Jan. 6, 1953

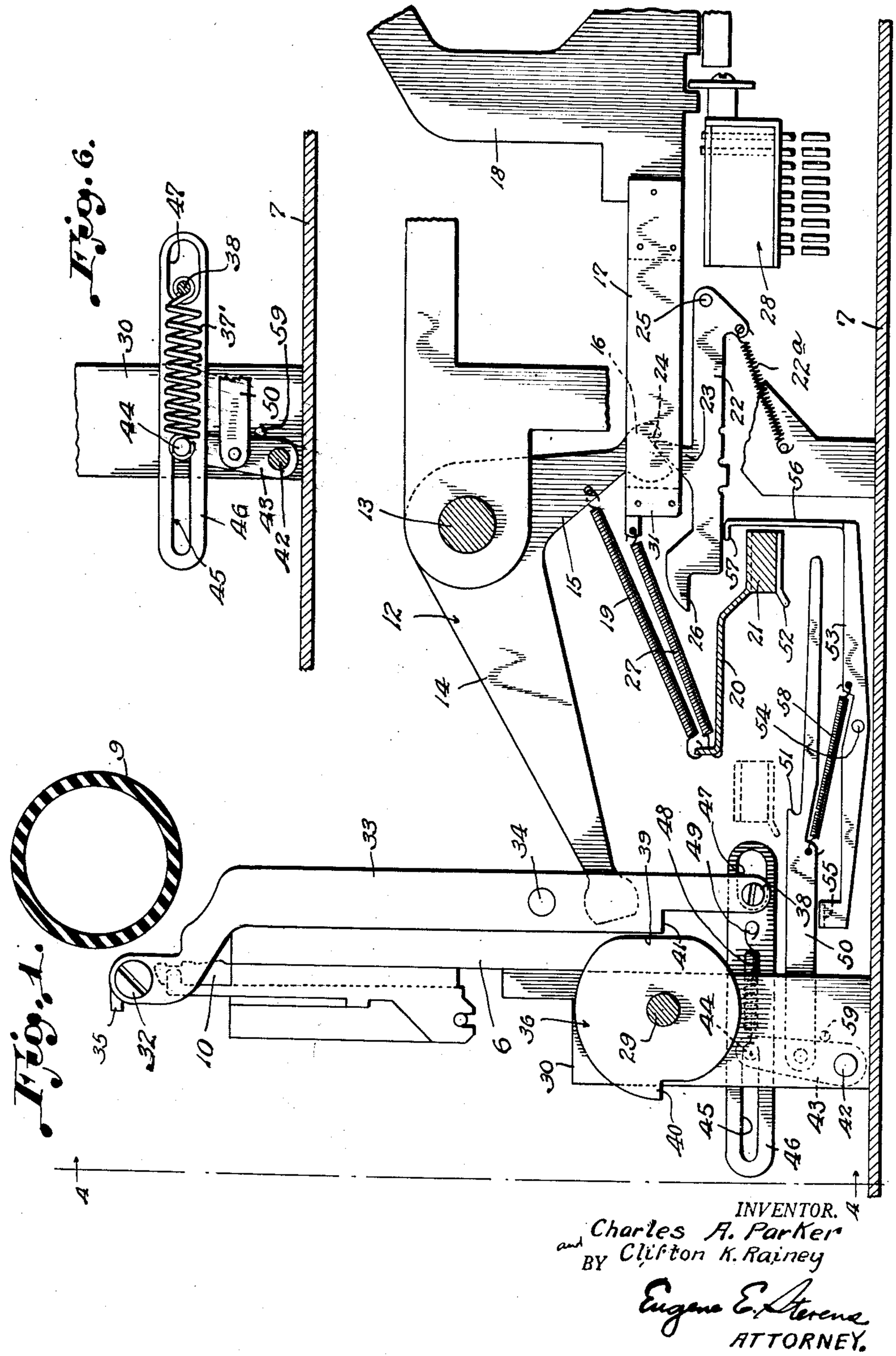
C. A. PARKER ET AL

2,624,275

HAMMER OPERATING MECHANISM

Filed June 14, 1949

3 Sheets-Sheet 1



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