May 16, 1939. R. L. MULLER 2,158,142

CALCULATING MACHINE

Original Filed Feb. 5, 1936 4 Sheets-Sheet 1

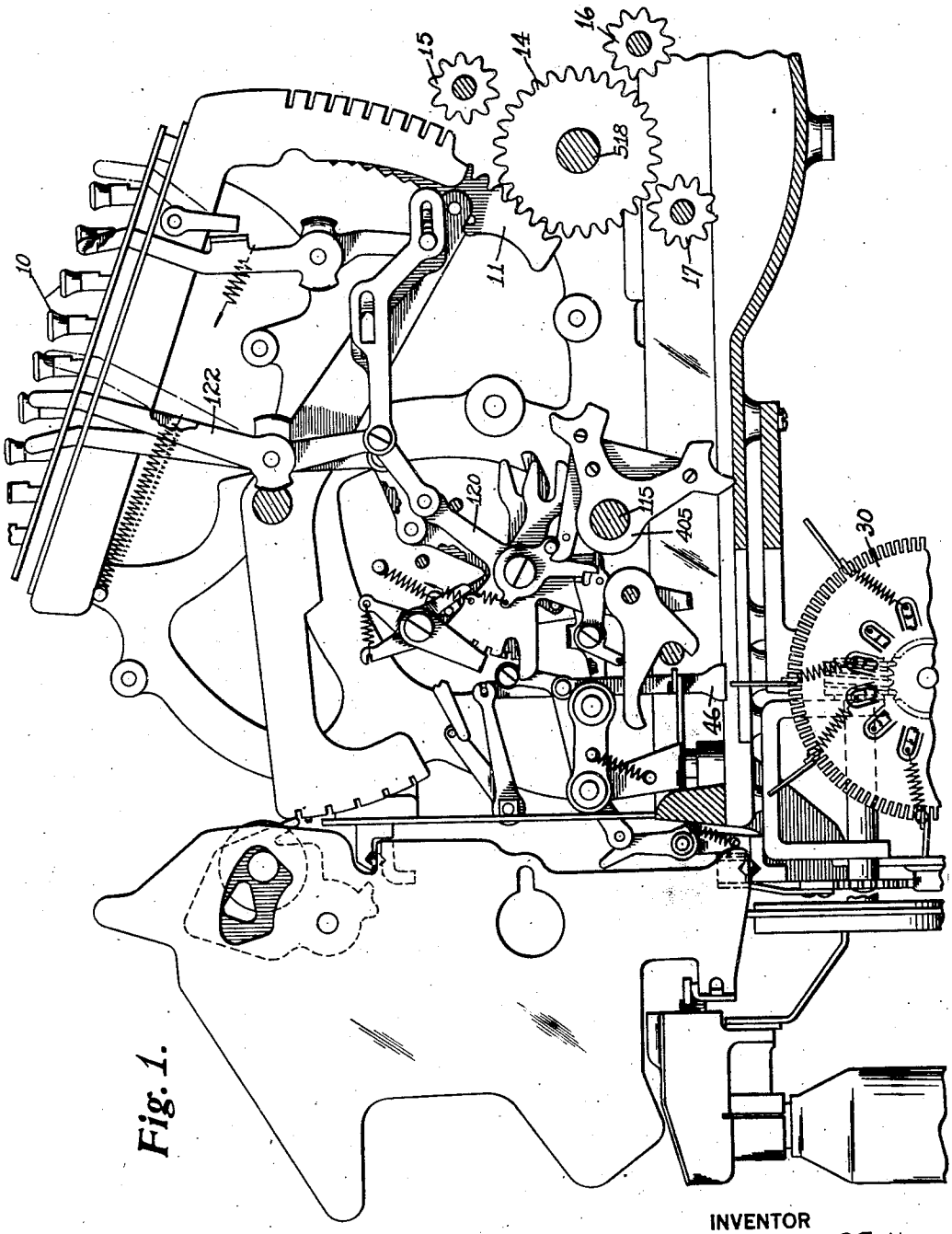


Fig. 1.

