A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135. Patented June 13, 1911.

11 SHEETS—SHEET 1.

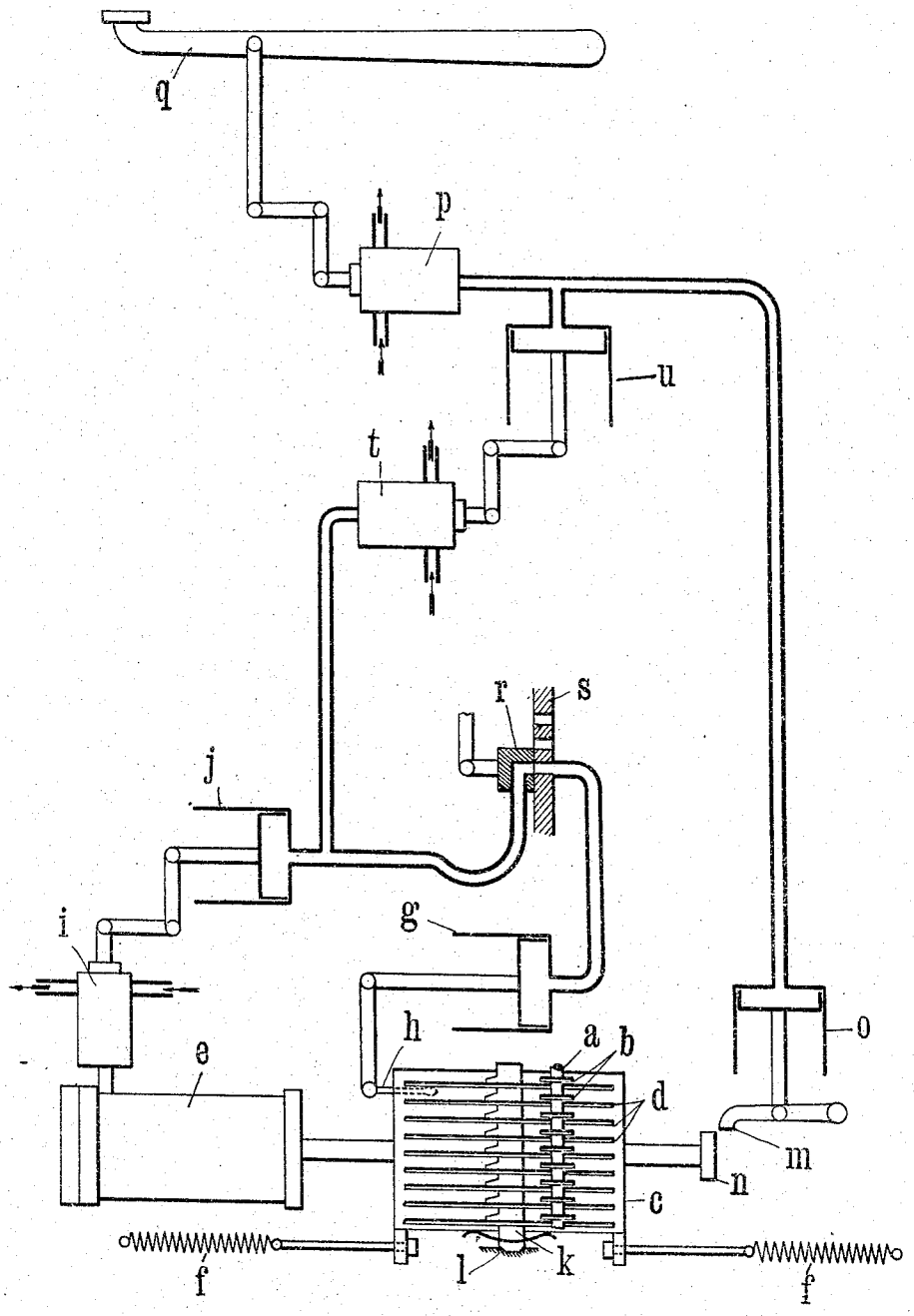


Fig. 1

Attest.
Bent. M. Stahl
Edward A. Sexton

Inventor
Arthur William Harris
by Spear, Middleton, Donaldson & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 2.

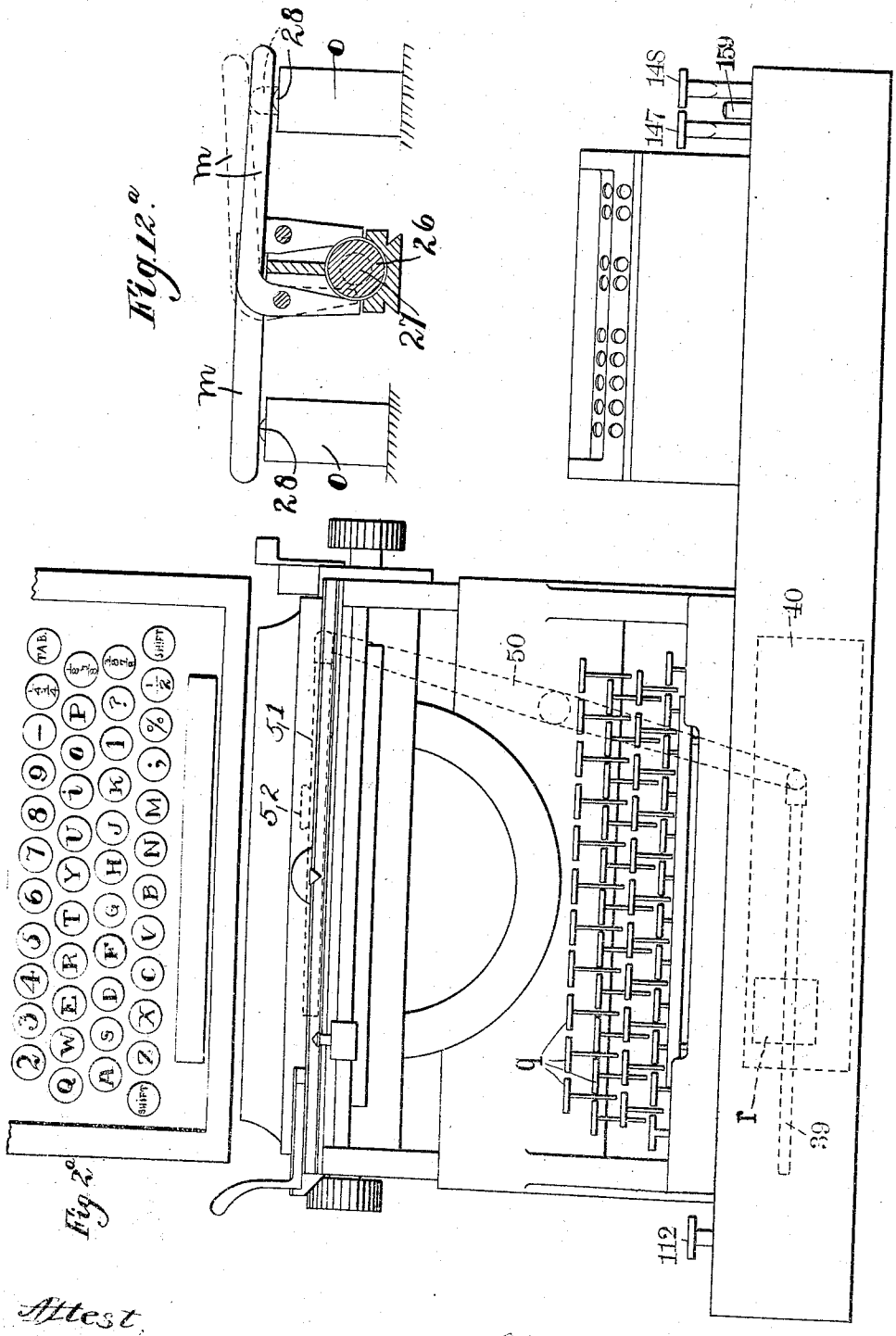


Fig.2

Fig.2ª

Fig.12ª

Attest,
Bentley Stahl,
Edward N. Santee

Inventor,
Arthur William Harris
by Spear, Middleton, Douglass & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 3.