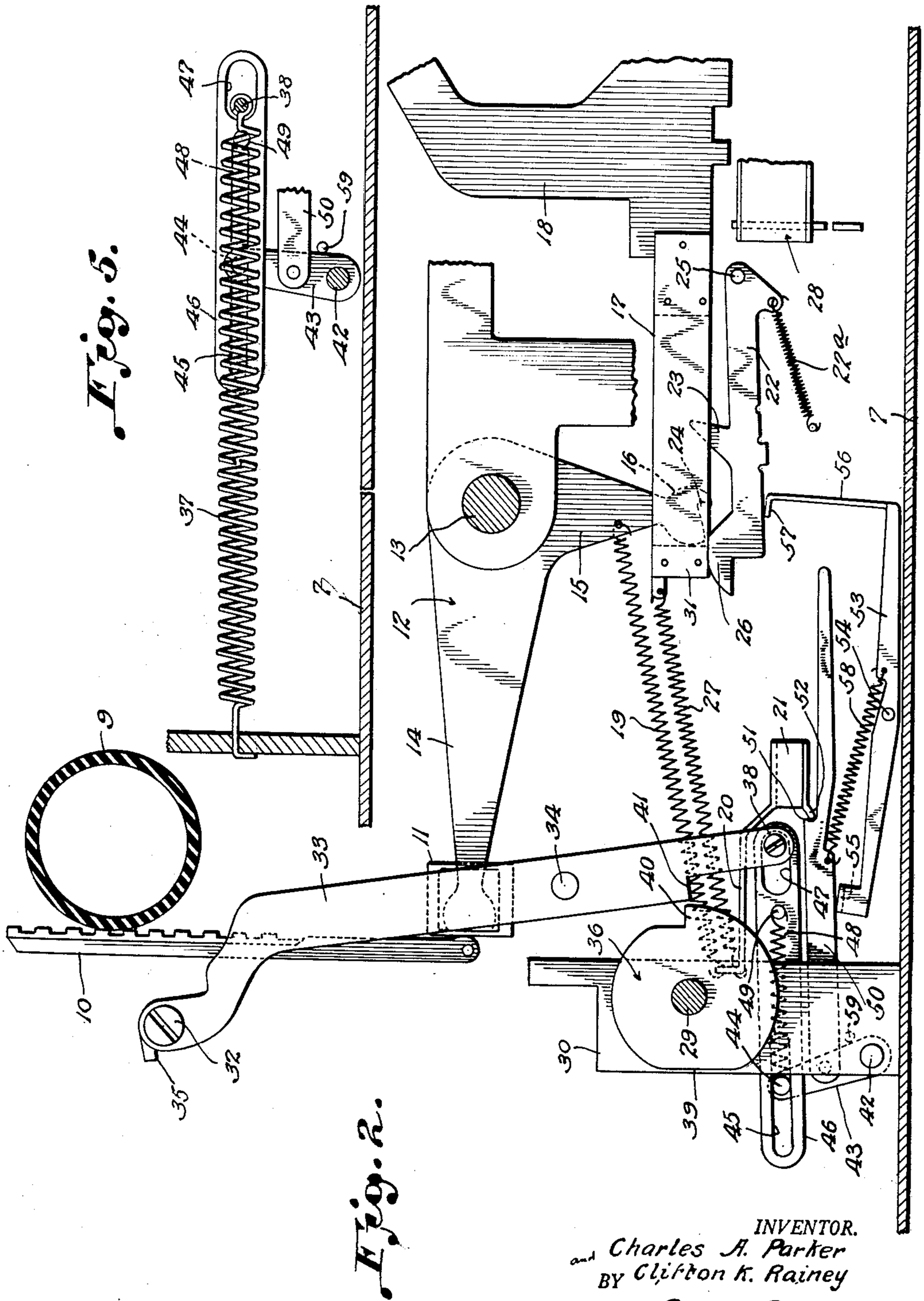

Fig. 2.

INVENTOR.
Charles A. Parker
and
BY Clifton K. Rainey
Eugene E. Stevens
ATTORNEY.

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Fig. 3.

