March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Filed Feb. 12, 1936 18 Sheets-Sheet 1

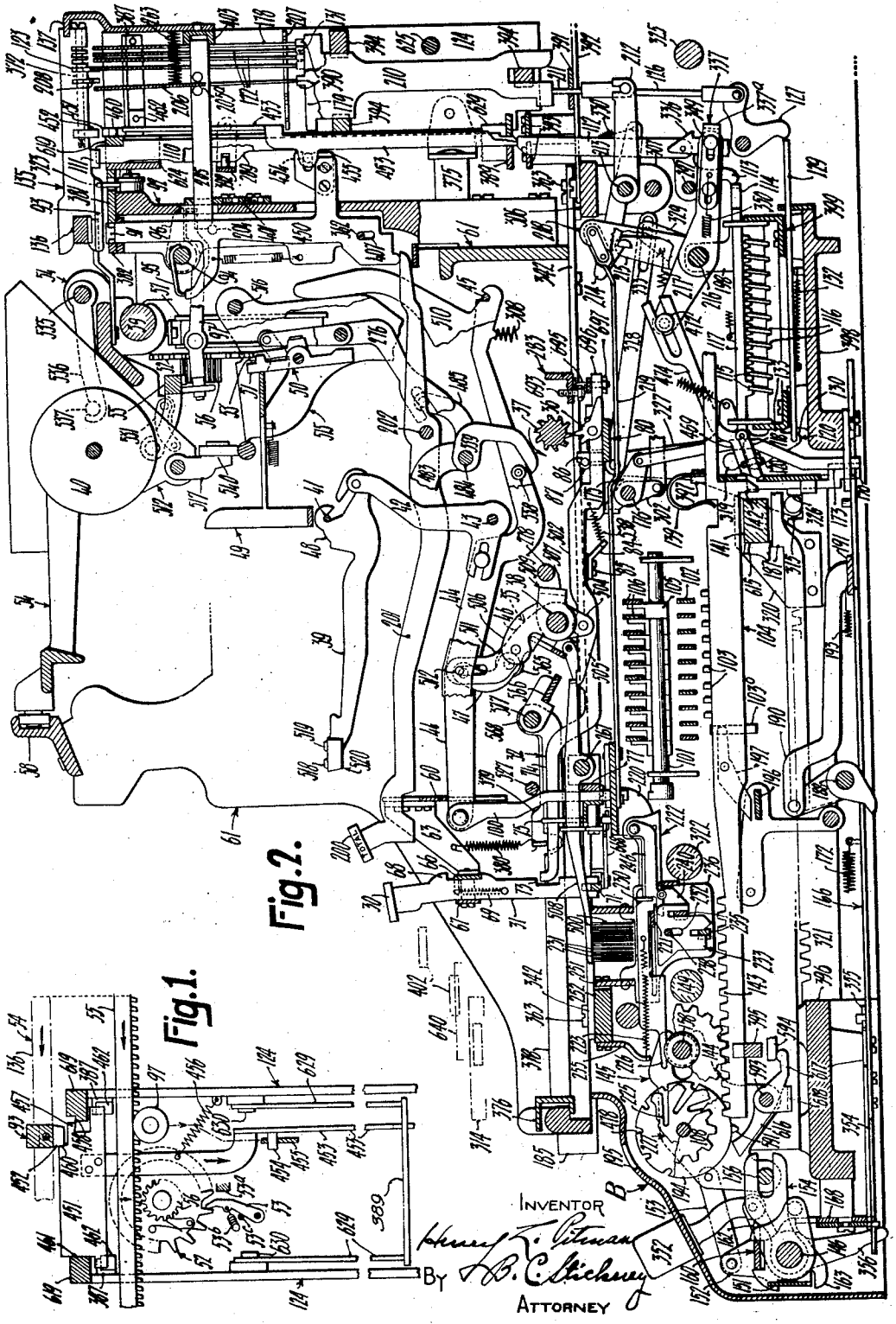


Fig. 2.

Fig. 1.

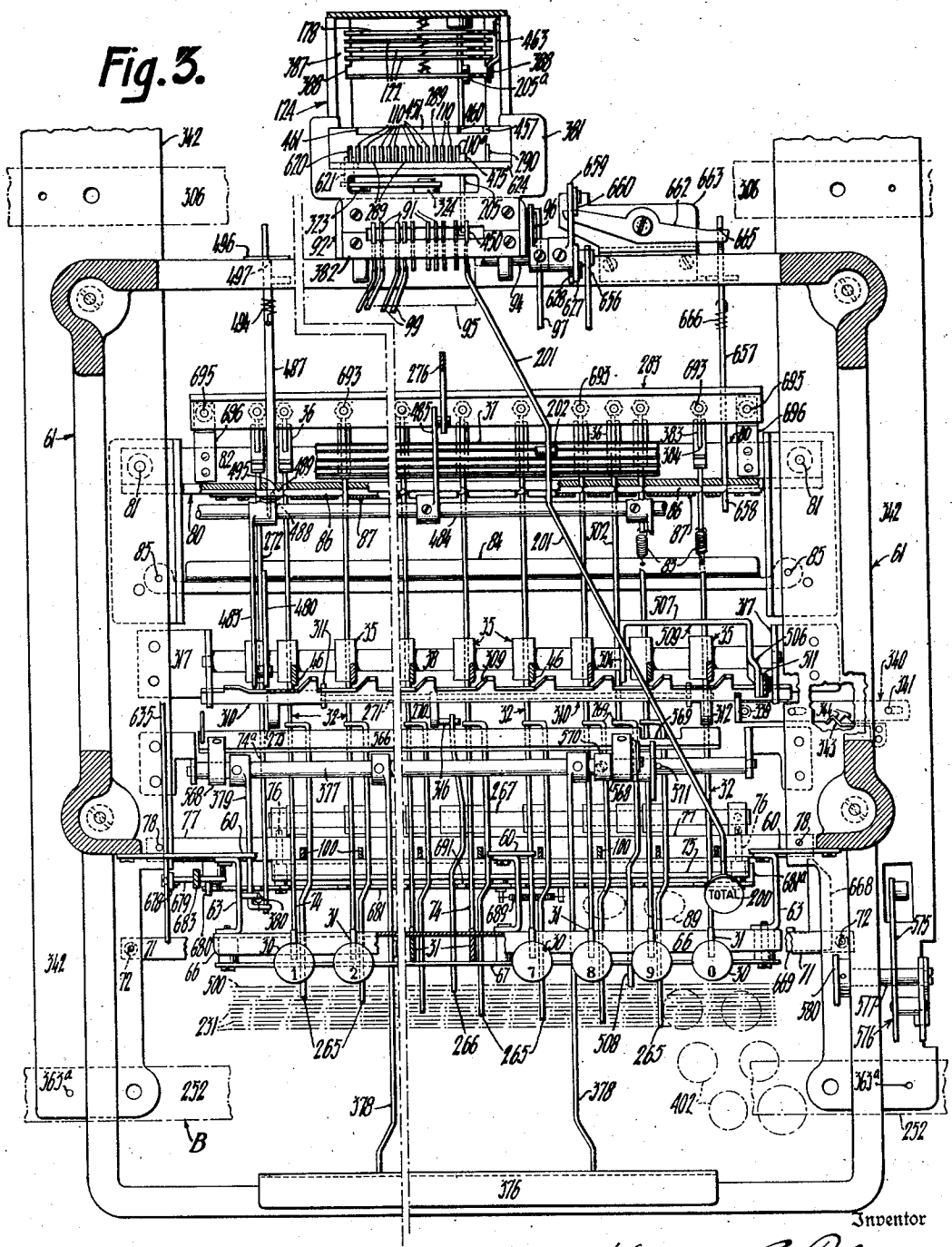
INVENTOR
Henry L. Pitman
BY B. C. Stickney
ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Filed Feb. 12, 1936 18 Sheets-Sheet 2

Fig. 3.



Inventor

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By B. C. Stickney

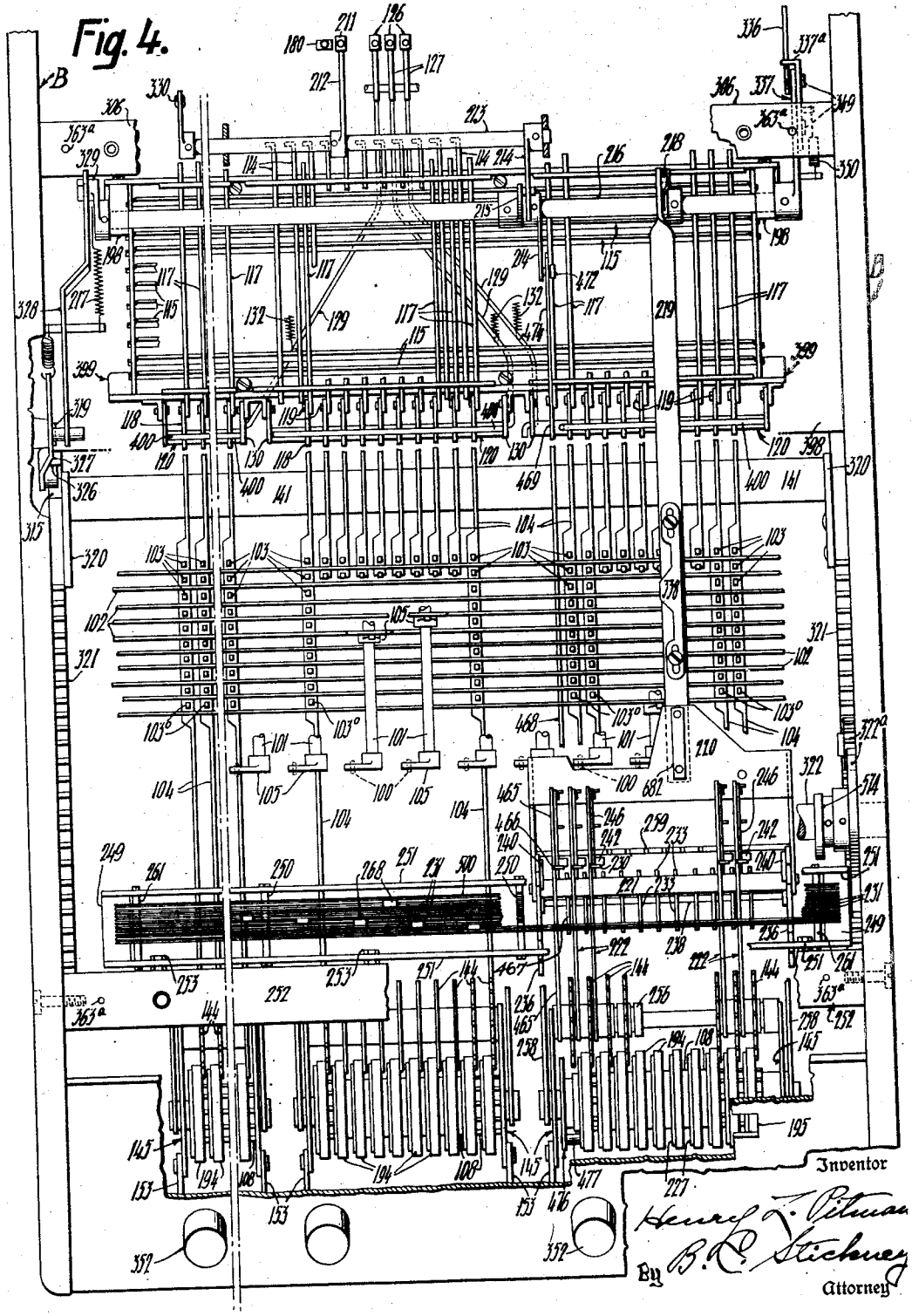
Attorney

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 4.



Inventor

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By B. L. Stichney

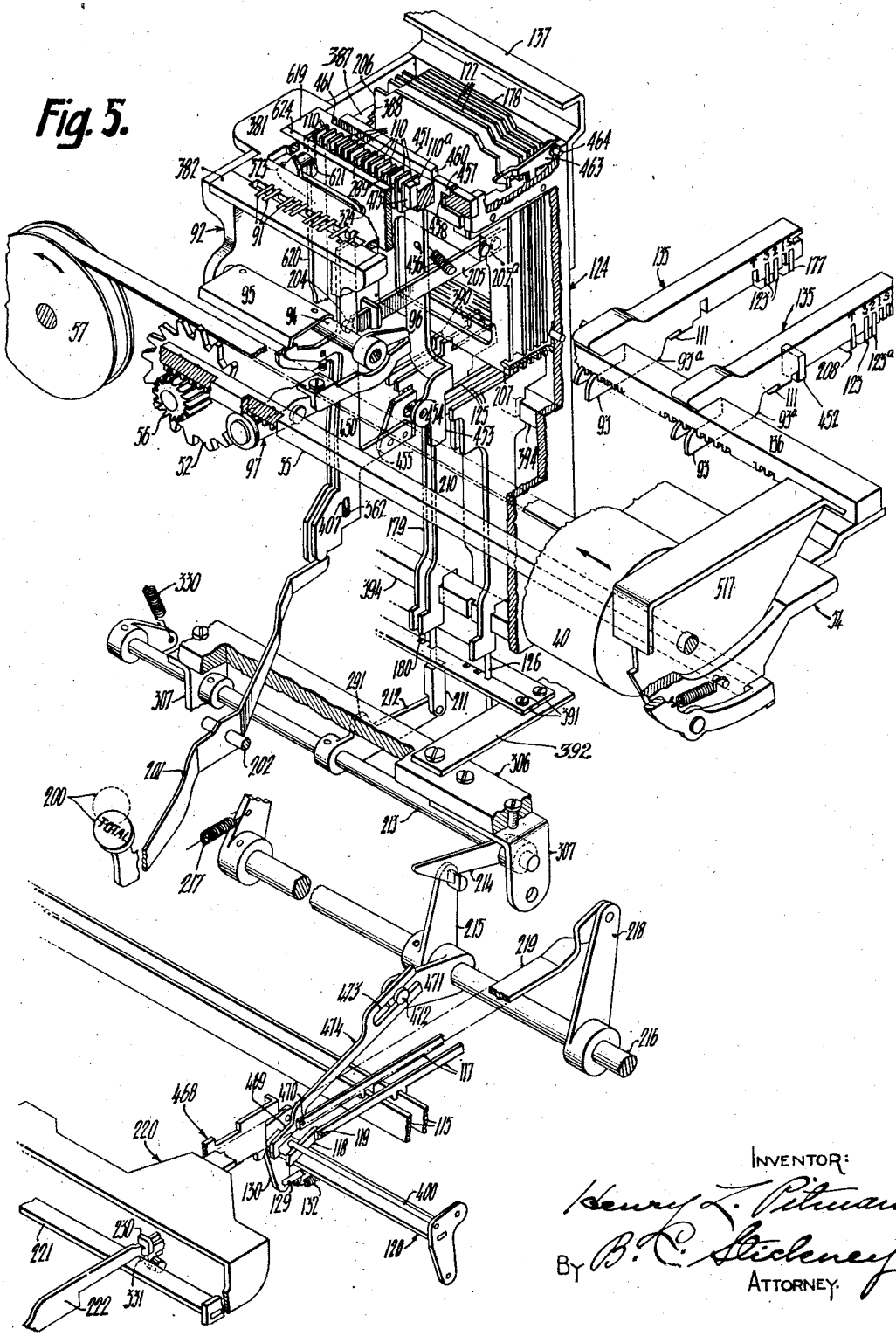
Attorney

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 5.



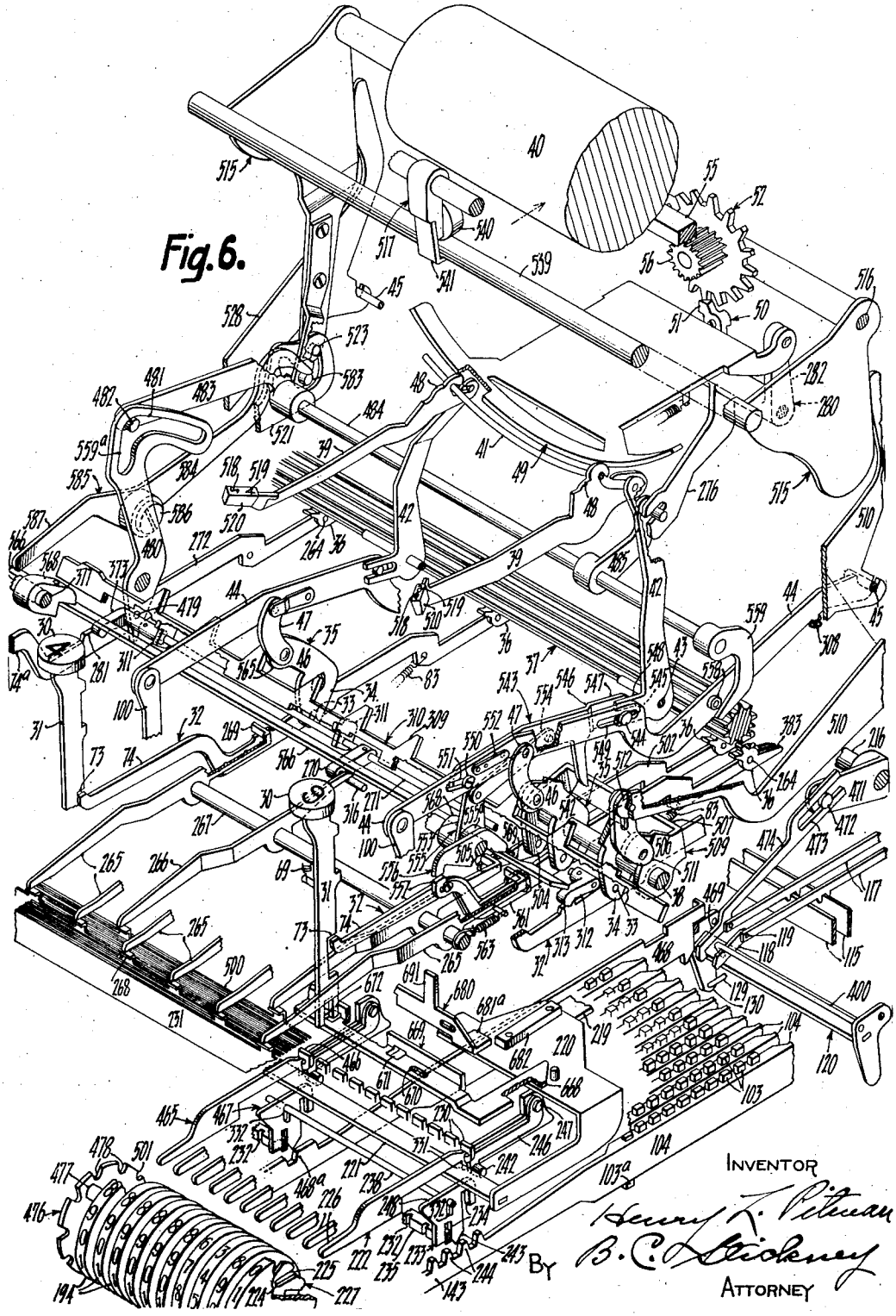
INVENTOR:
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March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 6.



INVENTOR

Henry L. Pitman

BY B. C. Stickney

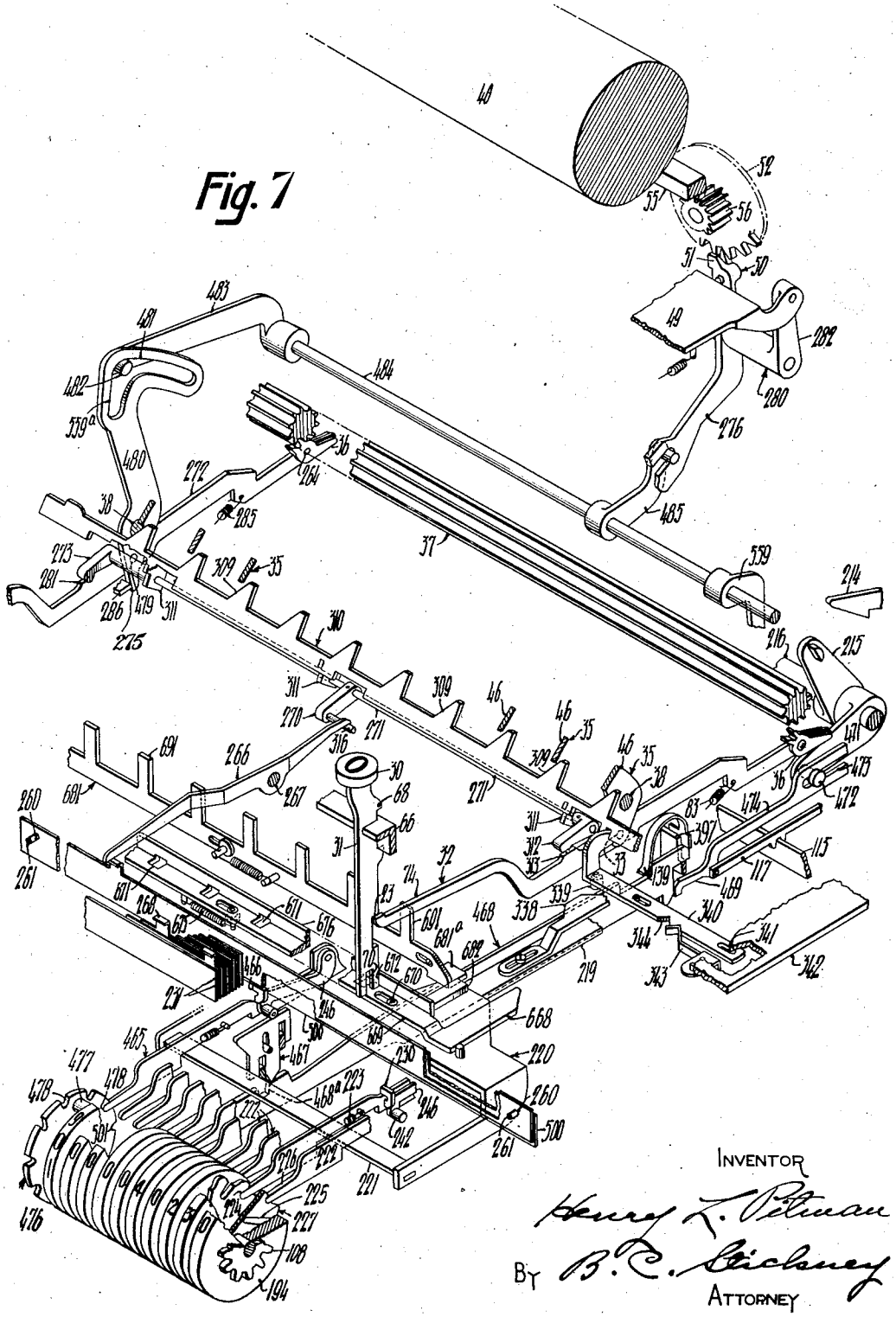
ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Filed Feb. 12, 1936 18 Sheets-Sheet 6

Fig. 7



INVENTOR

Henry L. Pitman

BY B. C. Richey

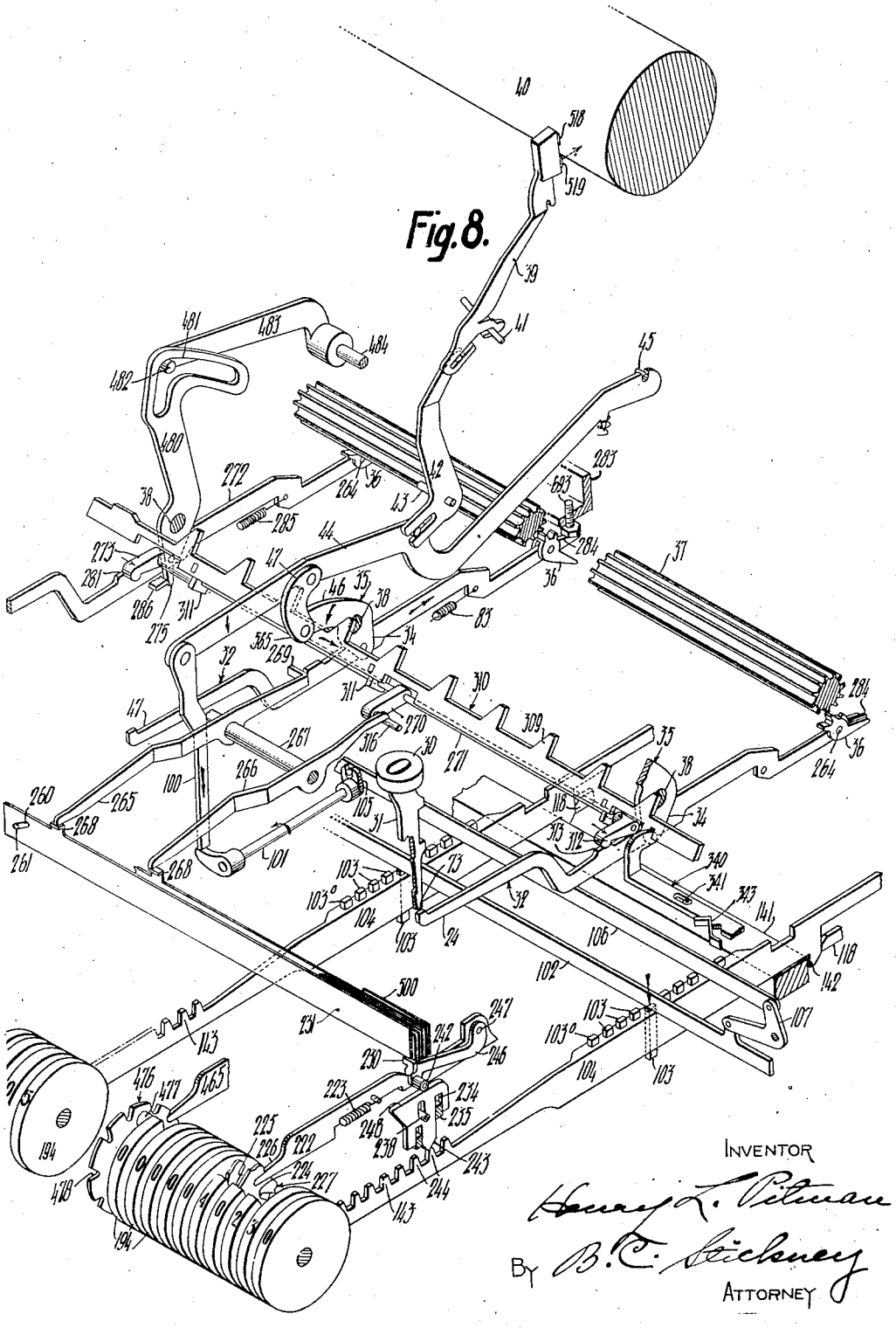
ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 8.



