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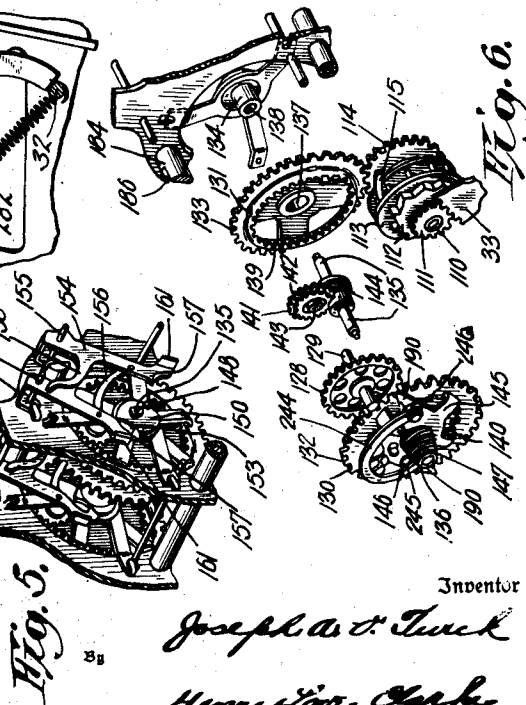
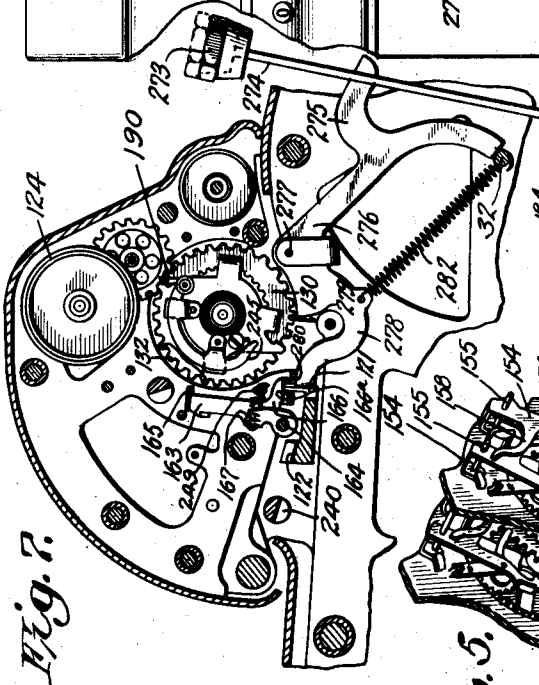
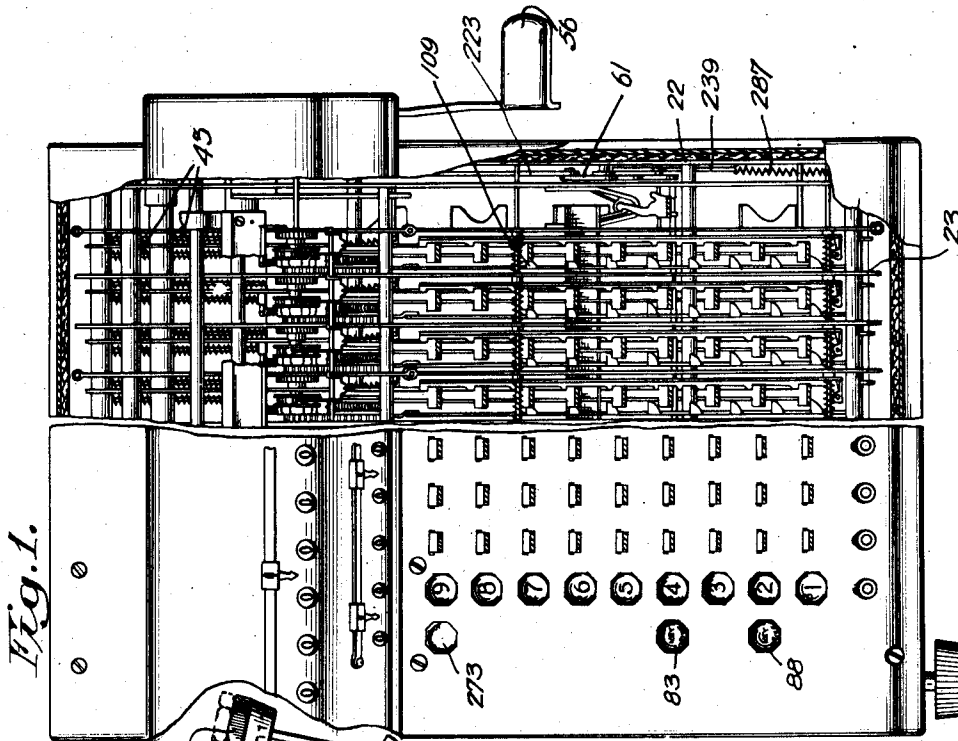
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2,020,975