INVENTOR
Robert L. Muller
BY
Davis Lindsey Smith & Thomas
ATTORNEYS

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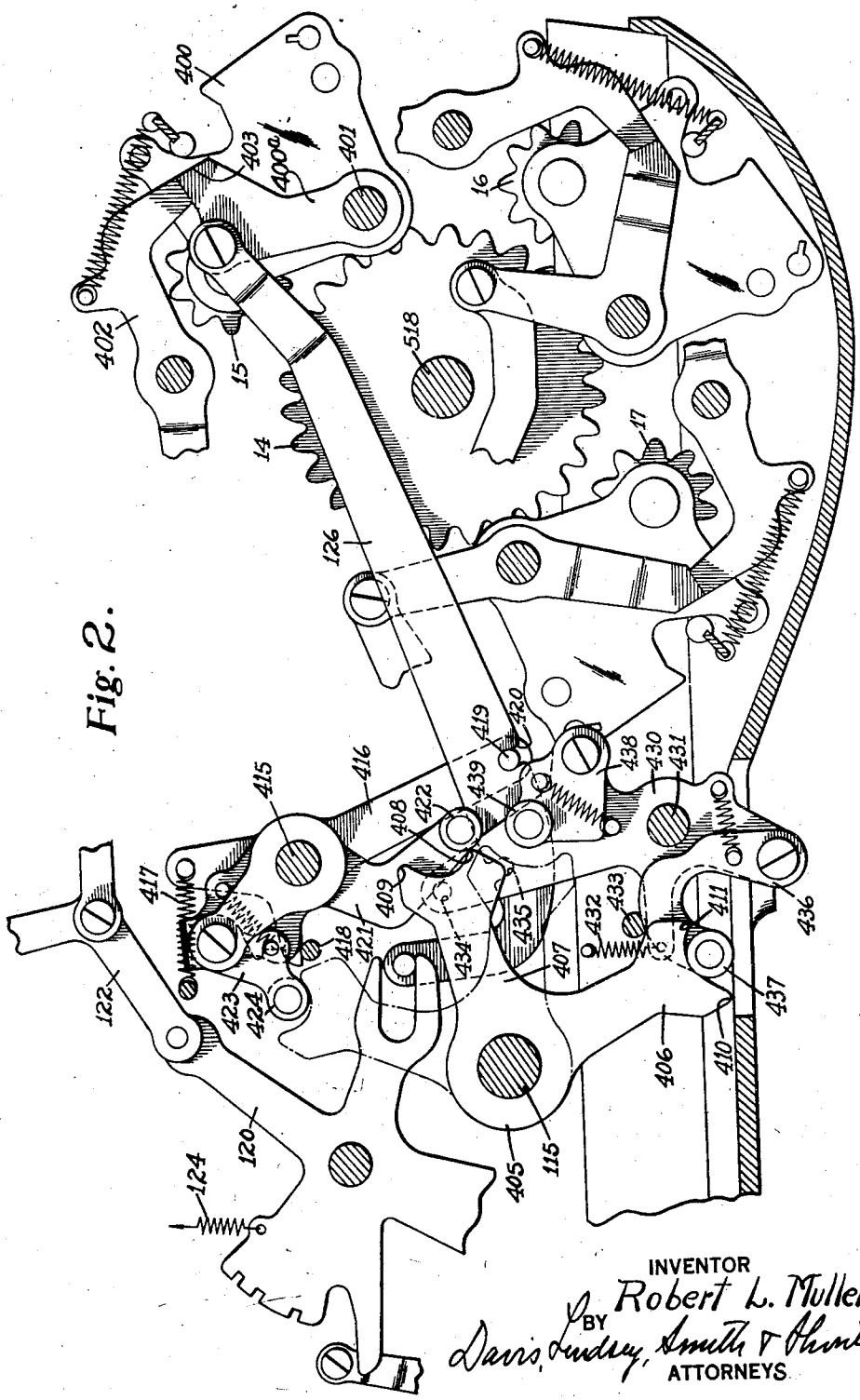


Fig. 2.