INVENTOR

Henry L. Pitman

BY B. C. Hickney

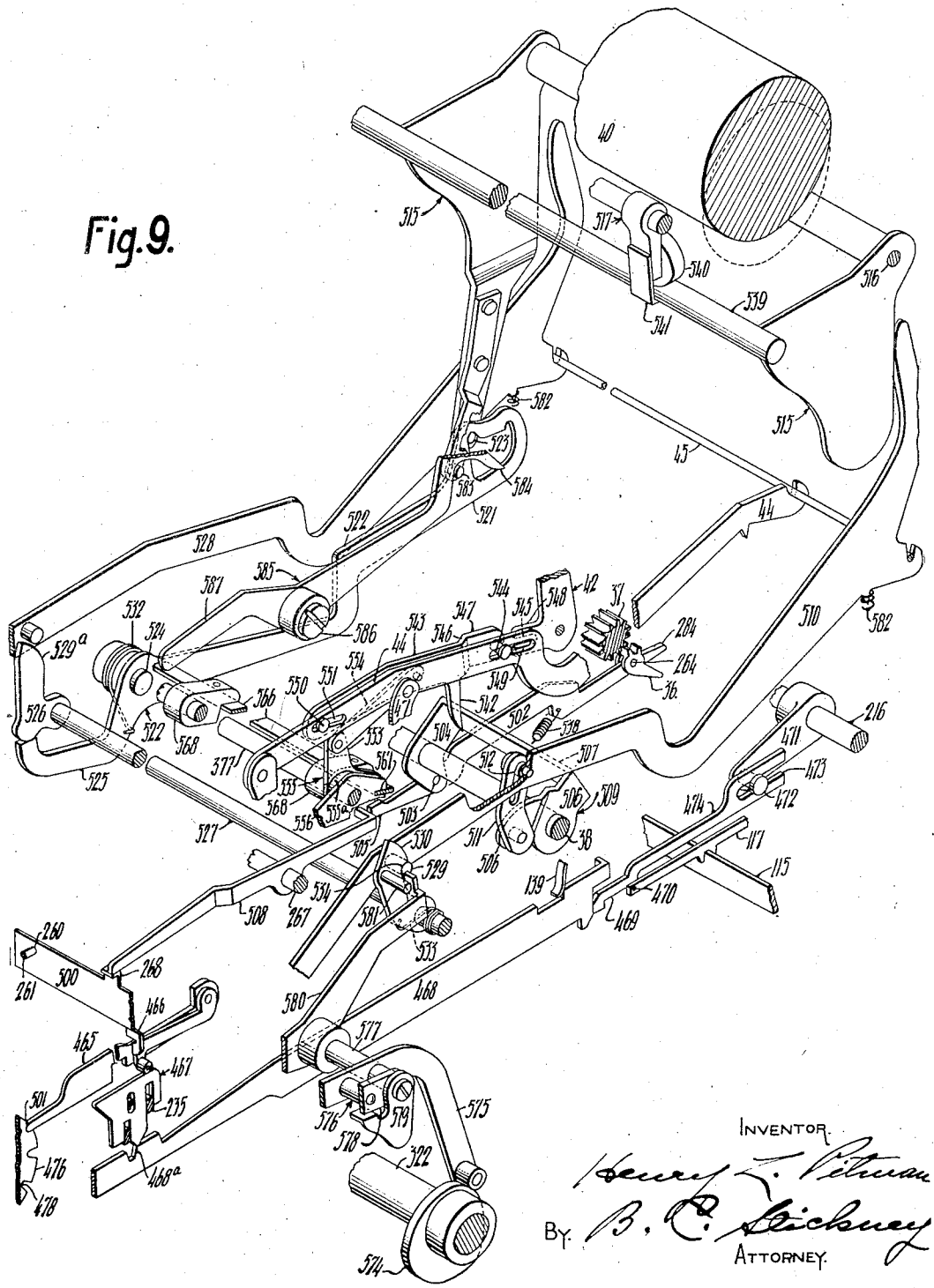
ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 9.



INVENTOR.
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March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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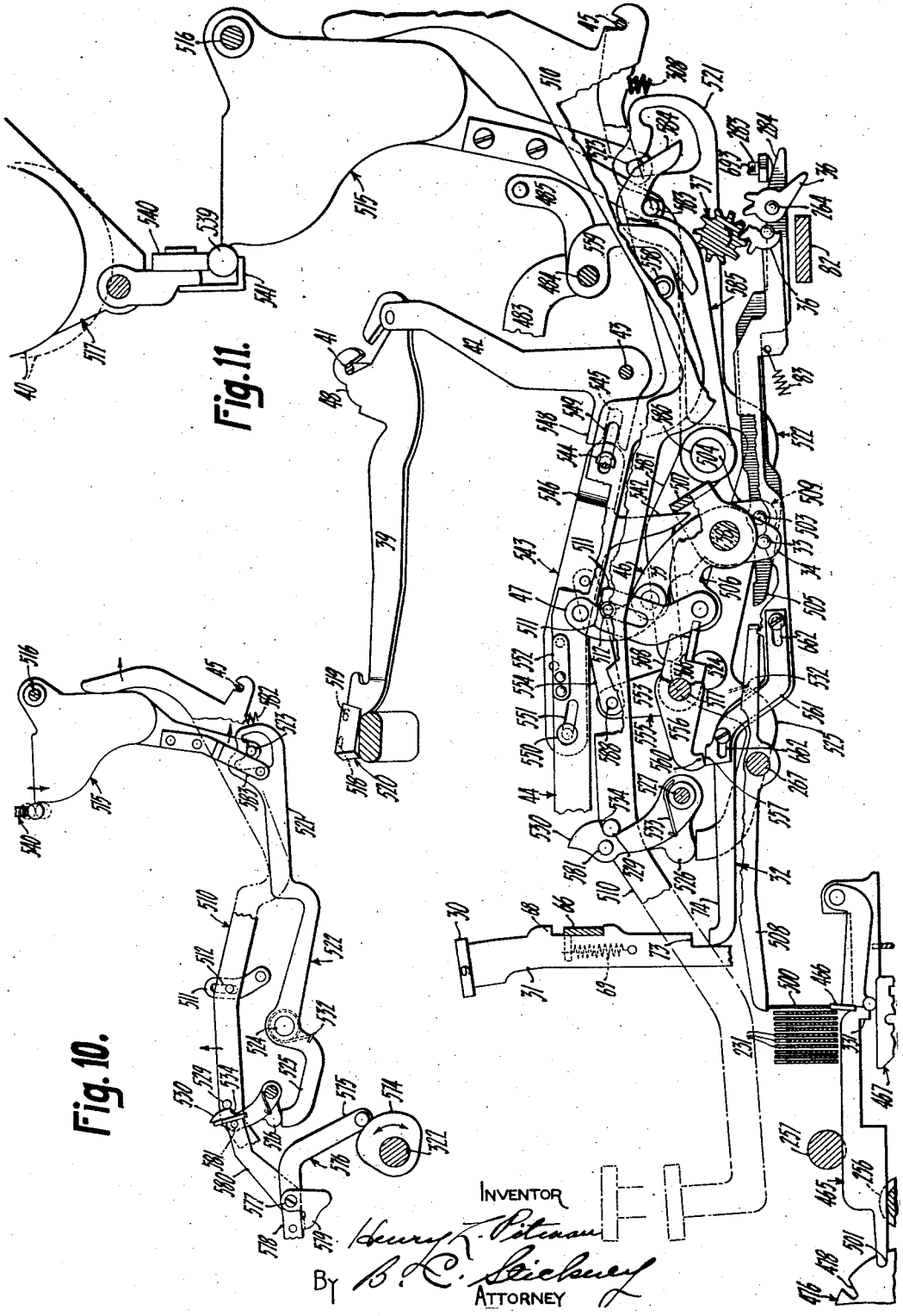


Fig. 11.

Fig. 10.

INVENTOR
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March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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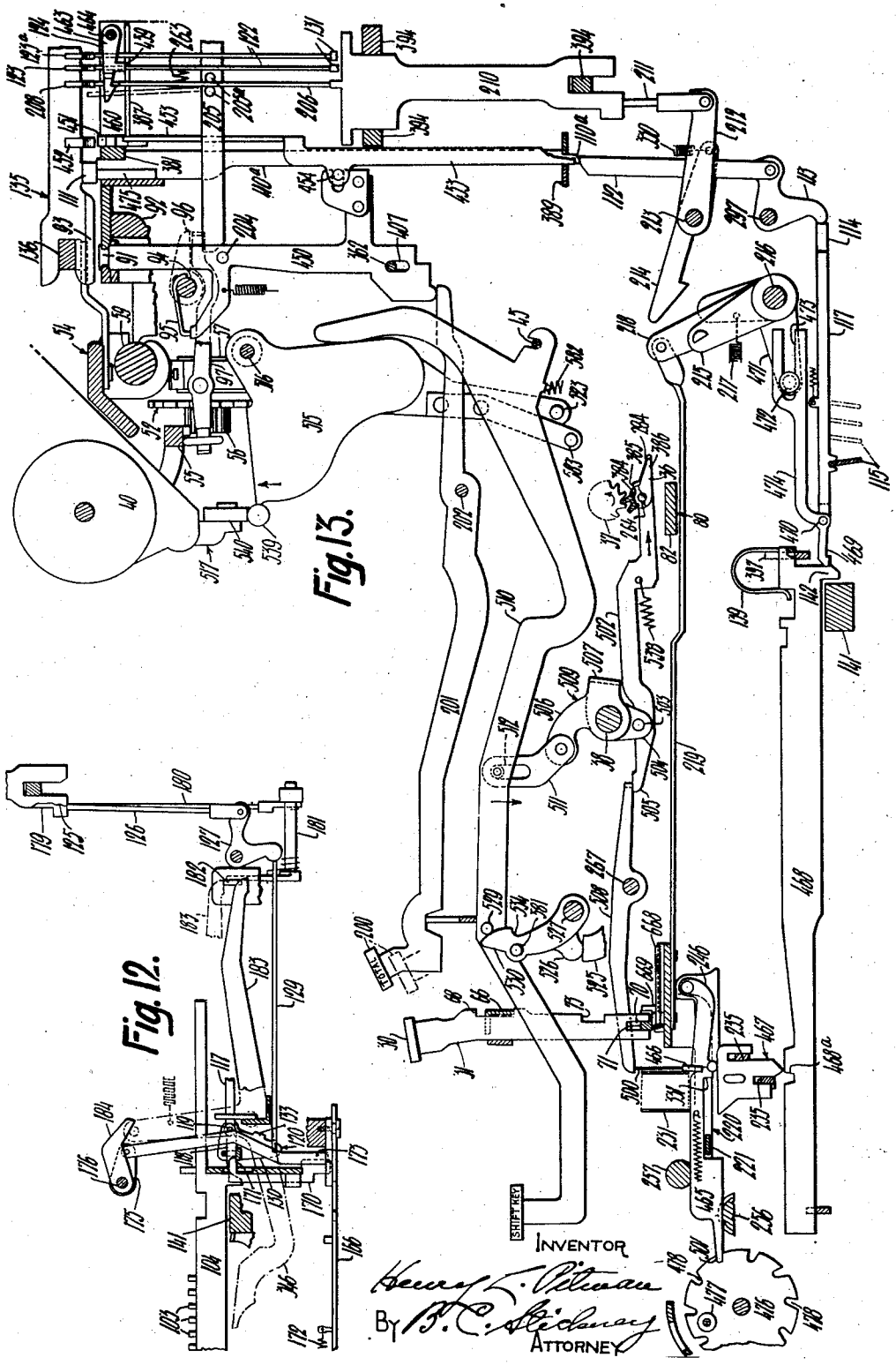


Fig. 13.

Fig. 12.

INVENTOR

Henry L. Pitman

BY P. C. Sidney

ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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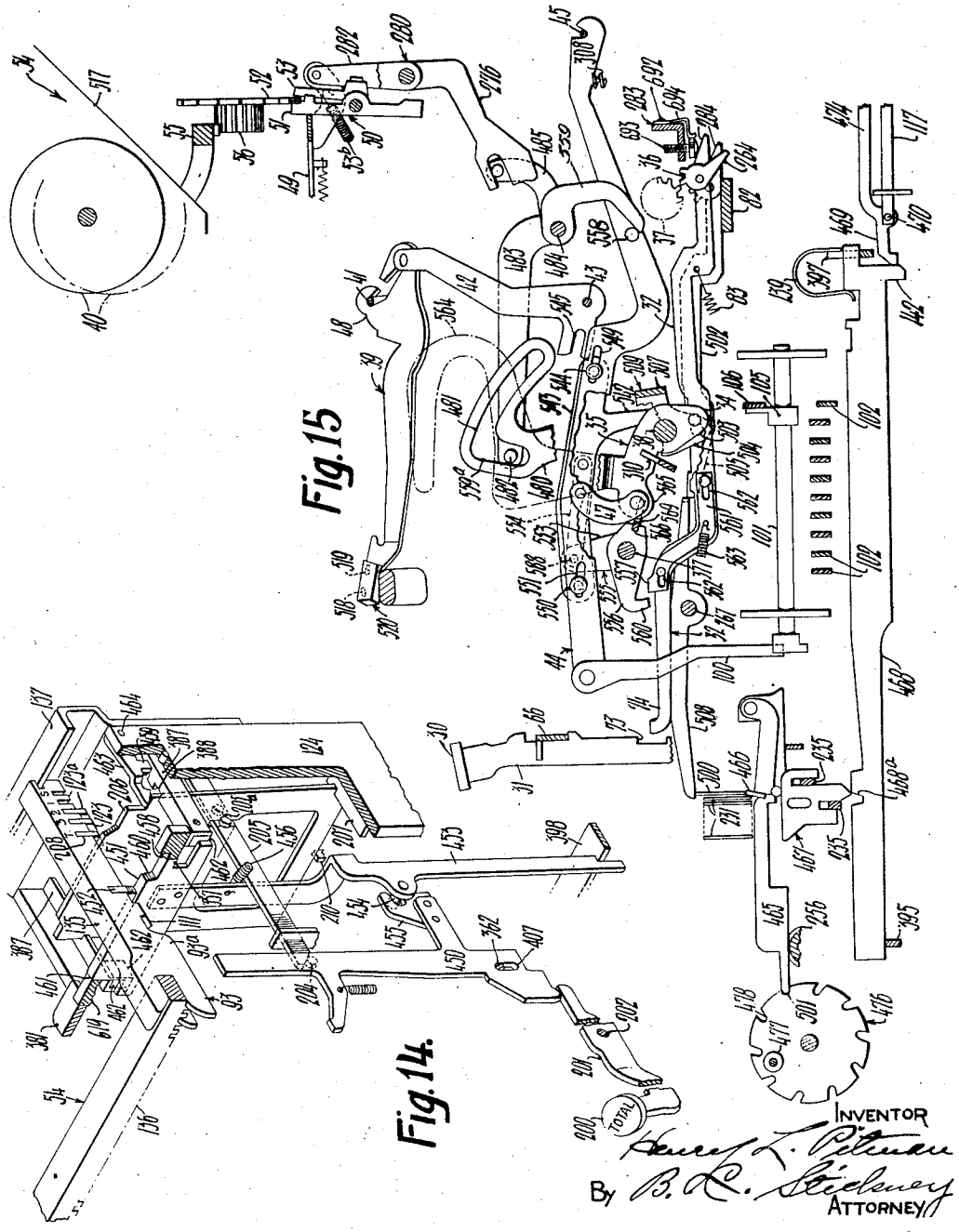


Fig. 15

Fig. 14.

INVENTOR
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By B. R. Stickney
ATTORNEY

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COMBINED TYPEWRITING AND COMPUTING MACHINE

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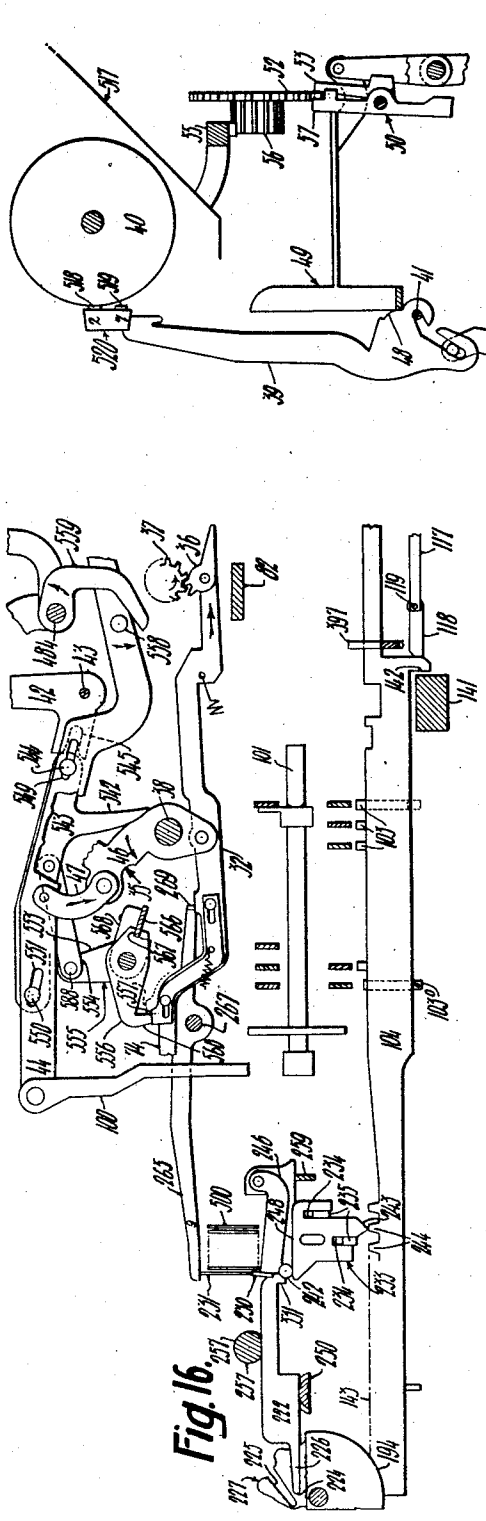


Fig. 16.

Fig. 17.

INVENTOR

Henry L. Pitman

BY B. C. Dickerson

ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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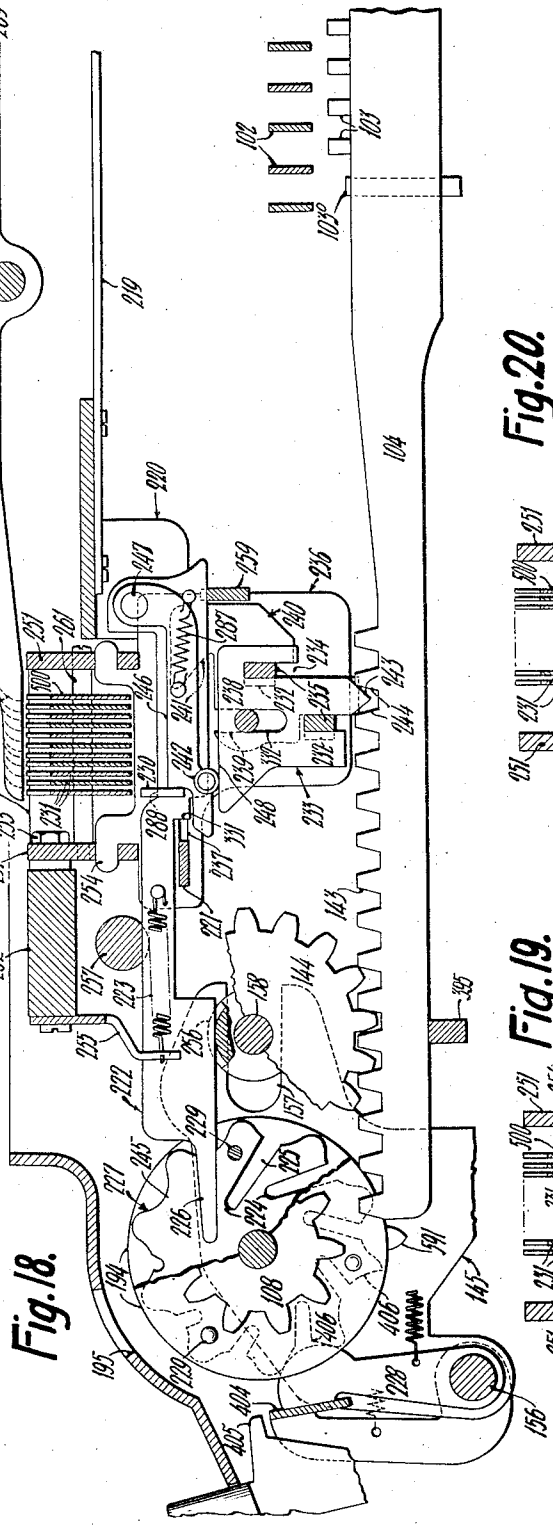


Fig. 18.

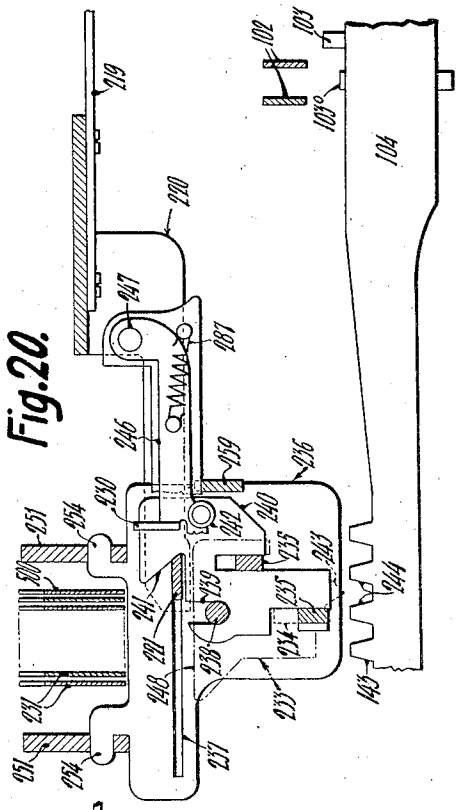


Fig. 20.

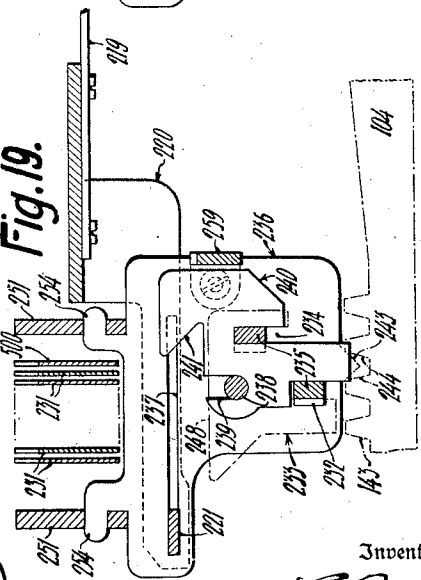


Fig. 19.

Inventor

Henry L. Pitman

By B. C. Stickney

Attorney

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Filed Feb. 12, 1936 18 Sheets-Sheet 14

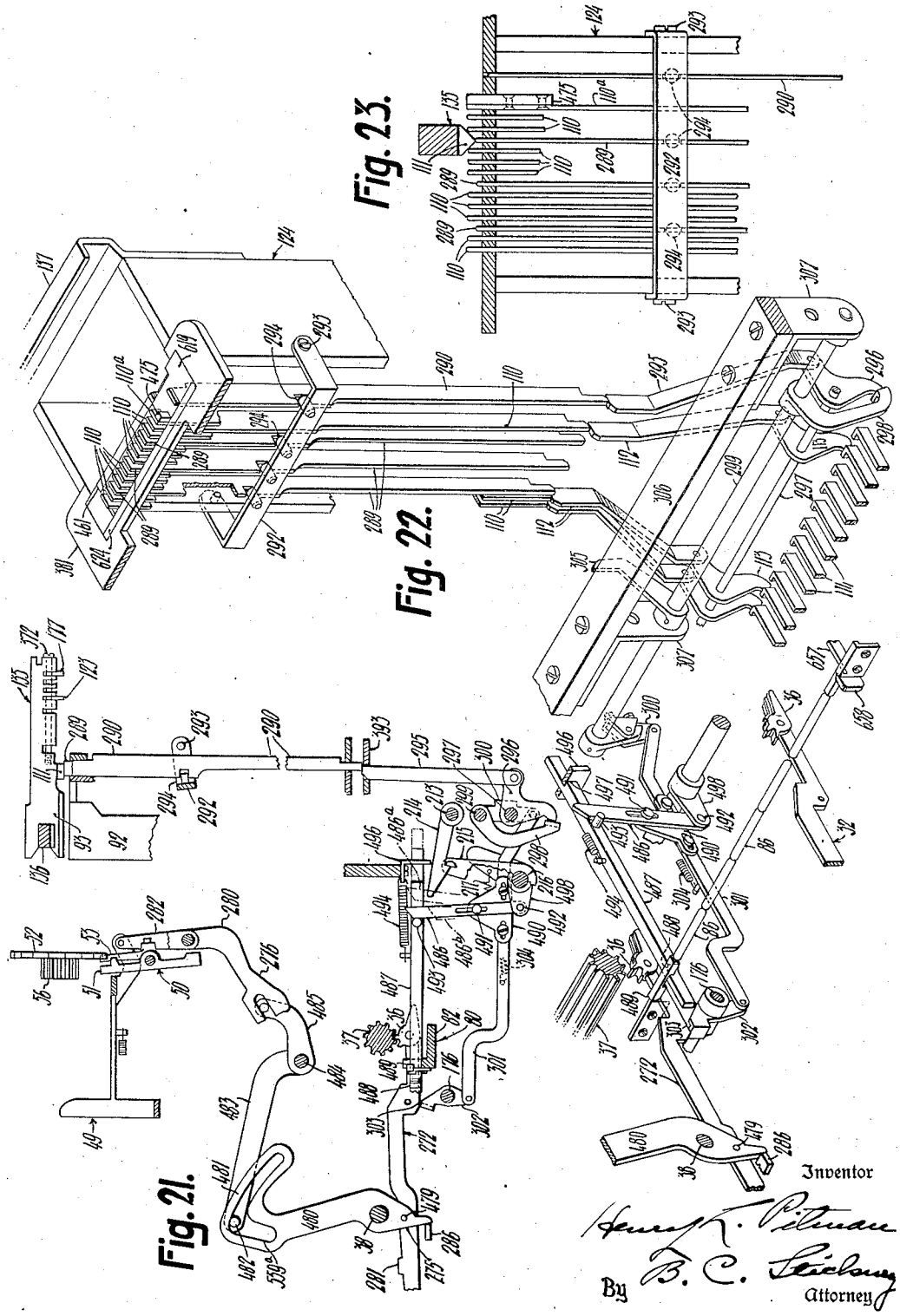


Fig. 23.

Fig. 22.

Fig. 21.

Inventor

Henry L. Pitman

By B. C. Sachs

Attorney

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Filed Feb. 12, 1936 18 Sheets-Sheet 15

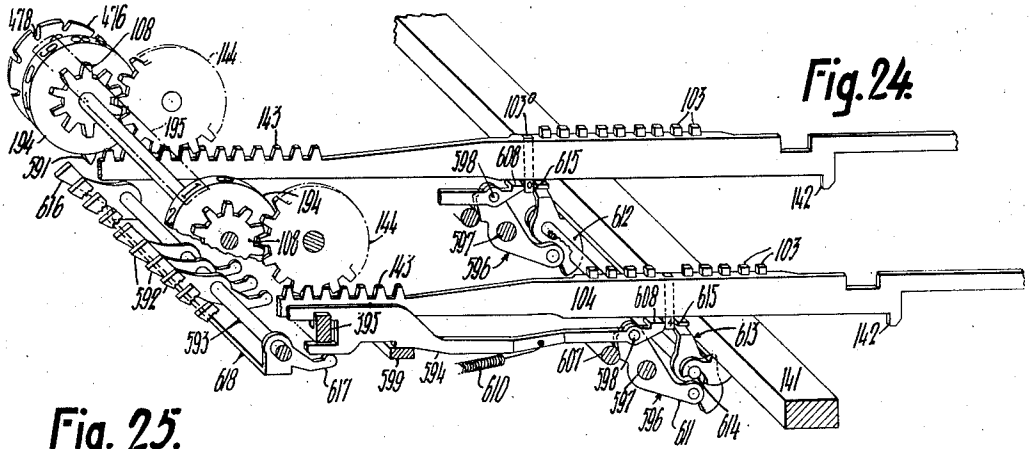
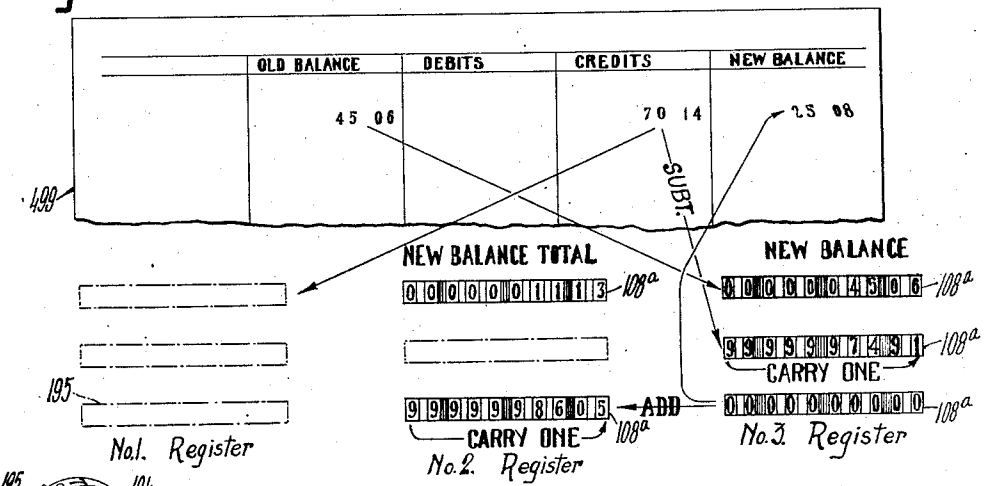


Fig. 24.