CALCULATING MACHINE

Original Filed July 7, 1932

3 Sheets-Sheet 1



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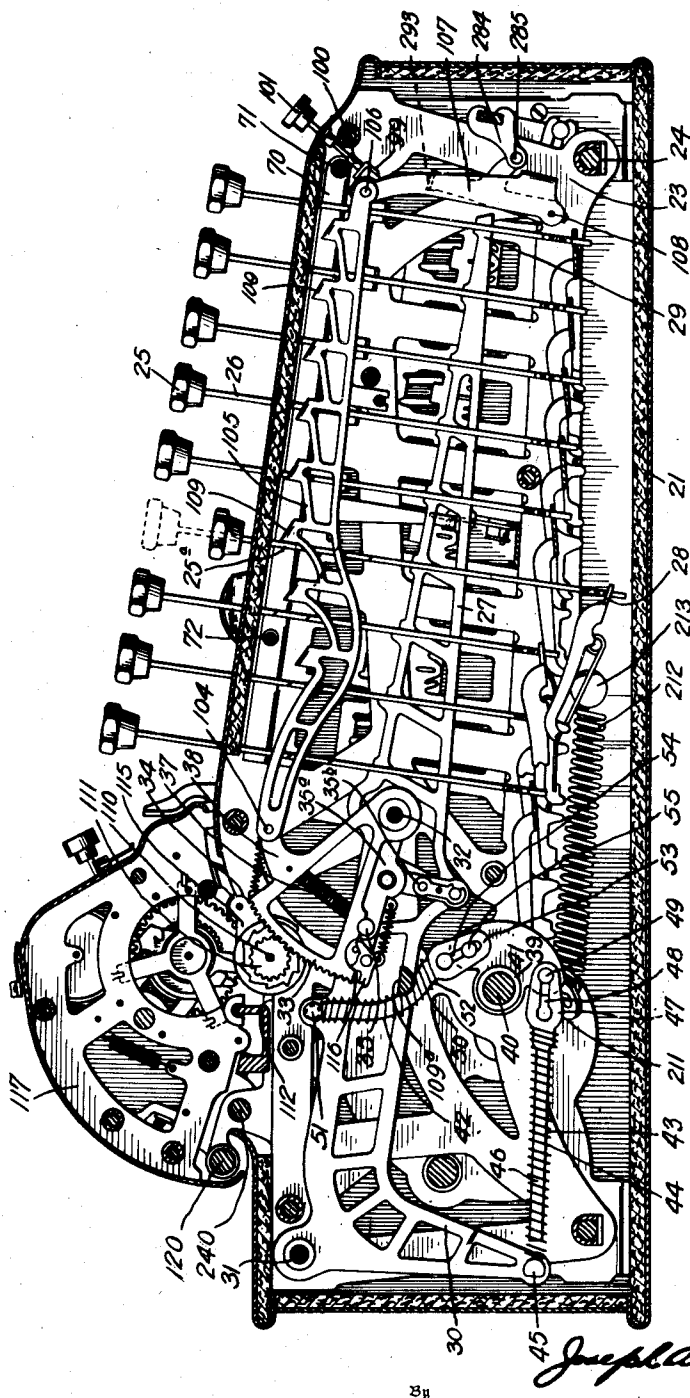
2,020,975