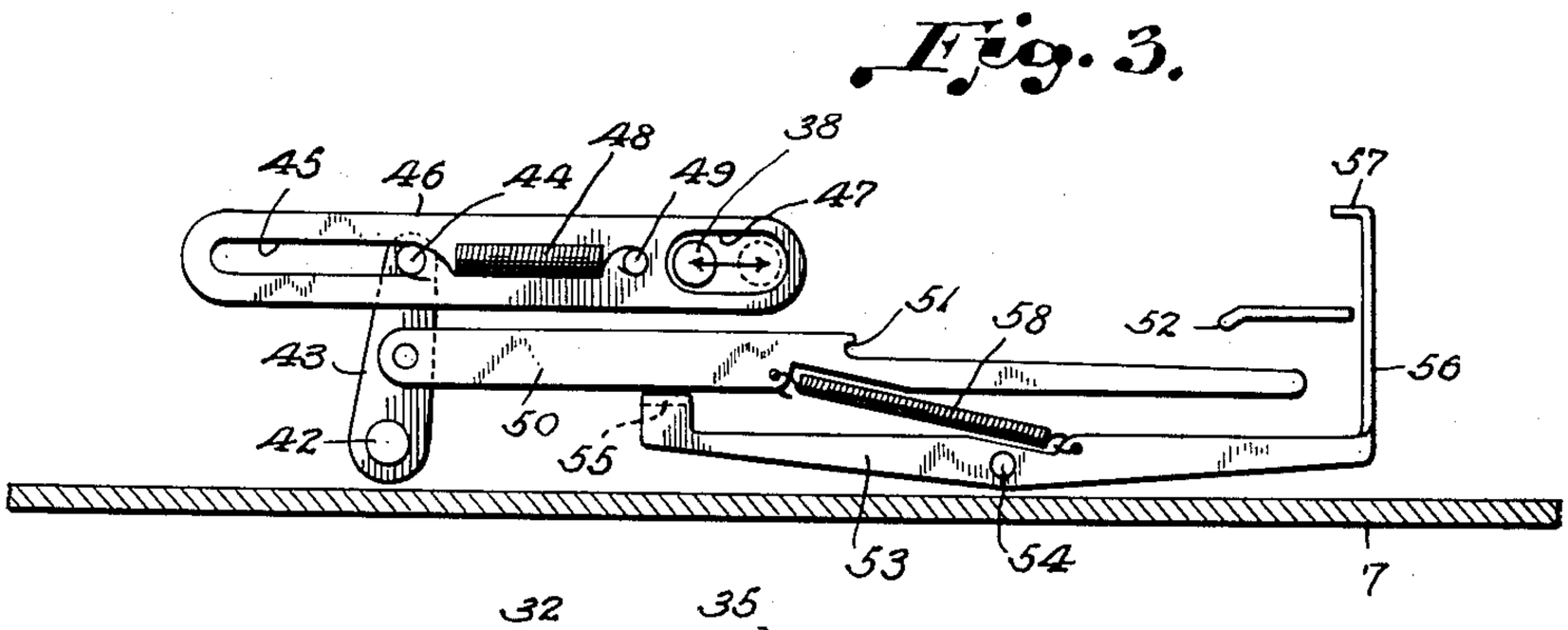
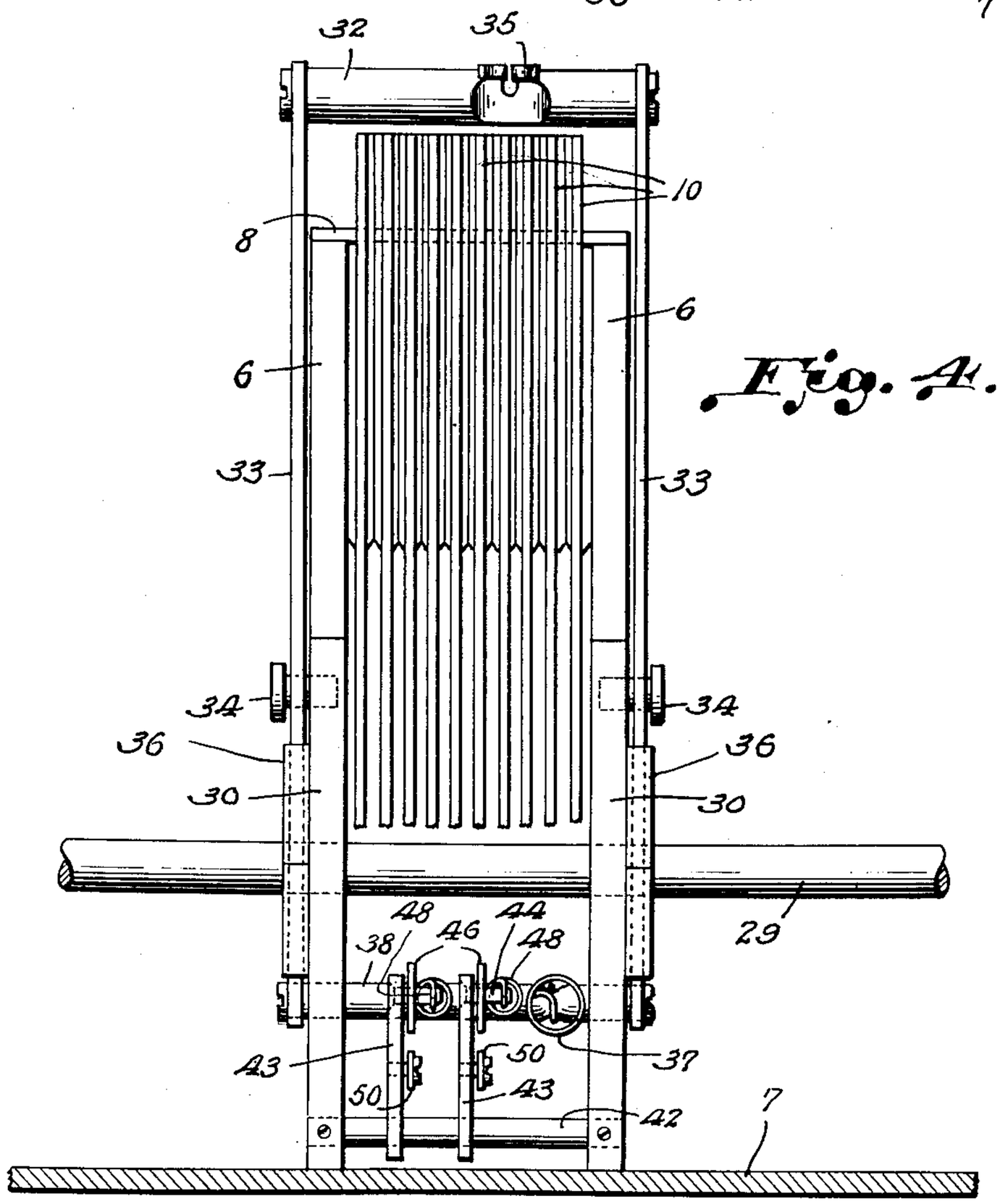