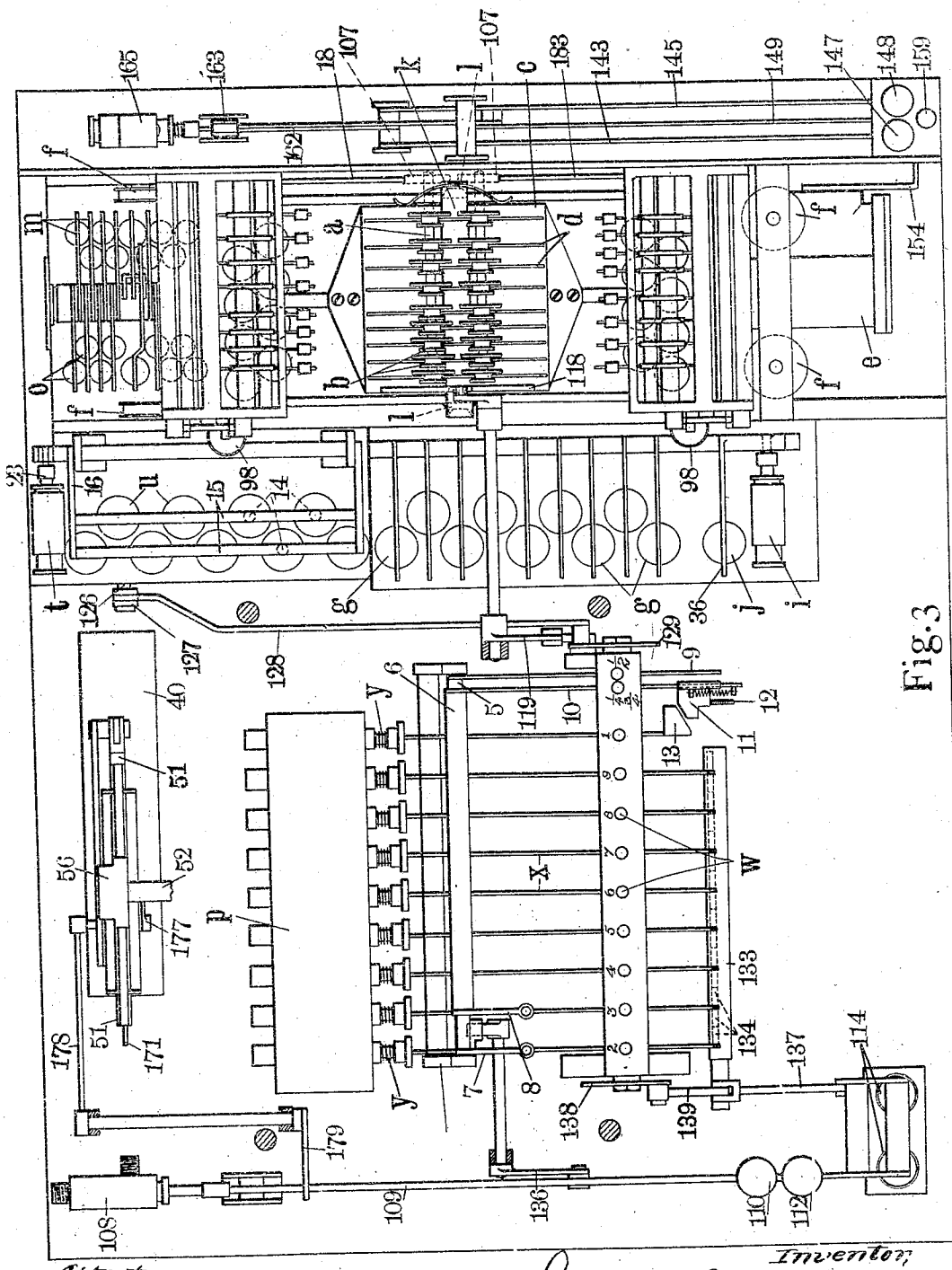


Fig. 3

Witnesses:
Bentley Stahl.
Edward N. Slaton

Inventor:
Arthur William Harris
by Spear, Middleton, Donnelan & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 4.

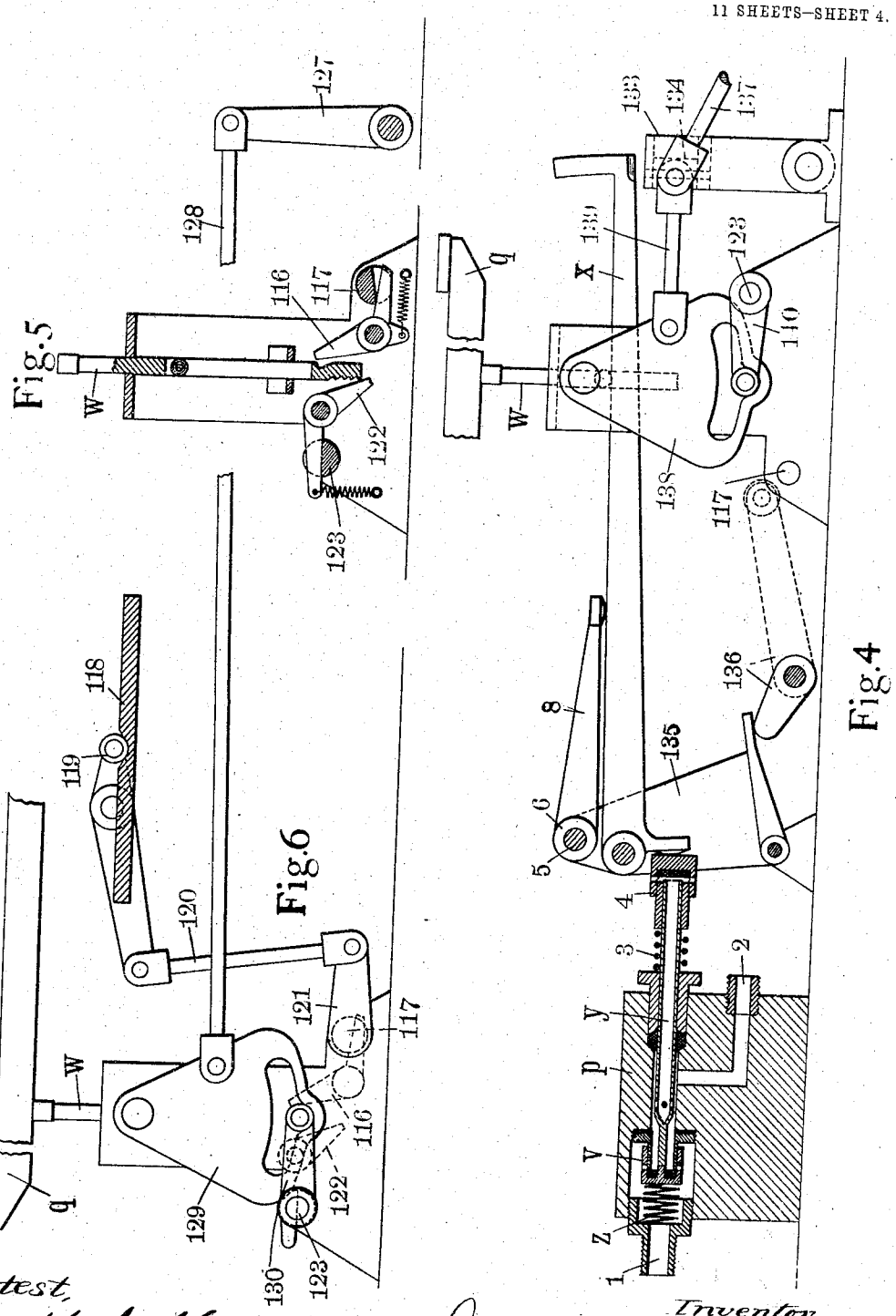


Fig.5

Fig.6

Fig.4

Attest,
Bent. W. Hall.
Edward N. Santos

Inventor
Arthur William Harris,
By Spear, Middleton, Donnelly & Spear
Attys

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135. Patented June 13, 1911.

11 SHEETS—SHEET 5.

Fig. 7

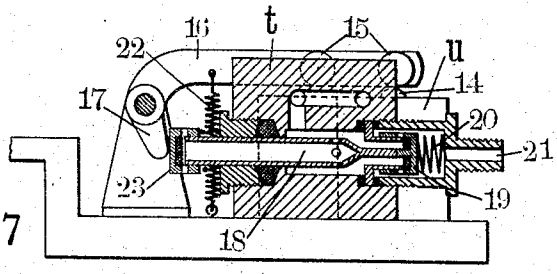
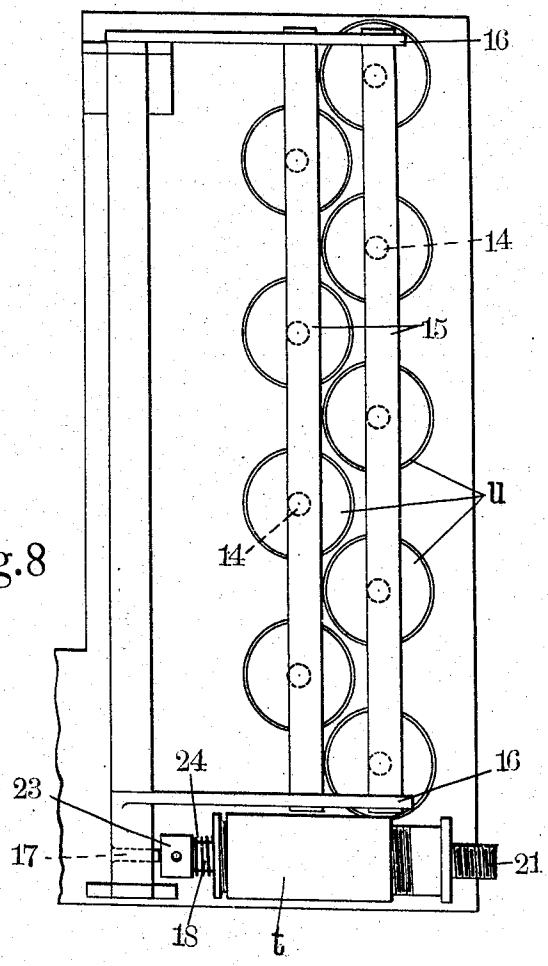


Fig. 8



Attest.
Benth, Stahl,
Edward N. Santee

Inventor:
Arthur William Harris
by Spear, Middleton, Donaldson & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

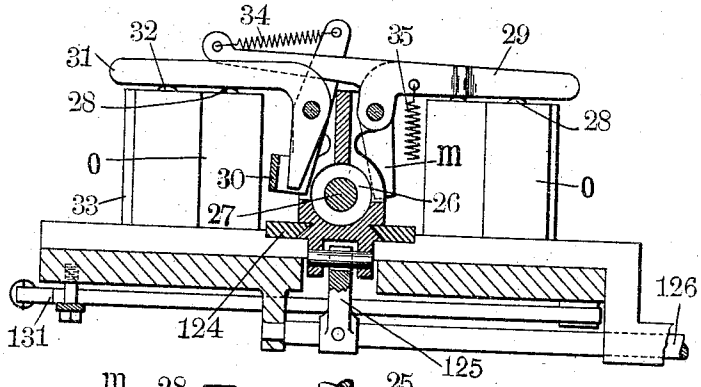
APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 6.