Fig. 25.



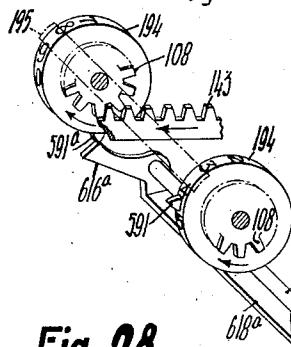


Fig. 26.

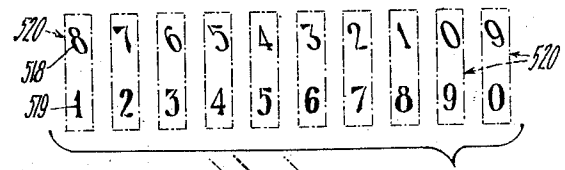


Fig. 27.

Fig. 28.

	OLD BALANCE	DEBITS	CREDITS	NEW BALANCE
499	402 20	10 00		412 20

INVENTOR

Henry L. Pitman

By B. C. Dickerson

ATTORNEY

March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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Fig. 29

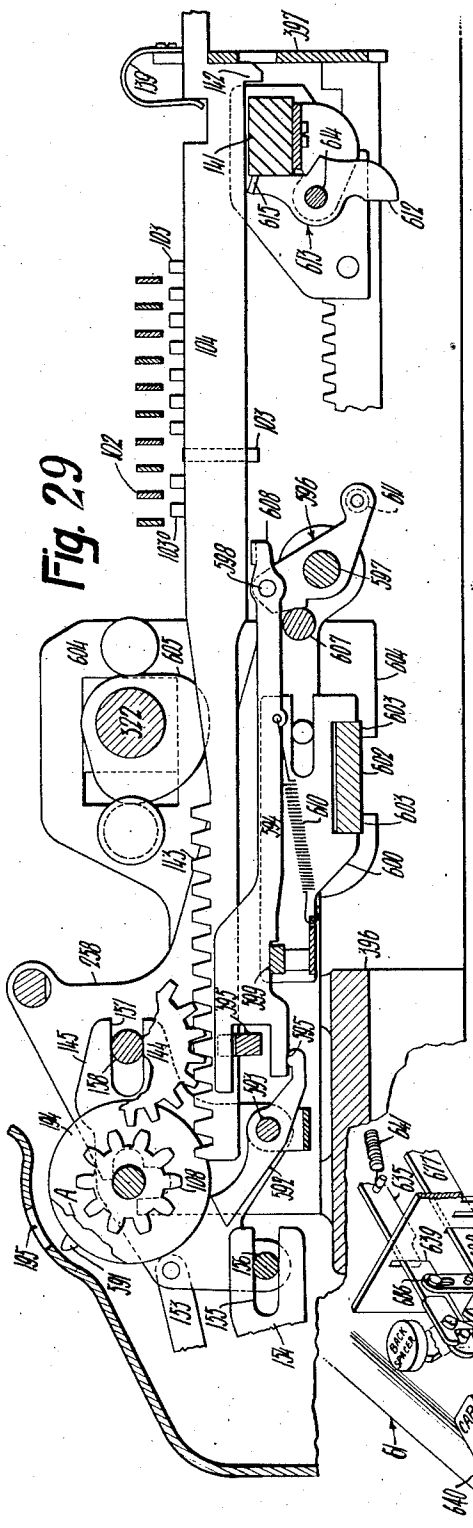
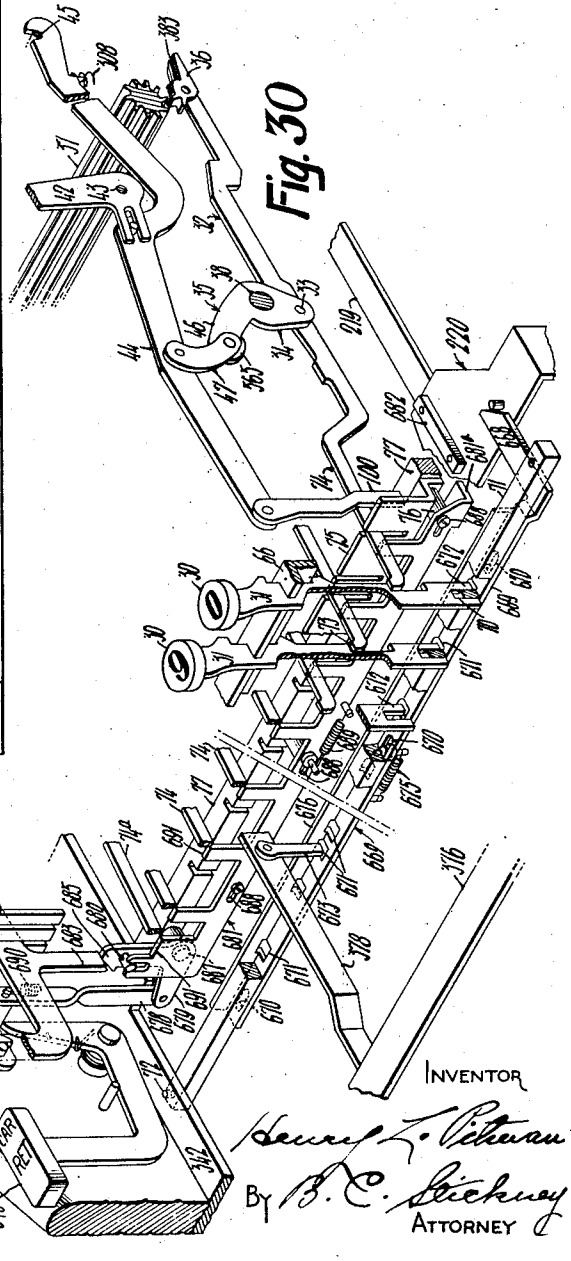


Fig. 30



INVENTOR

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By B. C. Stickney

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March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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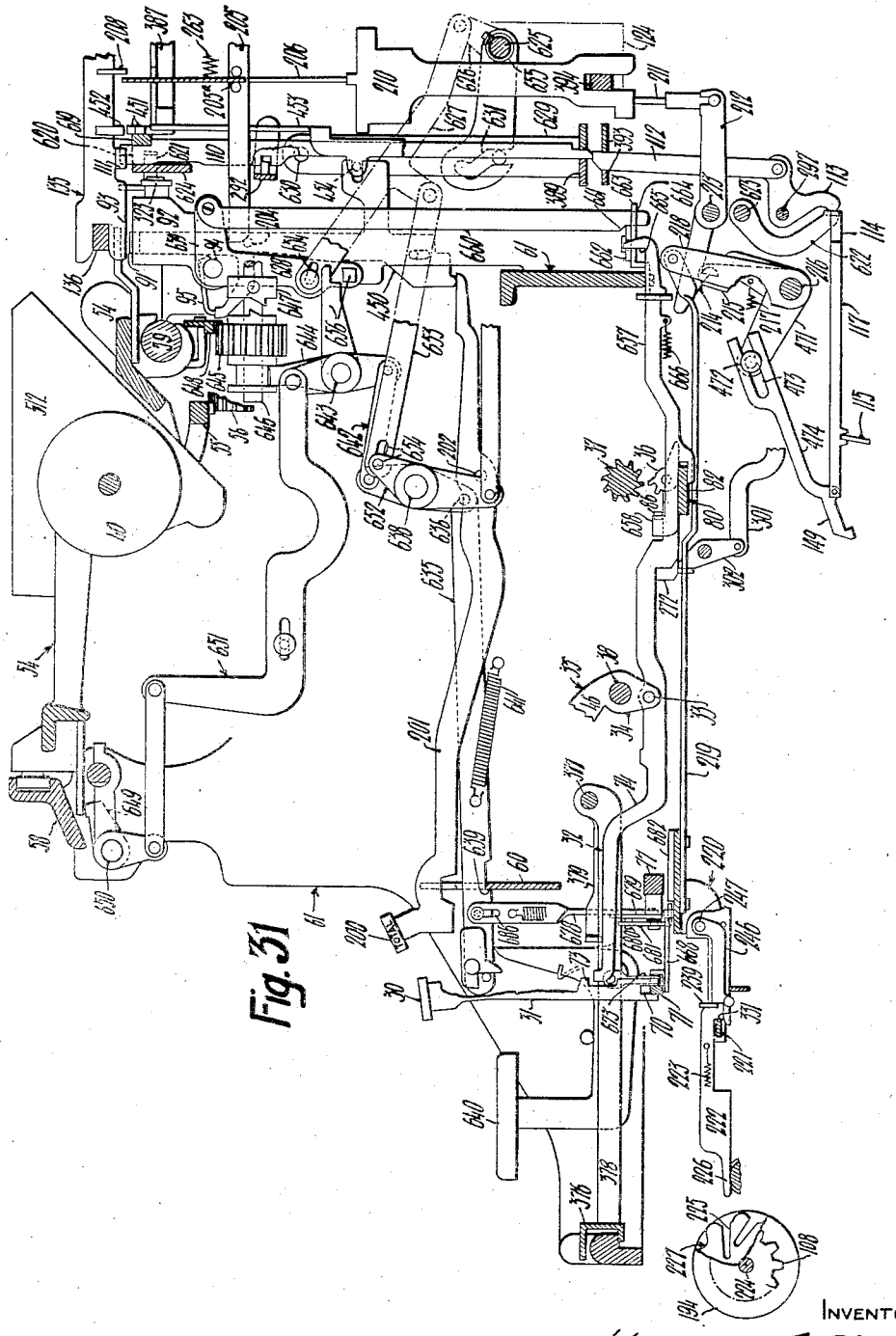


Fig. 31

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March 5, 1940. H. L. PITMAN 2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

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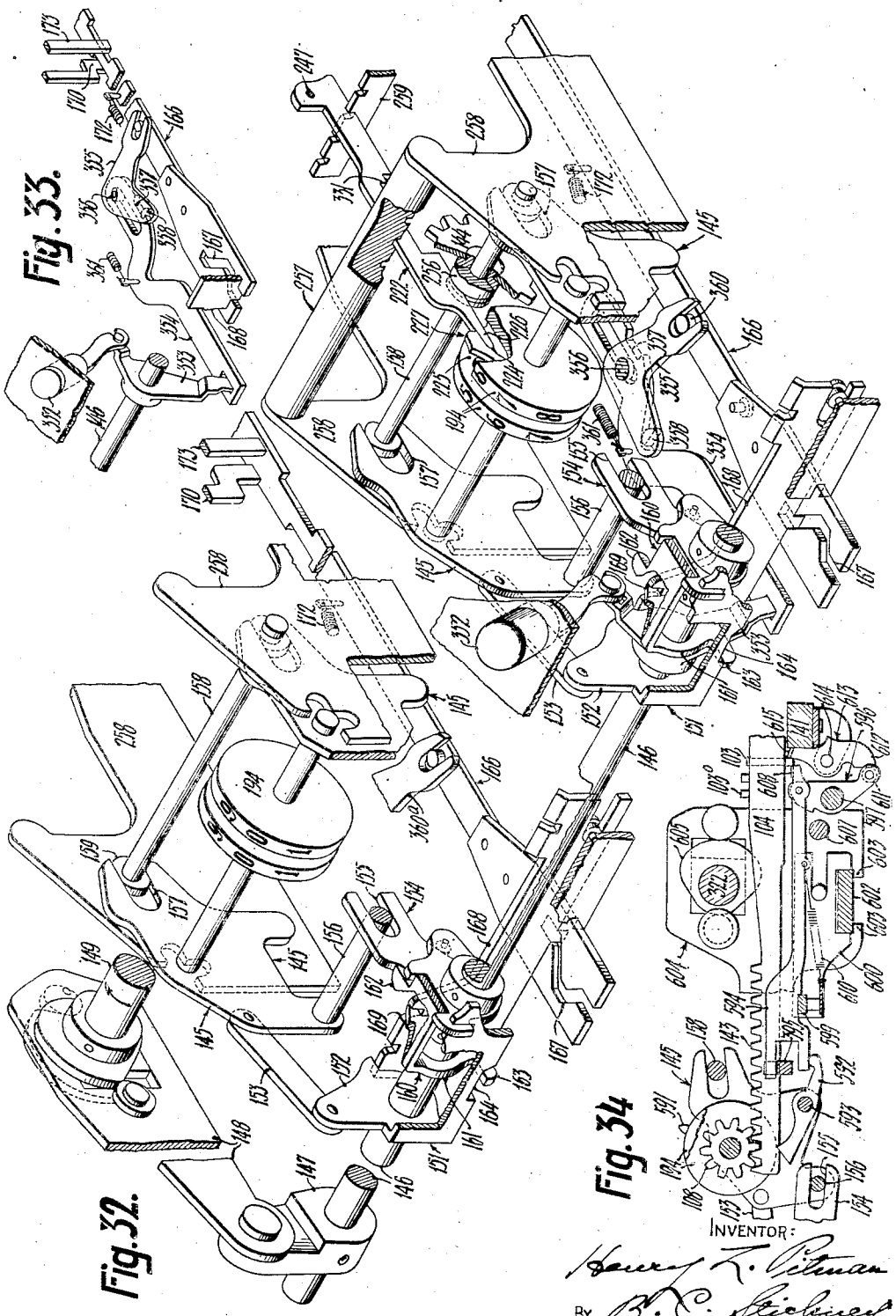


Fig. 32.

Fig. 33.

Fig. 34

INVENTOR:
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BY B. C. Richey
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Patented Mar. 5, 1940 2,192,365

UNITED STATES PATENT OFFICE

2,192,365

COMBINED TYPEWRITING AND COMPUTING MACHINE

Henry L. Pitman, Hartford, Conn., assignor to Underwood Elliott Fisher Company, New York, N. Y., a corporation of Delaware

Application February 12, 1936, Serial No. 63,627

37 Claims. (Cl. 235—60)

This invention relates to total-printing mechanism for a combined typewriting and computing machine of the Underwood-Hanson class exemplified in my Patent 1,927,951, dated September 26, 1933.

In my co-pending application 42,611, filed September 28, 1935, there is disclosed a total-printing mechanism whereby, upon operation of a total-taking control, the numeral-types of the typewriter are caused to be selected and actuated automatically, under control of a set of computing wheels and the letter-feeding carriage, to transcribe to a work-sheet on the typewriter-platen the total registered in said computing wheels, said total having been caused to be registered in said wheels consequent to operation of the numeral-type keys or types of the typewriter.

An object of the present invention is to provide a total-printing mechanism of this kind capable of printing, by means of numeral-types of the typewriter, true negative or overdraft totals as well as the usual positive totals.

When the computing wheels have become rotated, subtractively to overdraft or negative-total registering-positions, said positions correspond, angularly, to the complement of the true overdraft.

A feature of the invention resides in provision whereby said complementary angular positions of the overdraft-registering computing wheels determine selection and actuation of numeral-types of the typewriter to print the true overdraft-total.

Devices, employed to read the angular positions of the computing wheels, serve to determine the printing of either the positive digits or the complementary digits, corresponding to said angular positions, depending on whether the total is positive or negative. For example, the wheel-reading device for a given computing wheel may serve to determine the printing of either "0" or "9" when said wheel stands at what is ordinarily the "0" angular position. If the angular position of the wheel represents what is ordinarily "1", the wheel-reading device serves to determine the printing of either "1" or "8", and so on; the digits of each pair being complementary to each other with reference to the value "9",

Two complementary sets of digit-types, and a letter-feeding carriage are used, one set of digit-types being called into play by means of the wheel-reading devices when a positive total is to be printed, and the other set of digit-types being called into play by means of said wheel-reading devices when a negative or overdraft total is to be printed. Said two sets of digit-types have in common a system of actuating devices. The type-actuating device for the "0" type of one set of digit-types will also actuate the "9" type of the other set, the type-actuating device for the "1" type of one set will also actuate the "8" type of the other set, and so on.

Said type-actuating devices may be the digit-type actions of the typewriter which forms a part of the machine, and said two sets of digit-types may be upper and lower case components of said type-actions. The computing-wheel-reading devices serve to select the digit-type actions according to the angular positions of the computing wheels; and means are provided whereby the computing wheels determine use of either the lower or upper case digit-types, depending on whether said angular positions represent a positive or a negative total; said means being operative, through use of a negative-total characteristic, namely, the registration of "9" in a highest or ultra-denomination wheel, to determine that the appropriate case of digit-type will be used for printing when the total is negative.

It is contrived that the registration in the computing wheel of lowest or units denomination will be, like in the wheels of higher denominations, complementary with reference to the value "9" instead of to the value "10" usually effected for said units-denomination. This may be accomplished by the provision of a novel feature of carry-over or transfer mechanism, and conduces to the feasibility of printing positive and true negative totals by use of complementary digit-types.

It follows from the foregoing that a true negative total may be automatically printed directly from computing wheels which register the complement of said true negative total, and that, therefore, among other advantages, there is the advantage that neither complex computing operations nor supplementary register-mechanism is necessary to compute or set up the true negative total from its said complement preparatory to printing said true negative total.

In the Underwood-Hanson machine an amount is set up or indexed in reciprocable drivers for the computing wheels through operation of the digit-type actions of the typewriter to print the amount, the typewriter-carriage co-operating to effect the indexing of the drivers seriatim. Following the printing and indexing of the amount a general operator is cycled to reciprocate the drivers to extents corresponding to the digits indexed, thereby accumulating said amount in the computing

wheels; carry-over mechanism also being operative during the cycle to impart extra carry-over steps to the computing wheels.

By means of the computing-wheel-reading devices, the type-actions corresponding to the angular positions of the computing wheels are rendered potentially operable by power in that actual operations of said type-actions by power means are effected seriatim, with reference to the computing wheels, by means of denominational devices controlled by the typewriter-carriage in a total-printing zone.

The number of denominations in the total printed may be less than the number of computing wheels, and, in such case, one or more computing wheels, ahead of the wheel which registers the first significant figure of a positive total, will register "0". Provision is made whereby, upon operating a total-taking control, the typewriter-carriage becomes positioned at the first significant figure denomination automatically, so as to avoid printing of any "0" ahead of the first significant figure. This is accomplished preferably by starting the carriage at the denomination of the highest computing wheel and by having the computing-wheel-reading-device and carriage-controlled denominational device for said highest wheel effect operation of the carriage-escapement mechanism without operation of the "0" type. To this end means are conditionable whereby each computing-wheel-reading device may determine, by reason of a "0" position of its computing wheel, operation of the carriage-escapement alone, or of the "0" type, said means being initially in condition at said highest wheel denomination, so that operation of the escapement-mechanism alone is determined if the highest wheel registers a non-significant "0". The carriage will thereby be spaced, without printing, to the denomination of the next highest wheel. If the latter also registers a non-significant "0" the carriage-spacing operation will be repeated, and will continue to be repeated until the carriage arrives at the denomination of the computing wheel which registers the first significant figure of the total. As a result of the printing of the first significant figure which then takes place, the aforesaid means, which were initially conditioned for carriage-spacing alone, becomes automatically conditioned to enable the computing-wheel-reading devices to determine operation of the "0" type when their respective wheels register "0", so that any "0" following the first significant figure will be printed. It will be understood that carriage-feeding steps, effected by means of the escapement-mechanism, accompany the operation of any type from "0" to "9" to print a positive total.

Automatic spacing of the typewriter-carriage from the highest wheel denomination to the first significant figure denomination is set forth in my aforesaid co-pending application Serial No. 42,611, in conjunction with the printing of a positive total.

Since the computing wheels register a negative or overdraft total by angular positions, which correspond to the complement of the true amount of the overdraft, any computing wheel of higher denomination than the wheel which registers the complement of the first significant figure of the overdraft-total will register "9".

A feature of the present invention resides in contriving to effect automatic carriage-spacing, from the highest wheel denomination to the denomination of the wheel registering the first significant figure, for negative totals as well as for positive totals.

For this purpose novel means are provided whereby the aforementioned negative-total characteristic, namely, the registry of "9" in a highest or ultra-denominational wheel, determines spacing of the carriage, without printing, for each denomination ahead of the computing wheel which registers the complement of the first significant figure of the true overdraft, this being effected at said each denomination by reason of the registry of "9" in the corresponding computing wheel. When the carriage arrives at the denomination corresponding to the computing wheel which registers the complement of the first significant figure of the true overdraft, the appropriate type-action is caused to be selected and actuated to print said first significant figure. Concomitantly with the printing of said first significant figure, said means will be conditioned so that the wheel-reading device of any wheel which registers "9" after the first significant figure denomination will determine actuation of the "9" type-action to print "0" by means of the complementary type, said means having been initially conditioned by reason of said negative-total characteristic, so that the registry of "9" in any denomination ahead of the first significant figure of a negative total is ineffective to cause printing. Said negative-total characteristic as registered by the computing wheels also determines effectiveness of the "0" type-action to print "9" by means of the complementary type when the angular position of the first significant figure-registering computing wheel corresponds to "0".

It is contrived that mechanism comprising the computing-wheel-reading devices, the type-action controls, the carriage-controlled denominational device, and the type-action-operating power-means serves substantially without change for printing true negative totals as well as for printing positive totals. Such mechanism is shown herein as of the kind set forth in my aforesaid co-pending application 42,611.

Certain features of the invention relate to novel means whereby, concurrently with the automatic printing of the negative total from a given set of computing wheels, said negative total is indexed for and proper accumulation effected in another set of computing wheels.

Operation of a total-key releases the typewriter-carriage for a resulting advance or tabulation to a total-printing zone. Novel means are provided whereby the carriage, in its advance by operation of said total-key, may skip other zones, it being contrived by said means to tabulate the carriage directly to the total-printing zone independently of tabulating devices which are utilized for said other zones. Said novel means include provision whereby the operator of the machine is relieved of the necessity of holding down the total-key until the carriage arrives at the total-printing zone, in that a momentary pressure on said total-key serves to release the carriage, and to concomitantly project a carriage-stop to carriage-arresting position, said stop becoming restored automatically after it has served to arrest the carriage.

Certain features of the invention reside in the novel means whereby certain properties of the Underwood-Hanson machine are utilized for the purpose of the invention. For example, means are provided whereby, as one of the consequences of operating a total-key, the Underwood case-

shift mechanism automatically becomes conditioned for upper-case printing by means of an upper-case set of digit-types if the total to be printed is of overdraft character, manifested by the registry of "9" in the highest computing wheel.

Provison may be made for distinguishing a printed overdraft from a printed positive total. For this purpose the upper-case digit-types, used to print the overdraft, may be of a form or style, different from that of the lower-case digit-type, used to print the positive total.

Use of locking devices is provided for by novel means in order to prevent untimely operations of certain parts of the machine; as for example, to prevent manual operation of the numeral-type keys or to prevent use of a power-operated carriage-return mechanism while the machine is in process of automatically printing a total; and obviation of other liabilities of untimely operations is also provided for.

Other features and advantages will hereinafter appear.

In the accompanying drawings,

Figure 1 is a front elevation of the typing carriage and total key-operated tabulating devices acting to arrest the carriage at a total-printing zone.

Figure 2 is a sectional side elevation of the combined typewriter and computing machine embodying the novel total-printing mechanism.

Figure 3 is a partly sectioned plan of the typewriter showing principally the mechanism related to the operation of the numeral-types and letter-feed mechanism for total-printing.

Figure 4 is a plan of the computing base including a plurality of registers, indexing means therefor, cycling mechanism and total-reading and type-selecting mechanisms.

Figure 5 is a perspective of the register-selecting and indexing controls, the total-printing controls and tabulating devices, and shows the carriage released by operation of a total-key and advancing to engage said controls and tabulating devices.

Figure 6 is a perspective of the typing carriage, digit-type actions, letter-feed and case-shift mechanisms, and mechanism whereby the register and carriage control the operations of said digit-type actions and letter-feed and case-shift mechanisms for automatic total-printing.

Figure 7 is a perspective representing the mechanism involved in effecting carriage-spacing, without printing, under control of an ultra-denomination computing wheel and the typing carriage when said wheel is at "0" angular position.

Figure 8 is a perspective of the parts involved at the time a type-action is automatically operated in its printing stroke for the first significant figure of a positive total.

Figure 9 is a perspective of mechanisms, as operated under control of the ultra-denomination computing wheel, to effect a case-shift and to prepare for carriage-spacing operation of a "9" type-action, without printing, when said wheel is at "9" angular position.

Figure 10 is a side elevation of means whereby a cycle of the general operator restores the operated case-shift mechanism at the conclusion of total-printing.

Figure 11 represents in side elevation the mechanism, relating to case-shifting and carriage-spacing, shown in the perspective at Figure 9.

Figure 12 is a side elevation of mechanism conditionable by the carriage for subtractive operation of a state-controller.

Figure 13 is a side elevation showing means, as operated under control of the ultra-denomination computing wheel and the carriage, to connect the case-shift mechanism to a power-shaft.

Figure 14 is a perspective of the register selecting and indexing controls, total-printing controls and tabulating devices, and shows how the total-key-controlled tabulating device serves to block operation of the total-key when the carriage merely engages the register selecting and indexing controls for item-printing.

Figure 15 is a side elevation showing the relation of parts when the type-bar of the "9" type-action has been disconnected and the remainder of said type-action has been operated by the power-shaft, for spacing the carriage, without printing, under the control of the carriage and the ultra-denomination wheel.

Figure 16 is a side elevation showing the relation of parts when the "9" type-action, uncoupled from its type-bar, has been connected to the power-shaft, for a carriage-spacing operation, under the control of the carriage and a computing wheel which registers "9" ahead of the first significant figure of an overdraft.

Figure 17 is a side elevation showing the relation of parts when a significant-figure type-action has been operated in its printing-stroke by the power-shaft; the view also representing the recoupling of the "9" type-action and its type-bar, which may result from a primary operation of said significant-figure type-action.

Figure 18 is a sectional side elevation representing computing wheels, drivers therefor and parts of the computing-wheel-reading devices and type-action selecting means as relatively conditioned preparatory to carriage-controlled operations of the type-actions.

Figure 19 is a sectional side elevation showing certain details of Figure 17.

Figure 20 is a sectional side elevation showing the normal relative conditions of parts of the computing-wheel-reading devices and type-action selecting means.

Figure 21 is a side elevation showing mechanism in operated condition whereby the letter-feed mechanism is connected to the power-shaft by the carriage at a punctuation-space in a computing zone; the view also showing the operation of part of a key-locking train at said punctuation-space, and also showing means for disabling said train during total-printing.

Figure 22 is a perspective of some of the Figure 21 parts in normal condition.

Figure 23 is a sectional front elevation of denominational and punctuation jacks, and a jack-operating carriage-tappet.

