing it whenever it does occur, are discussed in my before mentioned copending application.

It will be understood that the lightening of each carrying-motor spring not only relieves the burden upon the column-actuator that directly rotates the accumulator meshing with the winding gear of the lightened spring, but also lessens the burden upon the carrying-spring of next lower order, because the carrying-lever impelled by the carrying-motor of such next lower order is itself compelled, when making the carrying-throw of the higher accumulator, to partly wind the carrying-spring of higher order, since every movement of the said higher accumulator proportionately rotates the winding gear of said carrying spring in that higher order. The importance of this result is especially apparent when the carrying-throw is flashed across a consecutive series of orders in the machine, as, for instance, when a row of "9's" stands upon the register and something is added to the "9" in the lowest order.

My invention is hereinabove set forth as embodied in one particular form of construction, but I do not limit it thereto or to less than all the possible forms in which said invention as hereinafter claimed may be embodied and distinguished from prior devices.

I claim:—

1. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, automatically controlled motor-devices and, actuated thereby, means adapted to impel the carrying-levers abruptly in the initial part of the carrying-

throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

2. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers automatically controlled motor-devices and, actuated thereby, carrying-cams of a contour adapted to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

3. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, automatically controlled motor-devices and, actuated thereby, carrying-cams 53 of a contour adapted to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

4. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, automatically controlled motor-devices and, actuated thereby, carrying-cams whose cam face contour is developed of two confluent arcs of which the one of lesser radius rises from the low point of the cam to the one of greater radius which extends up to the high point of the cam, to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

5. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers automatically controlled carrying-motor springs and, actuated thereby, means adapted to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

6. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, automatically controlled carrying-motor springs of conically helical form and, actuated thereby, means adapted to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

7. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers automatically controlled carrying-motor springs 36 of a conically helical form and, actuated thereby, means adapted to impel the carrying-levers abruptly in the initial part of the carrying-throw, while the motor power is at its higher tension, and at a reduced and diminishing pressure during the latter part of the carrying-throw, when the motor power is partly spent; substantially as specified.

8. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, locking-pawls for said levers, automatically controlled motor-devices and, actuated thereby, means adapted to impel the carrying-levers and to trip by an impinging touch the aforesaid coacting locking-pawls, substantially as specified.

9. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, locking-pawls for said levers, auto-

matically controlled motor-devices and, actuated thereby, means adapted to impel the carrying-levers and provided with trip-studs adapted to trip by an impinging touch the aforesaid coacting locking-pawls, substantially as specified.

10. In a calculating machine, in combination: a series of column-actuators; and multiple-order accumulator mechanism including automatic carrying-mechanisms that are adapted to permit actuation of a plurality of the column-actuators simultaneously, said carrying-mechanisms having carrying-levers, locking-pawls for said levers, automatically controlled motor-devices and, actuated thereby, carrying-cams adapted to impel the carrying-levers and bearing lateral trip-studs to trip by an impinging touch the aforesaid coacting locking-pawls, substantially as specified.

In witness whereof, I hereunto set my hand, in the presence of two subscribing witnesses.

DORR E. FELT.

Witnesses:
HENRY LOVE CLARKE,
GEORGE S. BOLLENSEN.