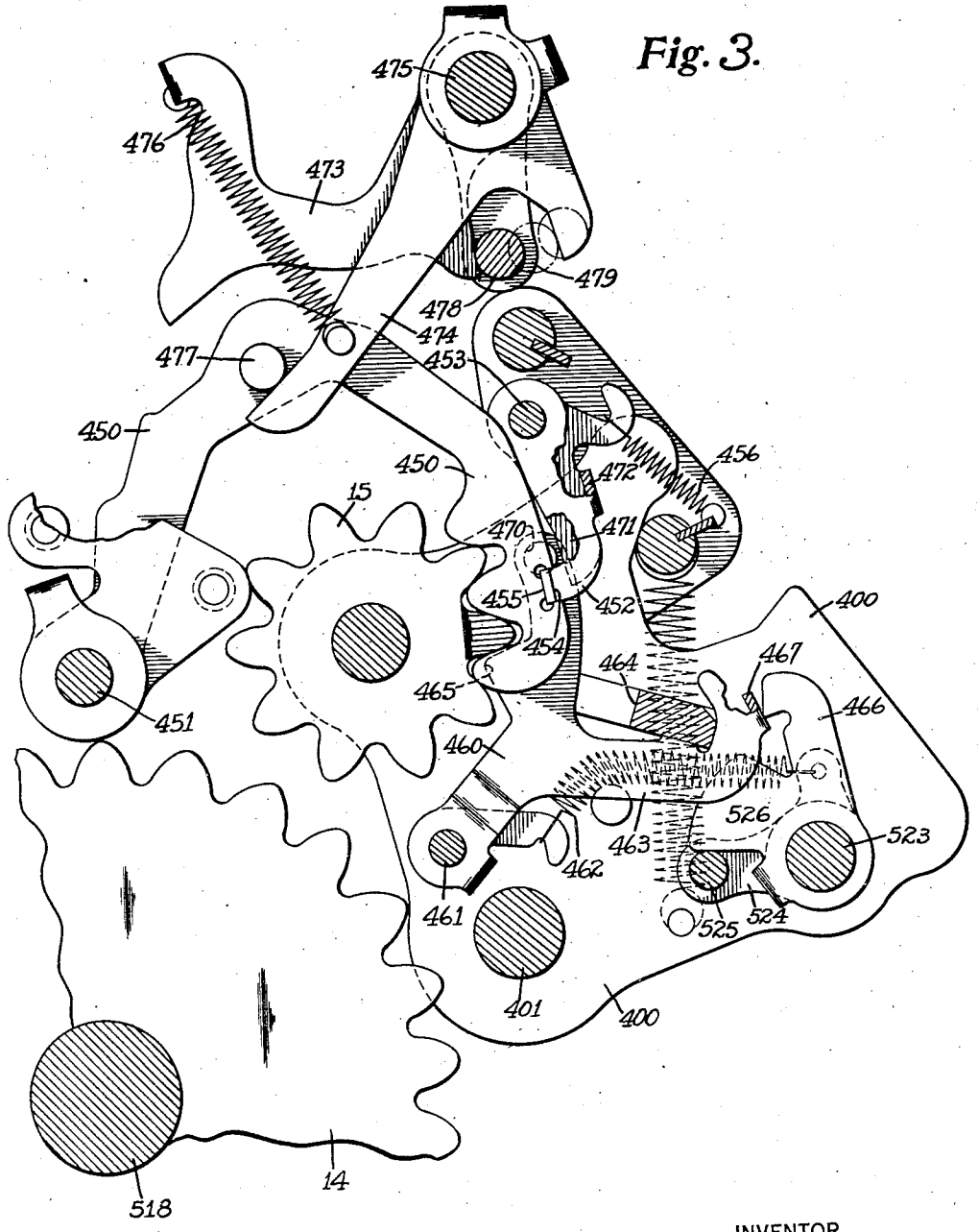
INVENTOR
Robert L. Muller
BY
Davis, Lindsey, Smith & Shuntz
ATTORNEYS

May 16, 1939. R. L. MULLER 2,158,142

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Fig. 3.