Fig. 4.



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Charles A. Parker
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Eugene E. Stevens
ATTORNEY.

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UNITED STATES PATENT OFFICE

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HAMMER OPERATING MECHANISM

Charles A. Parker and Clifton K. Rainey, Knoxville, Tenn., assignors to Rainey Accounting Machine Company, Inc., Knoxville, Tenn., a corporation of Tennessee

Application June 14, 1949, Serial No. 99,083

9 Claims. (Cl. 101—93)

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In its broad aspects this invention deals with spring actions for variable load mechanisms, in which a spring-propelled working member operating normally under a load suited to the tension of its spring propulsion means is at indeterminate intervals required to assume a greater load of such magnitude that, unless relieved, the effective force of its propulsion spring means would be impaired. A broad object of the invention is, therefore, to provide means for automatically increasing the strength of the spring propulsion means to the extent necessary to assume the greater load whenever the working member is called upon to assume a load of greater magnitude than that to which the strength of its normal spring propulsion means is best suited.

In particular, the invention relates to the art of accounting machines, and directly to calculating machines wherein adding type carriers are impacted by hammer means for printing against a platen. At present, the major utility of the invention appears to lie in the field of such devices, but it is by no means intended to be restricted thereto.

Calculating machines generally, and particularly those of the well known "ten key" type, make use of a plurality of adding type carriers that are moved into and out of printing position relative to a platen in accordance with the selective operation of calculating actuators. When a type carrier is disposed in its proper position for printing it is struck by hammer means individual thereto and driven with printing force against the platen. The provision of a separate hammer for each element to be struck, and separate actuating mechanism for each, necessarily entails the use of a great number of working parts, with consequent high cost of production, complexity, and liability to damage. In order to overcome these and other undesirable characteristics of prior art machines, the apparatus disclosed in the copending applications of Clifton King Rainey, Serial No. 629,185, filed November 16, 1945, now Patent No. 2,496,357, and Rainey and Parker application Serial No. 99,081, filed on June 14, 1949, was developed.

The apparatus disclosed in those applications employs a single hammer that is impacted simultaneously against a plurality of adding type bars disposed in printing position. Regardless of the number of adding type bars presented for printing, all are struck at the same time and with the same degree of force. A single hammer common to all the adding type bars is triggered to strike under the propulsion of a spring. It has been

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found that although the spring is well suited for clear, sharp printing of the lowest order digits, such as four figure items which constitute the bulk of entered items, the added load on the hammer caused by the increase in the number of type bars to be struck when higher order digits are included weakens the force of the hammer propulsion spring proportionately to the number of type bars added, so that the printing becomes progressively lighter and less sharply defined with the entry of digits in higher order. In manifolding operations, where a plurality of carbon copies are to be made of each item, the weakening of the spring action is a serious detriment to the production of clear carbons.

The provision of a spring operating at full strength and sufficiently strong to assure the desired striking force even though the entire set of adding type bars be presented for printing as one item is not a solution of the problem. At normal loads, such as the bulk of items, the striking force of the hammer is too great.

An object of the invention is to provide means for adapting the spring strength of the hammer propulsion means to the increase in load required of a single hammer common to a plurality of printing elements in a calculating machine, whenever the number of printing elements to be struck by the hammer is to be increased above that normally assumed by the hammer.

Another object is to provide, in a calculating machine having a spring propelled hammer for impacting a variable number of type carriers in printing position, a selective control whereby the effective spring propulsion force is automatically adapted to the load requirements of the hammer.

Another object is to provide means for automatically increasing the spring strength of the hammer propulsion means proportionately to the increase in load assumed by a single hammer common to a plurality of printing elements whenever the number of printing elements to be struck by the hammer is materially increased.

A further object is to provide calculating machine mechanism wherein the striking force of a hammer for impacting type bars is modulated by the action of control means operative under the influence of calculating actuators in the calculating mechanism.