CALCULATING MACHINE

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3 Sheets-Sheet 2

Fig. 2



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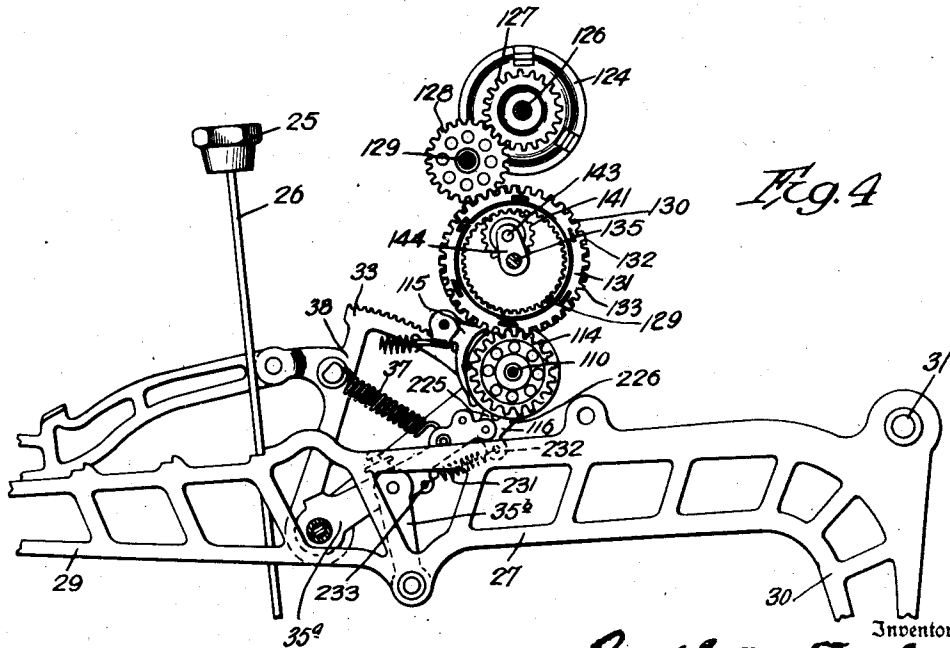
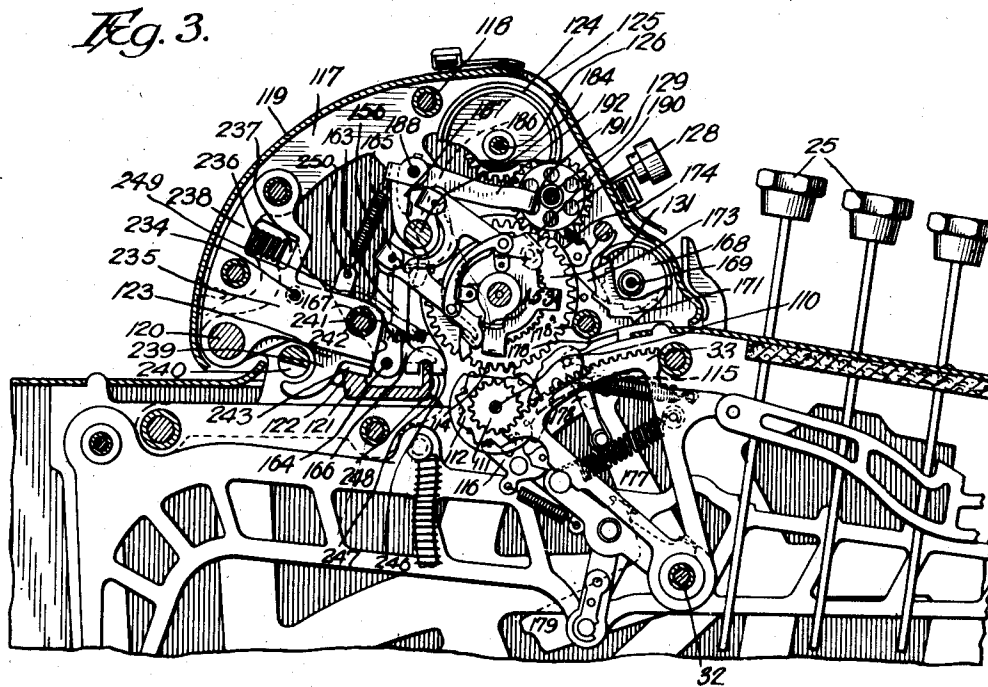
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CALCULATING MACHINE

Original Filed July 7, 1932

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,020,975

CALCULATING MACHINE

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cago, Ill., a corporation of Illinois

Application July 7, 1932, Serial No. 621,196
Renewed September 27, 1935

9 Claims. (Cl. 235—136)

This invention relates in general to improve-
ments in calculating machines, and more par-
ticularly to improvements in the accumulator
mechanism including a novel escapement mecha-
nism for calculating machine such, for example,
as is disclosed in my copending parent applica-
tion Ser. No. 107,527, filed May 7, 1926 now Pat-
ent Number 1,926,826, of which this application
is a continuation-in-part.