Fig. 9



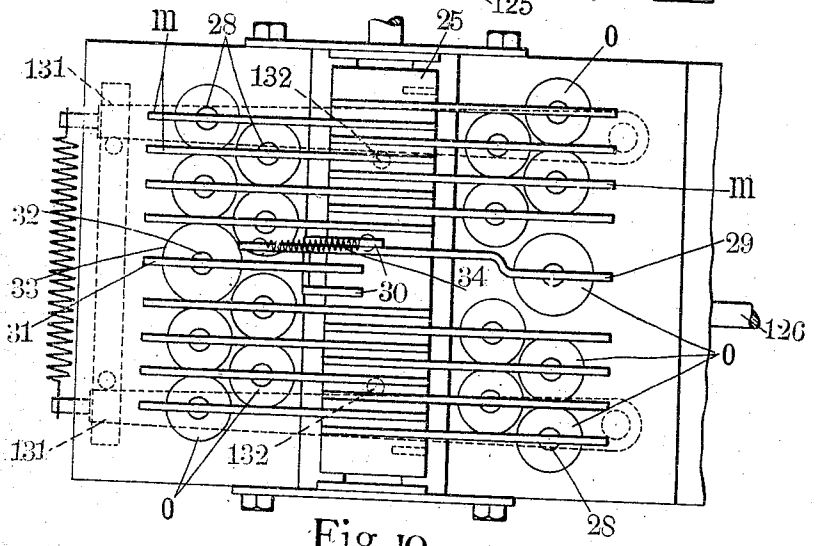


Fig. 10

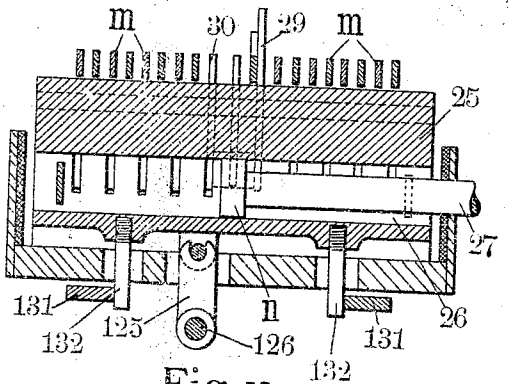


Fig. 11

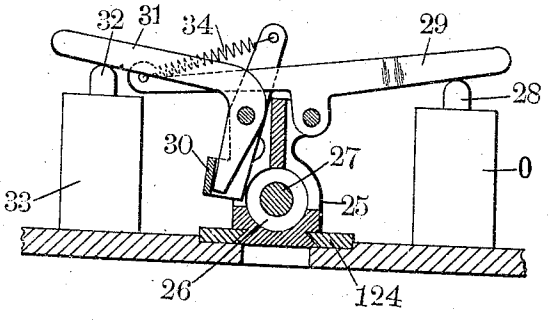


Fig. 12

Attest,
Bent. McStahl.
Edward N. Sartin

Inventor,
Arthur William Harris,
by Spear, Middleton, Donaldson & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135. Patented June 13, 1911.

11 SHEETS—SHEET 7.

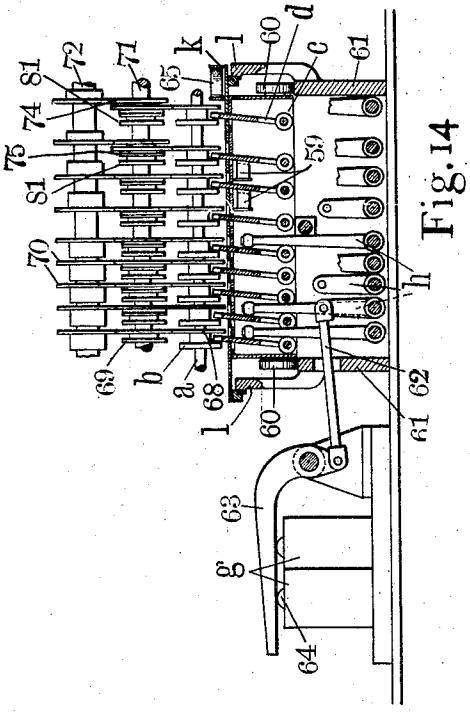


Fig. 14

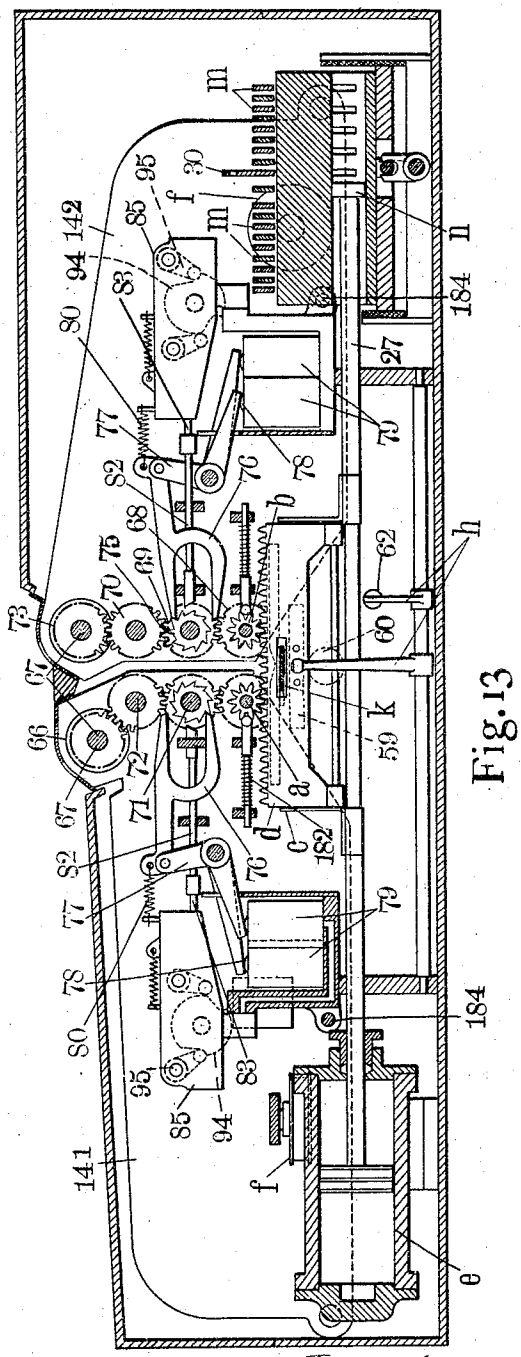


Fig. 13

Attest.
Benth. Stahl.
Edward N. Santos

Inventor
Arthur William Harris.
by Spear, Middleton, Donaldson & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 8.