INVENTOR
Robert L. Muller
BY Davis Lindsey Smith & Shorts
ATTORNEYS

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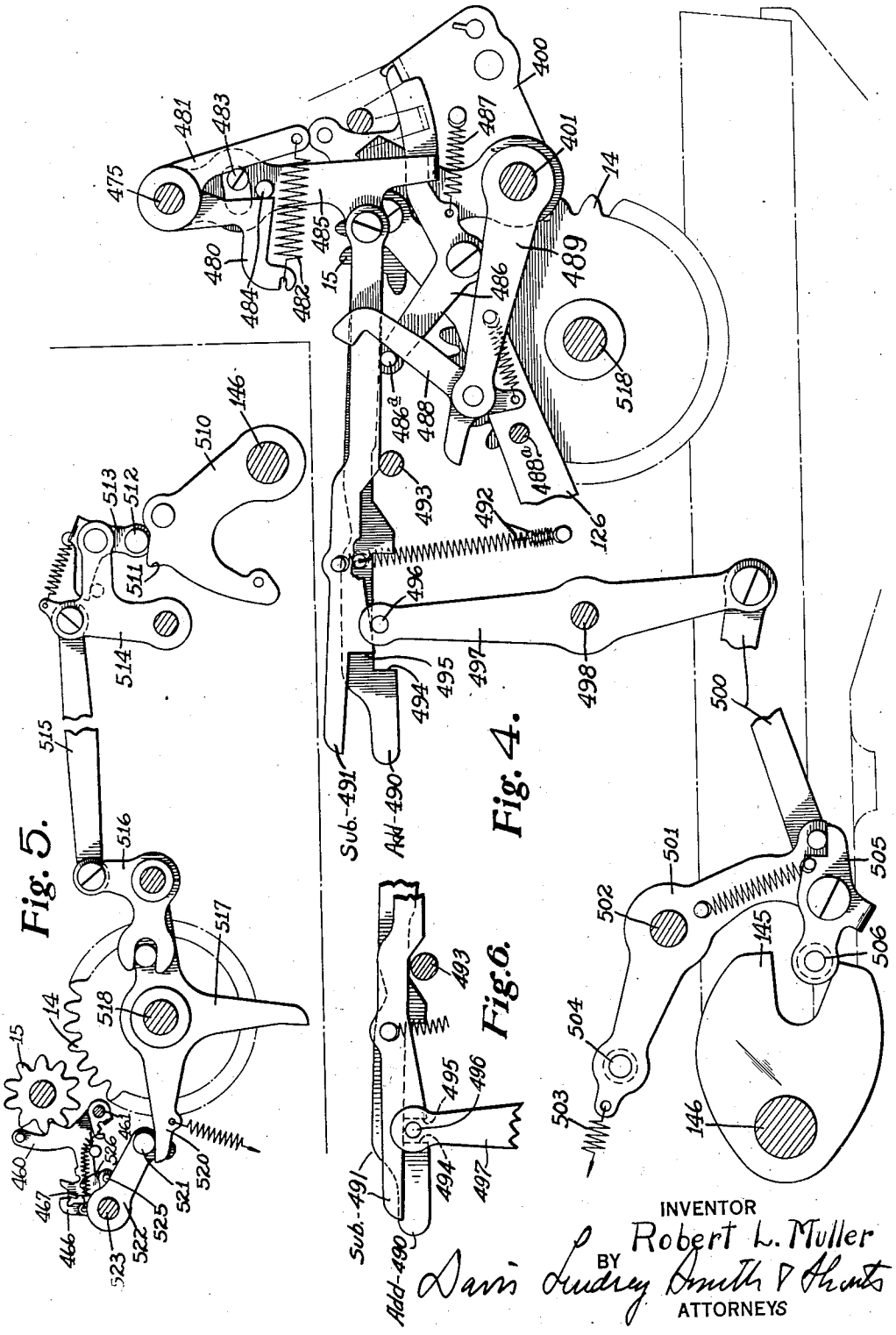


Fig. 5.

Fig. 4.

Fig. 6.

INVENTOR
Robert L. Muller
BY
Davis Audrey Smith & Adams
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,158,142

CALCULATING MACHINE

Robert L. Muller, Detroit, Mich., assignor to Burroughs Adding Machine Company, Detroit, Mich., a corporation of Michigan

Original application February 5, 1936, Serial No. 62,393. Divided and this application December 5, 1936, Serial No. 114,418

1 Claim. (Cl. 235—137)

This invention relates to tens-transfer mechanism. The application is a division of my application, Serial No. 62,393, filed February 5, 1936.

The general object of the invention is to provide an improved tens-transfer mechanism.

Other objects and advantages of the invention will appear from the following specification and drawings.

An embodiment of the invention is shown in the accompanying drawings in which—

Figure 1 is a left side elevation of a machine with which the invention has been illustrated.

Fig. 2 is a partial left side elevation showing some of the mechanism for controlling the registers or totalizers with which the tens-transfer mechanism is associated.

Fig. 3 is an enlarged detail of the tens-transfer mechanism with the parts shown in normal "add" position.

Fig. 4 is a partial left side elevation and section showing the mechanism for changing the condition of the tens-transfer mechanism.

Fig. 5 is a detail right side elevation and section of the restoring mechanism.

Fig. 6 is a detail view of portions of the control for the tens-transfer mechanism.

The invention is shown applied to a Burroughs machine of the type illustrated in my parent application, the most of the features of which are well known and the description of which will be confined in this application to a brief explanation of the parts more particularly associated with the tens-transfer mechanism.

General features of calculating machine

The machine has the usual amount keys **10** (Fig. 1) upon which items may be indexed and which control actuator racks **11** that are meshed with gears **14**. The gears **14** thus form a part of the actuating mechanism and for the purpose of the present description, will be included within the term "actuators."

A plurality of registering mechanisms or totalizers **15**, **16** and **17** mesh with the actuators **14**, but since the tens-transfer mechanism associated with each register is the same, the description of the present application will be confined to the register **15**.

The machine may be conditioned for addition or subtraction, or it may be non-added, either by hand or automatically. The manual control for the register **15** is by a lever **122** shown in Fig. 1. Automatic control is through an automatic sensing device including "feelers" such as the feeler **46** in Fig. 1, which move into engagement with stops on a drum **30** that is rotated by the paper carriage. This sensing control is described in detail in my present application.

The machine may be given cycles of operation by hand, or by a motor, during which the mechanism of the machine is moved through a forward and a return stroke.