Objects of the present invention are the pro-
vision of a novel accumulator mechanism and
escapement mechanism therefor which will per-
mit of lightening key or universal drive strokes of
the actuating mechanism, will lessen friction and
function more definitely and certainly than those
heretofore employed in calculating machines, the
provision of a linked pallet device operable by a
lower order accumulator device and controlling
the timing of the transfer of power for transfer
of the tens to a higher order accumulator device.

In addition to the general objects recited above
the invention has for further objects such other
improvements or advantages in construction and
operation as may be found to obtain in the struc-
tures and devices hereinafter described or
claimed.

In the accompanying drawings, forming a part
of this specification and showing, for purposes of
exemplification, a preferred form and manner in
which the invention may be embodied and prac-
ticed, but without limiting the claimed invention
specifically to such illustrative instance or in-
stances:—

Fig. 1 is a top plan view of a calculating ma-
chine constructed in accordance with the pres-
ent invention, but with parts of the top casing
plate and some of the keys broken away to show
the interior construction;

Fig. 2 is a vertical sectional view taken on the
line 2—2 of Fig. 1, showing the operation of the
actuating mechanism in individual-key-driven
actuation of the machine;

Fig. 3 is a sectional view taken through the
rear of the machine showing a cross-section of
the accumulator mechanism;

Fig. 4 is an elevational view illustrating the
accumulator in side elevation;

Fig. 5 is a perspective view illustrating the ac-
cumulator mechanism; and

Fig. 6 is a detached perspective view illustrat-
ing the accumulator mechanism in more detail.

Fig. 7 is a sectional view taken through the
rear of the machine.

As the present improvements are useful with
various types of calculating machines, and as the

detail of construction and operation of the pres-
ent machine may be readily understood from my
copending application, only such parts thereof as
are directly concerned with the present improve-
ments will be described in detail herein, reference
being hereby made to said application for an un-
derstanding of the rest of the present machine.
Figures 1 to 6 are exact copies of Figures 4, 7,
13, 20, 27, 28 and 14, respectively, of my aforesaid
application.

The various instrumentalities, which constitute
the actuating mechanism from which calculative
motion is transmitted to the accumulator mecha-
nism, are as described in my original Patent
1,926,826 aforesaid, of which this case is a con-
tinuation in part.

Features of the present invention are particu-
larly adapted to calculating machines, and espe-
cially that type which is well known as the
"Comptometer", the present illustrated embodi-
ment of the invention is described in connection
with and as an improvement upon the machine
shown, described and claimed in the copending
application of the present inventor, Joseph A. V.
Turck, Serial No. 654,874, filed July 31, 1923, now
Patent No. 1,869,872, and entitled Calculating
machines.

There is a column actuator 27 for each column
of nine keys of the machine, and each column ac-
tuator is preferably constructed in the form of
a bell-crank lever having a long, horizontal arm
29, a relatively short depending vertical arm 30,
and being pivoted at the junction point of said
arms to the framework at the rear of the ma-
chine, as shown at 31. The horizontal arm 29 of
the column actuator extends forwardly from rear
to front of the machine and receives the key-
impulse to actuate the accumulator, when the
machine is set for key-driven actuation. Pivoted
at 32 on a fixed shaft extending through and
supported by the framework of the machine is an
actuator sector 33 for transmitting the calcula-
tive motion of the column actuator to the ac-
cumulator. The pivoted sector 33 is provided
with a set of gear teeth 34 on its arcuate periph-
ery and said teeth are adapted to mesh with
ordinal gears forming part of the ratchet mecha-
nisms. Motion produced by the normal move-
ment of the column actuator is transmitted to the
pivoted sector 33 by an abutment 35 at the end
of a double-arm lever 35a pivoted on the hub of
the sector 33 concentrically with shaft 32 and
connected with the column actuator by a link 35b.
The abutment 35 is normally held in engagement
with the rear radial edge 36 of the sector by a

spring 37 connecting the forward radial arm 38 of said sector with said abutment 35. So long as any key 25 is depressed only that amount necessary to effect a movement of the sector 33 correspondingly with the digital value of the key, the spring 37, during the downward movement of the column actuator arm 29, will hold the sector 33 against the abutment 35. If, however, the key be depressed beyond such normal movement the spring 37 will permit the abutment 35 to move, with a yielding action, away from the sector 33 as the column actuator arm 29 continues to move downwardly.

In all forms of calculative actuation, it is the upward return movement of the transmitting gear or adding sectors 33 that effects the actual transfer of incremental ordinal accumulation to the accumulator mechanism, namely, the adding actuation. This is effected by an ordinal internal ratchet mechanism, operating in like manner in the "Comptometer" patents hereinbefore mentioned in my parent applications.