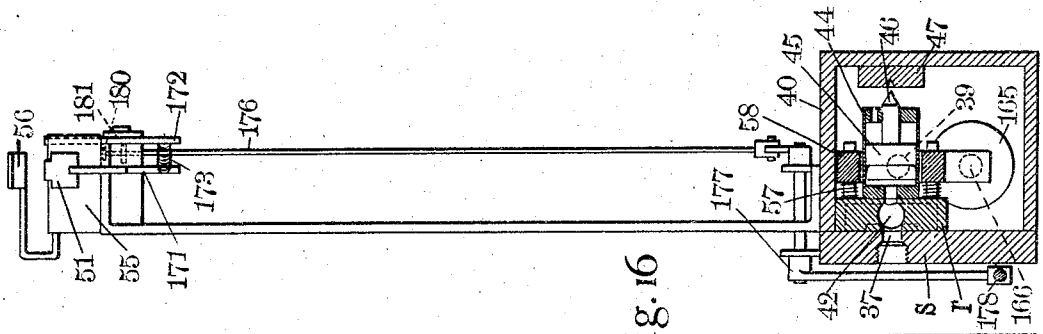


Fig. 16

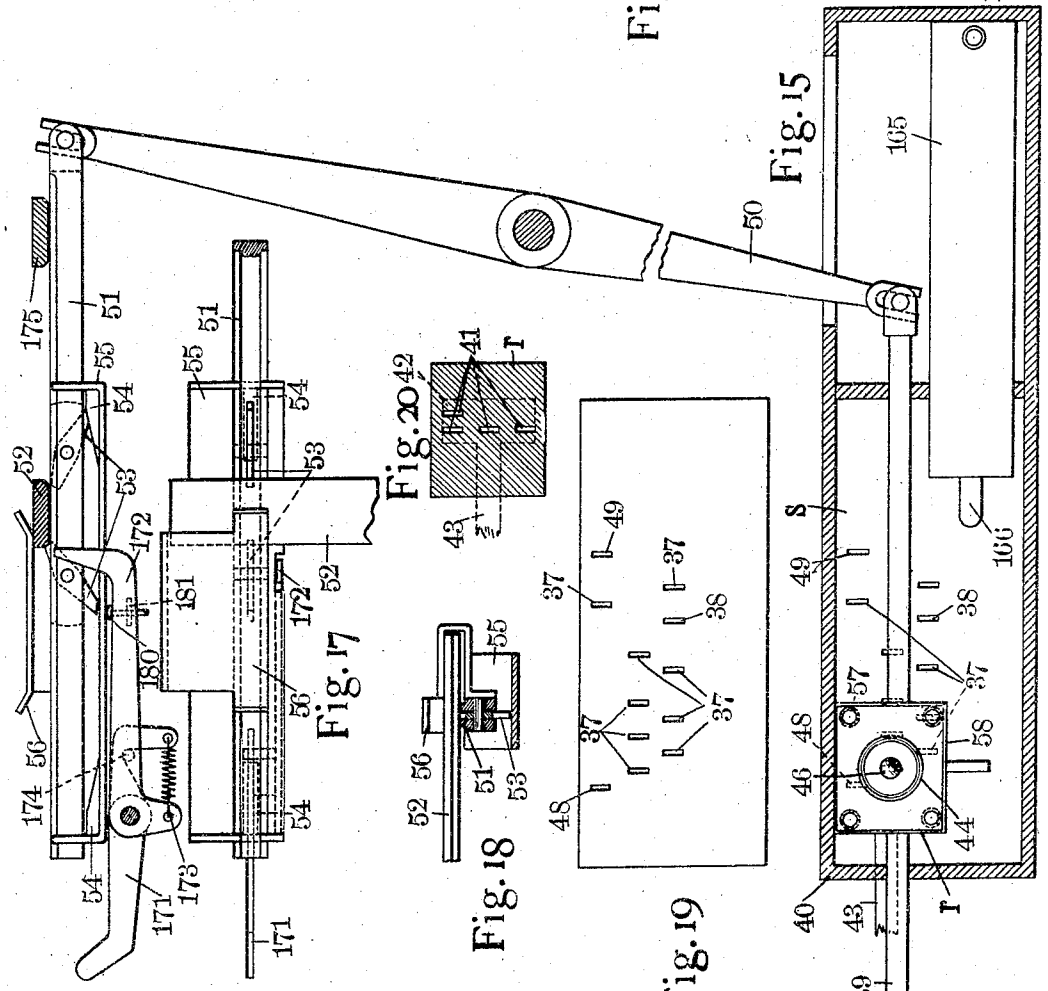


Fig. 15

Fig. 17

Fig. 20

Fig. 18

Fig. 19

Attest.

Bert. M. Stahl.

Edward N. Santee

Inventor,

Arthur William Harris.

by Speer, Middleton, Donaldson & Spear

Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 9.

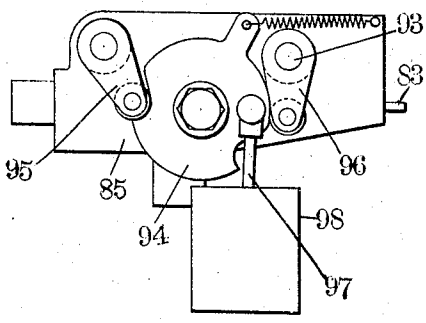


Fig. 22

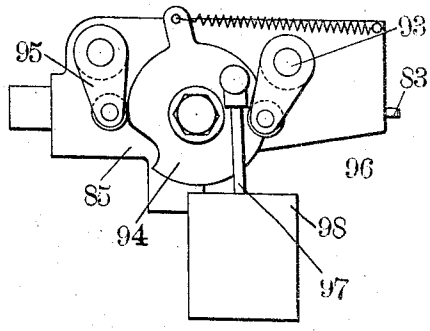


Fig. 23

Fig. 21

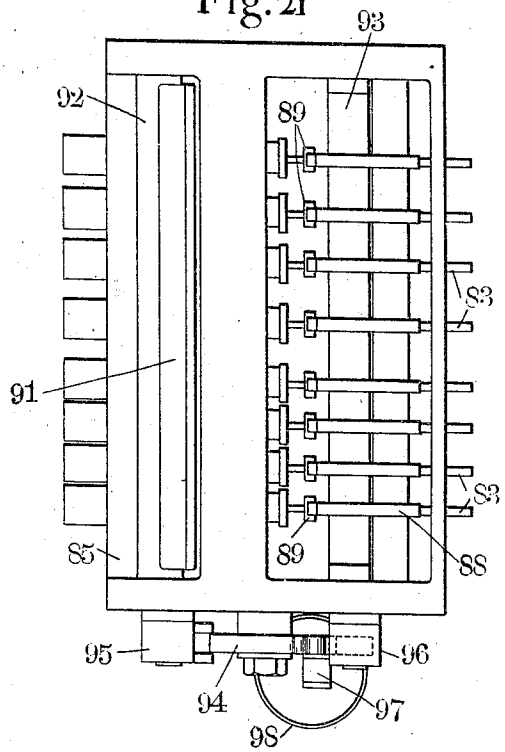


Fig. 24

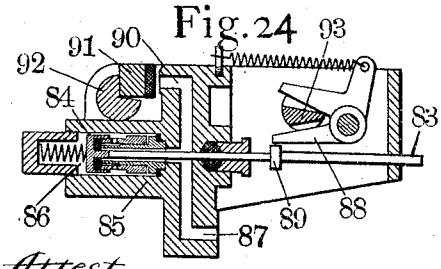
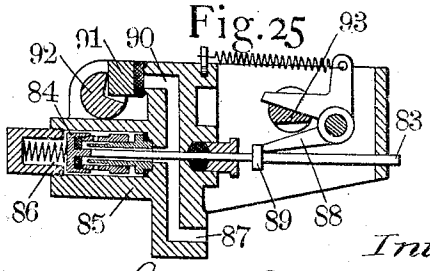


Fig. 25



Attest.
Bent. W. Stahl.
Edward N. Slater.

Inventor.
Arthur William Harris.
by Spear, Middleton, Donaldson & Spear
Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 10.

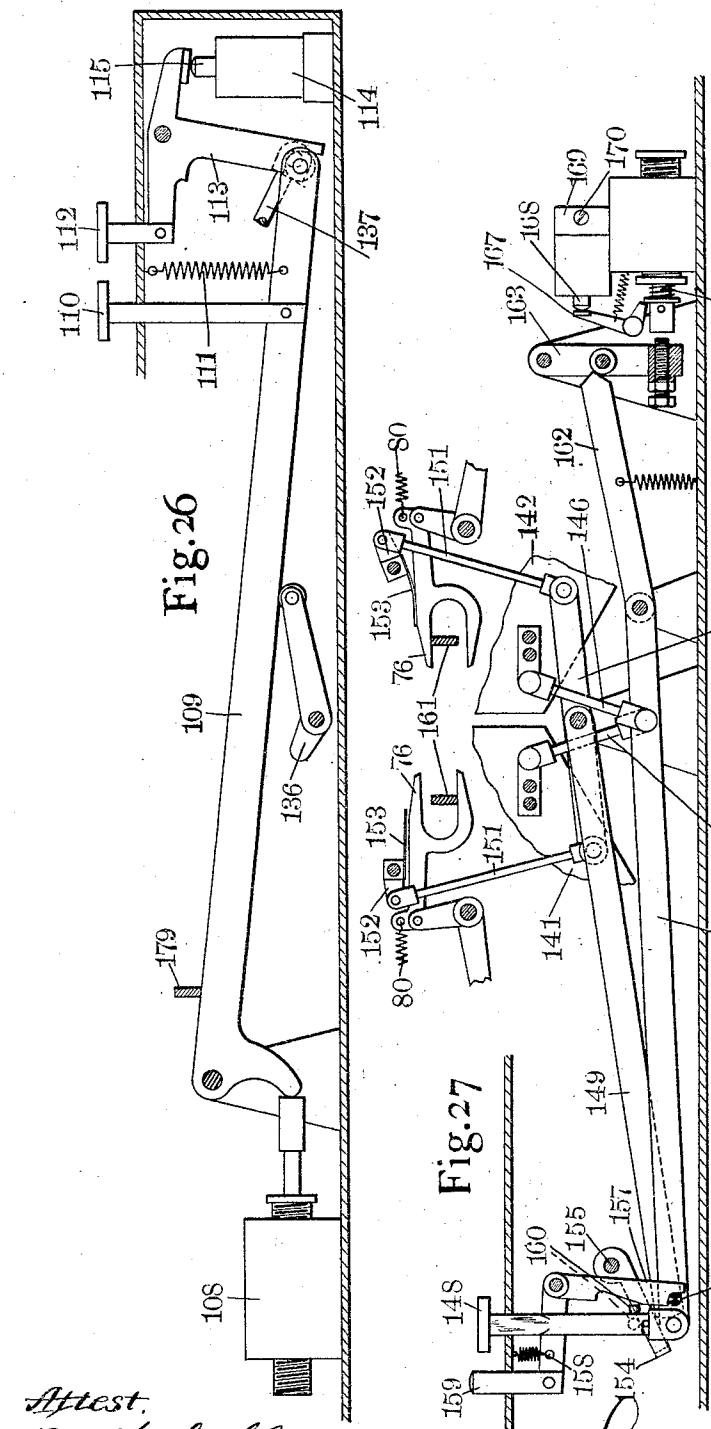


Fig.26

Fig.27

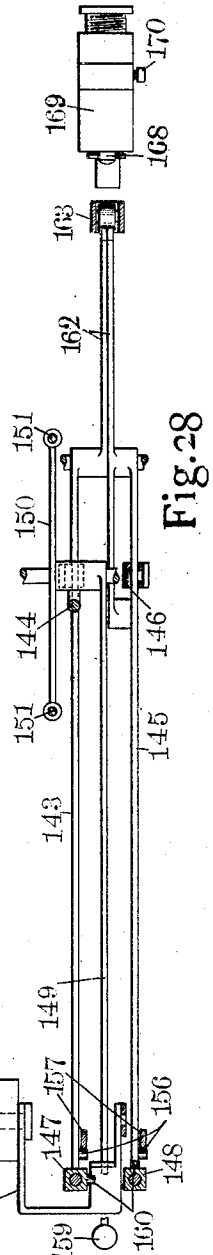


Fig.28

Attest.