Other objects will be apparent to those skilled in the art. In the drawings:

Figure 1 is an elevation, partly in section, of an embodiment of the invention in a "ten key" calculating machine having calculating actuators paired with adding type carriers movable into

printing position for impact by spring propelled hammer means.

Figure 2 is a view similar to Figure 1 but illustrating the spring force modulating means in operation.

Figure 3 is a fragmentary elevation illustrating details of the modulating means.

Figure 4 is a vertical section taken substantially on the line 4—4 of Figure 1.

Figure 5 is a detail illustration of the mounting for the main propulsion spring.

Figure 6 is a fragmentary elevation, partly in section, of an alternate embodiment of the modulating means.

As herein shown, the invention is incorporated specifically in the accounting machine disclosed in the copending application of Rainey and Parker, Serial No. 99,081 filed June 14, 1949. It includes an adding type bar guide frame having a pair of spaced vertical side posts 6 rigidly secured to a bottom element 7 of the machine and transversely connected at their upper ends by a top plate 8. The top of the frame is disposed in front of and adjacent to a platen 9. A series of adding type bars 10 is reciprocable vertically relative to the frame for movement into and out of printing position relative to the platen for front-strike visible printing against material on the platen. Each type bar has pivotal connection at its lower end with a corresponding cross-head 11 that is slidably mounted in the guide frame for reciprocation vertically therein under the influence of type bar moving means. The moving means, for each type bar, comprises a corresponding bell crank lever 12 pivotally mounted on a supporting shaft 13 that is secured in the main frame of the machine. The bell crank lever has a forwardly directed long arm 14 in cammed engagement at its end with the cross-head of its corresponding adding type bar. The short arm 15 of the lever is directed downwardly in the vertical plane of the long arm and is provided with a rounded terminal head 16 that is guided loosely between the parallel side walls of a forwardly directed horizontal extension 17 on the calculating actuator slide 18 corresponding to that particular type bar with which the bell crank lever is connected. Contractile spring means 19 is connected between the short arm of the lever and an extension 20 of an operating member 21 that is mounted for horizontal reciprocation in the machine. In the position of the parts as shown in Figure 1 the operating member 21 occupies its rearmost limit position, in which it is at rest. In this position the spring 19 is under slight tension normally urging the bell crank lever 12 to move in a clockwise direction to elevate its associated adding type bar towards printing position. Movement of the bell crank lever, however, is normally prevented by the holding action of a latch finger 22 which underlies the calculating slide extension 17. The latch is provided with an upstanding detent 23 normally engaged in a socket 24 of the bell crank lever terminal 16. The latch is pivoted at its rear end on a supporting rod 25 mounted in frame elements of the machine. Spring means 22a normally biases the detent 23 into latched holding engagement with the bell crank lever terminal. A cam head 26 on the front end of the latch finger projects into the path of travel of the calculating actuator slide extension 17.

Contractile spring means 27 connected between the extension 20 of the operating member and the forward end of the calculating slide extension 17 is normally under a light tension urging the slide to move forward. Arresting means, not shown, governed by the operating member 21, holds the slide against forward movement during an initial period of travel of the operating member forwardly away from its position of rest. The extent of forward movement permitted the slide is determined by a conventional stop pin box mechanism designated generally at 28, or by any other governing means conventional to calculating machines.

The operating member 21 moves forwardly and back through one full cycle at each revolution of a powered main drive shaft 29 journalled in supports 30 secured on the machine base slightly forwardly of the adding type bar guide frame. The operating connection between the drive shaft and the operating member forms no part of the present invention and is not shown. When the drive shaft is motivated at the start of a printing operation, forward movement of the operating member 21 in its first half cycle places the springs 19 and 27 under tension. Those calculating actuator slides permitted to move beyond their zero position travel forward, and the front end abutment 31 of each slide so moving engages and cams down the head 26 of its associated latch finger 22. This movement disengages the latch detent 23 and frees the bell crank lever for movement under the pull of its spring 19 as it moves forward with the operating member. The bell crank lever acts through its long arm 14 to lift its corresponding adding type bar into printing position. When the associated calculating actuator slide comes to rest at the position determined by its control means, the abutment 31 at the front end of the slide extension 17 holds the terminal 16 of the bell crank lever against further forward travel, so that the type bar is disposed in its proper position for printing. All type bars positioned for printing are set by the time the operating member 21 reaches the forward limit of its travel, at the end of its first half cycle.

Simultaneous printing from all adding type bars disposed in printing position is accomplished by the impact of a hammer 32 secured transversely between the upper ends of a pair of hammer levers 33 that are pivoted intermediate their ends on fulcrums 34 on the side posts 6 of the adding type bar guide frame. The hammer 32 is a substantially rounded bar of a length sufficient to span the entire set of adding type bars 10. It is provided with a letter type guide 35 in registry with the platen strike point of letter type actions, not shown, with which the machine may be provided. The guide 35 also determines the decimal printing point for items printed from the adding type bars.