In accordance with the invention, the accumulator mechanism includes the numeral wheels, and the interposed transmission gearing mechanism which receives direct incremental actuation from the column actuators and transfers it to the numeral wheels of the corresponding orders and also receives or transmits indirect actuation from a lower order gearing to a higher order gearing for effecting carrying of the tens from order to order, whenever a numeral wheel of a lower order passes the "9" point, whether in gear with the actuating mechanism or not. The carriage comprises a supporting framework including skeleton plates 117 (Figs. 2 and 3) interposed between the various orders of the accumulator and tied together by transverse tie rods 118, and a top inclosing casing 119. The carriage is both pivotally and slidably mounted on a rod 120 supported from the top of the fixed framework of the machine and is preferably constructed of a width somewhat greater than the width of the stationary casing to support a number of accumulator orders in excess of the orders of the actuating mechanism. This construction provides a machine of large capacity for multiple stroke calculation, whether positive as in multiplication or negative as in division. In the machine illustrated in the drawings there are eight columns of the actuating mechanism and fifteen columns or orders of the accumulator mechanism. Mounted on the stationary frame of the machine is a bed plate 121 provided with a series of notches or grooves 122, said grooves marking the various ordinal positions of the carriage when at rest and being adapted to co-operate with a depending lock arm 123 supported by rods 120 and 234 in the carriage which arm enters one of the grooves when the carriage has been lowered into proper registering position. The lock arm 123 is arranged between two guide plates 235, (Fig. 3) forming a housing for said arm, and a spring 236 is interposed between the upper rear end 237 of the lock arm 123 and an abutment 238. At its lower end, the member 123 is formed to provide a hook 239 which engages a rod 240 to limit the upward movement of the carriage.

When the carriage is shifted by mechanism hereinafter described, such shifting causes the tapered edge 243, of the lock arm 123 to ride out of the notch 122 on the inclined sides of said notch, and as the edge 243 is riding out of the notch it elevates the carriage to disentrain the accumulator mechanism from the actuating

mechanism. The edge 243 continues to ride out until the edge rides on the top surface 121 of the bed-plate, on which such edge 243 then slides until it reaches a next notch 122. During the sliding of the edge 243 on the surface 121 the carriage is maintained elevated, so that the accumulator mechanism may clear the actuating mechanism, the bushing and rod 241 engaging the surface 242 of the lock arm 123, which thus supports the carriage in elevated position to clear the mechanism of the stationary part of the machine during the shifting of the carriage until the lock arm 123 reaches and enters a next notch 122, when the tapered edge slides off the top surface 121 of the bed plate onto the inclined surface 15 of such notch, permitting the carriage to seat. Should the lock arm fail to seat completely within the notch, spring 236 forces the lock arm 123 downwardly so that the tapered edge is moved downwardly on said inclined sides of the notch 122 and thereby draws the carriage laterally and centers it and its accumulator mechanism, in proper alignment and engagement with the actuating mechanism. The numeral wheels of the respective orders of the accumulator mechanism are mounted to rotate on cross-rods or fixed supporting shafts 126 supported by the framework of the carriage and each numeral wheel is provided with its operating gear 127 in mesh with a gear 128 mounted on a parallel cross-rod 129, (Fig. 3). Direct or indirect actuation is transmitted by the transmission gear mechanism of the accumulator to the gear 128 and the latter in turn transmits the accumulative motion to the gear 127 for rotating the numeral wheel in accordance with the incremental movement of either direct or indirect, or concurrently direct and indirect actuation.

The transmitting gear mechanism of the accumulator receives the actuation of the column actuators from the gears 114 of the internal ratchet mechanisms and transfers such actuation to the numeral wheels of the corresponding orders. It also embodies a carrying mechanism that employs the same gear transmission for effecting a carrying of the tens from lower orders to higher orders, whenever the numeral wheels of lower orders pass from "9" to "0". The carrying movement in the higher order may take place, in accordance with the mechanism of the invention, concurrently with a direct actuation of said higher order by its own corresponding column actuator without in any manner swallowing up the carrying impulse or entailing loss of carry. The accumulator mechanism of each order supported by the carriage comprises a pair of juxtapositioned combined internal and external gears 130 and 131, the external gear teeth 132 of gear 130 being in mesh with the gear 128 and the external teeth 133 of the right-hand gear 131 being in mesh with the gear 114 of the internal ratchet mechanism. The gear 131 is loosely journaled upon a stub shaft 134 supported by a skeleton plate of the carriage frame and the left-hand gear 130 is loosely journaled upon a short stub shaft 135 which passes through the hub 136 of gear 130, the hub 137 of gear 131, and is itself mounted for rotary movement in a socket 138 formed in the stationary stub shaft 134. The external teeth of gear 131 are differential with respect to the external teeth of gear 130, for example gear 131 may have thirty-six external teeth while gear 130 has forty external teeth. The internal teeth 139 of gear 131 are also differential with respect to the in-