In order to understand the tens-transfer mechanism, it is necessary to understand the control of the register **15** in more detail.

Register control

Referring to Fig. 2, the register or totalizer **15** is carried by a rocking frame **400** fixed to a shaft **401**. In the machine with which the invention is shown, the registering mechanism is connected directly with the actuators by rocking the frame **400** to engage and disengage the registering mechanism with the actuators **14**, said rocking action being effected by a link or pitman **126** connected to a crank **400a** fixed to shaft **401**. The register **15** is shown in its disengaged position in Fig. 2 where it is held by a spring-urged detent **402** that cooperates with a cam point **403** on the register frame. This detent serves to releasably hold the crank **400a** in either of its two positions.

The pitman **126** is moved back and forth by a cam **405** fixed to a shaft **115** that is rocked during each cycle of machine operation, said shaft corresponding to the shaft ordinarily known as the "800 shaft" on the Burroughs machine. The cam **405** has two arms **406** and **407**, and each arm is provided with two cam points, the arm **407** having the points **408** and **409** and the arm **406** having the points **410** and **411**.

Fixed to a shaft **415** is a lever **416** urged counterclockwise by a spring **417** (Fig. 2) against a limit stud **418**. This lever has a stud **419** on its lower end adapted to engage in a slot **420** in the pitman **126**. When the pitman is in add position, which is the position illustrated in Fig. 2, the stud **419** is in the slot **420**.

Also fixed to the shaft **415** is an irregular shaped lever **421** having a roller stud **422** on its lower end and a pass-by pawl **423** on its upper end, the latter carrying a roller stud **424**. The two roller studs **422** and **424** are positioned for operation by the cam points of the cam arm **407** of cam **405**.

The manually controlled lever **122** is connected to a four-armed lever **120** which is normally urged to the add position of Fig. 2 by a spring **124**; and in this position the pitman **126** is held in its lower or Fig. 2 position with the stud **420** in the slot **419**.

With the parts in the position of Fig. 2, assume that the machine is given a cycle of operation. As the cycle starts, the cam 405 is moved counterclockwise from the full line position of Fig. 2 to the dot-dash position. The cam point 408 on the end of arm 407 passes away from stud 422 without affecting it. Near the end of the forward stroke, the cam point 409 passes the pawl 423 without affecting the position of the lever 421. At the very beginning of the return stroke, the cam point 409 engages the roller stud 424 and rocks the lever 421 clockwise. This rocks shaft 415 together with lever 416 clockwise and moves link 126 to the left in Fig. 2, thereby rocking the register 15 into engagement with the actuators. The register remains in engagement until the end of the return stroke when the cam point 408 engages the roller stud 422 on lever 421 and rocks said lever counterclockwise, thus moving the lever 416 in the same direction and pushing the link 126 to the right to rock the register out of engagement with the actuators. In the normal position of cam 405, the cam end 408 contacts the roller 422 and holds the lever 421 in position of Fig. 2 so as to maintain the register in disengaged position, although it is also releasably maintained in this position by the detent 402.

Subtraction is performed by changing the timing of the engagement between the register and the actuators. For this purpose, a lever 430 is provided, which is pivoted on the shaft 431 and urged clockwise by a spring 432 into engagement with a limit stud 433. The upper end of this lever carries a stud 434 adapted to engage in a slot 435 in the pitman 126 when said pitman is raised to subtract position by the four armed lever 120. The lever 430 carries two pass-by pawls, a lower pawl 436 having a roller stud 437 and an upper pawl 438 having a roller stud 439.

Assume that the link 126 has been swung upward to subtract position so that its slot 420 is disengaged from the stud 419 and its slot 435 is engaged over the stud 434. Then, assume that the machine is given a cycle of operation. As the cam 405 moves counterclockwise the point 410 of the cam arm 406 engages roller stud 437 and rocks the lever 430 counterclockwise. This pulls the link 126 to the left to engage the register with the actuators at the beginning of the forward stroke of the machine. The parts remain in this condition during the forward stroke. Near the end of the forward stroke the cam point 411 of the arm 406 passes the pass-by pawl 438 without affecting the position of lever 430. But, at the beginning of the return stroke, the point 411 engages the roller stud 439 and rocks the lever 430 clockwise to push the pitman 126 to the right to disengage the register from the actuators. It will thus be seen that, in subtraction, the register is engaged with the racks at the beginning of the forward stroke and the pinions are rotated in a direction opposite to that in which they are rotated for addition. This method of performing subtraction is well known and the theory of it need not be explained.