A pair of snail cams 36 secured on the drive shaft 29 for rotation therewith triggers the hammer for striking impact against the adding type bars under the pull of a contractile driving spring 37. This driving spring 37 is connected at its rear end to a transverse tie rod 38 secured between the lower ends of the hammer levers and at its front end to a point of anchorage on an element of the machine frame. As shown in Figure 1, when the operating member 21 is in its rearmost position of rest the forward pull of the spring 37 holds the lower front edge portion of each hammer lever engaged against a flat dwell 39 of the corresponding snail cam. Each cam has a high point 40 in diametric opposition to its dwell. When the drive shaft 29 is motivated to effect an operating cycle of the member 21, the snail cams are rotated clock-

wise with respect to Figure 1 to build up tension of the hammer driving spring **37** by camming the lower ends of the hammer levers rearwardly during the first half cycle of the operating member. This action moves the hammer forwardly away from the platen and out of the path of upward movement of the adding type bars into printing position. As the operating member **21** nears the end of its forward travel, as shown in Figure 2, the high point on each cam passes a shoulder **41** on the bearing edge of the hammer lever and allows the hammer lever to snap over under the propulsion of the hammer driving spring **37** whereby to strike all elevated type bars simultaneously, so that they are driven with the same degree of force for printing at the platen. During rearward movement of the operating member **21** the adding type bars and calculating actuator slides are restored to their initial position by means, not shown, which is not a part of this invention.

The mechanism and operation thus far described is that of the corresponding elements of the accounting machine disclosed in the said Rainey and Parker application, Serial No. 99,081, filed June 14, 1949. The force of the hammer propulsion spring **37** is ample to assure clear, sharp printing and manifolding action for at least those digits of lower order which comprise the bulk of items entered or indexed into calculating machines. Without restrictive intent, and for purposes of explanation only, let it be assumed that the spring **37** gives the desired imprint to and including the fourth digit of the lowest order. In such case, when an item including the fifth and higher order digits is to be printed, the additional type bars to be struck impose a greater load on the hammer and proportionately weaken the effective force of the spring **37**, tending to lighter and less distinct printing and the production of imperfect carbon copies.

This invention provides means for automatically boosting the effective force of the hammer propulsion spring whenever the hammer is required to assume the additional load of the greater number of adding type bars positioned for printing items including the fifth and higher order digits. For this purpose the main drive shaft brackets **30** mount between their lower forward ends a transverse horizontal fulcrum shaft **42**. One or more vertically disposed rock levers **43** are pivoted at their lower ends on the shaft **42** to oscillate in a vertical plane. The lever at the right, with respect to Figure 4, is substantially in longitudinal alignment with the latch finger **22** which underlies the calculating actuator slide extension **17** of the slide corresponding to the fifth digit in ascending order, and the lever **43** at the left is similarly aligned with the latch finger beneath the actuator slide corresponding to the eighth digit. It is to be understood that the number of levers **43** and their arrangement is optional.

Each lever **43** is provided at its upper end with a lateral stud **44** which rides in a closed end slot **45** in the front end of a link **46**. This link has a closed end slot **47** in its rear end that is loosely engaged over the tie rod **38** which connects the lower ends of the hammer levers **33**. The tie rod together with the lever studs **44** provides horizontal sliding support for each link. The length of each closed end rear slot **47** is such that the tie rod **38** plays freely in the slot in the normal operation of the hammer under the sole

influence of its main propulsion spring **37** without imparting movement to the link, except for the practically negligible pivoting of the link on its forward support stud **44** incident to the arc of movement of the tie rod in the operation of the hammer.

A contractile booster spring **48** is disposed longitudinally alongside each link **46** in connection at its forward end with the associated lever stud **44** and its rear end with an anchoring stud **49** on the link. Normal tension of the booster spring holds the link in its Figure 1 rest position, with the rear end of its front slot **45** engaged against the lever stud **44** and with the front end of its rear slot **47** engaged against the hammer lever tie rod **38**. Each rock lever **43** has pivotal connection intermediate its ends with the forward end of a throw link **50** which extends horizontally and rearwardly beneath the link **46** into the zone of movement of the operating member **21** and below its plane of reciprocation. The upper edge of the throw link is stepped to provide a shoulder **51** intermediate its ends. A depending lip **52** on the operating member is adapted to engage the shoulder **51** when the throw lever is conditioned to dispose the shoulder in the path of travel of the lip.

It is intended in this invention that the means for so conditioning the throw link, whatever be its specific form, shall be operated from any element of the mechanism that is movable to determine the number of type carriers to be disposed in printing position for impact by the hammer in any given printing operation.