Figure 24 is a perspective of the computing-wheel trains of highest and units denominations and devices whereby the rotation of the highest wheel to overdraft-position causes the units-wheel to be rotated an extra step.

Figure 25 is a diagram exemplifying a work-sheet form and its relation to use of different registers, including the total-printing register.

Figure 26 is a perspective showing the wheel of highest denomination initiating an operation of devices, like those seen in Figure 24, for rotating the units-wheel of a certain register an extra step.

Figure 27 is a diagram showing complementary arrangement and distinctive styles of the upper and lower case digit-types.

Figure 28 is a work-sheet illustrating the style of printing which distinguishes a positive total from the negative total seen on the work-sheet of Figure 25.

Figure 29 is a partly sectioned side view showing the train of carry-over devices from a lower computing wheel to the computing wheel of next higher denomination.

Figure 30 is a perspective of devices for preventing simultaneous operation of the carriage-return mechanism or of the back-space mechanism, and the total-printing mechanism.

Figure 31 is a sectional side view representing mainly the power-operable carriage-return mechanism and means whereby the carriage-operated jack-trains are silenced during a carriage-return operation and also during a tabulating operation.

Figure 32 is a perspective of a sub-total or throw-off-key mechanism and its relation to state-control mechanism.

Figure 33 is a perspective similar to Figure 32 and shows the sub-total key operated to silence the state-control mechanism.

Figure 34 is a view similar to Figure 29 and illustrates a certain phase in the operation of the carry-over mechanism relatively to the general-operator mechanism.

Depression of a typewriter numeral-key **30**, Figures 2, 3, and 6, surmounting a key-stem **31**, causes the latter to rotate a draw-link **32** about its pivotal connection **33** to depending arm **34** of a lever **35**; and dog **36**, pivoted to said draw-link, is thereby meshed with a toothed power-driven shaft **37** which may be journaled in the typewriter-frame and may be connected to a power-drive, not shown, for continuous rotation. Said power-shaft **37** thus pulls the draw-link **32** rearwardly to rock the lever **35**, counterclockwise of Figure 2, about a fulcrum-shaft **38**, to swing a numeral-type bar **39**, to print upon a work-sheet on platen **40**. The type-bar **39** is swung about the usual arcuate fulcrum-rod **41** by the usual bell-crank **42**, mounted on fulcrum-rod **43** and connected to an operating lever **44** extending forwardly from the usual Underwood key-lever fulcrum-rod **45**, said operating lever **44** being connected to the lever **35** by a link **47**.

At the end of the printing-stroke the draw-link **32** becomes disengaged from the power-shaft **37** to permit recoil of the type-bar **39** from the platen and restoration of the type-action as will be further described hereinafter with reference to automatic total-printing.

Near the end of the printing-stroke heel **48** of the type-bar **39**, Figures 2 and 6, engages the usual spring-returned universal bar **49** to actuate a dog-rocker **50**, as at Figure 17, to engage a holding dog **51** with an escapement-wheel **52** and withdraw a stepping dog **53** preparatory to a letter-feed step of platen-carriage **54** at recoil of the type-bar. Said escapement-wheel **52** has the usual connection, rack **55** and pinion **56**, to said carriage **54** which is urged leftward by the usual spring-motor **57** and runs along upon front and rear rails **58**, **59**.

There is one of the described numeral-type actions, including draw-link **32** and key-stem **31**, for each of the ten digits, from "0" to "9", see Figure 3. The operating levers **44** are guided by a comb **60** fastened to typewriter-frame **61** and presenting brackets **63** to which are attached a slotted angle-bar **66** and retaining strip **67** which serve as upper guide-means for the key-stems **31**. Key-stem shoulders **68** abut the angle-bar **66** to limit the key-strokes, and key-stem-restoring springs **69** are anchored to said angle-bar **66**. Each key-stem is slotted at **70**, Figure 13, for articulation with another slotted key-stem-guiding cross-bar **71** fastened at **72**, Figure 3. A key-stem shoulder **73** engages draw-link-arm **74** extending forwardly from the draw-link pivot **33**. The several draw-links **32** are guided by a front comb **75** attached at **76** to cross-bar **77** fastened at **78**, Figure 3. The draw-links **32** are further guided by a slotted angle-member **80** fastened at **81** and are normally kept, Figure 2, against leg **82** of said angle-member by restoring springs **83**, Figure 11, attached to an anchor-member **84** fastened at **85**.

A series of lock-rods **86**, Figures 2 and 3, is retained between said angle-member **80** and a keeper-plate **87** and is confined endwise to permit entry of only one draw-link **32** at a time therebetween to prevent simultaneous operation of more than one numeral-key.

Dotted circles **89**, Figure 3, represent a row of decimal-tabulating keys mounted upon key-levers **99**, partly shown, Figure 3, in connection with decimal-stop rods **91** for cents, hundreds and thousands. Said stop-rods **91**, retained in a housing **92**, are selectively liftable to engage a column-stop **93** on the carriage **54**. A universal bar **95**, on shaft **94**, Figures 2, 5 and 13, is rockable in the housing **92**, by the lifting of any stop-rod **91**, to release said carriage for an ensuing tabulating advance by raising the feed-rack **55** from the escapement-pinion **56**, said shaft **94** having an arm **96** engaging the usual rack-raising lever **97**.

At operation of any numeral-type action a companion rod **100**, depending from the type-action lever **44** into computing base B and guided by the slotted cross-bar **77**, Figures 2, 4, 8 and 15, engages and rocks a digit-shaft **101** to depress a digit cross-bar **102** for setting the proper one of a series of digit-pins **103** provided on each one of a sufficient number of register-bars or computing-wheel drivers **104**. Each digit rock-shaft **101** is connected to its pin-setting bar **102** by the usual means including rock-shaft arm **105**, endwise movable upper link **106**, and end bell-cranks **107**, Figure 8. The several pin-setting linkages each including the elements **101**, **102**, **105**, **106**, **107** are part of a known assemblage mounted in the computing base B, and a restoring spring, not shown, acts to restore each linkage upon retraction of the pendent rod **100** at restoration of the numeral-type action following printing.

The computing base B is represented, Figure 4, as having three registers and therefore three sets of computing pinions **108** and three sets of register-bars **104**, the pin-setting bars **102** being, as usual, common to all the register-bars **104**.

Pin-setting or indexing is under control of the type-writer-carriage **54**, for selecting the set or sets of register-bars to be indexed and for indexing the register-bars denominationally. The mechanism therefor may be substantially as shown in my co-pending application filed April 12, 1932, Serial No. 604,691 and, briefly described, is as follows.

A universal set of denomination-jacks **110**, Figures 2, 5, 22 and 23, traversible by a denomination-selecting tappet **111** on the typewriter-carriage **54**, is operatively connected by rods **112** and bell-cranks **113**, Figure 22, to a master set of denominational racks **114**, Figures 2, 4 and 22, meshing with a bed of distributive denominational cross-blades **115** seated in fulcrum-notches **116**,

in the computing base for rocking individually about their lower edges through endwise movement of the master racks 114. For each set of register-bars 104 there is a set of register-bar control-racks 117, Figures 2, 4 and 6, each of the latter meshing with the cross-blade 115 of corresponding denomination. The control racks 117 for the middle set of register-bars 104 are interspaced, Figure 4, with the set of master racks 114. Each control rack 117 has a coupler 118, and each set of couplers is individually swingable as a unit, about pivotal connections 119 of the couplers 118 to said racks 117, to bring the latter into or out of operative relation with the corresponding set of register-bars 104.

The forward ends of the couplers 118 are normally depressed, Figures 2 and 6, and each set of couplers is liftable into the operative position, seen in Figures 8, 12 and 16, by an individual bail 120 under control of the carriage. For each of the three sets of register-bars 104 there is a cam-plate 122, Figures 2 and 5, traversible by a register-selecting tappet 123 on the carriage, said cam-plate 122 being mounted in a housing 124 for edgewise depression which is translated into lift of the corresponding set of couplers 118 by means of a train including slide 125, Figures 5 and 12, retained in said housing, and a companion push-rod 126, connected to a bell-crank 127, Figures 2, 5 and 12, from which extends a push-rod 129 to an arm 130 of the coupler-lifting bail 120. The intermediate slides 125 stand crosswise of the cam-plates 122 and are properly allotted to the latter by means of tabs 131. A restoring spring 132 restores said train to the normal, Figure 2 position determined by stopping the bail-arm as at 133, Figure 2.

The connections of the master racks 114 and register-control racks 117 to the cross-blades 115 of the denominational trains are arranged to transpose the order of said control-racks 117 relative to said master racks 114.

A tappet-block or unit 135, Figures 2, 5 and 13, is located for a computing zone by means of a rack 136 on the carriage 54 and includes the zone-tabulating stop 93, the denomination-selecting tappet 111 and one or more of the register-selecting tappets 123. A guide-rail 137 steadies the tappet-block 135 as the latter traverses and actuates the denomination-jacks 110 and register-selecting cam-plates 122. Said cam-plates are substantially coextensive with the computing zone in order to maintain the selected couplers 118 in operative position throughout the traverse of said zone by the carriage.

The indexing operation may be summarized briefly now as follows: Upon entry of the carriage into a computing zone one or more register-selecting cam-plates 122 will be depressed, thereby causing the corresponding set or sets of couplers 118 to connect the corresponding set or sets of register-bars 104 to the universal set of denomination-jacks 110 through the master racks 114, the distributive cross-blades 115 and the register-bar control-racks 117. The denomination-selecting tappet 111 is thereby enabled, at whichever denomination the carriage reaches at said entry, to slightly advance the register-bar of corresponding denomination in each selected set to position its digit-pins 103 under the pin-setting bars 102. The printing-stroke of any numeral-type action will thus set the appropriate digit-pin 103 in the thus advanced register-bar 104 of each selected set.

At the beginning of the return stroke of the numeral-type action the carriage will step, by means of the carriage-feed mechanism, to the next denomination, thereby releasing the depressed jack 110 and consequently allowing the indexed register bar or bars to become restored to the Figure 2 position by the usual spring-device 139. In turn, at said next denomination, a register bar or bars of corresponding denomination will be slightly advanced for indexing by operation of any numeral-type action; and, similarly, by further operation of the numeral-type actions the indexing proceeds to the last denomination.

Following the indexing operation the usual reciprocatory general-operator cross-bar 141, Figures 2 and 4, is cycled to engage, in its advance stroke, the set pins 103 of the indexed register-bars 104 and advance the latter the indexed extents, for rotating the computing pinions 108 which, as will be explained later, will be connected to the register-bars 104 for rotation. Said general operator 141 at its return stroke engages shoulders 142 of the operated register-bars to restore the latter to the Figure 2 position. The springs 139 act in the usual manner to restore the register-bars beyond the general-operator return stroke to provide for the aforesaid slight advance of the register-bars for indexing.

Computing-pinion-driving racks 143 on the register-bars are permanently in mesh with idlers 144, the computing pinions 108 standing normally disengaged, Figure 2, from both said racks and idlers. A frame 145, Figures 2 and 32, mounting each set of computing pinions 108, is shiftable to mesh the latter either with the set of racks 143 for additive rotation or with the set of idlers 144 for reverse subtractive rotation. A frame-shifting rock-shaft 146 is connected by arm 147 and a cam-following link 148 to a cam-shaft 149, connected by known means (not shown) to the cycling mechanism, so as to make a single complete revolution at each general-operator cycle. Said cam-shaft 149 is timed to rock said shaft 146 clockwise of Figure 2, for bringing the computing pinions into mesh, with either the racks 143 or idlers 144, before the general operator advances the register-bars, and to rock said shaft 146 oppositely for unmeshing the computing pinions just before said general operator returns the register-bars.

Working connections between said pinion-shifting rock-shaft 146 and each one of the computing-pinion frames 145 and controlling means for said connections may be for the purpose of the invention substantially as shown in my co-pending application No. 611,838, filed May 17, 1932, and, briefly described, are as follows.

A yoke 151, Figures 2 and 32, for subtraction connection, is loosely mounted on the rock-shaft 146 for independent rotation of the latter and has at each end an arm 152 connected by link 153 to a side of the computing-pinion frame 145. Another arm 154, for addition connection, is also loose on said rock-shaft 146 and has a slot 155 engaging a cross-rod 156 at the front of said computing-pinion frame 145. Slots 157, in the sides of the computing-wheel frame, are fitted to an axle 158 by collars 159, said axle also mounting the idlers 144. A coupler 160 having end ears 161 fitting the pinion-shifting rock-shaft 146 is splined to the latter for turning therewith and for movement therealong from a normal neutral position to adding or subtracting position. In the adding position of said coupler 160 (see the left-hand register, Figure 32) a tongue 162 of

the latter registers with the adding arm 154, while another tongue 163 of said coupler is opposite a clearance notch 164 of the subtraction-yoke 151 and is thus disconnected from the latter. In the subtraction position of said coupler 160 (see the right-hand register, Figure 32) the adding tongue 162 is withdrawn from the adding arm 154 and the tongue 163, moved from the clearance notch 164, is ready to actuate the subtraction yoke 151. At the neutral coupler-position, between the adding and subtraction positions, both tongues 162, 163 are clear, respectively, of the adding arm 154 and subtraction yoke 151.

A state-controller 166, Figure 32, has a cam-slot 167, coacting with a cam-following slide 168 articulated to said coupler 160 at 169, for shifting said coupler 160 from neutral to an adding or subtracting position. Said state-controller is normally held in neutral position by a latch 170 connected to the register-selecting coupler-bail 120 as at 171, Figure 12, so that, by the register-selecting operation of said bail 120 at entry of the carriage into a computing zone, said latch 170 is withdrawn, whereupon said state-controller 166, urged by spring 172, shifts to an active position against a secondary latch 173 which is withdrawable for a further shift of said state-controller 166 to another active position, one of said active positions determining addition, and the other active position determining subtraction. For their automatic withdrawal, by entry of the carriage into a computing zone, the several secondary latches 173 are each connected, to an arm 175 of a common latch-retracting rock-shaft 176, Figures 2 and 12. The tappet-block 135 on the carriage 54 may include a subtraction-tappet 177, Figure 5, to depress a subtraction-cam plate 178 which thereby, through a slide 179, Figures 5 and 12, a push-rod 180 and a usual rock-shaft 181, withdraws a latch-bar 182 from a spring-pressed lever 183, and thereby causes the latter to coact with a cam-arm 184 of said latch-retracting rock-shaft 176 to rock the latter to withdraw the secondary latches 173, and thereby cause each state-controller 166, whose primary latch 170 is withdrawn for selecting the corresponding register, to assume its farthest forward position for determining subtraction, the state-controller position, effected by withdrawing only the primary latch 170, being determinative of addition. For a purpose and in a manner hereinafter explained, the first active position of the state-controller 166 for one of the registers will determine subtraction, instead of addition, the additive state being determined by withdrawing both latches 170, 173 for that state-controller. The slide 179 of the secondary or subtraction-state-controlling train may be similar to the slide 125 of the hereinbefore-described register-selecting train, and may be retained with the secondary or subtraction-cam plate 178 in the housing 124, said cam-plate 178 being similar to the register-selecting cam-plates 122.

It will be understood now, with reference to any set of computing pinions 108, that at entry of the typewriter-carriage into a computing zone, either the primary latch 170 alone or both said primary latch 170 and the companion secondary latch 173 may be withdrawn, thereby causing the state-controller 166 to differentially advance from its neutral position and shift the state-controlling coupler 160 from neutral position to its adding or subtracting position. The secondary latch-controlling rock-shaft 176 may be rocked, to withdraw the secondary latches 173, by pressing the usual subtraction-key 185, Figure 2, the latter having the usual connections (not shown) for controlling said rock-shaft 176.

As the typewriter-carriage 54 letter-feeds upon typing and indexing the last digit of an amount in a computing zone the register-selecting tappets 123 and the subtraction tappet 177 in the tappet-block for said zone pass from and thereby release the cam-plates 122, 178 and associated latch-trains including the latches 170, 173 preparatory to return of said latches into state-controller-holding place.

The general-operator cross-bar 141 may now be cycled, and during the cycle each selected set of computing pinions 108 meshes either with the racks 143 for addition, or with the idlers 144 for subtraction, depending on the extent of release of the corresponding state-controller 166 by means of the latches 170, 173. Near the end of the return stroke of the general-operator cross-bar 141 the latter engages and drives a hook-link 187 connected, see Figure 2, to a rock-shaft 188 connected by rods 190 to a cross-bar 191 which is thus driven, rightward of Figure 2, to engage and restore the released state-controllers 166 for reengagement with the now free latches 170, 173 which are urged downwardly into normal place by springs, not shown. Following return of the state-controllers 166, the hook-link 187 is caused to be disconnected from the general-operator cross-bar 141 before the end of the cycle, and said cross-bar 191 is thereby caused to be returned, by spring 193, to the Figure 2 normal position to leave the state-controllers 166 free for subsequent advance.

The digit-pins 103 on each register-bar 104 are interconnected, as shown in my aforesaid Patent 1,927,951, for example, so that the setting of any digit-pin higher than "0" restores the "0" digit-pin 103°, the latter being normally set as in Figure 2.

A carry-over train, which will be described later herein, may extend from each computing wheel 108, except the highest, and may serve to advance the register-bar 104 of next higher denomination an extra or carrying step by co-operating with the set digit-pin of said next register-bar during thet general-operator cycle.

During the general-operator return stroke, a pin-restoring bail 196 pivoted to the machine-framework is operated by the rock-shaft 188 to engage and rock lever 197, pivoted to the register-bars 104 and connected to the "0" digit-pins 103°. The latter are thereby depressed to the Figure 2 position, to cause restoration of all the higher value digit-pins 103 that were set for indexing.

Each computing pinion 108 has the usual digit-dial 194 visible at a sight-opening 195 in the computing base B.

The novel automatic-total-printing mechanism, usable, in lieu of visually reading the dials 194 at the sight-opening of a given register and manually operating the corresponding numeral-type keys 30, for transcribing the total to a work-sheet, will now be described.

With the typewriter-carriage 54 positioned for advancing leftward into a total-printing zone, a total-key 200, Figures 2, 5 and 13, is depressed with its key-lever 201, which is similar to the tabulating-key lever 99 and mounted with the latter on a common fulcrum-rod 202 in the typewriter. A rod 450, similar to the tabulating stop-rods 91 and mounted in the housing 92 is raised by the depression of said total-key lever 201 and at the initial part of its rise a pin 204

of said rod 450 cams a thrust-link 205 rearwardly. Thus said thrust-link 205, articulated to a cam-plate 206, as at 205a, Figures 2 and 5, turns said cam-plate 206 about a lower cam-plate guide-means 207 of said housing 92 to bring the upper edge of said cam-plate rearwardly from the normal Figure 2 position into line, as in Figures 5 and 13, with a total-printing-control tappet 208 provided on the tappet-block or unit 135 for the zone in which the total is to be printed. Further rise of said rod 450 by completing depression of the total-key 200 causes the carriage to be released in sequence to bringing said cam-plate 206 in line with said tappet 208, said rod 450 releasing the carriage by means of the universal bar 95, the arm 96 and feed-rack raising lever 97. Said rod 450 is shorter than the tabulating-stop rods 91, so that it does not engage the column-stop 93 on any tappet-unit 135 which may precede the one for the total-printing zone.

The carriage may therefore advance directly to a total-printing zone independently of any such preceding column-stops 93; and, for arresting the carriage at said total-printing zone, the elevation of the rod 450 by the total-key 200 raises a carriage-arresting plate 451, Figures 1, 2, 5 and 13, edgewise into the path of a counter-stop 452 provided on the tappet-unit 135 for said total-printing zone. A stem 453 of said carriage-arresting plate 451 works in a slotted guide-plate 389 provided in the housing 124, and, by means of a pin-and-slot connection 454 to a plate 455, vertically adjustable on the total-key-operated rod 450, the latter raises said stem 453 and its surmounting carriage-arresting plate 451. Upon their elevation, the carriage-arresting plate 451 and its stem 453, pulled by a spring 456, attached to the housing 124, Figure 1, swing laterally about the guide-plate 389, to bring a latching shoulder 457 of said carriage-arresting plate 451 over a catch 458 provided on the housing 124. Said catch 458 thus serves to maintain the carriage-arresting plate 451 in elevated position, as in Figure 5, and the total-key 200 may therefore be released immediately after its depression, which has also effected the turning of the cam-plate 206 into alignment with the total-printing-control tappet 208 and the release of the carriage as previously explained.

The ensuing advance of the carriage is terminated when the counter-stop 452, engaging a shoulder 460 of the carriage-arresting plate 451, moves the latter and its stem 453 leftward, about the guide-plate 389, to withdraw the latching shoulder 457 from the catch 458, the leftward movement of the carriage-arresting plate 451 and carriage being arrested, as at Figure 1, by said plate 451 striking a stop 461 provided on the housing 124. The weight of the carriage-arresting plate-train, aided by the spring 456, is then effective to retract said train, to the normal Figure 13 position, and to concomitantly cause the carriage-feed rack 55 to drop into re-engagement with the escapement-pinion 56. The carriage-arresting plate 451 works in front and rear guides afforded respectively by a cross-bar 619, Figures 2 and 5, and side blocks 462, Figures 1 and 14, attached to the housing 124.

Following the retraction of the carriage-arresting train and the re-engagement of the carriage with the escapement-pinion 56, the carriage takes the usual step as the stepping-dog 53 moves from the Figure 1 position to a stepping-dog stop 53a, this stepping-dog movement and concomitant limited rotation of the escapement-wheel 52 and its pinion 56 being usual upon reengagement of the feed-rack 55 with its pinion 56, and being the converse of the movements of said stepping-dog, escapement-wheel and pinion to the Figure 1 positions which resulted when said rack 55 became disengaged and the stepping-dog spring 53b pulled the stepping-dog 53 against stop 53c.

Substantially coincident with taking said step, the carriage depresses the cam-plate 206 by means of the total-taking-control tappet 208. By its depression, said cam-plate 206 is released from a latch 463 which has acted, up to then, to maintain said cam-plate 206 in alignment with the tappet 208. A spring 263 then acts to move said cam-plate 206 and its thrust-link 205 forwardly again. Said latch 463 is pivoted to the housing at 464, and, for downward retraction of the cam-plate 206 therefrom, said latch 463 stops, as at 459, Figure 13, against one of side guides 387 for the cam-plates.

During its depression by the tappet 208 and before its release from the latch 463 and restoration by the spring 263, the cam-plate 206 acts, through a slide 210, similar to the register selecting and subtraction slides 125, 179, a push-rod 211, arm 212 and a rock-shaft 213 to withdraw a latching arm 214 of said rock-shaft 213 from an arm 215 of a rock-shaft 216 journaled in lugs 198 of the computing-base framework. Said rock-shaft 216, thus released, is rocked by spring 217 counterclockwise, from the Figure 2 position to the Figures 7 and 13 position, and thereby, through a rock-shaft arm 218, and a connecting rod 219 connecting said arm 218 to a frame 220 having a cross-bar 221, causes said cross-bar 221 to recede forwardly from a set of total-reading feelers 222 which, each urged by a spring 223, thus assume total-reading positions with reference to one of the sets of computing pinions 108. The total-printing mechanism, including said feelers 222, is herein shown in association with the right-hand, Figure 4, or No. 3 register.

For reading the digit-positions of the computing wheels at total-taking, each total-reading feeler 222 is stopped by a digit-evaluating spiral, Figures 2, 17 and 18, formed by slots 225 ending at digit-evaluating points 224 on the line of approach of a spiral-engaging finger 226 of said feeler. Said slots 225 are shown formed in a disk 227 co-operating with the usual spring-pressed computing-wheel detent 228, Figure 18, and fastened to the companion computing-pinion dial 194 as at 229.

Each total-reading feeler 222 includes a numeral-type selector 230, which, according to the digit-reading feeler-position, becomes positioned under the corresponding one of a set of digit-blades 231, each of which extends crosswise of the computing base for co-operation with the feeler 222 of any denomination and for co-operation, as will be described later on, with the numeral-type actions. The stroke of the feeler 222 is least at engagement with the highest point of the digit-evaluating disk 227, and therefore at said highest point, herein corresponding to "0", a slot such as 225 may be omitted as shown at 245, Figure 18.

Recession of the feeler-controlling cross-bar 221 for total-reading may be utilized for causing the type-selectors 230 to become operatively connected to the register-bars 104 for denominational control of said type-selectors and for such connection there is a group of interponent-plates

233, Figures 2, 4, 6, 8, 18, 19 and 20, one for each denomination. Each interponent-plate 233 has slots 234 engaging guide-bars 235 fixed between two supporting plates 236 having horizontal guide-slots 237 for the feeler-controlling cross-bar 221 of the frame 220, the latter being guided also by the rock-shaft arm 218, to which is pivoted the connecting rod 219 fixed to said frame 220. Said guide-bars 235 have slots 232 spacing said interponent-plates 233 and the latter are collectively controlled by a cross-rod 238 seated in notches 239, Figure 18, of two side plates 240 guided by said guide-bars 235 for vertical movements. Each side plate 240 has a cam-edge 241 normally engaged by the feeler-controlling cross-bar 221, Figure 20, to uphold said side plates 240 and cross-rod 238.

As the cross-bar 221 recedes from the feelers 222, it also recedes from said cam-edges 241 of the side plates 240, and causes the latter to drop by gravity, together with the interponent-plate-upholding cross-rod 238 and the interponent-plates 233, and a cam-edged tongue 243, on each interponent-plate, normally clear of the register-bars 104, as in Figure 20, is dropped between two adjoining teeth 244 of the companion register-bar rack 143, and the latter is thereby operatively connected to the companion type-selector 230, Figure 18. Normally the register-bars 104 are clear of the interponent-plates 233 and therefore the latter are not actuated during item-indexing and accumulating operations.

Each type-selector 230 is bent transversely from an arm 246, pivoted to the companion feeler 222 at 247, and has a roller 242, which normally, when the feelers 222 are retracted, stands to the right of the interponent-plate 233, Figure 20. As the interponent-plates 233 drop and the feelers 222 move to digit-reading positions, each type-selector roller 242 becomes positioned over a top edge 248 of its interponent-plate 233, Figure 18, said top edge being long enough to engage said roller 242 at any digit-reading feeler position.

The cross-blades 231 are spaced according to the digit-reading steps of the feelers 222 by slotted end and intermediate guides 249, 250, forming with cross-members 251 a frame attached at 253 to a cross-bar 252 of the machine-framework.

The two supporting plates 236 may be articulated to said cross-members 251 as at 254, Figure 19, and the cross-bar 252 supports anchor-comb 255 for the feeler-springs 223. The several feelers 22 are guided and spaced laterally by grooved collars 256, between the idlers 144, grooved rod 257 mounted between side plates 258, seen at Figure 32, supporting the computing-pinion frame 145, and a slotted bar 259 supported by the plates 236. Each cross-blade 231 has diagonal slots 260 co-operating with blade-supporting rods 261, retained between the cross-members 251, to guide said blade parallelly for up-and-down movement.

Depression of the cam-plate 206, at the aforesaid carriage-step following retraction of the carriage-arresting plate 451, also depresses slide 179 of the subtraction-setting train to cause withdrawal of the subtraction-latches 173 from the state-controllers 166. The cam-plate 206, having done its work, and having been swung forwardly again by its spring 263, is raised to its normal position, Figure 2, by its train which includes the rock-shaft 213, the latter having a restoring spring 330, and its arm 212 abutting a bar 306 of the machine-framework as at 291, Figure 5, to gage the normal position of said cam-plate 206 and train.

The bail 120, acting at the depression of the cam-plate 122 for the No. 3 register to raise the corresponding set of couplers 118 into effective position, also withdraws the addition latch 170 for the No. 3 register, and the subtraction-latch 173, having also been withdrawn through depression of said cam-plate 206, the state-controller 166 for the No. 3 register shifts, to its extreme forward position, to cause the subtraction-yoke 151, for said No. 3 register, on the computing-pinion-shifting rock-shaft 146 to become coupled to the latter.