Bent. M. Stahl.

Edward N. Sartor

Inventor

Arthur William Harris,

by Spear, Middleton, Donaldson & Spear

Attys.

A. W. HARRIS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 12, 1909.

995,135.

Patented June 13, 1911.

11 SHEETS—SHEET 11.

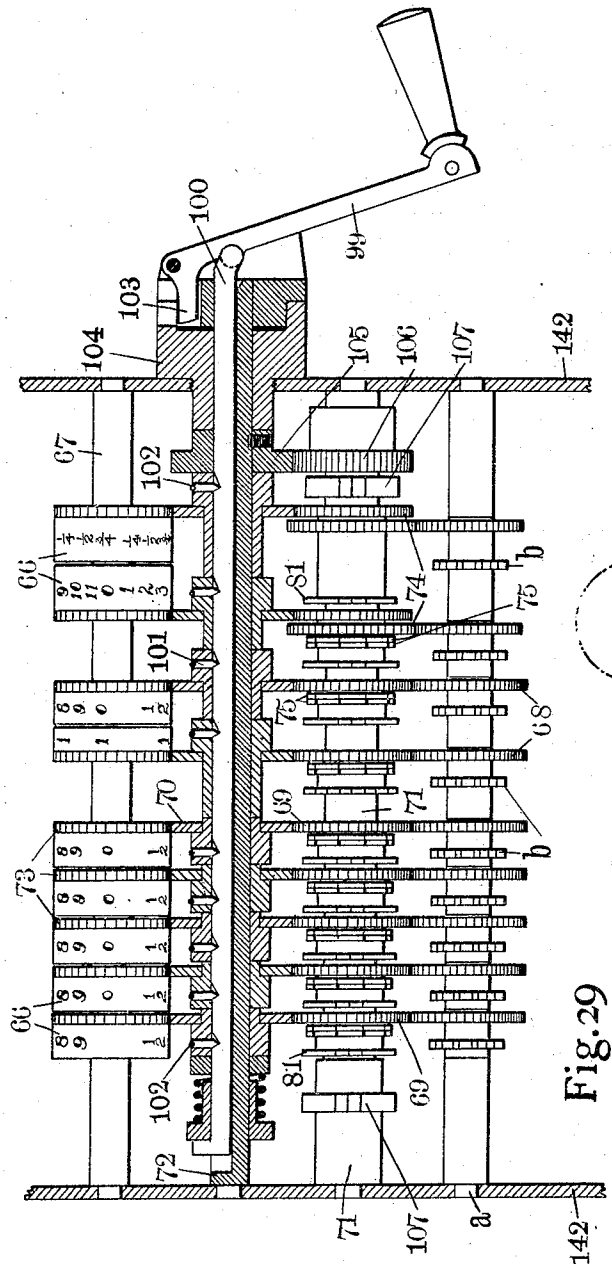


Fig. 29

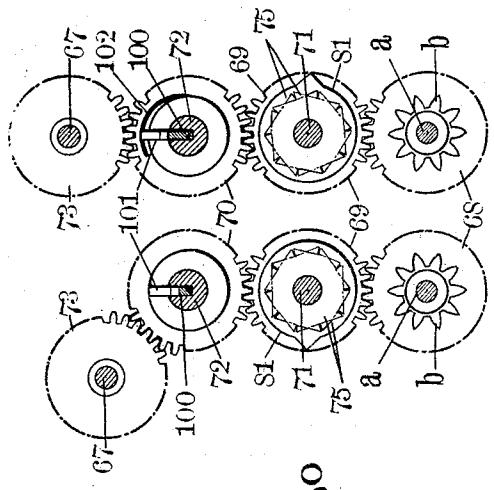


Fig. 30

Attest,

Bent. M. Stahl.

Edward N. Slater

Inventor,

Arthur William Harris,

by Spear, Middleton, Donaldson & Spear

Attys.

UNITED STATES PATENT OFFICE.

ARTHUR WILLIAM HARRIS, OF BIRMINGHAM, ENGLAND.

CALCULATING-MACHINE.

995,135. Specification of Letters Patent. **Patented June 13, 1911.**

Application filed November 12, 1909. Serial No. 527,664.

To all whom it may concern:

Be it known that I, ARTHUR WILLIAM HARRIS, subject of Great Britain, residing at 125–129 Edmund street, in the city of Birmingham, England, have invented certain new and useful Improvements Relating to Calculating-Machines, of which the following is a specification.

This invention has for its object to construct an improved adding or subtracting machine adapted for use in conjunction with typewriting machines.

Referring to the eleven accompanying sheets of explanatory drawings;—Figure 1 is a diagrammatic view illustrating the action of an adding and subtracting machine constructed in accordance with this invention. Fig. 2 is a front elevation showing a general arrangement of the adding and subtracting machine in conjunction with a typewriter, Fig. 2ª is a plan of the keyboard, while Fig. 3 is a plan with the typewriter and cover removed. Fig. 4 is a part sectional side elevation of valve actuating mechanism controlled from the operating keys. Fig. 5 is a sectional side elevation of means for locking the valve actuating mechanism, and Fig. 6 a side elevation taken on the opposite side to that of Fig. 4 showing means for releasing the said locking mechanism. Figs. 7 and 8 are respectively sectional end elevation and plan of a single valve arranged for operation from any one of a number of pneumatic cylinders. Fig. 9 is a sectional end elevation and Fig. 10 a plan of stop mechanism. Fig. 11 is a sectional side elevation of the said mechanism, and Fig. 12 a sectional end elevation in the operative position of a compound stop. Fig. 12ª is a sectional end elevation of a pair of the ordinary stops. Fig. 13 is a sectional side elevation and Fig. 14 a sectional end elevation of a double set of adding and subtracting mechanism. Fig. 15 is a part sectional side elevation and Fig. 16 a sectional end elevation of slide valve mechanism used with a typewriter, Figs. 17 and 18 being respectively a plan and end section of the portion actuated from the typewriter carriage. Fig. 19 is a side elevation showing the face of the distributing plate in the air chest and Fig. 20 a section parallel to the slide valve face. Fig. 21 is a plan of valves associated with the transfer mechanism, Figs. 22 and 23 end elevations showing in two positions valve controlling devices and Figs. 24 and 25 end sections in two positions of one of the valves. Fig. 26 is a side elevation of levers in conjunction with a main air valve for putting the whole machine into and out of action. Figs. 27 and 28 are respectively side elevation and plan of mechanism for setting the adding and subtracting mechanism to perform the required operations. Fig. 29 is a sectional side elevation and Fig. 30 a sectional end elevation of zeroising mechanism in conjunction with the indicating disks.

The same reference letters in the different views indicate the same parts.

The invention will be described first with reference to Fig. 1 which illustrates diagrammatically without constructional details the application of the invention to an adding and subtracting machine for use with a typewriter, fuller description of the complete mechanism being given hereafter. On a spindle *a* are arranged a series of gear wheels *b* by which are rotated a series of indicating disks supported on a spindle parallel with the spindle *a*. Any suitable mechanism is adopted for transferring motion from one disk to another in the ascending or descending order of the series.

Adjacent to the gear wheels *b* is mounted a carriage *c* movable transversely to the disk spindle on a slide. On the carriage are arranged a series of racks *d* for engaging the gear wheels *b*, suitable provision being made for movement of each rack either parallel to itself or about an axis at or near its bottom edge into or out of engagement with its gear wheel. Normally all the racks occupy an inoperative position between the gear wheels.

Of the nine racks shown in the diagram the first two, starting from the bottom, are associated with the disks indicating fractions and integral numbers of pence, the next two correspond to units and tens of shillings, and the next five to units, tens, hundreds, thousands, and tens of thousands of pounds.

For actuating the carriage a pneumatic cylinder *e* is arranged in conjunction with one end of the same, the carriage being connected directly or indirectly to the cylinder piston which normally occupies a position midway between the ends of the cylinder. Return of the cylinder piston to its initial position is effected by means of springs *f*. The one spring is used for actuating the carriage in one direction and the other for the

opposite direction, a sliding connection being provided between the springs and the carriage so that they do not affect each other's action. For operating the racks a series of cylinders and pistons acting through levers are employed. In the diagram one cylinder g is shown with piston connected to a lever h. It will be understood that there is a cylinder and lever for each rack. With the cylinder e is arranged an air valve in a box i controlled through levers from a piston in a cylinder j. To prevent movement of the carriage by the piston in e before a rack has properly engaged its wheel a spring controlled catch bar k capable of being moved laterally by any of the racks is adapted to engage an anchorage l on any fixed part of the machine. The carriage cannot move until the catch bar is free from the part l. After the disengagement of the rack and the return of the carriage the catch bar reëngages the anchorage.

It will be readily understood that on moving a rack into engagement with its gear wheel and then traversing the carriage along its slide, as above described, the disk connected to that rack is rotated to an extent corresponding with the motion of the carriage. In order that the motion given to the carriage at each operation may be equivalent to the particular number required to be transferred to the disks a series of stops m is situated in alinement with the carriage. One stop is shown in Fig. 1. Normally the stops occupy an unobstructive position, with respect to a projecting collar or abutment n on a bar at the front of the carriage, but each may be moved into an obstructive position for arresting the motion of the carriage. Additive movements are limited by stops acting on one side of the collar and subtractive movements by stops acting on the opposite side of the collar. A pneumatic cylinder o and piston and a return spring are arranged with each stop, the air supply being controlled by a valve in a box p actuated through suitable mechanism by a typewriter key q bearing the number corresponding with the stop.