The means herein shown for conditioning the throw link comprises an interponent **53** between the link and the latch finger **22** with which it is aligned. In the present embodiment of the invention this interponent consists of a lever pivoted intermediate its ends on a fulcrum **54** fixed to an element of the machine frame. The front end of the interponent lever **53** carries a laterally directed lug **55** which underlies and supports the body of the throw link, and at its rear end the interponent lever has an integral upstanding arm **56** formed with a lateral lug **57** engaged against the bottom edge of its associated latch finger **22**. A biasing contractile spring **58**, connected between a point of attachment on the interponent lever rearwardly of its fulcrum and a point of attachment on the throw link **50** forwardly of its shoulder **51**, serves to urge the lug **57** of the interponent lever into constant engagement with its associated latch finger and at the same time to maintain the throw link constantly seated against the supporting lug **55** on the front end of the interponent lever. In the normal position of the parts, and when the hammer is actuated solely from the propulsion of its driving spring **37**, the shoulder **51** of the interponent lever **53** is disposed beneath and out of the path of travel of the lip **52** on the operating member **21**.

In the operation of the machine, when an item is entered which includes the fifth or higher order digits, movement of the calculating actuator slide **18** beyond its zero position carries its extension **17** forwardly to engage and release the latch finger **22** as previously described. As the front end of the latch finger moves down it carries down with it the arm **56** of the interponent lever. This action correspondingly elevates the front end of the interponent lever and raises the throw link **50** to dispose its shoulder **51** in the path of forward travel of the operating member lip **52**. When the lip engages the shoulder, which occurs

before the operating member has reached the end of its forward movement, the throw link is propelled forwardly under the driving force of the operating member 21. This action rocks the lever 43 forwardly and its stud 44 moves forward in the intermediate link slot 45 building up tension on the booster spring 48 at the same time that tension on the spring 37 is building by the shifting of the hammer levers under control of the snail cams 36. During this interval the slidable link 46 advances under the pull of its booster spring 48 to engage the rear end of its rear slot 47 against the tie rod 38 of the hammer levers.

Both the main hammer propulsion spring 37 and the booster spring 48 are at peak tension when the high points 40 of the snail cams slip past the shoulders 41 of the hammer levers. The hammer levers are, therefore, propelled under the combined forces of both the main spring and the booster spring. The added power of the booster spring compensates for the increased hammer load of the added type bars of the fifth and higher order digits. When the eighth ascending order digit is included in an item to be printed, its associated booster spring is made effective in the same manner. The same is true for whatever increments are included in the use of additional boosters.

In the alternative embodiment of the spring modulating means shown in Figure 6, the propulsion of the hammer is effected from a single spring that is sufficiently strong to assure the desired force for printing from the group of type bars up to, for example, the seventh in ascending order, as one item but the effective force of the spring is adapted to the load which the hammer is called upon to assume at any given printing operation.

The booster springs previously described are eliminated, and the previously described main spring 37 is replaced by a single strong spring 37' of shorter length. At its front end the spring 37' is connected to the rock lever stud 44 and at its rear end it is connected to the hammer lever tie bar 38. A stop 59 extending laterally from the adjacent support 30 engages the rear edge of the rock lever 43 to hold it against rearward movement out of its Figure 1 position. It is to be understood that the rock lever and link assembly for the eighth type bar is similarly provided with a spring similar to but stronger than the spring 37'.

The spring 37' urges the rock lever stud 44 and hammer lever tie bar 38 in converging relation against the adjacent ends of their respective slots in the link 46. When the hammer is required to strike only the lower order type bars, as in the bulk of printing operations, the tie rod 38 plays in the link slot 47 as previously described. Only a portion of the strength of the spring 37' is employed to propel the hammer.

When an item is entered which includes the fifth and higher order type bars the hammer is called upon to assume the heavier load of the larger number of type bars to be struck. The throw link 50 is conditioned in the manner previously described so that it is propelled by the operating member to rock the lever 43 forwardly to carry its stud 44 forwardly and thus increase tension of the spring 37', whereby the major force of the spring becomes effective for propulsion of the hammer. A similar action occurs when the rock lever 43 for the eighth type bar is actuated.

If it is desired to do so, only one of the rock lever and throw link assemblies can be employed

at the intermediate point of the series of type bars, with a single spring sufficiently strong when operating at full strength to give the desired printing strike force when the hammer is called upon to strike the entire series of type bars as a single item.

It is intended that the invention may be embodied in any form and structure consistent with its scope as claimed.

We claim:

1. In an accounting machine, a platen, a series of type carriers movable to printing position relative thereto, hammer means adapted for striking simultaneously all carriers in printing position, spring means for operating said hammer means, and means operative in conjunction with said spring means and automatically responsive to the movement of predetermined type carriers to position for printing to increase the striking force of the hammer with an increase in the number of carriers to be struck thereby, means for holding said latter means in inoperative position, and releasing means effective upon movement of certain type carriers for positioning said latter means for actuation to increase the striking force of the hammer.