The carriage, as it takes the described step following retraction of the carriage-arresting cam-plate 451, arrives at an ultra-denomination position, which is one letter-space step before its denominational position corresponding to the highest computing-wheel proper of the total-printing or No. 3 register; there being provided to the left of the feeler 222 for said highest computing wheel 108 an ultra-denomination feeler 465 which is like the total-reading feelers 222 and is provided with a selector 466, which is like the selectors 230 which selectively engage the digit-blades 231. The No. 3 register, from which the total is printed, is shown as having ten computing wheels, Figures 4, 8 and 25, for the denominations 00 000 000 00, the last two computing wheels at the right being for units and tens of cents or decimals, and the first two computing wheels at the left being for tens and units of millions; said highest computing-wheel proper being therefore for the denomination, tens of millions.

If the total is positive, the ultra-denomination feeler 465 moves invariably to "0" position, so that its selector 466 registers with the "0" digit-blade 231 upon the described forward recession of the feeler-controlling cross-bar 221, the latter also controlling said ultra-denomination feeler 465 and a companion interponent-plate 467 for the ultra-denomination.

In its released position, the ultra-denomination interponent-plate 467, which is like the interponent-plates 233, connects the ultra-denomination selector 466 to an ultra-denomination bar 468, which is similar to the register-bars 104, in order to be slightly displaceable by means of an ultra-denomination train comprising, like the other denominational trains, a jack 110ª, rod 112, bell-crank 113, master rack 114, cross-blade 115 and control-rack 117. Said ultra-denomination control-rack 117 is normally disconnected from the ultra-denomination bar 468 and is connectible to the latter by means of an ultra-denomination coupler 469 pivoted to said ultra-denomination control-rack 117 at 470, Figure 5.

Said ultra-denomination coupler 469 is worked independently of the companion set of couplers 118, in that, instead of being moved to effective position through the depression of the No. 3 register-selecting cam-plate 122, as are said couplers 118, it is moved by the feeler-controlling rock-shaft 216 in order to come into effective position after the ultra-denomination selector 466 has become positioned under the digit-blade 231 which, in the case of a positve total, is the "0" digit-blade. For this purpose, said feeler-controlling rock-shaft 216 has an arm 471 having a wrist 472 working in a cam-slot 473 of an arm 474 of the ultra-denomination coupler 469. Said arms 471, 474 and cam-slot 473 are designed so that, at the rocking of said shaft 216, upon its release through

depression of the cam-plate 206, the ultra-denomination selector 466 becomes positioned under the appropriate digit-blade 231 before the movement of the ultra-denomination coupler 465 to effective position has cammed the ultra-denomination bar 468 forward to raise the ultra-denomination selector 466, it being noted that, in arriving at the ultra-denomination position, the carriage, through the jack-tappet 111, will have worked the ultra-denomination train 110a—115, and thereby will have advanced the ultra-denomination rack 117 and ultra-denomination coupler 469 simultaneously with the movement of the latter to effective position.

The tappet-engaged upper end of the ultra-denomination jack 110a may be broadened as at 475, Figures 22 and 23, so that its depression, by means of the jack-tappet 111, is started before the start of the depression of the cam-plates 122, 206 by their respective tappets 123, 208, thereby to facilitate the movement of the carriage to the ultra-denomination position.

For a purpose which will appear later with reference to the printing of negative or overdraft totals, an ultra-denomination wheel 476 is employed, and may serve to arrest the ultra-denomination feeler 465 in "0" position when the total to be printed is positive. Said ultra-denomination wheel 476 and the highest denomination (tens of millions) computing-wheel pinion 108 are coupled by a pin 477 so as to be driven as a unit by the highest denomination register-bar 104, and by the carry-over devices, it being noted that the ultra-denomination bar 468 has no operative driving connection with the ultra-denomination wheel, since said bar 468 primarily serves, by its slight advance at the ultra-denomination carriage-position, to raise the ultra-denomination interponent-plate 467 and selector 466. Said ultra-denomination bar 48 has a notch 468a for operative connection to the ultra-denomination interponent-plate 467 in the same manner as described for the connection of the interponent-plate 233 and register-bars 104.

The raising of one of the digit-blades 231 by means of the selectors 230, 466, positioned thereunder by means of the feelers 222, 465, rocks the corresponding one of a set of levers 265, one for each of the digits from "1" to "9", or another lever 266 related to the digit "0". The several levers 265, 266 (Figures 3, 6 and 8) turn about fulcrum-rod 267 mounted in the typewriter, and register with their respective digit-blades 231 by means of digit-blade lugs 268. The levers 265, for "1" to "9", have lateral turns 269 for engaging the draw-link arms 74 of the corresponding numeral-type actions.

The "0" lever 266 may operate the "0" type-action; or it may operate the carriage-escapement, without printing, for each "0" ahead of the first significant figure of the registered total when the latter is positive.

With the computing wheel 108 of highest denomination (tens of millions) at any one of its angular digit-positions from "0" to "8", inclusive, in accordance with the registry of a positive total, the ultra-denomination wheel 476, coupled thereto, stops the ultra-denomination feeler in "0" position, as at Figures 7, 13, at release of the feelers 222, 465, said ultra-denomination wheel having at each of said "0" to "8" angular positions a place or notch 478 of such depth as to arrest the ultra-denomination feeler in said "0" position. By its slight advance, which follows the movement of the ultra-denomination feeler 465 to "0" position, the ultra-denomination bar 468 coacts with the ultra-denomination interponent-plate 467 and the ultra-denomination selector 466 to raise the "0" digit-blade 231 to rock the "0" lever 266, whereby the latter, engaging an arm 270, Figure 7, of a rock-shaft 271, rocks the latter to rock a draw-link 272 by an arm 273. Said draw-link 272 is pivoted at 479 to a lever 480 mounted, with the numeral-type-action levers 35, on the fulcrum-shaft 38. Rocking of said draw-link 272 meshes its dog 36, pivoted at 264, with the rotating power-shaft 37, causing the latter to first rotate said dog into a stop position like that seen in Figure 17, representing a numeral-type action, and then to pull said draw-link 272 rearwardly to rock the lever 480 of Figure 7. When said lever 480 is thus rocked, a cam 481 thereof co-operates with a pin 482 of an arm 483 of a rock-shaft 484 to rock the latter, which, through an arm 485, rocks a frame 280 pivoted in the typewriter and having an arm 276 engaged by said arm 485, and also having side arms 282 connected to the escapement universal bar 49, which is thus drawn rearwardly to rock the escapement-dog-rocker 50 clockwise of Figure 7. Having thus actuated said dog-rocker, by means of the draw-link 272, the latter becomes disengaged from the power-shaft 37 by a cam-edge 284 of said draw-link 272 coacting with an abutment-bar 283, mounted in the typewriter, as depicted for the numeral-type action of Figure 15, and a spring 285, Figure 7, then acts to move said draw-link 272 and the arm 275 back toward normal position determined by a stop 286 on the typewriter-frame. (Said arm 275 is the lower portion of lever 480, seen at Figure 8.) The draw-link-rocking arm 273 remains depressed while the draw-link 272, by coaction with the abutment bar 283, is being disengaged from the power-shaft 37, and, in order that said depressed arm 273 may not obstruct such disengagement of the draw-link 272, a draw-link-land 281, initially engaged by said arm 273, will have moved rearwardly and clear of said arm 273. At return of the draw-link 272 and the lever 480, the arm 483 and the escapement-dog-rocker 50 connected thereto also return toward their normal positions, thereby causing the typewriter-carriage 54 to advance to the next denomination which corresponds to the highest computing wheel, thereby causing the ultra-denomination-bar 468 to be restored by its spring-device 139 with concomitant restorations of the ultra-denomination-interponent-plate 467, the ultra-denomination selector 466 and the "0" digit-blade 231. Each selector 230, 466 may have a restoring spring 287 and may normally stop against its companion bar 222 or 465, as at 288, Figure 18.

By the advance of the carriage 54 to said next denomination, (for tens of millions) the corresponding register-bar 104 is slightly advanced, and it results, if the computing wheel 108 at that denomination stands at "0", that the automatic carriage-spacing operation, without printing is repeated under control of the feeler 222 and selector 230 for said tens of millions denomination. Such automatic spacing of the carriage is similarly repeated for each succeeding denomination in which the computing wheel 108 registers a non-significant "0".

The printed item and total may be punctuated by spaces which the carriage traverses by operation of the escapement without printing.

Should the carriage reach a punctuation space by a step of the carriage from a non-significant

"0" denomination, the denomination-selecting tappet 111 will, at said space, depress a punctuation jack 289, Figures 21, 22, 23, for connecting the carriage-spacing draw-link 272 to the power-shaft 37 for causing the carriage to traverse said punctuation space. Depression of any one of the three punctuation jacks 289, herein shown interspersed with the denomination jacks 110, will depress a secondary jack 290 through cross-bail 292 pivoted to the jack-housing 124 at 293 and connecting the several punctuation jacks 289 to the secondary jack 290 by pin-and-slot connections 294. The secondary jack 290 does not extend into the path of the denomination-selecting tappet 111, and it is connected by link 295 to a bell-crank 296, mounted with the bell-cranks 113 of the denomination-selecting trains on a fulcrum rod 297 provided in the computing base.

The bell-crank 296 when rocked by depression of any punctuation jack 289, Figure 21, coacts with an arm 298 to rock a shaft 299, which, through another arm 300 and a link 301 connected to a lever 302, rocks the latter to rock the carriage-spacing draw-link 272 into engagement with the power-shaft 37, which is thus caused to step the carriage, as above described, for the punctuation space. Said lever 302 is fulcrumed on the shaft 176.

At the power-driven rearward movement, at punctuation spacing, of said draw-link 272 a land 303 thereof initially engaged by the punctuation-train lever 302 passes from the latter in order that said draw-link 272 may become disengaged from the power-shaft 37, it being understood that said lever 302 remains rocked, Figure 21, until the carriage passes from the punctuation denomination and releases the punctuation-jack-train which thereupon becomes restored, by a spring 304, to normal position gaged by a stop-arm 305, on the rock-shaft 299, abutting the cross-bar 306 having brackets 307 for said rock-shaft 299 and the feeler latching rock-shaft 213.

The numeral-type actions are locked against actuation, by the power-shaft 37, when the typewriter-carriage is at a punctuation-space during item-printing operations effected by manual operation of the numeral-type keys 30. For this purpose, the depression of any punctuation-jack 289 acts through the concomitant movement of the link 301 to rock a lever 486 from the dotted-line, normal position 486^a to the full-line position, Figure 21, to concomitantly move a cam-rod 487, whereby a cam-shoulder 488 of the latter displaces a block 489, Figures 3 and 22, to close up the series of lock-rods 86, and thereby prevent the engagement of any numeral-type action draw-link 32 with the power-shaft 37 at a punctuation-space of an item. Said link 301 has an adjustable plate 490 for a pin-and-slot connection 491 to said lever 486, said connection 491 being located between fulcrum 492 and the upper end of said lever 486 which engages a pin 493 of said cam-rod 487. Said lever 486 thus acts to multiply the movement of said cam-rod 487 relative to the movement of the rest of the punctuation-jack train. It will be seen therefore that the suitably proportioned cam-shoulder 488 acts to fully move the block 489 during a small initial portion of the jack-actuated stroke of said cam-rod 487, and that, therefore, the numeral-type actions become locked sufficiently early during the letter-feed step which brings the carriage to a punctuation-space. Said cam-rod 487 is guided partly in a slot 495 provided in the angle-member 80 which retains the series of lock-rods 86 and the block 489, Figure 3, and partly in a slotted guide 496 on the typewriter-frame. When the carriage leaves the punctuation-space, a spring 494 restores said cam-rod 487 to normal position gaged by a shoulder 497 of said rod abutting said guide 496, Figure 3.

Because of the described early locking action of the jack-actuated stroke of the cam-rod 487, the latter, conversely, produces a delayed unlocking action in its return stroke as the carriage leaves a punctuation-space. It is therefore desirable to render said cam-rod 487 inoperative at a punctuation-space during automatic total-printing; this being practicable because the carriage determines proper sequence of operations of the numeral-type actions during automatic total-printing, and because, moreover, other means to be described later are provided to lock the numeral-keys 30, 31 during automatic total-printing. Therefore, the fulcrum 492 of said lever 486 is on an arm 498 of the rock-shaft 216, which, it will be remembered, is caused to be released, and rocked from the Figure 21 position to the Figures 7, 13 position consequently to operation of the total-key 200. Thus, at said rocked position, said rock-shaft 216 will have retracted said lever 486 to the position indicated by the dotted outline 486^b, Figure 21, and thereby will have rendered said rod 487 inoperable by the punctuation-jack train.

By its automatic traverse of the non-significant "0" and punctuating denominations, the carriage 54 arrives at the denomination of the computing wheel 108, registering the first significant digit, for example "4", registered by the sixth computing wheel 108 from the left, Figure 8. At said first significant-figure denomination, the type-selector 230 at that denomination being under the "4" digit-blade 231, the slight advance of the register-bar 104 will raise said type-selector 230, and the "4" digit-blade 231, and thereby rock the draw-link 32 of the "4" numeral-type action into mesh with the power-shaft 37, which is thereby caused to actuate said type-action to print "4" upon the work-sheet, and step the carriage to the next denomination.

Figure 8 represents the slight advance of the register-bar 104 as having raised the companion interponent-plate 233, the companion type-selector 230 and the "4" digit-blade 231, and thereby rocked the lever 265 to move the draw-link 32 of the "4" type-action into mesh with the power-shaft 37, whereupon the "4" type-action is operated in its printing stroke by said power-shaft 37 as shown. Figure 8 also shows how said draw-link 32, by coaction with the abutment-bar 283, has become disengaged from the power-shaft 37 near the end of said printing stroke, it being understood that said printing stroke is followed by type-action restoration aided by the usual type-action spring 308, Figure 2, and the draw-link spring 83.

In order that any computing wheel, registering "0" after the first significant figure, may cause actuation of the "0" type-action, operation of any digit-type-action for a first significant figure results in shifting the connection of the "0" digit-blade 231 from the carriage-spacing draw-link 272 to the draw-link 32 for the "0" type-action. To this end, the printing stroke of the type-action, called into use for the first significant figure, causes the lever 35 of said type-action to engage a companion one of a series of cam-edges 309 of a cross-slide 310 to displace the latter right-

ward from the Figure 7 to the Figure 8 position. The rock-shaft 271, journaled in lugs 311 of said cross-slide 310, is thereby shifted rightward to move its arm 273 away from the carriage-spacing draw-link 272 and to move another arm 312 of said rock-shaft 271 over a land 313 of the "0" type-action draw-link 32, the latter thus becoming operatively connected to the "0" lever 266 which remains in connection with a pin 316 of the arm 270 of said rock-shaft 271. The cross-slide 310 is slidably supported by brackets 317, Figure 3, attached to the typewriter.

Before the arm 273 fully leaves the draw-link 272 at the rightward shift of the rock-shaft 271, the arm 312 will be partly over the draw-link 32 for the "0" type-action, and thereby a fall of said arms 273, 312 between said draw-links 272, 32, during such shift, is avoided.

The printing stroke of the type-action for the first significant figure will set a corresponding digit-pin 103, by means of the rod 100, in the register-bar 104 for the first significant figure denomination, since the slight advance of said register-bar, utilized to bring the type-action into play, also positions the pins 103 of said register-bar under the pin-setting bars 102.

At recoil of the type-action which printed the first significant figure, the carriage steps to the next denomination which may be either for a punctuation-space or for the next digit to be printed. In the latter case the register-bar 104 of said next denomination will be slightly advanced and thereby cause the digit-blade 231, corresponding to the digit read by the companion feeler 222 and type-selector 230, to be raised, thereby causing actuation, in the manner described, of the type-action for printing said next digit.

Should said next denomination, or any other denomination after the first significant figure, be for a punctuation-space the corresponding punctuation-jack 289 will be depressed to cause the carriage-spacing draw-link 272 to be meshed with the power-shaft 37, whereupon the carriage will be spaced, without printing as above described. The train from the punctuation-jacks 289 to the carriage-spacing draw-link 272 is unaffected by the described rightward shift of the cross-slide 310; and the latter remains in its rightwardly shifted position until the end of the total-printing, as will be further explained hereinafter.

The printing, digit by digit, of the entire total, including any "0" after the first significant figure, proceeds for each digit as described, and results in setting corresponding digit-pins 103 in the set of register-bars 104 for the computing wheels associated with the feelers 222.

At the carriage-step which ensues upon printing the last digit, the denomination-selecting tappet 111, the total-control tappet 208 and the register-selecting tappet 123 pass, respectively, from the field of jacks 110, 289, the restored cam-plate 206 and the register-selecting cam-plate 122, and thereupon the machine may be cycled to advance and return the general-operator cross-bar 141. Said general-operator cross-bar 141 has end plates 320, Figures 2 and 4, connecting it to the usual side racks 321, each connected to the usual cross-shaft 322 by the usual side gearing 322a, Figure 4, for reciprocating said cross-bar 141 parallelly.

For automatically initiating a cycle, an extension 93a, Figure 5, of the column-stop 93 may pass, at said last carriage-step, over and rock the usual trip-lever 323 about a fulcrum 324 on the housing 82. Operation of said trip-lever by said extension 93a connects the general operator 141, 320—322 to a power-drive (not shown), for a cycle in which said general operator first advances and then returns, and in which cycle a shaft 325, connected to said general operator, also cycles. Said general operator may also be connected to said power drive by manually pressing the usual cycling key 314, Figure 2. Said general operator may also be cycled by manual operation of the usual handle (not shown) which may be attached to the cross-shaft 322.

Starting with the advance of the general operator, a side 326 of a notch 315 in one of the general-operator side racks 321, coacting with a spring-pressed lever 327 pivoted to the framework at 319, Figures 2 and 4, rotates said lever for retracting the total-reading feelers 222 from the computing wheels 108, and the ultra-denomination feeler 465 from its wheel 476, and for raising the interponent-plates 233, 467 from the register-bars 104 and bar 468, before the computing wheels 108 are shifted rearwardly into mesh with the idlers 144, it being remembered that operation of the total-key 200 and resulting release of the state-controller 166 has caused the subtraction-yoke 151 to become connected to the pinion-shifting rock-shaft 146 through the coupler 160. Said lever 327 thus acts through a link 328 and an arm 329 of the feeler-controlling rock-shaft 216 to rock the latter clockwise from the Figures 7, 13 position so that the rock-shaft arm 215 may become re-engaged with the latch-arm 214 as in Figures 2, 5, said latch-arm 214 having been restored by means of the spring 330 for the latch-arm rock-shaft 213. The link 328 has pin and slot connection 333 to the arm 329 of the rock-shaft 216, for independent feeler-releasing rotation of the latter. Said clockwise rotation of said feeler-controlling rock-shaft moves the feeler-controlling cross-bar 221 and its frame 220 to the right of the Figure 13 positions to retract the feelers 222, 465 by engaging shoulders 331 of said feelers; and, as said cross-bar 221 nears the end of its return, it engages the cam-edges 241 of the plates 240 to restore the latter to the Figure 20 position, and thereby raise the cross-rod 238, and, with the latter, the dropped interponent-plates 233, 467. Each interponent-plate 233, 467 has a vertical slot 332, Figure 2, through which said cross-rod 238 is threaded, and which, when the latter is dropped, permits the interponent-plate to be raised individually by the slight advance of its companion bar 104 or 468.

Following restoration of the feelers 222 and interponent-plates 233 in the cycle the computing pinion-shifting cam-shaft 149 acts through the link 148 to rock the pinion-shifting rock-shaft 146 clockwise, Figure 32, thereby shifting the computing-pinion frame 145 rearwardly to mesh the computing pinions 108 with the idlers 144. Also following rocking of the feeler-controlling shaft 216 for restoration of the feelers 222, 465, a cam, not shown, on the shaft 325, connected to the general operator, acts to shift a latch-hook 336, partly shown, Figure 2, over an arm 337 of said feeler-controlling rock-shaft 216, to thereby lock the latter against feeler-releasing movement during the cycle. Following operation of the computing-pinion rock-shaft 146 to put the computing pinions 108 in train with the register-bars 104, the latter are advanced by the general-operator cross-bar 141 and thereby the No. 3 register computing pinions 108, con-

nected to the companion idlers 144, will be rotated subtractively to subtract the printed total from said computing pinion 108 to clear the latter.

Movement of the feeler-controlling rock-shaft 216 is used for restoring the cross-slide 310 which was shifted rightward for bringing the "0" type-action into use after printing the first significant figure. The connecting rod 219 from said rock-shaft 216 to the feeler-controlling frame 220 has a cam-plate 338, Figures 4 and 7, to coact with a roll 339 on a cross-slide arm 340 which is slidably supported as at 341 by a plate 342 of the machine-framework. Said plate 342 also presents a detent 343 coacting with detent-notches 344 for detenting the cross-slide 310 in either one of its two positions.

At retraction of the feeler-controlling frame 220 by operation of said rock-shaft 216 by the lever 327 during the cycle, said cam-plate 338 acts to shift said cross-slide 310 leftwardly from the Figures 3, 8 position to the Figure 7 position, thereby disconnecting the lever 266, controlled by the "0" digit-blade 231, from the "0" draw-link 32 and reconnecting it to the carriage-spacing draw-link 272. Should said cross-slide 310 with its rock-shaft 271 become shifted to the right again, after the cycle and before another operation of the total-key 200, such operation of the total-key would, through the resulting release of the rock-shaft 216 and forward movement of the connecting rod 219 and cam-plate 338, cause the cross-slide 310 to be shifted to the left before the total-printing initiated by said other operation of the total-key proceeds.

The general-operator cross-bar 141, in its advance, engages arm 346, Figure 12, of the subtraction-latch-withdrawing lever 183 to rotate the latter into re-engagement with the control latch 182, whereby the subtraction-latches 173 are freed for interlocking with the state-controllers 166 upon restoration of the latter, it being noted that the primary latch 170 will also have been freed, for interlocking with the state-controller, by passage of the register-selecting tappet 123 from the register-selecting cam-plate 122. Before the return of the general operator picks up the advanced register-bars, the cam-shaft 149 acts through the pinion-shifting rock-shaft 146 to shift the No. 3 register computing-pinion frame 145 forwardly to disconnect the computing pinions from the idlers 144. Near the end of the return stroke of the general operator, the cross-bar 191 acts, as hereinbefore described, to return the state-controller 166, whereupon the latches 170, 173 drop back into latching position. Restoration of the state-controller acts through the state-controller cam-slot 167 to return the coupler 160 to neutral on the computing-pinion shifting rock-shaft 146 and thereby disconnect the latter from the computing-pinion-shifting-frame 145.

At the end of the general operator return stroke, the lever 327 drops again into the general-operator-rack notch 315, and thereby the feeler-controlling rock-shaft 216 again becomes subject to the control of the latch-arm 214, the latch hook 336 also being withdrawn from the lock-arm 337 of said rock-shaft. Said lock arm 337 of the rock-shaft 216 may be in two parts connected by a pin-and-slot joint 349 and a spring 350, so that the hook-engaging end 337a may yield to permit the hook 336 to swing, at the start of the cycle, to locking position before said end 337a has passed thereunder.

Following, in the cycle, the advance of the register-bars 104 for clearing the computing wheels 108 after automatic total-printing, the set digit-pins 103 will be restored by depressing their companion "0" digit pins 103° during the cycle as hereinbefore mentioned.

It will be seen now that the cycling of the general operator following total-printing has served, besides clearing the computing wheels 108, to restore the parts, released by the carriage as a result of operating the total-key 200, to their normal conditions which obtained before the operation of said total-key; and that, after such cycle, therefore, a new total may be accumulated in the set of computing wheels 108 (the No. 3 register), associated with the automatic total-printing mechanism.

For automatic sub-total printing, without clearing the computing wheels, the state-controller 166 may be silenced, to prevent rotation of the computing wheels during the cycle following sub-total printing, either by returning said state-controller 166 to neutral position or by blocking its release from neutral position; it being understood that as a result of pressing the total-key 200 for a sub-total, the state-controller holding addition-latch 170 will be withdrawn incidentally to connecting the register-bars 104, by means of the couplers 118, to the denomination-selecting trains, to enable the latter to control the total-printing-controlling digit-blades 231, and that withdrawal of the subtraction-latch 173 also results from operation of said total-key 200 for a sub-total.

For silencing said state-controller 166, there may be provided a throw-off key-mechanism, such as shown in my aforesaid co-pending application 611,838, and herein used as a sub-total key mechanism. Said mechanism includes a key 352, Figures 2, 32, 33, which, when depressed, rocks a bell-crank 353 about the rock-shaft 146 to draw forwardly a cam-slide 354 which, by engagement with a pin 358 of a lever 355, cams and turns the latter about its pivot 356 until a latching notch 357 of said cam-slide 354 is opposite said pin 358. Said lever 355, connected to the state-controller 166 at 360 and thus turned, moves said state-controller 166, if the latter has been advanced, rearwardly to neutral position and holds it there by reason of said pin 358 settling in the corner of said latching notch 357 through the influence of the state-controller spring 172 and letting go of said throw-off or sub-total key 352. Slight excess of restoring movement of the state-controller 166 by its restoring bar 191 during the general operator cycle causes the pin 358 to be withdrawn from the notch 357 of the cam-slide 354 whereupon the latter, urged by its spring 361, moves back to its normal position, Figure 32, together with the depressed total-key 352.

The sub-total key 352 may be pressed before pressing the total-key 200 for sub-totaling, in order to silence the state-controller 166 before the general operator cycle which automatically ensues by means of the trip-lever 323 upon printing the last sub-total digit. In such case the state-controller 166, without being first released, will nevertheless become interlocked with the cam-slide 354, by means of the lever 355 as said cam-slide 354 is moved forwardly by pressing the sub-total key 352. Figure 33 shows the state-controller latches 170, 173 still in normal place at the operation of the sub-total key 352 to block the state-controller 166, and as a result of said

sub-total-key-operation withdrawal of said latches 170, 173 through operation of said total key 200 cannot result in advance of said state-controller 166 from its normal neutral position.

Pressing of the sub-total key 352 in connection with operation of the total-key 200 for a sub-total will result in the same operations of the machine as resulted, as hereinbefore described, from pressing the total-key 200 alone, with the exceptions that the operation of said sub-total key 352 prevents, by blocking the state-controller 166, rotation of the computing wheels during the cycle included in said operations, the indexed register-bars 104 being idly reciprocated and having their digit-pins 103 restored during the cycle and that, near the end of said cycle, the state-controller 166 becomes disengaged from the control of the sub-total key-mechanism, and the latter becomes restored. By preventing rotation of the computing wheels, the sub-total as automatically printed by said operations remains in said computing wheels.

The items accumulated in the total-printing register may be printed in the same vertical column as the totals or sub-totals and in such case the same tappet-block 135 serves both for item printing and automatic total printing. The total-controlling tappet 208, provided in said tappet-block to initiate the total-printing operation, will be ineffective at the passage of the carriage into said column for item printing because, the total-key 200 not having been operated, the upper edge of the cam-plate 206 will be out of the path of said tappet 208, see Figure 14, when the carriage enters or traverses said column for item printing and accumulating. Figure 14 further shows how an attempt to press the total-key 200 while the carriage is in said column for item printing and accumulating would be checked because the upward movement of the carriage-arresting plate 451, which accompanies effective operation of the total-key 200, would be blocked by the counter-stop 452. The typist is thus prevented from inadvertently bringing the total mechanism into play while the carriage is at any position in said column for item printing, it being noted that the upper edge of the carriage-arresting plate as opposed by said counter-stop 452 is co-extensive with said column.