For determining which of the racks d shall be operated when a number key of the typewriter is depressed, the admission of air to the cylinders g is controlled by a slide valve r acting in conjunction with a distributing plate s having ports each of which is connected by a pipe to a corresponding cylinder g. The valve is connected to the carriage of the typewriter. Both valve and plate are so placed that when the typewriter carriage is in position for the printing on the usual sheet of paper the first or highest figure in the pounds column, the valve is opposite the port in the plate communicating with the cylinder of the first rack. The movement of the carriage after the printing of the figure carries the valve into position opposite the next port. As the carriage progresses the valve is moved past each port in the plate until the port communicating with the cylinder for actuating the rack of the farthings disk is reached. The movement of the valve is limited to an amount which is a little greater than the distance between the first and last port in the plate. At the limits of its motion it is automatically connected to or disconnected from the carriage as hereinafter described.

Admission of air to the slide valve and the cylinder j is controlled by a valve in a box t actuated by a piston in a cylinder u through suitable mechanism. There is a valve in p and a cylinder u with each number key of the typewriter, but a single valve in t capable of operation from any of the cylinders u is employed, also a single cylinder j, and single valve in the box i. The various parts are connected by metal, rubber or other pipes as shown, sufficient flexibility being permitted in the pipe connected to the slide valve for the latter to perform its movements. After operating the cylinders the air is exhausted by returning along the same pipes, the various valve boxes i, p, t, being adapted both to admit compressed air to the pipes from a reservoir or pump and exhaust the air after use to the atmosphere. Air inlets and outlets are indicated by arrows in Fig. 1.

As a simple instance of the manner of using my machine, let it be supposed that the amount three hundred pounds is required to be printed and also transferred to the indicating disks of the adding machine. The typewriter key such as q bearing the number three is first depressed. Simultaneously with the printing of the figure on the paper in the machine, the valve in p is opened and air admitted to the cylinders u and o, thus opening the valve in t and also putting into action the stop m corresponding to number three. With the opening of the valve in t air is admitted to the cylinder j and to the slide valve, and since the latter is in the position corresponding to the hundreds column the third rack from the top in Fig. 1 is moved into engagement with the gear wheel of the hundreds disk of the adding mechanism. The actuation of the valve in 1 admits air to the cylinder e whereupon the carriage is advanced, its motion being limited to that required for the rotation of the hundreds disk through three divisions by the stop m. With the release of the lever q, all the parts return to their original position (excepting the hundreds disk) under the action of appropriate springs. By the ordinary action of the typewriter the carriage now advances a step and carries the valve r opposite the port in

the plate *s* communicating with the tens rack in the pounds section. With the depression of any other number key than the zero key the above cycle would be repeated, but the zero key affects none of the pneumatic system so that with the depression of the zero key, the only result is to record the number on the paper. Similarly the next depression of the zero key prints another nought but does not affect the adding mechanism. It will be understood that before the adding mechanism is brought into operation the carriage of the typewriter must be in a certain predetermined position corresponding to the usual cash columns at the right hand side of the bill or other sheet, and that as the carriage moves the valve is simultaneously moved for causing the proper rack to be brought into operation in the adding mechanism. For subtracting operations, the carriage is actuated in the reverse direction to that for the adding operations, and in consequence the sum recorded on the sheet by the typewriter is deducted from the amount originally indicated by the disks. Admission of air to the appropriate side of the piston in the cylinder *e* is controlled by a suitable cock situated between the valve box *i* and the said cylinder and arranged for actuation by the operator.

The adding and subtracting machine as applied to a typewriter will now be described in detail.

With reference to Figs. 2 to 6 of the drawings and commencing with the lever *q* which is an ordinary number key or lever of a typewriter, motion is transmitted therefrom to a valve *v* in a valve box *p* by means of a rod *w* and a lever *x* acting on a hollow perforated stem *y* which can move the valve *v* off its seating against the action of a spring *z*. Air can then pass from the inlet 1 connected to a pump or air reservoir through the outlet 2 to the cylinders *u* and *o*. On releasing the key *q* the valve is closed by its spring *z*, and the stem *y* and the lever *x* with rod *w* are returned by a spring 3. Air can then escape after operating in the said cylinders through the hollow stem *y* and a cap 4 which can move to a limited extent on the stem *y*. As the cap is interposed between the stem and the lever *x*, it closes the end of the stem during the operative movement of the lever *q* and so prevents flow of air through the stem when the valve *v* is pressed off its seating. On the return movement of the lever the cap opens the end of the stem under the action of the spring 3 for the escape of air as above mentioned.

It will be understood that a valve with actuating mechanism is required for each number key of the typewriter representing a whole number. Nine such sets of mechanism are consequently required, the arrangement or disposition being shown in Fig. 3. For actuating the fractions or farthings disk alongside the pence disk the mechanisms associated with the integral numbers, one, two, three, are employed, and the keys respectively denoting a farthing, half-penny and three farthings, are adapted in any convenient manner to operate the same levers as the keys of the said integral numbers. The arrangement shown in the drawings is intended for use with a typewriter in which a farthing and three farthings type are operated from the same key with the use of a shift key. A pair of concentric shafts 5 and 6 are mounted over the levers *x*. The shaft 5 is provided with a lever 7 adapted to act on the lever *x* corresponding to the number two and the shaft 6 is provided with a lever 8 for acting on another of the levers *x* corresponding to the number three. The shaft 5 is further provided with a lever 9 for operating by the half-pence key, and the shaft 6 with a lever 10 for actuation by the three farthings key. In conjunction with the lever 10 is mounted a spring controlled sliding clutch piece 11 capable of being moved by a bar 12 connected to the usual shift key mechanism into engagement with a clutch piece 13 on the lever *x* corresponding to the number one. On engaging the parts 11 and 13 both the levers corresponding to the numbers one and three will be operated, but this will not interfere with the proper working of the counting mechanism for the reason to be hereinafter mentioned.

Passing now to the mechanism associated with the cylinders *u* which is shown in detail in Figs. 7 and 8, the number of cylinders is equal to the number of valves *v* in the valve box *p*. Communication between the cylinders and the outlets 2 of the valve box *p* is obtained by suitable pipes, not shown in the drawings. With the actuation of any valve *v* air is immediately admitted to the corresponding cylinder *u*. Over plungers 14 connected to pistons in the cylinders *u* are arranged a pair of bars 15 secured to levers 16. The latter actuate a lever 17 which can transmit sliding motion to a hollow perforated valve stem 18 in the valve box *t* for moving a valve 19 off its seating against the action of a spring 20. With the operation of any one of the plungers 14 in the cylinders *u* the valve 19 is opened and air admitted through an inlet 21 to the box *t* whence it passes to the cylinder *j*. After the liberation of air from the cylinder *u* the plunger 14 and levers 16 and 17 are returned by a spring 22, and the valve 19 is closed by its spring 20. Air can then escape from the cylinder *j* through the valve box *t* and stem 18 to the atmosphere by way of a cap 23 on the outer end of the stem. The cap is in-

terposed between the lever 17 and stem 18 and can slide to a limited extent on the stem so that when the latter is moved by the lever 17 in the direction for opening the valve 19 the cap is caused to close the end of the stem and so prevent escape of air through the stem from the inlet 21. In the opposite movement of the stem the cap is pressed outward by a spring 24, and the end of the stem thereby opened for the escape of air as above mentioned.

Simultaneously with the passage of air from the valve box *p* to one of the cylinders *u* air also passes to one in each of two sets of cylinders *o* arranged in conjunction with stop mechanism shown in detail at Figs. 9 to 12. The cylinders are disposed on opposite sides of a bracket 25 carrying a number of bell crank stop levers *m*. One end of each lever is so placed that it can be moved across the central aperture 26 of the bracket in which moves a bar 27 connected with the rack carriage *c* and formed with a collar *n*. The other end of each lever extends across one of the cylinders *o* so that it can be actuated by the plunger 28 of a piston in that cylinder. Corresponding cylinders in each set are connected to each other and to the corresponding outlet in the valve box *p*. With the admission of air to any pair of cylinders the associated stop levers are caused to move into an obstructive position across the aperture of the bracket 25. It will be understood that the two sets of stop levers are situated on opposite sides of the collar *n* of the bar 27 so that the motion of the latter and the carriage to which it is secured is limited by one or other of the pair of stops in either direction of travel of the carriage. The pitch or distance apart of the stop levers is equal to the motion necessary for moving any disk through one division on its periphery. Supposing it is desired to add number three to any disk, the stop corresponding to number three is actuated and the motion of the bar 27 and carriage *c* is limited to that required for moving the disk through three divisions.

It has already been stated that when the farthings key on the typewriter is actuated two levers *x* (those corresponding to numbers one and three) are depressed and in consequence the stops corresponding to one and three will be brought into operation. Since, however, the bar 27 will be arrested in either direction of travel by the number one stop the simultaneous operation of number three stop does not interfere with the proper working of the machine. When the same typewriter key is used to print three farthings the lever *x* corresponding to number three and consequently number three stop only is actuated.