When the four armed lever 120 is moved to non-add position, that is, to a central position as related to its add and subtract positions, the pitman 126 is swung to a position such that it is disengaged from both the stud 419 and the stud 434. When the machine is given a cycle of operation the cam 409 actuates the levers 421 and 430 as heretofore described but, since these levers are not connected to the pitman 126, they have no effect upon the position of the register.

Tens-transfer mechanism

The tens-transfer mechanism is capable of operation during both addition and subtraction, that is, it will effect both "carrys" and "borrows".

Referring to Fig. 3, each register pinion 15 is provided with a toothed, tens-transfer member or segment 450 pivoted on the shaft 451. These segments are spring-urged to either "carry" or "borrow" by mechanism that will be presently described. The tens-transfer segments are normally latched in the position of Fig. 3 by latches 452 pivoted on a shaft 453. The latches have lugs 454 engaging in notches 455 in their respective segments, said latches being urged clockwise as viewed in Fig. 3 by springs 456. The shaft 451 to which the tens-transfer segments 450 are pivoted and the shaft 453 to which the latches are pivoted are carried by stationary frame plates of the machine.

A transfer pawl 460 is provided for each pinion, said pawls being pivoted loosely on a shaft 461 and urged counterclockwise as viewed in Fig. 3 by their respective springs 462. Each pawl has a forwardly extending arm 463 limiting against a bar 464 on the register frame. Each pawl is also provided with a nose 465, arranged to be engaged by a wide pinion on its respective register pinion, said noses being shaped so that the pawls will be operated by their pinions when the latter are rotated in either addition or subtraction direction. The shaft 461 carrying the pawls 460 is carried by the register frame so that these pawls move with the register as the latter is moved into and out of engagement with the actuators.

When one of the pinions passes from its "9" to or through its "0" position, or vice versa, the wide tooth engages the nose 465 on the respective pawl 460 and rocks said pawl clockwise as viewed in Fig. 3 to an "initial transfer" position where it is latched by a latch 466 having a hooked end engaging over a lug 467 on the extension 463 of the transfer pawl 460.

Each pawl 460 has an upward extension carrying a stud 470 adapted to engage an arm 471 formed by a yoke 472 to the latch 452 for the tens-transfer segment for the pinion of next higher order. The arrangement is such that, if one of the pawls 460 is set in its "initial transfer" position while the register is engaged with the actuators, then, as the register is moved out of engagement with the actuators and into engagement with the transfer segments, the stud 470 on the pawl will engage the arm 471 for the next higher order and rock the corresponding latch 452 so as to release the transfer segment to enable the same to move to effect a tens-transfer.

The tens-transfer segments 450 are urged in either add or subtract direction by means of a scissors device comprising, for each segment, a pair of arms 473 and 474 (Fig. 3) loosely pivoted on a shaft 475 and urged toward one another by a spring 476. The free ends of these arms are on opposite sides of a stud 477 on the respective transfer segment 450. The position of the arms is controlled by a bail 478 extending between projections on all the arms 473 and 474 and carried by arms 478 fixed to shaft 475. When this bail is in the position of Fig. 3, it engages the arm 473 and holds it in the position shown to put a tension on spring 476 tending to urge the arm 474 clockwise. This urges the tens-transfer segments 450 in add direction, that is, in a direction to cause a "carry" as distinguished from a "bor-

row". When the bail 478 is swung to the right hand, or dot-dash position of Fig. 3, it engages an extension on the arm 474 and swings it counterclockwise so as to put a tension on spring 476 urging the arm 473 counterclockwise against stud 477; thus tending to move the tens-transfer segments 450 downward in a subtract or "borrow" direction. The bail 478 is positioned in response to the addition or subtraction condition of the machine by a mechanism best shown in Fig. 4.

Pivoted on the shaft 475 is another scissors device comprising arms 480 and 481 whose free ends are joined by the spring 482. These arms limit against a stationary stud 483 and also cooperate with a stud 484 on an arm 485 fixed to the shaft 475. The arm 485 may occupy either a central or neutral position shown in dot-dash lines (Fig. 4), an "add" position shown in full lines, or a "subtract" position shown in dot-dash lines at the right of Fig. 4. The arm may be latched in either its "add" or "subtract" positions by a bell crank latch 486 urged clockwise by a spring 487. This latch has appropriate shoulders for the purpose adapted to engage over a lug on arm 485 as shown in Fig. 4. The left hand end of latch 486 carries a stud 486a adapted to be engaged by a shoulder on a pawl 488 pivoted on the end of an arm 489 fixed to the shaft 401 that carries the register frame, said pawl 488 being urged counter-clockwise as viewed in Fig. 4 by a spring. When the register 15 is rocked into engagement with the actuators, the shaft 401 is rocked counter-clockwise (Fig. 4), which moves the arm 489 in the same direction, whereupon the pawl 488 rocks the latch 486 counter-clockwise to release the arm 485. The arm 435 is then free to move under the influence of the scissors device 480—481 in the direction in which it is urged. Thus, every time the register is rocked into engagement with the actuators, no matter whether timed for addition or subtraction, the latch 486 is moved, the arm 485 attached to shaft 475 is released, and this arm, together with shaft 475 and the bail 478 (Fig. 3), is moved to a neutral position.