Concomitantly with the automatic printing of the total from the No. 3 register, said total may be transferred to say the middle register (No. 2) of the computing base. For this purpose the total-printing-zone tappet block 135 may include, besides the total-printing control tappet 208 and the tappet 123 for selecting said No. 3 register, a tappet 123a, for selecting the No. 2 register, as shown in Figure 5. Thus, upon operating the total-key 200, the ensuing advance of the type-writer-carriage to the position of the ultra-denomination in the total-printing zone, besides having depressed the cam-plate 122, to select the No. 3 register, and the cam-plate 206 to bring the feelers 222, 465 and interponent-plates 233, 467 into total-printing-control position, will also have depressed the No. 2 register cam-plate 122 to connect the register-bars of the No. 2 register to the universal set of denomination-jacks 110 by means of the No. 2 register couplers 118, the No. 2 register-control racks 117, and the cross-blades 115. The raising of the couplers 118 for the No. 2 register into operative position will also have withdrawn the primary latch 170 for the No. 2 register, and the secondary latch 173 for the latter, which is the register represented at the left of Figure 32, will also have been withdrawn through depression of the total-printing-control cam-plate 206, so that the No. 2 register-state-controller 166 will have advanced to its extreme forward position. Since said extreme forward position of the latter state-controller 166 is to determine additive connection of the No. 2 register computing pinion-shifting frame 145 to the pinion-shifting rock-shaft 146 while the No. 3 register pinion-shifting frame 145 is connected subtractively to said rock-shaft 146 by the extreme forward movement of its own state-controller 166, the cam-slot 167 of the No. 2 register state-controller 166 is reversed relatively to that for the No. 3 register, as indicated in Figure 32. Thus extreme forward movement of the No. 2 register-state-controller 166 will shift its coupler 160 toward the right of the neutral position to connect the No. 2 register arm 154, by means of the coupler-tongue 162, to said rock-shaft 146 while the No. 3 register-coupler 160 will have been shifted to the left to connect the No. 3 register subtraction-yoke 151 to said rock-shaft 146. Upon the carriage reaching the ultra-denomination position of the total-printing zone, operation of the carriage-spacing mechanism and numeral-type actions will proceed automatically to print the total as hereinbefore described, and said total will be indexed not only in the set of register-bars for the No. 3 register, but also in the register-bars for the No. 2 register. In the general-operator cycle which follows the printing of the last digit of the total, the No. 3 register-computing pinions will be meshed with their companion idlers 144 as hereinbefore described, but the arm 154, of the No. 2 register, being connected to the pinion-shifting rock-shaft 146, will cause operation of the latter, at the start of the cycle, to swing the No. 2 register computing pinion frame 145 downwardly about the axle 158 to mesh the No. 2 register computing pinions 108 directly with the companion register-bar racks 143. Thus, during the cycle, the No. 3 register computing pinions will be rotated subtractively to the extents of the indexed total, and will be cleared while the No. 2 register computing pinions will be rotated additively, thereby causing said total to be transferred thereto. Before the return of the register-bars and while the No. 3 register computing pinions are being withdrawn from the idlers 144, the No. 2 register computing pinions will be withdrawn from the register-bar racks 143, and, before conclusion of the cycle, the No. 2 and No. 3 register-state-controllers 166 will be restored by the cross-bar 191. The set digit-pins 103 of the No. 2 register will also be restored during the cycle. The No. 2 register may have, for the purpose of suppressing the transfer of the total thereto, a throw-off key-mechanism represented in Figure 32 by its partly shown lever 360a and constructed like the sub-total key-mechanism described for the No. 3 register. Operation of said throw-off key-mechanism by its key blocks the No. 2 register-state-controller to prevent rotation of the No. 2 register computing wheels and thereby prevents said transfer of the total thereto.

The tappet block 135, at the left of Figure 5, is for a computing zone in which no total is printed by means of the automatic total-printing mechanism and such tappet block, of which there may be as many as needed on the carriage, will not be provided with the total control tappet 208. It will be seen therefore that a total cannot be printed in any work-sheet column unless

the tappet block therefor is provided with a total-printing control-tappet 208 and that inadvertent automatic total printing in the wrong work-sheet column is thereby prevented. Each tappet block has a tappet-holding pin 372 removable for placing upon said tappet block such tappets 208, 123 and 177 as may be required for any computing zone.

A manually operable typewriter-carriage spacing-key 376, Figures 2 and 3, connected to a rock-shaft 377 of the typewriter by arms 378, may rock the carriage-spacing draw-link 272 into mesh with the power-shaft 37. Said space-key rock-shaft 377 may have an arm 379 arranged to so rock said carriage-spacing draw-link 272, upon depression of said space-key 376 which may be restored by spring 380 acting on said arm 379.

The dog 36, pivoted to each draw-link 32 or 272, is slotted, as at 383, Figure 3, to straddle the draw-link, and to form a corner 384 which stops against an edge 385, Figure 13, of the draw-link to limit the rotation of said dog 36 about its pivot 264, said rotation preceding the power-shaft driven rearward movement of the draw-link. A tail 386 of the dog 36 coacts with the leg 82 of the angle-member 80 to stabilize the engagement of said dog 36 with the power-shaft 37 at the initial portion of the rearward movement of the draw-link. At the forward movement of the draw-link after its disengagement from the power-shaft, said tail 386 coacts with said angle-member leg 82 to rotate the dog 36 back to its normal position.

The typewriter has fastened to each side of its base, Figures 2 and 3, one of the plates 342, by means of which said typewriter rests upon the cross-bars 252, 306 of the computing base framework and is secured by screws 363, and dowels 363a, Figure 3. The cam-plate housing 124 is supported by brackets 375 of the typewriter framework, and by a plate 381 attached to the stop-rod housing 92. Said plate 381 with a companion plate 382, Figure 5, guides the upper ends of the stop-rods 91, and the total-key-operated rod 450, said rods also being guided by slots 407 therein and a cross-rod 362 of said housing 92.

Slotted side guides 387 of the housing 124 guide the cam-plates 122, 178, 206, each side-guide 387 having an elongated guide-notch 388 to permit the cam-plate 206 to swing about the lower cam-plate guide-means 207. The slides 125, 179 and 210, companion to said cam-plates, work in slotted upper and lower guides 394 of said housing 124. The slide 179 has two tabs 390 engaged respectively by the total-control cam-plate 206 and the subtraction-control cam-plate 178. The thrust-rods 126, 180 and 211 companion to the slides 125, 179 and 210 are guided by plates 391 supported by arms 392 of the cross-bar 306 of the computing base framework. Said arms 392 also support guide-plates 393 for the rods or links 112, 295 companion to the jacks 110, 290. The housings 92, 124 afford respectively a guide plate 401 and a guide socket 403 for the thrust link 205 of the total-key train.

The register-bars 104 and the ultra-denomination bar 468 work in slotted guides 395 supported by the plates 258, attached to cross-bar 396, and in slotted plates 397, attached to cross-bar 398, said cross-bars 396, 398 being part of the computing-base frame. The cross-bar 398 also supports a frame 399 for the assemblage of master and register control racks 114, 117, cross-blades 115, and coupler-raising bails 120. The arms of each coupler-raising bail 120 also support a cross-rod 400 extending over the couplers 118 to insure restoration of the latter. The typewriter may be lifted off the computing base upon removing the screws 363, the jacks 110, 110a, 290, 620, the slides 125, 179, 210, the lock-bar 669, the key-locking slide 681, the case-shift-control lever 508 and the numeral-type-action levers 265, 266 being liftable, with the typewriter, from their companion parts of the computing base. Keys 402 other than the numeral-keys 30 of the typewriter-keyboard are shown in Figure 2.

With all the computing wheels of a set standing at "0", and with each spring pressed detent 228 consequently entered farther into the detent disks 227 than for any digit position from "1" to "9" by reason of greater depth of the "0" detent notches 406, the usual spring pressed cross-bar 404, abutting the row of detents 228, will have moved away from a member 405, Figure 18, to thereby, in known manner, permit printing of a clear sign by one of the typewriter-types.

The foregoing detailed description sets forth the operation of the machine for automatically printing positive totals. The description of other devices and their use, in conjunction with the above-described mechanisms, for automatically printing negative or overdraft totals will now be taken up.

In the Figure 25 diagram, 499 exemplifies a work-sheet form, and the three registers of the machine are respectively indicated as No. 1, No. 2 and No. 3; the diagram representing successive readings 108a of the registers in accordance with entries upon said work-sheet form.

Thus, by way of example, an old balance of 45 00 is printed in the first column of the work-sheet and is concomitantly indexed, and then additively entered in the No. 3 register preparatory to computing and printing a new balance which results from a credit of 70 14, which is printed in the third work-sheet column and is concomitantly indexed, and then entered subtractively in the No. 3 register. Said subtractive entry of 70 14 results in an overdraft of 25 08 relatively to the lesser old balance, 45 06, and therefore the No. 3 register computing wheels will have been rotated to angular positions corresponding to the complement, of said overdraft, namely, 99 999 974 91. It will be noted that the first significant figure of the complement is any digit, from "0" to "8", which appears first in succession from the computing wheel of highest denomination (tens of millions), and that one or more preceding computing wheels, starting with said highest computing wheel, each register an insignificant "9". Thus, in the illustrated reading 99 999 974 91, Figure 25, the significant figures are 74 91, "7" being the first significant figure and being preceded by the insignificant "nines".

By regular algebraic-summation the above example and result would be, disregarding the insignificant "nines":

$$\begin{array}{r} +45\ 06 \\ -70\ 14 \\ \hline -74\ 92 \end{array}$$

That is, in the lowest denomination which registers any complementary digit from "1" to "9", such digit would be complementary to the true overdraft digit with reference to the value "10", while the digit in each higher denomination would be complementary to the true overdraft digit with reference to the value "9". Thus the com-

plement of said regular algebraic-summation result, 74 92, would be 25 08, which is the true overdraft.

The lowest denomination which shows a complementary digit from "1 to 9" is in said regular summation example, the units of cents or decimals denomination, the latter registering "2". If there be one or more "zeros" at the right of the result of a regular overdraft summation, as, for example,

+4 506 00
−7 014 00

−7 492 00

the lowest denomination which registers any digit from "1 to 9" in the result is, in the latter example, the third denomination from the right, and therefore said latter denomination and each lower denomination, register the complement of the true overdraft digit with reference to the value "10", and each denomination, higher than said third denomination from the right, registers the complement of the true overdraft digit with reference to the value "9". Thus the complement of 7 492 00 is 2 508 00, which is the true overdraft.

For the purpose of printing the true overdraft by means of the numeral-type actions and under control of the computing wheels **108** which register the complement of the true overdraft, means are provided whereby every one of the several computing wheels registers a digit which is the complement of the true overdraft digit with reference to the value "9". Thus, using the No. 3 register in the example

+45 06
−70 14

99 999 974 91

it will be seen that the result, 99 999 974 91, is the complement of the true overdraft, 25 08, with reference to the value "9" in every one of the denominations. This is accomplished by causing the computing wheel of units denomination to be rotated an extra step subtractively, at a subtractive entry which results in an overdraft.

Said means whereby the units-denomination computing wheel **108** is caused to rotate said extra step will be described later herein, it being sufficient to note at this time that the true overdraft will be the complement, relative to the value "9", of the angular-position values of every one of the computing wheels **108** when said wheels register an overdraft.

It will be seen now that the registry of "9" in the computing wheel of highest denomination (tens of millions) may serve as an indication of an overdraft condition, the number of denominations of computing wheels being such that, practically considered, no registration of positive amounts will ever bring said computing wheel of highest denomination to the "9" position.

Upon pressing the total-key **200**, the carriage becomes positioned at the ultra-denomination of the total-printing zone; the feelers **222**, **465** become released and engaged with their respective wheels **108**, **476**, the No. 3 register state-controller **166** becomes conditioned for subtraction, and the interponent-plates **233**, **467** become dropped to connect their companion bars **104**, **468** with the selectors **230**, **466**, all as hereinbefore described, and irrespective of whether the computing wheels **108** register a positive total or an overdraft.

Should the No. 3 register be in overdraft condition, its computing wheel **108** of highest denomination will be at the "9" angular position, and the ultra-denomination wheel **476**, which it will be remembered is connected to said highest wheel, will be similarly positioned, and therefore will present a notch **501**, Figure 13, of such depth as to arrest the ultra-denomination feeler **465** in a position wherein the ultra-denomination selector **466** will be under a blade **500**, which is similar to the digit-blades **231**, and is located next to the "0" digit-blade.

At the slight advance of the ultra-denomination bar **468** by means of the ultra-denomination train **110**ᵃ—**115**, **117**, **469**, Figure 13, and which advance, as hereinbefore described, is a concomitant of the positioning of the carriage at the ultra-denomination through operation of the total-key **200**, said bar **468** works through the ultra-denomination interponent-plate **467** to raise the ultra-denomination selector **466** and the overdraft-blade **500**, as in Figures 9 and 13. The raising of said blade **500** rocks a lever **508** about the fulcrum-rod **267** to swing a draw-link **502**, pivoted at **503** to an arm **504**, into connection with the rotating power-shaft **37**, said draw-link **502** having one of the power-shaft-engaging dogs **36** and also having an arm **505** engageable by said blade-operated lever **508**. Said arm **504**, to which the draw-link **502** is pivoted, and an arm **506** are spaced apart and connected by a yoke **507** to constitute a lever **509** rockable on the fulcrum-shaft **38**.

At its rearward movement, resulting from its said connection with the rotating power-shaft **37**, said draw-link **502** rocks said lever **509** counterclockwise from the Figure 13 position to the Figures 9 and 11 position to depress a case-shift lever **510**, which is connected to said lever **509** by a link **511** and a pin-and-slot connection **512** to said case-shift lever **510**. The depression of said case-shift lever **510** swings a shift-rail frame **515**, fulcrumed in the typewriter-frame at **516**, to raise a frame **517**, which mounts the platen **40**, from lower-case to upper-case position.

A rock-shaft **535**, Figure 2, journaled in the carriage **54**, has arms **536** connected to the sides of the platen-frame **517** at **537**, and side links **531** also connect said platen-frame **517** and carriage **54**, for guiding the case-shifts of the platen-frame. The platen-frame **517** has the usual roller **540** and hook **541**, Figures 9 and 11, for engaging a shift-rail **539** of the shift-rail frame **515**.

An arm **521** of a lever **522** remains in engagement with a pin **523** of the shift-rail frame **515** following the usual function of said lever **522** of preventing rebound of said frame **515**, when, later, it drops back to lower-case position. Said lever **522** has a fulcrum **524** in the typewriter-frame, and also has an operating arm **525** under a companion arm **526** on a rock-shaft **527** journaled in the typewriter-frame. At the start of the depression of the case-shift lever **510**, a pin **529** of the latter coacts with a cam-arm **530** of said rock-shaft **527** to turn the latter, and thereby rock the locking lever **522** counterclockwise to release the shift-rail frame **515** before movement of the latter to upper-case position results from further depression of the case-shift lever **510**. At the end of the depression of the case-shift lever **510** and of the accompanying shift to upper-case positions of the shift-rail frame **515** and the platen-frame **517**, the locking lever **522** will have been turned clockwise again by a spring **532**; and the rock-shaft **527** will also have been turned clockwise again by a spring **533**,

so that a shoulder **534** of the cam-arm **530** opposes the case-shift lever-pin **529**, Figure 11, to maintain the case-shift lever **510** in depressed position and the platen **40** in upper-case position for the printing of the overdraft.

The case-shift lever **510**, the case-shift rail-frame **515**, the rebound-preventing lever **522**, the rock-shaft **527** with its arms **526**, **530**, and the platen-frame with its described connections to the carriage **54**, are shown arranged structurally substantially like the manually-operable Underwood case-shift mechanism, which also includes a second case-shift lever **528**, Figure 9, which is operable manually only and does not become locked down at its depression. Said second case-shift lever **528**, at the start of its depression, releases the shift-rail frame **515** by engaging a cam-arm **529a** of the rock-shaft **527** to rock the latter to withdraw the locking lever **522** from the pin **523**.

The described case-shift operation by power, effected automatically at the ultra-denomination position of the carriage, is preparatory to printing the true overdraft by means of upper-case digit-types **518**, which are provided on the several type-bars **39** in addition to lower-case digit-types **519**, the two cases of digit-types being complementary to each other with reference to the value "9". Figure 27 represents the complementary arrangement of the upper and lower cases of digit-types on their respective type-bar heads **520**. Thus, the type-bar head **520**, which bears the lower-case type for the digit "1", also bears an upper-case type for the digit "8", which is the complement of "1" with reference to the value "9". The next type-bar bears lower and upper case types for the digits "2" and "7", respectively; and so on up to the type-bar which bears lower and upper case types for the digits "0" and "9", respectively.

The lower-case digit-types **519** are used in the hereinbefore-described operations for automatically printing a positive total, because when the total is positive the computing wheel **108** of highest denomination does not reach the "9" position, and therefore does not operate to determine a shift of the platen from its lower-case position.

The carriage **54** having coacted, at the ultra-denomination position, with the ultra-denomination wheel **476**, the ultra-denomination train **110a**—**115**, **117**, **469**, and the ultra-denomination interponent-plate **467**, feeler **465**, and selector **466**, and the overdraft-blade **500**, to institute the described case-shift operation, said carriage is caused to step to the next denomination, which is the denomination of the highest computing wheel. For this purpose and other purposes which will presently become clear, the type-action, having the complementary types "9 and 0", is brought into play concomitantly with said case-shift operation.

Therefore, while the lever **509** is being rotated counter-clockwise from the Figure 13 position to the Figures 9 and 11 position, as a result of the described rearward movement of the case-shift draw-link **502** by the power-shaft **37**, the yoke **507** of said lever **509** works against a tongue **542** of a coupling bar **543** on the operating lever **44** of the "9 and 0" type-action, and thereby moves said coupling bar **543** forwardly, from the Figure 6 position to the Figures 9 and 11 position, to withdraw a coupling pin **544**, carried by said coupling bar **543**, from a slot **545** of the bell-crank **42** of the "9 and 0" type-action, to thereby disconnect the "9 and 0" type-bar **39** from its said operating lever **44**, preparatory to an operation of the latter for carriage-spacing only.

Having effected the depression of the case-shift lever **510** and the forward movement of the coupling bar **543**, the case-shift draw-link **502** becomes disengaged from the power-shaft **37** by means of the abutment-bar **283**, and thereupon becomes restored, by its spring **538**, to normal position together with the lever **509**, whose pin-and-slot connection **512** to the case-shift lever **510** permits such restoration, while the latter remains held down by the cam-arm **530**.

A bend **546**, Figures 6 and 9, in said coupling bar **543**, laterally spaces its rear portion **547**, from which the coupling pin **544** projects, from said operating lever **44**; an arm **548**, having the slot **545**, of said "9 and 0" type-action bell-crank **42**, being disposed between said rear end-portion **547** and the lever **44**. Said coupling pin **544** is extended and headed to work in a slot **549** of said lever **44**, and a headed pin **550** at the forward end of said coupling bar **543** works in a companion slot **551** of said lever **44**, which thus slidably mounts said coupling bar **543**. A spring-detent device **552** yieldably detents the coupling bar **543** in its normal position, Figure 6, or in its forward position, Figures 9 and 11.

As the "9 and 0" operating lever **44** becomes disconnected from its companion type-bar **39**, its draw-link **32** becomes engaged with the power-shaft **37**. This may be accomplished by the forward movement of the coupling bar **543** acting through a link **554** to rock a lever **555** by its operating arm **553**, whereby another arm **556**, of said lever **555**, engaging a land **557**, provided on the arm **74** of the "9 and 0" type-action draw-link **32**, moves the latter into engagement with the revolving power-shaft **37**. Said lever **555** may be fulcrumed on the space-key rock-shaft **377**, and its arms **554**, **556** are at opposite sides of its hub **555a**, Figures 6 and 9.

At the described depression of the "9 and 0" type-action lever **44**, without operation of its companion type-bar **39**, a roll **558** on said lever **44** works against an arm **559** of the escapement-actuating rock-shaft **484** to rock the latter, and thereby move the escapement-dog rocker **50** clockwise to the position seen in Figure 15, which also shows how said "9 and 0" type-action draw-link **32** becomes disconnected from the power-shaft **37**, by means of the abutment-bar **283**, for restoration toward normal positions of the depressed "9 and 0" lever **44** and its draw-link **32** by their springs **308**, **83**.

Concomitantly with said restoration, the dog-rocker **50** is rotated counterclockwise by its spring **53b** for restoration from the Figure 15 position to its normal position, together with the dog-rocker train which includes the escapement-actuating rock-shaft **484**. Consequently to said restoration of the dog-rocker **50**, the carriage **54** moves to the next denomination, thereby causing the ultra-denomination bar **468**, and its carriage-operated train, from the jack **110** to the coupler **469**, to be restored by its spring-device **139** with concomitant restorations of the ultra-denomination interponent-plate **467**, the ultra-denomination selector **466** and the overdraft-blade **500**. At the operation of said escapement-actuating rock-shaft **484**, by means of the "9 and 0" type-action lever **44**, the pin **482** of its arm **483** plays idly, as in Figure 15, in a clearance slot **559a** of the idle lever **480** which it will

be remembered is workable by means of the draw-link 272 to operate said rock-shaft 484.

The numeral-type actions gain sufficient momentum by reason of their inertia to make it feasible to disconnect their draw-links 32 from the power-shaft slightly before the end of the printing stroke, the latter being completed by such momentum. In order that there may be sufficient momentum for the "9 and 0" type-action lever 44 when the latter is operated while disconnected from the companion type-bar 39 and bell-crank 42, the lever 35 for said "9 and 0" type-action lever is provided with a fly-weight-forming extension or arm 564, Figure 15. The lever 480, which is worked by the carriage-spacing draw-link 272, also serves, by reason of its form, as a momentum device.

The described depression of the "9 and 0" type-action lever 44, without printing, at the ultra-denomination position of the carriage has also acted, by means of the companion lever 35, to shift the cross-slide 310, and the rock-shaft 271 journaled thereon, to the right, whereby the lever 266 operable by means of the "0" digit-blade 231 becomes operatively connected, as hereinbefore described with reference to printing a positive total, see Figure 8, to the draw-link 32 for the "0 and 9" type-action, as in Figure 3, instead of to the draw-link 272 used for carriage-spacing only. This shift is preparatory to selection and use of said "0 and 9" type-action, for printing the upper-case "9", at the first denomination at which the computing wheel stands at "0" angular position, it being noted that the first significant figure of the true overdraft total might be "9".

No restoration of the coupling bar 543 has been effected so far. Therefore, when the carriage has been stepped from the ultra-denomination position to the next denomination (tens of millions), at which the computing wheel 108 registers "9", which signifies the overdraft condition, the "9 and 0" type-action lever 44 will still be disconnected from its type-bar 39. It results at said next denomination that the slight advance of the register-bar 104, effected by means of its denomination train 110—115, 117, 118, will act through the companion interponent plate 233 and selector 230 to raise the "9" digit-blade 231 to rock the "9 and 0" type-action lever 265, to thereby connect the "9 and 0" type-action draw-link 32 to the power-shaft 37, as in Figure 16, for ensuing operation of the "9 and 0" type-action lever 44, without printing. At such operation the "9 and 0" type-action lever 44 will act by means of its companion pin-setting bar 102 to set the "9" digit-pin 103 in said register-bar 104, and will also act to space the carriage 54 to the succeeding denomination (units of millions) by means of the roller 558.

It may be noted that the "9 and 0" type-action lever, when operated at the ultra-denomination, operates its pin-setting bar 102 idly, because the ultra-denomination-bar 468 has none of the digit-pins 103.

The coupling bar 543 remains, as just explained, in its forward position, Figures 11 and 16, and therefore, during the restoration of the "9 and 0" type-action lever 44 and the accompanying forward movement of its draw-link 32, the draw-link land 557, having passed rearwardly beyond a nose 560 of the arm 556, the land-engaging lever 555, at the rearward power-operated movement of the draw-link 32, may become caught behind said nose 560, which also remains in the Figure 11 position, since said lever 555 is connected to said coupling bar 543 by the link 554. In order that this condition, represented by the dotted outline of the land 557 in Figure 16, may not impede said forward movement of said draw-link 32 and the restoration of said lever 44, said land 557 is formed by a plate 561 slidably mounted on said draw-link 32 by pin-and-slot connections 562. Said connections 562 thus permit said draw-link 32 to move forwardly independently of the land 557 when the latter is caught behind said nose 560. A spring 563, attached to said plate 561, serves to move said land-forming plate 561 forwardly to its normal position when the land 557 is not caught behind said nose 560.

With the carriage now at said units of millions denomination, it results, if the corresponding computing wheel 108 also stands at the "9" angular position, as in Figure 6 which represents the computing wheels 108 registering the complement of the true overdraft, 25 08, exemplified in Figure 25, the "9 and 0" type-action lever 44 will again be operated to set the "9" digit-pin in the register-bar 104 for the units of millions denomination, and to space the carriage to the next denomination which will be a punctuation-space.

By its step to said punctuation-space, the carriage actuates the hereinbefore-described punctuation-train, from the punctuation-jack 289 to the carriage-escapement-actuating draw-link 272, as in Figure 21, for a resulting carriage-spacing operation, which brings the carriage to the denomination of the third computing wheel 108 from the left of Figure 6. Since said third computing wheel 108 also stands at the "9" angular position, as do also the fourth, fifth and sixth computing wheels from the left of Figure 6, it will be understood from the foregoing that each one of said third, fourth, fifth and sixth computing wheels determines, in co-operation with the carriage and carriage-operated denominational trains, an operation of the "9 and 0" type-action lever 44 without printing, to thereby set a "9" digit-pin in the corresponding register-bar 104 and to step the carriage to the next denomination.

It will also be understood that a carriage-spacing operation occurs at the punctuation-space between the denominations of the fifth and sixth computing wheels 108 from the left of Figure 6.

Thus the carriage is stepped automatically from the ultra-denomination-position to the position of the denomination of the seventh computing wheel 108 from the left of Figure 6. Said seventh computing wheel, since it is at one of its angular positions from "0" to "8", namely, "7", Figure 6, registers the first significant figure of the overdraft complement.

The slight advance of the seventh register-bar 104, Figure 17, resulting from the arrival of the carriage at the denomination for said seventh computing wheel 108, coacts under control of the companion feeler 222, with the interponent-plate 233 and selector 230 to raise the "7" digit-blade 231 to rock the companion lever 265, and thereby move the draw-link 32 for the "7 and 2" type-action into engagement with the rotating power-shaft 37. The resulting rearward movement of said latter draw-link 32 rocks the lever 35 and thereby depresses the companion operating lever 44, which, working through the companion bell-crank 42, swings the "7 and 2" type-bar 38, see Figure 17, to print the true upper-case

digit "2" by means of the upper-case digit-type **518** of said type-bar, it being remembered that the platen **40** is at its upper-case position. The depression of the "7 and 2" type-action lever **44** also acts, by means of its pin-setting bar **102**, to set the "7" digit-pin in said seventh register-bar **104**.

At the operation of any type-action from "0" to "8" for printing such first significant figure of the overdraft, the "9 and 0" type-action type-bar **39**, and its bell-crank **42**, become reconnected to the companion operating lever **44**, so as to render said "9 and 0" type-action operable for printing again, preparatory to the printing of an upper-case digit "0", which may occur after the first significant figure of the overdraft. Therefore, a nose **565**, of the lever **35** of whichever type-action from "0" to "8" is operated for the first significant overdraft figure, works against a universal bail **566** articulated as at **567**, Figure 9, to the arms **553**, **556** of the lever **555**, to rock the latter clockwise from the Figure 11 position to the position, see Figure 17 which represents the "7 and 2" type-action and thereby, through the link **554**, move the coupling bar **543** rearwardly on the "9 and 0" type-action lever **44**, so that the coupling pin **544** re-engages the "9 and 0" type-action bell-crank **42** at the slot **545**.