ternal teeth 140 of gear 130, for example, gear 131 may have forty-four internal teeth 139 and gear 130 may have forty internal teeth 140. The short stub shaft 135 is concentric with the axis of rotation of the gears 130 and 131 and itself constitutes a carrier for a pair of differential epicyclic pinions 141 and 142, pinion 141 corresponding to gear 131 and meshing with its internal teeth 139 and pinion 142 corresponding with gear 130 and meshing with its internal teeth 140. The pair of differential pinions 141, 142, are fixed together and rotate about a common axis 143 that is eccentric to the axis of rotation 135 of gears 130 and 131. For example, pinion 141 may have twenty-two teeth and pinion 142 eighteen. Said pinions are journaled on the outer end of a carrier arm 144 fixedly supported by and projecting from shaft 135 in a direction transverse to its axis of rotation. The pair of differential epicyclic pinions 141, 142, constitute the interposed transmitting gearing for transmitting direct actuation from the gear 114 of the internal ratchet mechanism to the numeral wheel gear 127 of the corresponding order. The transmission of direct incremental actuation may take place while the epicyclic pinions are moving only about their axis 143 and no epicyclic movement of said pinions about the axis 135 is taking place. In fact, this is the mode of operation except when a carry is being transferred from a lower order, but the carrying transfer which involves an epicyclic movement of the pair of pinions does not disturb the work of the pinions in transmitting direct actuation by rotation on axis 143. The transmission of direct actuation is as follows: On the up-stroke of the column actuator arm the internal ratchet mechanism gear 114 is rotated for a distance sufficient to move the numeral wheel the number of numeral spaces required by the key actuated or set. The movement of gear 114 is transmitted to external gear 133 which in turn rotates internal gear 139, internal gear 139 rotates the pair of differential pinions 141, 142, pinion 141 meshing with gear 139 and pinion 142 meshing with gear 140 to rotate the latter. The rotation of gear 140 also rotates external gear 130, thereby rotating gear 128 and the numeral wheel gear 127. The gearing just described is so proportioned that external gear 132 turns a half rotation during each complete rotation of the corresponding numeral wheel gear 127 and numeral wheel 124.

The epicyclic movement of the pair of differential pinions 141, 142, is employed to receive and impart to the combined internal and external gear 130 a further one-step movement when a carry is released by the next lower order of the machine, that is when the numeral wheel of the next lower order passes between "9" and zero. The left-hand face of each combined internal and external gear 130 is provided with gear arms 145 to a projecting stud 146 of which is secured one end of the carrying spring 147 which embraces the hub 136 of the gear 130. The other end of the carrying spring 147 is secured to a hook 148 (Fig. 5) projecting from a small disk 150 mounted on the right-hand end of and rigidly secured to the stub shaft 135 of the pair of differential pinions of the next higher order. The disk 150 constitutes an escapement wheel for the carrying transfer in the next higher order, whenever a carry is to go over from a lower order. The disk 150 is provided on its periphery with one carry-storage stop-lug 153 which is adapted to retain the escapement wheel 150 against ro-