The shillings and pounds disks are each divided peripherally into ten equal parts, but twelve divisions are marked on the pence disk. When it is required to add ten to either the pounds or shillings disks, a unit movement is given to the tens disk. But when it is required to add ten to the pence disk a movement through ten divisions is required, since there is only one disk for integral numbers; and as the zero key bar has no effect upon the adding mechanism it is necessary to be able to impart movement to the pence disk through either one division or ten divisions by the operation of the number one key. For this purpose the number one stop consists of three parts namely, a lever 29 actuated from the plunger in the number one cylinder *o*, a double stop lever 30 which acts on opposite sides of the collar *n* of the bar 27 and limits the motion of the bar in either direction to that corresponding to one division of the indicating disks, and a lever 31 which can be actuated from a plunger 32 in a compensating cylinder 33 for moving the lever 30 against the spring 34 by which the lever 30 is connected to the lever 29. When the typewriter carriage is in the required position for printing number one in the tens side of the pence column of the paper, air is not only admitted to the cylinder *o* beneath the lever 29, but also to the compensating cylinder 33 beneath the lever 31. The latter is consequently raised and caused to arrest the stop lever 30 and prevent the same from passing into the path of the collar *n* on the bar 27; the motion of the lever 29 therefore merely causes the spring 34 to be extended, and the said collar and bar with the rack carriage can consequently move through the full length of its stroke and rotate the pence disk through ten divisions. After the next movement of the typewriter carriage air is admitted to number one cylinder *o* only on the depression of the number one key, and the lever 30 is moved into the path of the collar *n* by the action of the lever 29 and spring 34. Rotation through a single division is then imparted to the pence disk. Depression of the number one key twice in succession when the pence rack comes into operation therefore causes figure eleven to be printed on the paper in the machine and the pence disk to be moved through eleven divisions. It is to be understood that while all the cylinders *o* receive air from the valves in the box *p* the cylinder 33 receives air from the slide valve *r* which is described in detail hereafter. On liberation of air from the cylinders *o* and 33 the various levers are returned by springs as 35.

Air admitted to the machine through the valve box *t* passes into the cylinder *j* which opens a valve in the valve box *i* and admits air to the carriage cylinder *e*. The construction of the valve in the box *i* and the manner of operating it is similar to that of

the valve 19 in the box t above described. The cylinder j is mounted adjacent to the cylinders g as shown in Fig. 3, and the lever 36 in conjunction with the cylinder j for actuating the valve in the box i is mounted on a common fulcrum bar of the levers to be hereinafter referred to arranged with the cylinders g.

Simultaneously with the admission of air to the cylinder j, air is also admitted from the valve box t to the slide valve r and thence to one of the cylinders g for moving one of the racks d into engagement with a disk gear wheel b. The slide valve and distributing plate with associated parts are shown in Figs. 15 to 20. The distributing plate s which is secured to any convenient portion of the machine frame is provided with nine apertures 37 as shown, each connected to a cylinder g, and an aperture 38 connected to the compensating cylinder 33 above referred to. Across the face of the plate s moves the valve r carried by a rod 39 passing through the ends of the valve case 40. A section through the slide valve near its face is shown in Fig. 20 and the valve is seen to be provided with four apertures 41 each communicating with an inner cavity 42 in the valve. Air is conducted to the valve by a flexible pipe 43. To maintain the valve on the face of the plate s an air cylinder 44 with piston 45 is attached to the back of the valve and arranged so that the pointed projection 46 of the piston can engage holes in the plate 47 on one side of the valve case. This device also serves to position the valve correctly after each movement.

With the valve at the left hand side of the valve case as shown in Fig. 15 air is admitted through the first aperture of the top row in the plate s. This causes the operation of the rack of highest denomination in the pounds section. In the next position air is admitted through the first aperture in the bottom row for the actuation of the pounds rack of next denomination in the descending order, and so on. With the valve over the third aperture in the bottom row air is admitted to the tens rack in the shillings section; in the next position air is admitted to the units rack of the shillings section. When the valve lies opposite the fourth aperture 38 in the bottom row it also uncovers the aperture 37 situated above the top row, and at the same time that it passes air through the latter for the operation of the pence rack it also passes air through the aperture 38 in the bottom row to the cylinder 33 for actuating the compound stop mechanism above described. In the next position the aperture 37 situated above the top row only is opened and the pence rack is again operated. The last aperture in the bottom row admits air for operation of the farthings rack. The extreme end apertures 48 and 49 will be referred to hereafter. Progressive movement of the valve r across the plate s is obtained by connecting the rod 39 through a lever 50 and bar 51 to a projection 52 attached to the carriage of the typewriter. The movements of the said carriage are thus attended by corresponding movements of the valve. As the total movement of the carriage is greater than that of the valve it is necessary to automatically connect and disconnect the projection 52 with the bar 51 when the carriage is in the position corresponding with the cash column on the right hand side of the bill or other sheet in the machine. This is effected by pivoting a pair of catches 53 on the bar 51 and arranging a pair of inclined abutments 54 on a fixed bracket 55. Supposing the projection 52 to be on the right hand side of the catches and moving toward them, on encountering the first catch it passes idly over the top of the same, but on engaging the next catch it transmits its further motion to the bar 51 and causes the valve to move as aforesaid. When the second named catch strikes against the inclined abutment toward which it is carried it is raised and withdrawn from the carriage projection, and the latter completes its movement with the carriage alone. On the opposite movement of the carriage the first named catch is engaged and the valve returned, this catch being also withdrawn from the projection when the valve reaches its original position. A guard piece 56 on the bracket prevents the projection from accidentally clearing either of the catches while in action. The extent of engagement of the projection 46 from the cylinder 44 on the slide valve with the plate 47 is not sufficient to resist movement of the valve by the lever 50 but sufficient to bring the valve into its correct position after each operation and hold the valve face closely against the face of the distributing plate. Light springs 57 situated between a block 58 on the rod 39 and the valve may also be employed for pressing the latter against the distributing plate.

From the slide valve air passes to the particular cylinder g which is connected to the aperture in the distributing plate covered by the valve. A group of cylinders g are mounted adjacent to the rack carriage c. On the latter are pivoted the racks d, Figs. 13 and 14, which are normally kept out of contact with the gear wheels b by flat springs 59. The carriage is supported by wheels or rollers 60 running on tracks 61. Beneath the carriage are pivoted a number of levers h arranged in abutment with the respective racks and connected by rods 62 to levers 63 actuated by the plungers 64 of pistons in the cylinders g. With the admission of air into any cylinder a corresponding rack is

moved into engagement with its gear wheel. On the liberation of air from the cylinder the racks and other parts are returned by the springs 59. As already mentioned the rack carriage is provided with a catch bar *k* laterally movable by any rack out of engagement with a stationary portion or portions *l* on the machine frame. Reverse motion of the bar is produced by a spring 65. When any rack is actuated the catch bar is disconnected from the fixed part *l* and the air admitted to the cylinder is then free to advance the rack carriage to the extent permitted by one of the stop levers *m*. After the return of the carriage the catch automatically reëngages the parts *l*. For effecting the return of the carriage the latter is connected by cords or like chains to drums *f* containing suitable coil springs against the action of which the forward motions of the carriage are effected. In the drawings two sets of gear wheels *b* are shown with the racks; two sets of adding and substracting mechanism can therefore be actuated from the same racks.

The counting disks may be mounted alongside of the gear wheels *b* on the spindle *a*, but it is found more convenient to arrange the disks 66 on a separate spindle 67 and rotate the same from wheels 68 through intermediate wheels 69 and 70 on separate spindles 71 and 72, and wheels 73 secured to the disks, the gear wheels *b* and 68 being formed or secured together in pairs as shown. The ratios of the wheels 68 and 73 are all the same excepting that of the wheels operating the pence and farthings disk which is suitably modified by variation of size and the introduction of extra wheels 74 to correspond with the extra divisions on those disks. The above described arrangement of gear wheels and disks is illustrated in Figs. 13 and 14, and also in Figs. 29 and 30.

It has already been mentioned that the transference of motion from one disk to another may be effected by any convenient mechanism. The mechanism preferred is shown in detail in Figs. 13 and 14, and 22 to 25, and comprises pneumatically controlled elements which will now be fully described.

In conjunction with each of the aforesaid intermediate wheels 69 there is arranged a pair of ratchet wheels 75, and in conjunction with the latter is mounted a double pawl 76 (see Fig. 13) hinged on a lever 77 one end of which is arranged over the plunger 78 of a piston in a small air cylinder 79. The number of cylinders and levers is one less than the number of disks. Two ratchets and a double pawl are required to obtain motion of the disks in either direction. The lower member of the pawl is kept in contact with its ratchet and the lever 77 on its plunger 78 by a spring 80 as shown in the adding mechanism at the left hand side of Fig. 13. But for maintaining the upper member of the pawl in engagement with its ratchet against the action of the spring 80 as shown in the right hand mechanism of Fig. 13, special means are required as shown in Fig. 27 to be hereinafter referred to. Alongside each ratchet is secured a cam 81 which operates a spring controlled plunger 82 whereby a valve rod 83 can be actuated. When the latter is pressed inward the valve 84 in the valve box 85 (Figs. 22 to 25) is pressed off its seating and air admitted from a common channel 86 communicating with all the valves in the valve box to the outlet 87 whence air can pass to the particular cylinder 79 to be operated. The channel 86 receives air from the same source as the valves in the box *p*. By means of a spring pawl or catch 88 acting on a collar 89 on the plunger 83 the latter is prevented from returning after the above movement by the cam until released. The release outlets 90 through which air can escape from the cylinders are controlled by a common bar 91 which is operated by a cam 92. The said bar and also another bar 93 by which the retaining pawls 88 can be simultaneously released, are actuated from a spring controlled cam 94 having a pair of peripheral notches therein and spring controlled levers 95 and 96. Movement is imparted to the cam by a rod 97 connected to a piston in a cylinder 98 mounted at one end of the valve box 85, such cylinder receiving air from the valve box *p* with the opening of any of the valves therein. With the admission of air to the cylinder 98 the cam 94 is rotated and the adjacent end of the lever 95 pressed outward, whereupon all the outlets 90 are closed by the bar 91. Also the lever 96 falls into the adjacent notch in the cam under the action of a spring and by so turning rotates the bar 93 and allows any of the catches 88 to fall behind a collar 89 when its plunger 83 is moved for the opening of the valve. On the liberation of air from the cylinder 98 the lower end of the lever 96 is pushed outward by the cam 94 and the bar 93 caused to lift the catches 88 out of action. The lower end of the lever 95 subsequently falls into the adjacent notch in the cam 94 whereupon the cam 92 connected to the said lever permits the bar 91 to open the outlets 90 in the valve box 85. Fig. 22 shows the relative positions of the cam 94 and levers 95 and 96 before the admission of air to the cylinder 98 and Fig. 23 the same parts after admission of air to the cylinder. Fig. 24 shows the pawl or catch 88 held out of action by the bar 93 and Fig. 25 the same catch in action with the bar turned to permit the engagement of the catch with the collar 89. When one of the disks indicating pence, unit shillings or pounds, has completed a revolu-