Said universal bail **566** has lugs or arms **568**, Figures 3 and 9, whereby it is fulcrumed, along with said lever **555**, upon the shaft **377**. Opposite the lever **35** of the "9 and 0" type-action, the universal bail **566** has a cutout **569**, so as to remain unaffected at the described use of the "9 and 0" type-action lever **44** at the denominations preceding the first significant figure. A collar **570** and a pin **571**, Figure 3, retain the universal bail **566** and the companion lever **555** laterally on the shaft **377**.

The carriage-step which ensues upon the printing of the first overdraft digit "2", results from engagement of the type-bar heel **48** with the escapement universal bar **49** and brings the carriage to the next denomination at which, see Figure 6, the computing wheel **108** stands at the "4" angular position. It will be understood from the description relative to the printing of the first overdraft digit "2", that said "4"-registering computing wheel **108** determines, in co-operation with the carriage at the corresponding denomination, an operation of the "4 and 5" type-action by the power-shaft **37** to print the upper-case digit "5" which is the second significant figure of the true overdraft 25 08; and the "4" digit-pin becomes set in the corresponding register-bar **104**.

The ensuing carriage-step brings the carriage to a punctuation space, and therefore the punctuation train from the punctuation jack **289** to the escapement actuating draw-link **272** becomes actuated to space the carriage to the next denomination at which, see Figure 6, the computing wheel **108** stands at the "9" angular position. The "9 and 0" type-action therefore becomes actuated by the power-shaft **37** to print the upper-case "0", which is the third significant figure of the true overdraft 25 08; and the "9" digit-pin becomes set in the corresponding register-bar **104**.

The ensuing step of the carriage brings the latter to the denomination of the last computing wheel **108**, which stands at the "1" angular position, see Figure 6, and it results therefore that the "1 and 8" type-action becomes operated by the power-shaft **37** for printing the upper-case "8", which is the last figure of the true overdraft, 25 08; and the "1" digit-pin becomes set in the last register-bar **104**.

It will be seen now that, although the computing wheels **108** register, by their angular positions, the complement of the true overdraft, the operations of the type-actions, corresponding to said angular positions, result in printing the true overdraft, as in the new balance column of the work-sheet form **499**, Figure 25, by reason of the preparatory case-shift and resultant use of the complementary upper-case digit-types **518**.

The upper-case digit-types **518** and the lower-case digit-types **519** may be respectively formed in different styles. For example, Figure 27, the upper-case digit-types **518**, used for overdraft-totals, are shown formed for printing in backwardly slanting style, and the lower-case digit-types **519**, used for positive totals, are formed for printing in vertical style, whereby, as printed on the work-sheet, an overdraft and a positive total are distinguishable. Thus the amount 25 08, printed in slanting characters in the fourth column of the Figure 25 work-sheet, is recognizable as an overdraft; and the amount 412 20, printed in vertical characters in the fourth column of the work-sheet at Figure 28, is recognizable as a positive total.

Following the printing of the last overdraft-digit "8", the general-operator mechanism in the computing base may be cycled for operating the indexed register-bars **104** to clear the computing wheels **108** of the overdraft-complement by rotating said computing wheels subtractively; it being remembered that the state-controller **166** for the No. 3 register became set to subtractive position consequently to operation of the total-key **200** and the advance of the carriage to the total-printing zone. Furthermore, in the cycling operation which follows the printing of the last overdraft-digit, the feelers **222**, **465** and the interponent-plates **233**, **467** become restored as the rock-shaft **216** becomes rocked back to its normal position and becomes relatched by the arm **214**, and the set digit-pins **103** also become restored during the cycling, as does also the state-controller mechanism controlled by the state-controller **166**; all as hereinbefore explained with reference to the cycle which follows the printing of a positive total.

It may be desired to print the overdraft as a sub-total, that is, without having the overdraft cleared from the computing wheels by the cycle of the machine which follows the printing of the last overdraft-digit. This may be accomplished, like in the case of positive sub-total printing, by pressing the sub-total key **352** preparatory to operating the total-key **200** for printing the overdraft. As hereinbefore described with reference to printing the positive sub-total, the operation of said sub-total key **352** associated with the No. 3 register results in silencing the No. 3 register state-controller **166**, so that the computing-wheel-shifting frame **145** for the No. 3 register remains in neutral position during the cycle, thereby to prevent the indexed register-bars **104** from clearing the computing wheels **108** of the overdraft.

The cycle which follows the printing of the last overdraft-digit may automatically effect restoration of the platen **40** to lower-case position. Therefore, a cam **574**, Figures 3, 4, 9 and 10, on the general-operator cross-shaft **322** works during the cycle against an arm **575** of a lever **576**, fulcrumed on a rock-shaft **577**, journaled

in the typewriter-frame, Figure 3. Said lever 576 is thereby rocked counterclockwise of Figure 9 and works, through another arm 578, against an arm 579 of said rock-shaft 577 to rock the latter, whereby an arm 580 of said rock-shaft 577 works against a pin 581 of the cam-arm 530, as in Figure 10, to displace said cam-arm 530, for releasing the depressed case-shift lever 510, for resulting restoration of said case-shift lever 510 by its spring 582, and restoration, to lower-case positions, of the shift-rail frame 515 and platen-frame 517 by gravity. The cam 574 is formed so that restoration of the train 575—580 will have occurred at the end of the cycle.

By its movement back to lower-case position, said shift-rail frame 515 works, by means of an arm 583 thereon, Figure 9, against a cam-arm 584 of a lever 585, fulcrumed in the typewriter-frame at 586, to rock said lever 585 counterclockwise from the Figures 9 and 11 position to the Figure 6 position, in which an arm 587 of said lever 585 opposes the bail 566 in its restored position, in order to make sure of the restoration of the coupling bar 543 and the attendant reconnection of the "9 and 0" type-action type-bar 39, and its bell-crank 42, to the companion operating lever 44, and to conduce to obviation of any liability of said type-bar 39 and its bell-crank 42 becoming disconnected from said operating lever 44 during lower-case printing. It may be noted that the link 554 is arranged to swing idly, about its pivotal connection 588, Figure 11, to the arm 553, at operation of the "9 and 0" type-action lever 44, and hence said operation does not affect the connected or disconnected states of said type-bar 39 and its lever 44.

In the amount-registering rotations of the computing wheels 108, carry-over devices are employed and may be of the kind set forth in my co-pending application No. 601,173, filed March 25, 1932 (now Patent No. 2,078,274, dated April 27, 1937), and briefly described are as follows:

Each computing wheel 108 which may carry over to or borrow from the computing wheel 108 of next higher denomination has a carry-over tooth 591. In Figure 29, a computing wheel 108 of lower denomination is shown broken away, as at A, to distinguish from the computing wheel 108 of next higher denomination. A carry-over train extending from said computing wheel of lower denomination and operative for determining an extra advance of one step of the register-bar 104 for the computing wheel of next higher denomination includes, Figure 29, a lever 592 on a fixed fulcrum-rod 593, and a stop-rod 594 engageable by said lever 592, as at 595, and extending therefrom to a lever 596 which is on a fixed fulcrum-rod 597 and is pivotedly connected to said stop-rod at 598. A transverse latch-bar 599 is slidedly guided at its ends by the plates 258 which flank the computing-wheel frame 145. Side-plates 600 connect said latch-bar 599 to a cross-rod 602 which is common to the several registers, said cross-rod being supported as at 603 by a pair of slides 604 which are aligned with companion cams 605 spaced along the general-operator cross-shaft 322. At the initial part of the cycle said cams 605 move said slides 604 and therefore move the latch-bar 599, the several stop-rods 594 and the levers 596 from the Figure 29 position to the Figure 34 position. In the Figure 29 or normal position wherein the levers 596 abut a fixed cross-rod 607 the ends 608 of the stop-rods 594 are sufficiently removed from the normally depressed "0" digit-pins 103° to permit the hereinbefore described slight advance of the register-bars 104 at the indexing operations. The described shift of the latch-bar 599, stop-rods 594 and the levers 596 to the Figure 34 positions puts said stop-rod ends 608 into positions, normally reached by the indexed digit-pins 103 at the end of the indexed advance of the register-bars, to prevent the overthrow of the register-bars 104.

It will be remembered that the computing wheels 108 are brought into mesh either with the register-bar racks 143 or the idlers 144 at the initial part of the cycle, for additive or subtractive rotations, at the advance of the indexed register-bars 104 by means of the general-operator cross-bar 141. As a computing wheel 108 of lower denomination, during its additive or subtractive rotation, passes its carrying point its carrying-over tooth 591 rocks the companion lever 592 to raise and thereby release the companion stop-rod 594 from the latch bar 599. The released stop-rod 594, urged by its spring 610, moves leftward and rocks the lever 596 counterclockwise until stopped by the cross-rod 607. An arm 611 of said lever 596 is thereby positioned to work against an arm 612 of a lever 613 associated with the register-bar of next higher denomination fulcrumed on a rod 614 attached to the general-operator cross-bar 141. At the final period of the advance of the general-operator cross-bar 141 said arm 611 thus positioned engages and rocks said lever 613 counterclockwise whereby a finger 615 of said lever 613 working against the depressed digit-pin 103 of said next higher register-bar 104 advances the latter an extra step beyond the advance of the general-operator cross-bar 141. This extra advance of said register-bar 104 effects an extra carrying step of the corresponding computing wheel 108. The extra step may also occur immediately after said final period of advance of the general-operator cross-bar 141 and its levers 613, if the interponent lever 596 has become rocked counterclockwise from the Figure 34 position during or after said final period as, for example, when a carrying step of a computing wheel 108 induces a carrying step of one or more higher wheels. Before the completion of the cycle the cams 605 act to restore the carry-over trains to their normal Figure 29 position.

It will be understood that there is one of the described carry-over trains for each lower denomination computing wheel 108, and the register-bar 104 of the computing wheel of next higher denomination; and that in ordinary positive-amount registering operations an extra carrying advance of the units-denomination register-bar 104 does not occur. However, to prevent overthrow of the units-denomination register-bar 104, there is provided for the latter one of the stop-rods 594 and lever 596, and also one of the digit-pin-engaging levers is provided on the general-operator cross-bar 141.

It will be remembered that when the computing wheels of the No. 3 register are rotated subtractively to overdraft registering positions, the units denomination computing wheel 108 is to be rotated subtractively an extra step so that its angular position will be complementary to the true overdraft digit with reference to the value "9" instead of to the value "10", in order to utilize the numeral type-actions, as hereinbefore explained, for printing the true overdraft. Reg-

istry, in the computing wheels of an overdraft, rotates the computing wheel of highest denomination past its carrying point, it being remembered that an overdraft condition of the computing wheels is manifested by registry of "9" in said computing wheel of highest denomination.

This condition is utilized to determine the extra subtractive step of the units-denomination computing wheel at overdraft registration. Therefore, a carrying tooth **591**, Figure 24, is provided on the computing wheel **108** of highest denomination (tens of millions) of the No. 3 register, and at each rotation of said highest wheel to the "9" angular position consonantly with the registry of an overdraft, said tooth **591** engages and rocks a contiguous arm **616** and thereby rocks another arm **617**, which is contiguous to the stop-rod **594** for the register-bar **104** of units-denomination, to release said stop-rod **594**, from the latch-bar **599**, for resulting movement thereof and its lever **596** to the Figure 24 position. Said lever **596** therefore coacts with the lever **613** for the units denomination register-bar **104** to advance the latter an extra step, and thereby rotate the units-denomination computing wheel **108** an extra step subtractively, it being understood that at this time the computing wheels **108** are meshed with the idlers **144**. For their joint rocking, the arms **616**, **617** may be connected by a yoke **618**; and said arms are shown fulcrumed, along with the carrying levers **592**, on the rod **593**. The released stop-rod **594** and its companion lever **596** for the units-denomination register-bar **104** become restored, by means of the cams **605**, relatively to the latch-bar **599** along with the released stop-rods **594** and their levers **596** for the other denominations. The stop-rods **594** are slidably guided in the slotted guides **395**.

It will be seen now that in the second reading **108**ª, Figure 25, under "New balance", namely 99 999 974 91, the registry of the "1" in the units-denomination resulted in part by reason of the registry of the "9" in the tens of millions denomination. That is, at the subtractive entry of the credit 70 14, Figure 25, in the No. 3 register, in which the positive "Old balance" 45 06 was previously entered, the units-denomination register-bar **104** alone would have rotated the units computing wheel back four steps to the "2" position. But, consonantly with the overdraft condition, the registry of "9" in the highest denomination computing wheel **108** causes an extra step of advance of the units register-bar **104** by means of the described transfer train, thereby bringing the units-denomination wheel **108** to the "1" angular position, which is the complement of the true overdraft digit "8" with reference to the value "9", said "1" position determining, in the total-printing operations, the use of the "1 and 8" numeral-type action to print said true overdraft digit by means of the uppercase type "8".

The overdraft or "New balance" computed in the No. 3 register, as in Figure 23, may be transferred to the No. 2 register in the same manner as was hereinbefore described with reference to the transfer of a positive total to said No. 2 register. That is, such transfer of an overdraft is effected by additive rotation of the No. 2 register computing wheels **108** in the cycle which follows the printing of the overdraft, the register-bars **104** for the No. 2 register having been indexed, along with the register-bars **104** for the No. 3 register, according to the angular positions of the No. 3 register computing wheels, said angular positions being complementary to the true overdraft.

In order to effect a regular algebraic summation or true result in the No. 2 register at the transfer thereto of said overdraft, it is necessary at such transfer to rotate the units-denomination computing wheel of the No. 2 register an extra step additively, in order to recover the "1" which was dropped by the extra subtractive rotation of one step, as above described, in the units-denomination computing wheel of the No. 3 register.

This may be accomplished by virtue of the condition that at the additive transfer to the No. 2 register of the overdraft complement as registered in the No. 3 register, the computing wheel of highest denomination of the No. 2 register will be rotated additively at least nine steps, because "9" will have been indexed in the highest denomination register-bar **104** of the No. 2 register as well as in the highest register-bar of the No. 3 register by operation of the "9 and 0" type-action lever **44** for the total-printing operations. The minimum rotation of nine steps of the highest computing wheel **108** of the No. 2 register will have occurred whenever the transfer of an overdraft complement thereto results in a positive amount, or in a change from a previously registered positive amount to an overdraft condition. If the transfer results in an increase of a previously registered overdraft in the No. 2 register, the highest computing wheel **108** of the latter will be rotated ten steps.

In any case therefore the highest computing wheel **108** of the No. 2 register rotates one step past the "8" position at the transfer of the overdraft complement from the No. 3 register. At such step a carry-over tooth **591**ª of the highest computing wheel **108** of the No. 2 register, Figure 26, rocks an arm **616**ª and a companion arm **617**ª to release a stop-rod **594**ª and a companion lever **596**ª associated with the units-denomination register-bar **104** of the No. 2 register. This determines an extra advance of one step of said units-denomination register-bar **104**, and concomitantly an extra step of additive rotation of the units-denomination computing wheel **108** of the No. 2 register, whose computing wheels **108** at this time mesh with the register-bar racks **143**. Like the similar arms in the No. 3 register, the arms **616**ª and **617**ª of the No. 2 register are connected, for joint rotation, by a yoke **618**ª.

Thus, if the complement, 99 999 974 91, in the No. 3 register, Figure 25, is transferred to the No. 2 register, the result in the latter relative to the positive amount 11 13, already standing in said No. 2 register, will be 99 999 986 05. The "5" in the units-denomination of said result, resulted partly from the indexing of "1" in the units-denomination register-bar **104** of the No. 2 register, and partly from the extra step of said units-denomination register-bar caused by the highest computing wheel, of said No. 2 register, rotating past its "8" position. That is, two steps of additive rotation instead of the indexed one step will have been imparted to the units-denomination computing wheel **108** which previously registered "3" in the No. 2 register. Said result in the No. 2 register, see the last reading **108**ª under "New balance total", Figure 25, indicates an overdraft or complementary condition in view of the registry of "9" in the highest denomination, and the true overdraft is the regular algebraic complement, namely, 13 95 of the signifi-

cant figures 86 05 of said reading. Said 13 95 represents the true amount by which the true overdraft, 25 08 represented by its complement in the No. 3 register, exceeds the positive amount 11 13 previously standing in the No. 2 register.

The total-printing operation of the machine will be understood in detail from the foregoing description and is summarized as follows:

Depression of the total-key **200** releases the carriage **54** from the escapement-pinion **56** and projects the carriage-arresting plate **451** to effective position, in which said plate **451** becomes latched, Figure 5. The resulting carriage-advance is arrested as said plate **451** is encountered by the tappet-block **135** placed on the carriage for the total-printing zone. At the arrest of the carriage, said plate **451** becomes unlatched, Figure 1, and restored, and the carriage takes the usual step as its feed-rack **55** becomes reconnected to the escapement-pinion **56** concomitantly with the restoration of said plate **451**.

Said usual step brings the carriage to the ultra-denomination position, at which the cam-plates **206**, **122** and the subtraction-slide **179** will have become depressed to release the feelers **222**, **465**; select the No. 3 register by moving its couplers **118** into effective position, and concomitantly with drawing the primary latch **170** from the No. 3 register state-controller **166**; and to release the secondary state-controller latch **173** to predetermine subtractive operation of the No. 3 register computing wheels.

If the total is to be transferred to the No. 2 register the total-printing zone tappet-block **135** will have been provided with a tappet **123** for depressing the No. 2 register cam-plate **122**.

At said ultra-denomination position of the carriage, the ultra-denomination wheel **476** effects, in co-operation with the carriage-engaged ultra-denomination train extending from the jack **110a**, a carriage-spacing step by means of the "0" digit-blade **231**, the lever **266**, and the draw-link **272** if the total is positive; or by means of the "9 and 0" type-action lever **44** if the total is an overdraft. In the latter case, said ultra-denomination computing wheel **476** and said ultra-denomination train co-operate, Figure 13, to determine, by means of the overdraft-blade **500**, connection of the case-shift lever **510** to the power-shaft **37** for a resulting shift of the platen **40** to upper case, Figures 9 and 11, and disconnection of the "9 and 0" type-action lever **44** from its type-bar **39**, the operation of said lever **44** for carriage spacing being concurrent with the case-shift. The effected case-shift is maintained because the cam-arm **530** keeps the depressed case-shift lever **510** down.

The carriage-spacing operation of the "9 and 0" type-action lever **44** in the case of an overdraft, also moves the slide **310** and rock-shaft **271** to the right, Figure 3, to render the "0 and 9" type-action draw-link **32**, instead of the carriage-spacing draw-link **272**, selectable by means of the "0"-digit blade **231**.

The carriage having been stepped to the denomination tens of millions, of the highest computing wheel **108**, the latter, if it registers an insignificant "0" as in a positive total, or an insignificant "9" as in an overdraft, determines another step of the carriage, by means, respectively, of the carriage-spacing draw-link **272** or the "9 and 0" type-action lever **44**. Such carriage-spacing operation is repeated at each succeeding denomination, at which the computing wheel **108** registers an insignificant "0", or insignificant "9". Referring to both a positive total and an overdraft, the carriage is also automatically spaced by means of the punctuation-jack train, extending from the punctuation-jack **289** to the draw-link **272**, at each intermediate punctuation-space. The carriage is thus automatically brought to the denomination of the computing wheel which registers the first significant figure of the positive total or the overdraft. The operation of the "9 and 0" type-action lever **44** resulting for each insignificant "9"-denomination sets the "9"-digit pin **103** in the corresponding register-bar **104**. If the total is positive, the operation of the first significant figure-type-action moves the slide **310** and its rock-shaft **271** to the right, for rendering the draw-link **32** for the "0 and 9" type-action selectable. At the first significant figure-denomination and each succeeding denomination, the corresponding computing wheel **108** and the carriage co-operate to determine selection and operation of the type-action corresponding to the angular position of said computing wheel. The type-actions thus actuated at the significant figure-denominations print either by means of the lower-case type **519** or the upper-case type **518**, depending on whether, as was predetermined at the ultra-denomination, the total is positive or an overdraft. Concurrently with the type-action operations for the significant figures, corresponding digit-pins **103** are set in the appropriate register-bars **104**.

Following the printing of the last figure of the total the general operator in the computing base is cycled to restore the feelers **222**, **465**, and the interponent-plates **233**, **467**. The cycle may also subtractively rotate the No. 3 register computing wheels as was predetermined by means of the No. 3 register state-controller **166**, it being understood also that the latter can be silenced by pressing the sub-total key **352** before operation of the total-key **200** in order to print the total without clearing the computing wheels in the following cycle. The general-operator cycle acts to restore the state-controller **166** and the sub-total-key mechanism. The total will be transferred to the No. 2 register computing wheels **108**, if indexing of the register-bars **104** for the No. 2 register was predetermined by reason of the provision of a No. 2 register tappet **123** in the tappet-block **135**. During the cycle, the indexed digit-pins **103** are restored. The cycle which follows the printing of an overdraft, for which, it will be remembered, the platen **40** was shifted to upper-case position, also restores said platen to lower-case position.

The cycle may be initiated automatically by the carriage as it takes its usual letter-feed step following the printing of the last digit of the total.

A cycling-tripping train extends from the cycle-initiating trip-lever **323** which is rocked at said step by the column-step extension **93a**. Said train may be similar to that set shown in my copending application 15,789, filed April 11, 1935, in that it includes a jack **620** having a pin-and-slot connection **621**, Figures 5 and 31, to said trip lever **323**. Said cycle-initiating jack **620** is not engaged by the tappet **111** but, like the denominational jack **110**, normally abuts a rod **112** connected to a bell-crank **113**. At the rocking of said trip-lever **323** said bell-crank **113** of the cycle-tripping train engages an arm **622**, Figure 31, of a rock-shaft **623** to rock the latter and thereby operate a cycle-gaging clutch, not shown,

to connect the general operator to a power-drive, not shown.

When the carriage 54, at operation of the total-key 200 skips a computing zone, as, for example, skips the credit-column zone by moving directly from the debit-column zone to the new balance-column zone, Figure 28, the denomination punctuation and cycle-initiating jack-trains are inoperable by the carriage. This serves to prevent an unnecessary cycle of the general operator as the carriage passes the skip zone, it being understood that said cycle might prevent depression of the cam-plate 206 from being effective, since the parts, such as rock-shaft 216 controlled by said cam-plate 206, are restrained during the cycle and the depression of said cam-plate 206 is momentary, as hereinbefore described, and might occur while such cycle was still in progress.

The jack-train silencing means may be as shown in my co-pending application Serial No. 472,610, filed August 2, 1930, now Patent No. 2,115,870, and, briefly described, are related to the novel total-key mechanism and the tabulator mechanism as follows.

The rod 450 elevated, by operation of the total-key 200, to project the carriage-arresting plate 451, rocks the tabulator universal-bar shaft 94 and thereby rocks counterclockwise a shaft 625, Figure 31, journaled in the housing 124 and having an arm 626 connected by a link 627 to an arm 628 of said universal-bar shaft 94. The guide-plate 389 for the lower ends of the several jacks 110, 110a, 290, 620 has side arms 629 depending from pivots 630 in the housing 124. As said shaft 625 becomes rocked counterclockwise a cam 631 thereof swings the jack-frame 389, 629 forwardly about the pivots 630 to thereby swing the several jacks forwardly to disconnect them from their companion rods 112, thereby to render the several jack-trains inoperative when traversed by the carriage. When the carriage, in its total-key initiated advance, encounters the carriage-arresting plate 451, the latter becomes unlatched, Figure 1, and becomes restored and therefore the rod 450, universal-bar shaft 94, rock-shaft 625 and frame 389, 629 also become restored, and the several jacks are swung back and reconnected to their companion rods 112. Said jacks are free at their upper guides, a slotted bar 619 and companion plate 624 in the housing 124, to swing as described.

Following the typing of a line a power-operable carriage-return mechanism is used to return the carriage, and is represented, Figure 31, as of the type seen in my Patent 1,624,068, dated April 12, 1927. At the carriage-return operation the jack-trains are rendered inoperative, this being accomplished also by means of the jack-frame 389, 629, and the rock-shaft 625, the latter being connected to the carriage-return mechanism as set forth in my said Patent No. 2,115,870.

Said carriage-return mechanism includes, Figure 31, a trip-rod 635 pivotally connected at 636 to a rock-shaft 638. A key-lever 640 is operable to engage and release said rod 635 from a latch at 639 for resulting rearward movement, by a spring 641, to rock said shaft 638 counterclockwise, which by means of linkage 642 rocks another shaft 643, whereby an arm 644 of the latter moves a pinion 645, which is loose on a power-operable shaft 646, rearwardly to engage a clutch-head 647 of said power-shaft 646. Ensuing rotation of the pinion 645 returns the carriage 54 by means of a rack 648. At a predetermined point in its return movement and to end the latter, the carriage engages a dog 649 of a rock-shaft 650 and rocks the latter, which by means of linkage 651 rocks the shaft 643 to disconnect the pinion 645 from the clutch-head 647 and relatch the rod 635. When the shaft 638 is rocked, to initiate a carriage return, it acts by means of an arm 652 and link 653, connected to the link 627, to rock the shaft 625 to disconnect the jacks from their companion rods 112 to render the jack-trains inoperable by the carriage during the carriage-return run. Conversely, as said shaft 638 becomes rocked back for ending the carriage run, the shaft 625 is also caused to be rocked back for reconnecting the jacks to their companion rods 112. Pin-and-slot connections 654 permit independent operations of the jack-train silencing rock-shaft 625 by means of the tabulator universal-bar shaft 94 or the carriage-return-mechanism rock-shaft 638, said rock-shaft 625 being restorable by a spring 655. 656, Figure 31, represents an interlocking device for preventing simultaneous operations of the carriage-return and tabulating mechanisms.

While the carriage is released and advancing, as a result of operating the total-key 200 or tabulator-key 89, the concomitantly rocked tabulator-universal-bar shaft 94 will have moved a lock-rod 657, Figures 3, 31, rearwardly so that lip 658 thereof enters and closes the series of locks 86, 489, thereby to lock the numeral-type actions, the carriage-spacing mechanism and the case-shift mechanism against operation by means of their respective draw-links 32, 272, 502. Therefore, as said universal-bar shaft 94 is rocked, an arm 659 thereof moves a cam-rod 660 downwardly, so that a cam 661 of the latter rocks a lever 662 pivoted to a bracket 663, on the typewriter-frame, which also guides said cam-rod 660 at 664. Said lever 662 engages a shoulder 665 of the lock-rod 657 to move the latter rearwardly. Conversely, while one of said draw-links 32, 272, 502 is entered in the series of locks 86, 489, the rod 657 is locked against rearward movement, thereby locking the universal-bar shaft 94 and hence the total-key 200 and the tabulator-key 89 against operation. At retraction of the cam-rod 660, a spring 666 restores the lock-rod.

By its forward movement to permit the feelers 222, 465 to engage their respective wheels 108, 476 and to release the interponent-plates 233, 467, the feeler-control frame 220 works against a cam-arm 668 of a lock-bar 669 slidably supported, as at 670, Figure 30, by the cross-bar 71 which guides the numeral-key stems 31. Said lock-bar 669 thereby becomes displaced leftward from its normal, Figure 30, position, whereby openings 671 which are normally under lower ends 672 of the numeral-key stems 31 and under a pendant 673 of the space-key arm 378 are displaced so that said lock-bar 669 becomes opposed to depression of said numeral-key stems 31 and space-key 376. Conversely, when the space-key 376 or one of numeral-key stems 31 is depressed, the pendant 673 or key-stem end 672, by entry in the companion opening 671 of the lock-bar 669, opposes displacement of the latter and thereby prevents release of the feeler-frame 220 during the operation of said keys 376, 31. At the restoration of the frame 220 a spring 675 restores the lock-bar 669. 676 is a stiffening flange of the lock-bar 669.