The arm 485 is also controlled by two links 490 491, said links comprising respectively an add and a subtract link, and having their right hand ends (Fig. 4) pivoted to arm 485. The free ends of these links are urged downwardly by springs 492 against a limit stud 493 whose purpose will be presently described. The add link 490 is provided with a shoulder 494 and the subtract link with a shoulder 495, the two shoulders being oppositely positioned and adapted for engagement with a stud 496 on the end of a lever 497 pivoted at 498. The lower end of this lever is connected by a link 500 to another lever 501 pivoted at 502 and urged to its central position by a toggle spring 503. The lever 501 has a roller stud 504 on its upper end and a pass-by pawl 505 on its lower end carrying a roller 506. These two roller studs 504 and 506 are positioned so as to be engaged by a cam 145 on the shaft 146 that is rocked during each cycle of machine operation. When the machine is given a cycle, the cam 145 is first rocked counter-clockwise and then returned clockwise. During the forward stroke, the cam 145 passes pawl 505 and, near the end of said stroke, said cam engages the roller stud 504 to rock the lever 501 clockwise.

Assume that, at the beginning of the cycle, the arm 485 is in the "add" position of Fig. 4 and the links 490 and 491 are in the position there shown in which the "add" link 490 is in its lower or active position while the subtract link is inactive. These two links are so positioned by reason of the shape of their lower edges which engage stud 493. Also, assume that addition is being performed. As stated, near the end of the forward stroke, the cam 145 engages roller 504 and rocks lever 501 clockwise, which, through link 500, rocks lever 497 in the same direction. The notch in link 490 is of such length that, when lever 497 is rocked clockwise under the conditions just explained, the stud 496 does not move link 490. Accordingly, the parts remain in the position shown in Fig. 3 during the forward stroke of the machine. During this portion of the stroke the register is not in engagement with the actuators but is in engagement with the tens-transfer segments.

At the beginning of the return stroke, the register is rocked into engagement with the actuators. As the register is rocked toward the actuators, the arm 489 (Fig. 4) is rocked counterclockwise, which causes the shoulder on pawl 488 to engage stud 486a, thereby rocking latch 486 counterclockwise. This frees arm 485 for movement to its central or neutral position under the urge of its spring 482. As the arm 489 completes its counterclockwise movement, a rearward projection on the pawl 488 engages a stud 488a on the side frame of the machine, thereby causing the pawl 488 to be rocked clockwise, which releases latch 486 for movement back to latching position, the arm 485 having in the meantime moved to its central position. The latch 486 contacts the lug on the lower end of arm 485 but does not latch said arm because there is no shoulder on latch 486 for engaging arm 845 when the latter is in its central position. The effect of this movement of arm 485 is to move the links 490 and 491 to a central position (Fig. 6) so that stud 493 allows both to be lowered to active position where they are responsive to further movements of stud 496. Also, the tens-transfer segments scissors device 473—474 (Fig. 3) is moved to a neutral position which moves the tens-transfer segments to their normal or restored position where they are latched by latches 452. To put it another way, when the register is rocked into engagement with the actuators, the mechanism controlling the transfer segments is moved to a neutral position ready to be conditioned to either carry or borrow.

During the return stroke of the machine the register is in engagement with the actuators and the tens-transfer segments are not active to effect tens-transfers. The transfer pawls 460 are, however, being set in "initial transfer" positions. Near the end of the return stroke, the cam 145 (Fig. 4) rocks the lever 501 counterclockwise and moves the lever 497 counterclockwise. This pulls the "add" link 490 to the left to pull the arm 485 to "add" position, which rocks shaft 475 clockwise in Figs. 3 and 4, thus putting a tension on the tens-transfer segments 450 tending to cause a "carry". The latch 486 being free snaps to position under the urge of its spring 487 to hold arm 485 in "add" position. The timing of the parts is such that the tension is put on the tens-transfer segment before the register is rocked out of engagement with the actuators and into engagement with the transfer segments. The movement of the register into engagement with the transfer segments trips the latches 452 for all orders where the pawls 460 have been set and causes the necessary "carry" to take place.