2. In an accounting machine, a platen, a series of type carriers movable to printing position relative thereto, a single hammer common to all said carriers for impacting them simultaneously with printing force against the platen, a main propulsion spring for the hammer, a separate means for moving each individual carrier to printing position independently of the others for impact by the hammer, booster spring means normally ineffective during actuation of the hammer under the propulsion of the main spring only, and means operative upon the movement of at least one type carrier intermediate in the series to add the force of the booster spring means to that of the main spring for actuation of the hammer.

3. In an accounting machine, a platen, a series of type carriers movable to printing position relative thereto, a single hammer common to all said carriers for impacting simultaneously all carriers in printing position, spring propulsion means for the hammer, actuators operative to determine the number of type carriers movable to printing position for any given printing operation, a driven operating member, an interponent between said operating member and the spring propulsion means and normally ineffective to establish connection therebetween, and means operative from at least one of said actuators to render said interponent effective whereby to modulate the force of the spring propulsion means upon actuation of said operating member.

4. In an accounting machine having a plurality of type carriers independently shiftable into position for printing, a hammer coextensive with all of the type carriers and swingably mounted for impacting type carriers in position for printing, spring means for propelling said hammer to impact the type carriers under normal load conditions, auxiliary spring means operative only in response to shifting movement of predetermined type carriers to position for printing to supplement the propelling force operating upon the hammer for impacting, and a cyclically operated member having one portion which releases the hammer during its cycle of operation for impacting the type carriers in position for printing and a reciprocal portion for shifting the type carriers into position for printing and simultaneously rendering said auxiliary spring means effective in

response to movement of predetermined type carriers into position for printing.

5. In an accounting machine having a plurality of type carriers shiftable to position for printing, a hammer common to all of said type carriers for simultaneously impacting those in position for printing, spring means normally operative for urging said hammer under constant load to impact the type carriers in position for printing, auxiliary means for increasing the force effective to urge said hammer in impacting relation with the type carriers in position for printing, and a cyclically operated member operative in response to movement of predetermined type carriers to position for printing for rendering said auxiliary means effective to increase the impacting force of the hammer and operative also to release said hammer during its cycle of operation for impacting the type carriers in position for printing.

6. In an accounting machine having a plurality of type carriers shiftable to position for printing, a hammer common to all of said type carriers for impacting those in position for printing, spring means normally operative to propel the hammer under constant load to impact the type carriers in position for printing, auxiliary means for increasing the force effective to urge the hammer in impacting relation, a cyclically operated member for rendering said auxiliary means effective to increase the impacting force of the hammer and operative also to release said hammer during its cycle of operation for impacting the type carriers in position for printing, and means for holding said auxiliary means out of position to be rendered effective by said operating member until released by movement of predetermined type carriers to position for printing.

7. In an accounting machine having a plurality of type carriers shiftable to position for printing, a hammer common to all of said type carriers for impacting those in position for printing, spring means normally operative to propel the hammer under constant load to impact the type carriers in position for printing, auxiliary means for increasing the force effective to urge the hammer in impacting relation, a cyclically operated member for rendering said auxiliary means effective to increase the impacting force of the hammer and operative also to release said hammer during its cycle of operation for impacting the type carriers in position for printing, means for holding said auxiliary means out of position to be rendered effective by said operating member until released by movement of predetermined type carriers to position for printing, and an operative connection between predetermined type carriers and said auxiliary means for adjusting same in position to be rendered effective by the operating member during a portion of its cycle movement.

8. In an accounting machine having a plurality of type carriers shiftable to position for printing, an impacting member pivoted intermediate its ends for rocking movement in the direction toward and away from the type carriers in position for printing, a hammer on one end portion of said impacting member coextensive with all of the type carriers for impacting those in position for printing, spring means normally urging said impacting member to rock the hammer for impacting said type carriers in position for printing, a cyclically operated member having a cam surface in contacting relation with said impacting member to actuate same in rocking movement and suddenly to release same during the cycle of operation whereby the hammer is propelled for impacting the type carriers in position for printing, and auxiliary means rendered effective by the cyclically operated member in response to shifting movement of predetermined type carriers to position for printing to increase the impacting force of the hammer.

9. An accounting machine as claimed in claim 8 in which the auxiliary means comprises spring means operatively connected to the impacting member at one end, a rocker arm pivoted at one end and operatively connected to the free end of the spring at the other, means for rocking said rocker arm in the direction to tension the spring means, means for holding said rocker operating means out of the path of the operating member, and other means responsive to movement of said type carriers to position for printing for positioning said operating means to be actuated by the operating member whereby the auxiliary means are rendered effective for increasing the impacting force of the hammer.

CHARLES A. PARKER.
CLIFTON K. RAINEY.

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