tation and the differential pinions 141, 142, of the higher order against epicyclic movement, by the co-operation of a pair of carry-storage-retaining latches 154. Each carry-storage-retaining latch is mounted on a transverse rod 155 supported by the framework of the carriage, and the two latches 154 are connected together by a curved link 156 which causes both of the latches to move simultaneously when either one is moved. Each latch is provided with a curved stop arm 158 each of which makes contact with the transverse rod 155 of the other member when its detent 157 is in engagement with stop lug 153. Projecting from the free end of each latch 154 is cam lug 161 which when engaged moves its latch 154 and its detent 157 away from the stop lug 153 to release the escapement wheel 150, whenever a carry is to go over from the lower to the higher order. When said latch 154 is moved to release the escapement wheel 150 it pulls the connecting bar 156 which moves the other latch 154 into position so that its detent 157 is ready to engage the released stop lug 153. This movement occurs at each one-half revolution of the lower order gear 130, at the time when the numeral wheel of said lower order is passing between the "9" point and zero. Secured to said arms 145 of said gear 130 is a curved inside guard 244 that extends around for about one-half of the perimeter of said gear 130. One end of said guard is depressed at 245 and in front of the other end of the guard 244 is a dolly-roll 246. The dolly-roll and the depressed portion are positioned oppositely with respect to the gear 130, the dolly-roll being adapted to engage and move one or the other of the cam lugs 161, and its respective latch 154 whose detent 157 is in engagement with the stop lug 153 of the higher order, at the movement of carry release. When the external gear 130 moves its numeral wheel beyond the "9" point, the guard or cam presses outward the cam lug 161 that corresponds to the detent 157 that is in engagement with the stop lug 153, and this movement causes the connecting link 156 to move the opposite cam lug 161 down into the recess 245 to hold the other detent 157 in position to move into engagement with the stop lug 153 when the numeral wheel moves to zero. The contour of the recess in the guard 244 is designed to prevent the impact of the dolly-roll 246 from releasing the detent 157 too early, by offering resistance to the opposite latch that must move in as the engaged latch is disengaged. At the instant when the gear 130 has completed one-half revolution, i. e., moved its numeral wheel to zero, the dolly-roll moves the cam lug 161 whose detent 157 is holding the stop lug 153 to release the stop lug and effect a carry, and at the same instant the guard 244 moves from under the other cam lug 161, and said other detent's latch 154 is moved so that its detent 157 will catch the released stop lug 153. During direct actuation by its own column actuator the combined internal and external gear 130 of each lower order of the machine acts as a carrying spring winding gear for the purpose of winding the carrying spring 147 to impart a carry-producing impulse to the escapement wheel 150 of the higher order. The carrying spring 147 is wound during each one-half revolution of the gear 130 between the points of carrying release by the dolly-roll and the depressed portion of the inside guard. At the moment of carry release the carrying spring 147 has power stored in it sufficiently to turn the escapement wheel 150 of the higher order, to which said carrying spring 75

is also attached, and this effects an epicyclic movement of the pair of differential pinions 141, 142, of said higher order, by reason of the turning of the carrier 144. By such epicyclic movement of the pinions 141, 142, in the next higher order, because of the differential number of teeth in the pinions themselves and in the combined internal and external gears with which said pinions mesh and co-operate, the gear 130 of the higher order is imparted a movement sufficient to actuate the numeral wheel of said higher order one extra numeral space required by the carrying transfer.

As external gear 130 receives all accumulator actuation from pinion 142, and is not in mesh with gearing other than pinion 142, gear 128 and numeral wheel gear 127, it is free to take a carry over at all times and there is no delay in transmitting a carry from a lower order to a higher order until the higher order has finished its direct actuation. In fact the carry may complete itself before the direct actuation in the higher order has been completed. A carry will go over even though a key in such next higher order is held in its lowermost depressed position. Such mechanism permitting a carry to go over and complete the transfer from a lower order to a higher order regardless of the movement or position of the mechanism in the next higher order, greatly facilitates dual actuation of various orders simultaneously in either key-driven or key-set and universal-key-driven operation of the machine.

The operation of lifting the carriage disengages the gears 131 of the ordinal accumulator mechanism from the gears 114 of the ordinal actuating mechanism, and this would, unless prevented, release the tension of the carrying springs 147 which are attached to the gears 130. In order to prevent the carrying springs from unwinding reversely and losing their tension, there is provided in each order of the accumulator mechanism a locking lever 163 (see Figure 3) for locking the gears 130 against movement, whenever the respective gear trains are disengaged from the actuating mechanism. The locks 163 are pivoted at their lower ends on a rod 164 secured to the several plates of the carriage frame and the upper ends of said lock levers are provided with detents 165 adapted to move into engagement with the external teeth of the gears 131, when the locks 163 are released by the lifting of the carriage. The said lock levers 163 are provided with horizontal arms 166 which engage a ledge of the bar 121 to throw the detents out of engagement with such gears as are to be engaged with the actuating mechanisms, when the carriage frame is in its lowered position. Said arms 166 are arranged between a frame plate and a folded portion 246—247 thereof, forming a guard against accidental release of the lock lever by an operator or any one else who may by accident grasp the projecting portion of the carriage to lift the machine. Said portion is provided with a slot 248 so that said guard may fit over the ledge of the bar 121. These slotted portions are provided to limit the throw of said arms 166 when they are lowered onto said ledge. When, however, the carriage is lifted springs 167 connecting the vertical arms of the lever 163 with the rod 249 are released to pull the detents 165 of said lever forwardly into locking engagement with the gears 131. As the gears 130 are not locked, even in those orders of the accumulator in which locks 163 have not been released by engagement

with bar 121, the carrying transfers may nevertheless take place although such orders may not be in operative position with respect to any part of the actuating mechanism.