When the subtraction is performed the register is rocked into engagement with the actuators at the beginning of the forward stroke of the machine. The pawl 488 is thus moved immediately and it pulls the latch 486 to released position and permits arm 485 to move to its central or neutral position at once. This positions both links 490 and 491 in active relation to stud 496 and restores the scissors device for the tens-transfer segments to normal which causes said segments to move to their normal or restored postion where they are latched. The register is in engagement with the actuators and not with the tens-transfer segments and the latter are not used during the forward stroke. Near the end of the forward stroke the cam 145 (Fig. 4) engages roller 504 and rocks lever 501 clockwise. This rocks the lever 497 clockwise and stud 496 then engages the shoulder 495 and moves link 491 to the right to move the arm 485 to the "subtract" position shown in dot-dash lines in Fig. 4. This rocks shaft 475 counterclockwise and moves the scissors device 473—474 (Fig. 3) to place a tension on the tens-transfer segments before the register engages said segments as it moves out of engagement with the actuators at the beginning of the return stroke. This movement of the register trips the latches 452 for all orders where a pawl 460 has been set and causes the necessary "borrows" to take place.

Near the end of the return stroke, the cam 145 engages roller 506 and rocks lever 501 counterclockwise. This moves lever 497 in the same direction. If the link 490 were in active position, its shoulder 494 would be engaged by stud 496 and there would be a force exerted tending to pull link 490 and arm 485 back toward neutral position. But, when the links 490 and 491 were moved by movement of arm 485 to subtract position, the lower cam edge of link 490 riding on stud 493 moves said link to inactive position and no movement of the link 490 will occur at the end of said return stroke.

A restoring mechanism for the tens-transfer is provided, which is best shown in Fig. 5. Fixed to the shaft 146 that is oscillated during each machine cycle is an arm 510 having a cam nose 511 adapted to engage a roller stud 512 on a pass-by pawl 513 carried by a bell crank 514. This bell crank is connected by a link 515 to a second bell crank 516 having a stud and slot connection with a three-armed lever 517 pivoted on the shaft 518. The left hand arm 520 of the three-armed lever 517 is positioned under a stud 521 upon an arm 522 fixed to the shaft 523 on which the latches 466 are loosely pivoted (Fig. 3). The arrangement is such that, at the very beginning of the forward stroke of the machine, the cam nose 511 operating on rollers 512, moves the parts just described so as to rock the shaft 523 clockwise as viewed in Fig. 3. Fixed to the shaft 523 are two arms 524 carrying a bail 525 positioned under extension 526 on the latches 466. When the shaft 523 is rocked clockwise, the latches 466 are moved to released position which permits the pawls 460 to be moved to normal by their springs 462. The other two arms of the three-armed lever 517 (Fig. 5) to one of which the bell crank 516 is connected are for restoring the latches of the tens-transfer mechanisms of the registers 16 and 17.

The transfer segments are restored to normal every time the arm 485 (Fig. 4) is moved to its central position, which occurs every time the latch 486 is released, and the latch 486 is released when the register is moved into engagement with the actuators.

From this it will be seen that, whenever the register is moved out of engagement with the tens-transfer segments, said segments are restored to normal. This does not always occur at the same point in the machine cycle. In adding operations it occurs near the beginning of the return stroke and, in subtraction, it occurs at the beginning of the forward stroke. The time at which the register moves into engagement with the actuators not only determines when the transfer segments are returned to normal, but it also determines whether the tens-transfer mechanism shall be conditioned to carry or to borrow, because the question of which of the links 490, 491 shall be moved depends upon when they are both placed in active position, and the time of this event depends upon the movement of the register into engagement with the actuators. This automatic control of the tens-transfer mechanism during a machine cycle in accordance with whether the connection between the registering mechanism and the actuators is an add or subtract connection is believed to be new.

It is to be understood that the construction shown is for purposes of illustration only and that variations may be made in it without departing from the spirit and scope of the invention.

I claim:

In a machine of the class described having actuators and a registering mechanism adapted to be connected together to perform addition or subtraction, a tens-transfer mechanism, actuating means for said tens-transfer mechanism adapted to occupy a "neutral", a "carry", or a "borrow" condition, means operating at the beginning of each machine cycle to restore portions of said tens-transfer mechanism operated during prior tens-transfers, means operating automatically as said registering mechanism and actuators are connected together to place said actuating means in a "netural" condition, and means operating automatically as said registering mechanism and actuators are connected to perform addition, to condition said actuating means to cause it to be operated during a machine cycle to place the tens-transfer mechanism in "carry" condition, and as said registering mechanism and actuators are connected for subtraction, to place said actuating means in condition to cause it to be operated during a machine cycle to place said tens-transfer mechanism in "borrow" condition.

ROBERT L. MULLER.