Simultaneous operation of the carriage-return

mechanism, or of the usual back-spacing mechanism, represented by the back-space key-lever 677, and of the total-printing mechanism is also opposed. Therefore the rod 635, when lifted and moved rearwardly from the normal, Figures 30, 31 position for a carriage-return operation, will have worked through a link 678 and a bell-crank 679, articulated at 680 to a key-locking slide 681, to move the latter rightwardly from the Figure 30 position, so that an end-portion 681a of said slide 681 confronts a block 682 on the feeler-controlling frame 220, to thereby prevent movement of the feelers 222, 465 and interponent-plates 233, 467 to effective positions. Said locking slide 681 will have been similarly moved by depression of the back-space key-lever 677, a tongue 683 of the latter having worked against a nose 685 of the bell-crank 679, the latter being rockable independently of the rod 635 because of a pin-and-slot connection 686 to the latter. Said bell-crank 679 turns on a stud 687 on the cross-bar 77, and the latter also slidably supports the locking slide 681 as at 688, Figure 30. Springs 689, 690 co-operate to restore the locking slide 681 after the carriage-return or back-spacing operation. When the feeler-controlling frame 220 is in its forward position its block 682 confronts the end-portion of the locking slide 681 to thereby prevent operation of the carriage-return mechanism or of the back-space mechanism during the total-printing operations.

The locking slide 681 may also lock the space-key 376 and the numeral-key stems 31 and is therefore provided with shoulders or tongues 691 which become positioned under the arms 74, 74a of the draw-links 32, 272, when said slide 681 is displaced rightwardly at the back-spacing or carriage-return operation, said shoulders or tongues in the normal position of said slide, Figure 30, being to one side and clear of said arms 74, 74a.

In order that the draw-links 32, 272, 502 may be regulated individually in their disengagement from the power-shaft 37, the abutment-bar 283, Figures 2, 3 and 15, is provided with individually adjustable abutment-screws 693 against which the cam-edges 284 of said draw-links react to effect said disengagement. A detent-spring 694 may be attached to the abutment-bar as at 692, and engages the heads of said screws 693 laterally, as in Figure 15, to maintain their adjusted positions. The abutment-bar 283, with its said abutment-screws 693 and detent-spring 694, is also adjustable bodily up and down, and for this purpose is provided with adjustable screw-jack devices 695, Figures 2 and 3, retained in arms 696 presented by the angle member 80, and including nuts 697 adjustable to regulate abutment-bar 283.

Variations may be resorted to within the scope of the invention, and portions of the improvements may be used without others.

Having thus described my invention, I claim:

1. In a combined typewriting and computing machine, the combination of a series of computing wheels; complemental digit printing instrumentalities and a letter-feeding carriage, for printing an amount or its complement digit by digit; and means, including mechanism operable under the control of said computing wheels and mechanism operable under control of said carriage, to select and actuate said printing instrumentalities and thereby automatically print, digit by digit, an amount standing in said computing wheels, or the complement of said amount, said means also including a device differentially co-operative with one of said wheels, according to certain angular positions thereof, to determine the selection and actuation of said printing instrumentalities to automatically print digits in representation of the angular positions of said computing wheels or to automatically print digits in representation of the complements of said angular positions.

2. In a combined typewriting and computing machine, the combination of a series of computing wheels; complemental digit printing instrumentalities and a letter-feeding carriage, for printing an amount or its complement digit by digit; and means, including mechanism operable under the control of said computing wheels and mechanism operable under control of said carriage, to select and actuate said printing instrumentalities and thereby automatically print, digit by digit, an amount standing in said computing wheels, or the complement of said amount, said means including a device differentially operative in accord with a positive or negative amount in said wheels, to determine the selection and actuation of said printing instrumentalities to automatically print digits in representation of the angular positions of said wheels when the amount is positive, or to automatically print digits in representation of the complements of said angular positions when said amount is negative.

3. In a combined typewriting and computing machine, the combination of a series of denominational computing wheels, means, including carry-over devices, for rotating said wheels additively or subtractively, said means including provision whereby, when said wheels register an overdraft, the angular position of each of said wheels, including the wheel of units denominations, represents the complement, with reference to the value "9", of the overdraft, two sets of digit-types, a set of type-actuators common to said two sets of digit-types in that each type-actuator may print by means of a certain digit-type of one set or the complementary digit-type of the other set, a latter-feed carriage co-operative with said type-actuators, means, including mechanism operative under the control of said computing wheels and mechanism operative under control of said carriage, to select and operate the type-actuators in accordance with the angular positions of said computing wheels, and means serving under the control of one of said wheels to determine that the type-actuators, when thus operated, print by means of the appropriate set of types in accordance with a positive amount or an overdraft as indicated by said wheels.

4. The invention as set forth in claim 3, said last-mentioned means being arranged so as to operate automatically under control of the carriage.

5. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of printing bars and a co-operative letter-feeding carriage for printing an amount digit by digit, means, including mechanism operable under control of said wheels and mechanism operable under control of said carriage, to select and actuate said printing bars in accordance with digit-representing angular positions of said computing wheels to print the registered amount which may be of either positive or overdraft character, an overdraft being indicated by angular positions which represent the

complement of the overdraft, each printing bar having associated therewith two digit-types, each complementary to the other, the digit-types of the several printing bars constituting two complementary sets of digit-types, and means automatically operative, to determine use of one or the other set of digit-types at the operation of said printing bars, in accordance with the registered amount being of positive or of overdraft character.

6. The invention as set forth in claim 5, inclusive of provision whereby the printing effected by one set of digit-types is distinguishable from the printing effected by the other set of digit-types thereby to distinguish between printed positive and overdraft amounts.

7. In a combined typewriting and computing machine, the combination of key-controlled digit-printing bars and a co-operative letter-feeding carriage, a set of computing wheels, each printing bar having associated therewith two digit-types, each complementary of the other, the digit-types associated with the several printing bars constituting two complementary sets of digit-types, type-set selecting means normally conditioned so that consonantly with the printing and the accumulation of an amount, one of said two sets of digit-types is used, means including mechanism operative under control of said computing wheels and mechanism operative under control of said carriage, to cause the printing bars corresponding to the total-representing angular positions of said computing wheels to be automatically operated, and means operable, when said angular positions represent an overdraft, to condition said type-set selecting means for use of the other set of digit-types at the automatic operation of the printing bars, said type-set selecting means remaining normally conditioned, at the automatic operation of the printing bars, when said angular positions represent a positive total.

8. In a combined typewriting and computing machine, the combination of a set of denominational computing wheels, a set of digit-type-actions and a co-operative letter-feeding carriage, two sets of digit-types associated with said set of type-actions whereby each type-action may print one or the other of two digits which are complementary to each other with reference to a certain value, means, including mechanism operative under control of said computing wheels and mechanism operative under control of said carriage, to select and actuate seriatim the type-actions corresponding to a total as registered, by the angular positions of said computing wheels, and means operable to determine that the type-actions print by means of one or the other of said sets of digit-types, depending on whether the angular positions of said computing wheels indicate a positive or a negative total, a negative total being registered by angular positions having values corresponding to complements of the true negative total.

9. In a combined typewriting and computing machine, the combination of a set of denominational computing wheels, a set of digit type-actions and a co-operative letter-feeding carriage, two sets of digit-types associated with said set of type-actions whereby each type-action may print one or the other of two digits which are complementary to each other with reference to a certain value, means, including mechanism operative under control of said computing wheels and mechanism operative under control of said carriage, to select and actuate seriatim the type-actions corresponding to a total as registered by the angular positions of said computing wheels, and means operable to determine that the type-actions print by means of one or the other of said sets of digit-types, depending on whether the angular positions of said computing wheels indicate a positive or a negative total, a negative total being registered by angular positions having values corresponding to complements of the true negative total, said last-mentioned means including devices operative to detect whether a total is positive or negative and to therefrom determine printing by means of the appropriate set of types.

10. In a combined typewriting and computing machine, the combination of complementary sets of digit-types, a set of type-operators common to said sets of digit-types, a letter-feeding carriage, digit-keys, a power-shaft, connecting means, conditionable by operation of any digit-key, to connect a corresponding one of said type-operators to said power-shaft and thereby cause said type-operator to print, and the carriage to be letter-spaced, computing wheels, means including mechanism co-operative with said computing wheels to collectively select the type-operators corresponding to a total registered in said computing wheels, and also including mechanism operative under control of the carriage at a total-printing zone, to bring said connecting means into condition to connect the selected type-operators, one by one, to said power-shaft in denominational order to print automatically said total, said connecting means serving, either under control of said digit-keys, or under total-printing control of said computing wheels and carriage, for connecting said type-operators to said power-shaft, and means whereby the automatically actuated type-operators print by means of one or the other of said sets of complementary digit-types, depending on whether said total is of positive or overdraft character.

11. A combined typewriting and computing machine having a system of digit-type-actions and a co-operative letter-feeding carriage, each type-action having associated therewith two complementary digit-types, a power-shaft, each type-action including a connector movable to connect said type-action to said power-shaft for a printing stroke, said connector becoming disconnected from the power-shaft for recoil of the type-action, register-mechanism, including a set of computing wheels wherein amounts printed by said type-actions are registered, and total-printing mechanism whereby, according to the angular position of each computing wheel, the connector of a corresponding digit-type-action is selected for connection to said power-shaft, said total-printing mechanism including devices acting under control of said computing wheels to effect connector-selection for all of the computing wheels simultaneously, and also including devices acting under control of said carriage to move the selected connectors in denominational order into engagement with said power-shaft, and means operable to determine that said type-actions print by means of one or the other of their respective two complementary digit-types, depending on whether the total, as registered in said computing wheels, is of positive or overdraft character.

12. In a combined typewriting and computing machine, the combination of a set of digit-type-actions, each type-action being operative to print

one or the other of two complementary digits, a set of computing wheels, a set of computing wheel reading devices movable to engage the computing wheels in different digit-reading positions, a series of transverse digit-blades, one for each type action, each computing wheel reading device having associated therewith a selector which, at each digit-reading position registers with the corresponding one of said digit-blades for determining selection of a corresponding digit-type-action, a power-shaft, means acting through said selectors seriatim and through said digit-blades to connect said digit-type-actions to said power-shaft to print the total registered in said computing wheels, and means operable to determine that said type-actions print one or the other of their respective two complementary digits depending on whether the total, as registered in said computing wheels, is of positive or overdraft character.

13. A computing machine having, in combination, a set of digit-type-actions, a letter-feeding carriage, each type-action having associated therewith two complementary digit-types, a set of computing wheels, mechanism operable for selectively actuating said type-actions by power, means conditionable to effect selection of said type-actions according to the total-registering angular positions of said computing wheels, means conditionable to co-operate with the carriage at a total-printing zone to effect, in denominational order, the actuation of the selected type-actions by means of said type-actuating mechanism, means operable to determine that the actuated type-actions print by means of one or the other of their respective two complementary digit-types depending on whether the total, as registered by said angular positions, is of positive or overdraft character, and a tappet on said carriage acting, by the advance of the carriage to a total-printing zone, for conditioning said conditionable means preparatory to total printing.

14. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable digit printing devices corresponding to the digit-representing angular positions of said computing wheels, each printing device including two complementary digit types, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, and means, including mechanism under control of said wheels and mechanism under control of said carriage, to effect selection and operation of said printing devices according to the angular positions of said computing wheels, whereby to print digits corresponding to said angular positions or the complements of said digits, said means including a device controlled by one of said wheels for predetermining the printing either of said digits or of said complements.

15. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable digit printing devices corresponding to the digit-representing angular positions of said computing wheels, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, each printing device having associated therewith two complementary digit-types, means, including mechanism under control of said wheels and mechanism under control of said carriage, to effect selection and operation of said printing devices according to the angular positions of said computing wheels, and means co-operating with one of said wheels to determine that said printing devices print by means of one or the other of their respective two complementary digit-types, thereby to print the digits corresponding to said angular positions or the complements of said digits.

16. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable digit printing devices corresponding to the digit-representing angular positions of said computing wheels, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, each printing device having associated therewith upper and lower case digit-types, each the complement of the other, means, including mechanism acting under control of said wheels and mechanism acting under control of said carriage, to effect selection and operation of said printing devices, and a case-shifting mechanism controlled by one of said wheels, whereby at the selective operation of said printing devices according to the angular positions of said computing wheels, the digits corresponding to said angular positions or the complements of said digits may be printed.

17. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable printing devices corresponding to the digit-representing angular positions of said computing wheels, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, each printing device having associated therewith upper and lower case digit-types, each the complement of the other, means, including mechanism acting under control of said wheels and mechanism acting under control of said carriage, to effect selection and operation of said printing devices, a case-shifting mechanism, whereby at the selective operation of said printing devices according to the angular positions of said computing wheels, the digits corresponding to said angular positions or the complements of said digits may be printed, and means acting under control of one of said computing wheels and carriage to control said case-shift mechanism to automatically determine the printing either of said digits or of said complements.

18. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable printing devices corresponding to the digit-representing angular positions of said computing wheels, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, each printing device having associated therewith upper and lower case digit-types, each the complement of the other, means, including mechanism acting under control of said computing wheels and mechanism acting under control of said carriage, to effect selection and operation of said printing devices, a case-shifting mechanism, whereby at the selective operation of said printing devices according to the angular positions of said computing wheels, the digits corresponding to said angular positions or the complements of said digits may be printed, and means acting to control and actuate said case-shift mechanism to automatically determine the printing either of said digits or of said complements, said means including a power-operable driver, and also including a connection controlled by one of said wheels and carriage to connect said case-shift mechanism to said driver for automatic

operation to cause said printing devices to print by means of the upper case digit-types when said computing wheels register an overdraft.

19. In a combined typewriting and computing machine, the combination of a set of computing wheels, a set of selectively operable printing devices corresponding to the digit-representing angular positions of said computing wheels, a letter-feeding carriage co-operative with said printing devices for printing an amount digit by digit, each printing device having assosciated therewith upper and lower case digit-types, each the complement of the other, a case-shift mechanism operable by power, and means controlled in part by one of said computing wheels, when said wheels register an overdraft, and in part by the carriage, at a total-printing zone, to cause the actuation of said case-shift mechanism by power, whereby at selective operation of the printing devices at said zone according to the angular positions of said computing wheels, said printing devices print by means of the case of digit-types appropriate to said overdraft.

20. In a combined typewriting and computing machine, the combination of a series of denominational computing wheels, digit-types and a co-operative letter-feeding carriage, means, including mechanism operative under the control of said computing wheels and mechanism operative under control of said said carriage, to automatically select and actuate seriatim the digit-types corresponding to a total as registered by the angular positions of the computing wheels, said carriage being initially positioned at the denomination of the highest one of said set of computing wheels preparatory to the seriatim actuation of the selected digit-types, and means whereby the carriage is automatically spaced, without printing, from said initial position to the first significant figure denomination when the number of denominations in the registered amount is less than the number of computing wheels, said last-mentioned means including devices, namely, one device responsive to a "0" angular position, and another device responsive to a "9" angular position, of one or more computing wheels ahead of the first significant figure denomination to determine such automatic spacing of the carriage without printing, said "9" position obtaining for a negative amount in said wheels and said "0" position obtainining for a positive amount in said wheels.

21. The invention as set forth in claim 20, inclusive of means operative so that the angular registry of "0" or "9" in any computing wheel after the first significant figure denomination causes the actuation of a corresponding digit-type.

22. In a total-printing mechanism, the combination of a set of denominational computing wheels, a set of digit-types and individual operators therefor, a carriage and letter-feed mechanism therefor co-operative with said digit-types and operators, a power-operable driver for said type-operators, means operative under control of said computing wheels to select the type-operators which correspond to the total-registering angular positions of the computing wheels, means operative under control of the carriage to operate the selected type-operators seriatim by means of said driver beginning with the type-operator selected for the computing wheel of highest denomination, and means rendered effective, when said highest wheel and any succeeding wheels register a non-significant figure, to disable the type of the corresponding type-operator, selected by means of said highest and succeeding wheels, whereby said type-operator is ineffective, when operated by said driver under control of said carriage, to print said non-significant figure, said non-significant figure type-operator, when operated without printing, co-operating with said letter-feed mechanism to space said carriage, whereby to automatically space said carriage to the denomination of the wheel which registers the first significant figure.

23. In a total-printing mechanism, the combination of a set of denominational computing wheels, a set of digit-types and individual operators therefor, a carriage and letter-feed mechanism therefor co-operative with said digit-types and operators, a power-operable driver for said type-operators, means operative under control of said computing wheels to select the type-operators which correspond to the total-registering angular positions of the computing wheels, means operative under control of the carriage to operate the selected type-operators seriatim by means of said driver beginning with the type-operator selected for the computing wheel of highest denomination, means rendered effective, when said highest wheel and any succeeding wheels register a non-significant figure, to disable the type of the corresponding type-operator, selected by means of said highest and succeeding wheels, whereby said type-operator is ineffective, when operated by said driver under control of said carriage, to print said non-significant figure, said non-significant figure type-operator, when operated without printing, co-operating with said letter-feed mechanism to space said carriage, whereby to automatically space said carriage to the denomination of the wheel which registers the first significant figure, and means acting in response to the printing of said first significant figure to restore said disabled type to determine that subsequent operation of said type-operator shall be effective to print.

24. In a total-printing mechanism, the combination of a set of denominational computing wheels, a set of digit-types and individual operators therefor, a carriage and letter-feed mechanism therefor co-operative with said digit-types and operators, a power-operable driver for said type-operators, means operative under control of said computing wheels to select the type-operators which correspond to the total-registering angular positions of the computing wheels, means operative under control of the carriage to operate the selected type-operators seriatim by means of said driver beginning with the type-operator selected for the computing wheel of highest denomination, and means rendered effective, when said highest wheel and any succeeding wheels register a non-significant figure, to cause the corresponding type-operator, selected by means of said highest and succeeding wheels, to be disconnected from its type when operated by said driver under control of said carriage, said non-significant-figure type-operator, without its type, coacting with said letter-feed mechanism to space said carriage, whereby to automatically space said carriage, without printing, to the denomination of the wheel which registers the first significant figure.

25. In a total-printing mechanism, the combination of a set of denominational computing wheels, a set of digit-types and individual operators therefor, a carriage and letter-feed mechanism therefor co-operative with said digit-types

and operators, a power-operable driver for said type-operators, means operative under control of said computing wheels to select the type-operators which correspond to the total-registering angular positions of the computing wheels, means operative under control of the carriage to operate the selected type-operators seriatim by means of said driver beginning with the type-operator selected for the computing wheel of highest denomination, one of said type-operators corresponding to a computing wheel angular position, which may be of non-significant value depending on whether the computing wheel which selects said one type-operator is of higher denomination than the wheel which registers the first significant figure of an amount, means conditionable to couple and uncouple said one type-operator and its type, and means whereby, when said highest wheel and any succeeding wheels register a non-significant figure and said one type-operator is consonantly selected and operated, said coupling means will be conditioned to uncouple said one type-operator and its type, said one type-operator, without its type, co-operating with said letter-feed mechanism to space said carriage, whereby to automatically space said carriage to the denomination of the wheel which registers the first significant figure.

26. A combined typewriting and computing machine having digit-type-actions, a carriage and carriage-feed mechanism coacting with said digit-type-actions, a power-shaft, connectors individually operable for connecting any type-action, or the carriage-feed mechanism alone, to said power-shaft, a set of denominational computing wheels, means controlled by said computing wheels to select said connectors according to the total-registering angular positions of said computing wheels, said means including a "0" control-device whereby any computing wheel registering "0" may effect selection, when the total is positive, either of the connector for the "0" type-action or the connector for the carriage-feed mechanism, depending on whether said wheel is of lower or higher denomination than the first significant figure of said positive total, means controlled by said carriage for operating in denominational order, the connectors as selected by said computing-wheel-controlled means, thereby to print said positive total, means whereby when said computing wheels register a negative total, manifested by the registry of "9" in one or more wheels ahead of the first significant-figure registering wheel, the operation of the "9" type-action consonantly with any wheel registering "9" is effected with or without printing, depending on whether said wheel is of lower or higher denomination than said first significant figure-registering wheel, and means whereby consonantly with the first operation of the "9" type-action without printing, said "0" control-device acts to cause selection of the "0" type-action connector by any "0" registering wheel after the wheel which determines said first "9" type-action operation.

27. In a combined typewriting and computing machine, the combination of a series of computing wheels, digit-types and a co-operative letter-feeding carriage, said carriage being releasable from an escapement-mechanism for an ensuing tabulating-advance, a total-key, means conditionable by a momentary depression of said total-key to release said carriage and arrest its ensuing advance at a total-printing zone, a latch-device acting to sustain said means in operated condition independently of said total-key, said latch-device being automatically tripped for restoration of said means concomitantly with the arrest of the carriage at said zone, and means, rendered operative by said carriage at said zone through said conditioned means, before the latter is restored, and including mechanism under the control of said computing wheels and mechanism under control of said carriage, to select and actuate digit-types corresponding to the total standing in said wheels.

28. A combined typewriting and computing machine having, in combination, a set of computing wheels, devices for reading the total-representing angular positions of said wheels and including a device for determining whether said angular positions represent a positive total or an overdraft, a series of pairs of complementary digit-types, namely, 0 and 9, 1 and 8, . . . 8 and 1, 9 and 0, a letter-feeding carriage co-operative with said pairs of digit-types, means co-operative with said reading devices according to said angular positions of said wheels, to select said digit-types by pairs and to determine, according to whether the total is a positive or an ovedraft, which complement of the selected pairs is to be used, and means for causing the digit-types thus selected for use to be automatically operated to print the positive total or overdraft digit by digit, said carriage co-operating to letter-space the automatically printed digits.

29. A combined typewriting and computing machine having, in combination, a set of denominational computing wheels, a set of total-reading devices, one for each wheel for reading its angular position, another reading device, associated with the wheel of highest denomination, operative to ascertain whether or not said highest wheel is at a certain angular position, two complementary sets of digit-types selectable by pairs, each pair including one digit-type from one set and a complementary digit-type from the other set, said pairs being selectable by means of said total-reading devices, a letter-feeding carriage co-operative with said digit-types, means controlled by the said other reading device which is associated with the highest denomination computing wheel, to determine which set of selected digit-types is to be used, and means for causing the digit-types thus selected for use to be automatically operated to print digit by digit, said carriage co-operating to letter-space the automatically printed digits.

30. The combination of a set of denominational computing wheels, an ultra-denomination wheel permanently united with the highest denomination computing wheel for rotation therewith, a set of digit-types and cooperative letter-feeding carriage, a device operable for letter-feeding the carriage without printing, a total-key operable to tabulate said carriage to an ultra-denomination position from which the carriage may proceed to the denomination of the highest computing wheel, means operated by means of said carriage at said ultra-denomination position to register a selection of the digit-types corresponding to the angular positions of said computing wheels, means operative under control of said ultra-denomination wheel and carriage to operate said carriage-feeding device to bring said carriage from said ultra-denomination to the highest computing wheel denomination, and means whereby the carriage at said highest computing wheel denomination causes either a printing operation of the digit-type selected for said highest computing wheel denomination or reop-

eration of said means, that operated under control of said ultra-denomination wheel, to reoperate said carriage-feeding device without printing, depending on whether or not said highest wheel registers a significant figure, the carriage, in either case, becoming stepped to the next denomination, said carriage being similarly stepped, without printing, as recited, from said next denomination and from each succeeding denomination if said next denomination and each succeeding denomination register a non-significant figure.

31. The combination of a set of digit type-actions, a letter-feeding carriage co-operating therewith, two complementary sets of digit-types associated with said type-actions, a case-shift action for said sets of digit-types, power-mechanism for actuating said type-actions and case-shift action selectively, a set of computing-wheels, selectors differentially positionable under control of said wheels to select, for coaction with said power-mechanism, the type-actions corresponding to the total-registering angular positions of said wheels, a type-set selector differentially positionable under control of one of said wheels to predetermine non-operation or operation of said case-shift action by said power-mechanism, said selectors being operable to effect operation of said case-shift action and type-actions by said power-mechanism, elements shiftable from an idle position for operatively connecting said type-action selectors and the type-set selector to said carriage to enable said carriage to operate said selectors, a cycling mechanism, means acting automatically to effect an operation of said cycling mechanism after the type actions have been operated, and means operable by said cycling mechanism to restore said elements, including the element associated with said type-set selector, to idle position.

32. A combined typewriting and computing machine having, in combination, a set of type-carriers and a letter-feed carriage co-operative therewith, each type-carrier having associated therewith two digit-types that are complementary, relative to the base "9", thereby forming two complementary sets of digit-types, a series of computing-wheels of successive denominations including a units-denomination, for additively or subtractively accumulating amounts, means acting, when said wheels register overdraft positions, characterized by angular position registry of the complement of the true overdraft in said wheels, to impart an extra step of movement to the wheel of units-denomination, whereby the units-wheel angularly registers a digit that is, like in the other wheels, the complement, relative to the base "9", of the true-overdraft units-denomination-digit, mechanism operative under control of said computing-wheels for effecting a selection of type carriers according to a total standing in said wheels, mechanism controlled by said carriage to actuate the selected type-carriers to print the total, and means acting automatically to determine that the type-carriers print by means of one or the other set of types depending on whether the wheels register a positive total or an overdraft total.

33. A combined typewriting and computing machine of the class described having, in combination, a set of computing wheels, digit-types, a power-operable driver for said digit-types, connectors operable by said digit-keys to selectively connect said digit-types to said drivers, said connectors being arranged so as to be operable, independently of said keys, to connect said types to said driver, means conditionable for operation, and including mechanism under the control of said computing wheels and mechanism under control of said carriage, to select and operate said connectors independently of said digit-keys, whereby to operate said digit-types automatically to print the total in said wheels, and a locking device automatically becoming effective, when said means are conditioned, to lock said digit-keys against operation during the progress of such total printing, said locking device acting only on said keys so as to leave said connectors independently operable as aforesaid.

34. The invention as set forth in claim 33, said locking device being arranged so as to co-operate with said digit-keys to act during operation of any one of said digit-keys to lock said means against becoming conditioned for total printing.

35. A combined typewriting and computing machine having, in combination, a set of computing wheels, digit-printing type-bars and a letter-feeding carriage cooperative therewith, a total-key, means rendered effective, by operation of said total-key, to cause said type-bars to automatically print a total, digit by digit, in one or the other of two ways, that is, according to the digit-representing angular positions of said computing wheels or according to a complement of said angular positions, said type-bars having complemental digit types associated therewith so as to be operative to print said total either way, and means acting automatically to predetermine which way said total is printed.

36. A combined typewriting and computing machine having, in combination, a set of computing wheels, digit-printing type bars and a letter-feeding carriage cooperative therewith, a total-key, means rendered effective by operation of said total-key, to cause said type-bars to automatically print a total in one or the other of two ways, that is, according to the digit-representing angular positions of said computing wheels or according to a complement of said angular positions, said type-bars having complemental digit types associated therewith so as to be operative to print said total either way, and means operable under the control of one of said computing wheels to automatically predetermine which way said total is printed.

37. In a total-printing mechanism of the character described, the combination of a computing wheel, a type-train, a co-operative letter-feeding mechanism, said type-train including an operating lever connectable, depending on a certain angular position of said wheel, to a power-operable driver and disconnectable from the latter before the end of the printing stroke, the latter being completed by the momentum of said type-train, said type-train including a type-carrier to print in representation of said angular position, said type-carrier being disconnectable from said operating lever, depending on another angular position of said wheel, preparatory to an operation of said lever by said driver without printing, means whereby said operating lever actuates said letter-feeding mechanism, and a fly-weight connected to said operating lever, so that the latter has sufficient momentum when operated while disconnected from said type-carrier.

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