The invention is hereinabove set forth as embodied in a particular form of construction but may be variously embodied within the scope of the claims hereinafter made.

I claim:

1. In a calculating machine, in combination: a carry transmitting mechanism; a plurality of movable arms each pivotally mounted independently of the others; an inflexible member connecting the free ends of said arms; each of said arms having a detent thereon for holding the carry transmitting mechanism; a guard in engagement at all times with one or the other of said arms, said guard being moved by the lower order accumulating mechanism and arranged therewith so as to release one arm from engagement with and simultaneously move the other arm into position to engage the carry transmitting mechanism when a carry is to go over from said lower order.

2. In a calculating machine, in combination: a carry mechanism; a carry stop member associated therewith; two positively co-operatively linked detents each adapted to engage and restrain movement of said stop member; means, operable when a carry is to go over, for releasing said stop member from engagement with one detent and for simultaneously moving the other detent into the path of the moving stop member to engage and restrain further movement of the stop member.

3. In a calculating machine, in combination: a carry transmitting mechanism including a spring impelled carry stop member; a plurality of connected arms; means moving with the lower order accumulating mechanism for moving past and pressing against one arm and thereby maintaining the other arm in engagement with the stop member, said means operating when a carry is to go over to move past and press against the holding arm to disengage it from the stop member to permit the stop member to move under the action of its spring and to pull the other arm into the path of the moving stop member.

4. In a calculating mechanism, in combination: a lower order accumulator mechanism; a higher order accumulator mechanism; a disk secured to a shaft that carries a pair of pinions for operative engagement with the higher order accumulator mechanism; a carry storage spring secured to said disk and arranged to be wound up by the lower order accumulator mechanism; a pair of connected arms arranged so that one or the other is in engagement with the disk to restrain it from movement under the influence of said spring; means moving in harmony with the lower order accumulator mechanism, said means engaging one of said arms to hold the other arm in restraining engagement with said disk, said means acting when a carry is going over to release said first-named arm to permit it to come into position to catch the disk, at the same time that said means engages the other arm to disengage said arm from the disk to permit the disk to move under the action of its spring to effect a carry.

5. In a calculating machine, in combination: lower order accumulator mechanism giving off power for the transfer of the tens to higher order accumulator mechanism; means controlling the time of delivery of said power, consisting of

a pallet device positively oscillated by the lower order accumulator mechanism and controlling said timing of each half pallet-stroke.

6. In a calculating machine, in combination: ordinal accumulator mechanism; a carry transmitting mechanism; a plurality of pivotally mounted movable arms rigidly connected relative to each other for unitary pivotal movement; each of said arms having a detent thereon for holding the carry transmitting mechanism; a guard in engagement at all times with one or the other of said arms, said guard being moved by another order of the accumulating mechanism and arranged therewith so as to release one arm from engagement with and simultaneously move the other arm into position to engage the carry transmitting mechanism when a carry is to go over from one order to the other.

7. In a calculating machine, in combination: ordinal accumulator mechanism; a carry mechanism; a stop-member associated therewith; a pallet comprising two positively co-operating detents each adapted to engage and restrain movement of said stop-member; means, operable when a carry is to go over, for releasing said stop-member from engagement with one detent and for simultaneously moving the other detent into the

path of the moving stop-member to engage and restrain further movement of the stop-member.

8. In a calculating machine, in combination: ordinal accumulator mechanism; a carry transmitting mechanism therefor including a spring impelled stop-member; a pallet comprising plurality of connected arms; means moving with one order of the accumulating mechanism for moving past and pressing against one arm and thereby maintaining another of said arms in engagement with the stop-member, said means operating when a carry is to go over to move past and press against the holding arm to disengage it from the stop-member and permit the stop-member to move under the action of its spring and to pull another of said arms into the path of the moving stop-arm.

9. In a calculating machine, in combination: accumulator devices for an order giving off power for the transfer of the tens to accumulator devices of another order; means controlling the time of delivery of said power, consisting of a pallet device positively oscillated by the accumulator devices for the order first mentioned and controlling said timing of each half pallet-stroke.

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