tion, its cam operates the adjacent plunger and so opens the air inlet to the cylinder of the next disk, and by the action of the air on the piston and pawl the said disk is advanced through an angular distance corresponding to the addition of one digit. Thus the complete rotation of any of the said disks is followed by a unit angular rotation on the next disk in the ascending or descending order of the series. The periphery of the farthings disk is divided into twelve parts each four of which are numbered consecutively naught, one, two, three, and the periphery of the tens of shillings disks is divided into ten parts and numbered consecutively naught and one. Further the cam of the farthings disk is adapted to open the adjacent valve three times on each revolution as four divisions on the disk correspond to one penny and the cam of the tens of shillings disk is adapted to open its adjacent valve five times in a revolution, as two divisions correspond to a pound. Consequently transfer from the farthings disk to the pence disk is effected three times on every complete revolution of the farthings disk, and transfer is effected to the unit pounds disk five times in every complete revolution of the tens of shillings disk.

For resetting or returning the indicating disks to zero a hinged handle 99 is attached to the outer end of the wheel spindle 72 above mentioned. The said spindle has the wheels 69 mounted loosely thereon. Along the slot on spindle is arranged a sliding bar 100 which is formed with inclined slots into which sliding keys 101 on the bosses of the wheels can enter under the action of springs 102. By moving the handle inward the bar raises the keys so that the wheels are all free. In the inner position the handle is locked by the engagement of a projection 103, with a fixed part 104 of the machine frame. On moving the handle outward the bar is correspondingly moved and the keys opposite the slot are allowed to engage the spindle. Rotation of the handle through a suitable distance causes the wheels and disks to be returned to the initial or zero position. In conjunction with the spindle 72 is secured a wheel 105 gearing with the wheel 106 which rotates a cam 107 on the spindle 71. The said cam presses against the end of a thrust rod 183 which by its abutment against the valve box 85 of the transfer mechanism rocks the whole of the latter sufficiently to carry the pawls 76 out of engagement with their ratchets, and each complete set of transfer mechanism being normally mounted on its supports at 184 to permit such movement. The rods 183 of the two sets of transfer mechanism are indicated in Fig. 3 where the cams 107 are shown by dotted lines.

Hitherto the description has been confined to fundamental portions of the machine. Certain detailed features will now be described.

For putting the whole of the adding and subtracting mechanism into and out of action, a main air valve 108 (Figs. 3 and 26) is provided through which the air passes from the pump or reservoir to the machine. The valve which is similar in construction to the valve i above referred to is actuated by a lever 109 which can be depressed for the opening of the valve by a finger piece 110 and returned for closing the valve by a spring 111. Adjacent to the said piece is mounted another finger piece 112 with a catch 113 for engaging one end of the lever 109. By the action of any conveniently arranged spring the catch can engage the lever when the latter is depressed. On depressing the finger piece of the catch the lever is returned by its spring. To prevent actuation of the adding or subtracting mechanism when a number is printed in any other position on the paper than in the cash column a port 48 is provided at the extreme left hand end of the distributing plate s and a port 49 at the extreme right hand end, both ports being at the limits of the movement of the valve. From such ports air is conducted to a pair of cylinders 114 fitted with piston and plunger 115 beneath one end of the catch 113 for the lever 109. Should the slide valve be opposite either of the ports 47 or 48 air will be admitted to the corresponding cylinder 114 and the catch withdrawn from the lever 109. The latter then rises under the action of its spring and closes the valve 108.

To prevent operation of the typewriter keys at a speed which is too great for the adding mechanism, catches 116 are mounted along one side of the rods w Figs. 4 to 6. Normally the catches 116 are held out of action by a bar 117. Simultaneously with the movement of the rack carriage a notched bar 118 secured to the carriage lifts one end of the lever 119 which rests in a notch in the bar. Through the medium of a rod 120 and lever 121 on the end of the bar 117 the latter is rotated for the release of the catches 116 so that the catches can engage notches in all the rods w except that which has been depressed, thus preventing operation of any other rod until the adding mechanism has completed its movement. Elevation of the bar for the withdrawal of the catches is effected when the rack carriage has been returned by the lever 119 falling into its notch in the bar 118. To insure the various valves being held open for a sufficient time to allow an adequate supply of air to the rack carriage cylinder and other parts and thus avoid imperfect operation of the adding mechanism, another set of catches 122 is mounted in conjunction with the rods w

opposite the catches 116 and arranged to engage notches in the rods. When a key is depressed one of the catches 122 engages a notch in the corresponding rod and retains the rod until the catch is released by a bar 123. Operation of the bar 123 for the release of the catches is effected from the stop bracket 25 which is arranged on a slide 124 to receive a limited endwise movement under the impact of the rack carriage projection 27. Such movement is utilized by a lever 125, shaft 126, lever 127, and rod 128 to rock a slotted plate 129 with which engages one end of a lever 130 secured to one end of the bar 123 (Figs. 5 and 6). Normally the end of the lever 130 lies in a central depression of a slot in the plate 129, but when the plate is moved in either direction the lever 130 is raised and the bar actuated for the withdrawal of the catch from the rod w. The stop bracket 25 is maintained in its mid position and returned thereto after each displacement by spring controlled levers 131 acting on pegs 132.

To prevent simultaneous operation of two or more keys q a frame 133 (Fig. 4) carrying a number of disks 134 is employed and arranged adjacent to the ends of the levers x. The disks are placed edge to edge with sufficient freedom between them to accommodate one only of the levers x. If two keys q are depressed the corresponding levers x cannot pass between the disks and consequently neither valve connected to such levers is actuated.

For lowering all the levers x so that they cannot be actuated with the depression of the keys q the said levers are mounted on a hinged bracket 135 which is movable by a lever 136 arranged in conjunction with the lever 109 (Fig. 26). When the lever 109 is depressed the levers x together with rods w are raised to their operative position but with the opposite movement of the lever the levers x together with rods w are lowered into an inoperative position with respect to the typewriter keys q. Simultaneously with the lowering of the levers x the frame 133 is swung aside by the link 137 connected to the catch 113, and a slotted plate 138 hinged at the opposite end of the row of rods w to the plate 129 is rocked by a link 139, connected to the link 137 for moving the catches 122 into an inoperative position through the medium of a lever 140 and the bar 123 to prevent accidental locking of any of the rods w.

When two sets of adding and subtracting mechanism are employed it is necessary to be able to bring either or both into action at the same time. For this purpose the indicating disks with associated mechanism of one set are mounted between a pair of plates 141 hinged on the frame of the machine, while the disks of the other set are mounted between similar plates 142. Both sets of mechanism can be raised independently for disengaging the wheels b from the racks d. Such movements are effected by means shown in Figs. 27 and 28 where are also shown the mechanism for raising or lowering the pawls 76. A lever 143 is connected by a link 144 to one of the plates 141 while another lever 145 is connected by a rod 146 to one of the plates 142. With the levers elevated both sets of adding mechanism are out of action. On depressing a finger piece 147 the lever 143 is depressed and the wheels b of the left hand mechanism are lowered into engagement with the rack d. Similarly on depressing a finger piece 148 the lever 145 is depressed and the wheels b of the right hand mechanism are lowered into engagement with the racks. Between the levers 143 and 145 is mounted a lever 149 secured to a lever 150, which is connected at its end by links 151 to levers 152 carrying springs 153 arranged to act on the pawls 76. Adjacent to the end of the lever 149 is also mounted a bent lever 154 connected to a spindle 155 which actuates a two way cock on the cylinder e. Each of the levers 143 and 145 is provided with a projection 156 for engagement by one of a pair of catches 157 which can be actuated against the spring 158 by a finger piece 159. Further each finger piece 147 and 148 is provided with a projection 160 which by rotating the said piece can be caused to abut on the lever 154. With the projections 160 of the finger pieces 147 and 148 in the position shown in Fig. 28, depression of the finger piece 148 causes the gear wheels of the right hand mechanism to be engaged with the operating racks, while depression of the finger piece 147 not only has a like effect upon the gear wheels of the left hand mechanism but also by abutment of the projection 160 against the lever 154 rotates the valve spindle 155 for the admission of air into one end of the cylinder e and through the medium of the said lever 154 depresses the lever 149 whereupon the spring 153 of the left hand mechanism is raised out of contact with its pawl 76 and the spring 153 of the right hand mechanism is lowered into contact with its pawl. The said pawl of the left hand mechanism can then rise under the action of its spring 80 into contact with the lower side of the stop 161, while the pawl of the right hand mechanism is depressed against its spring 80 into contact with the upper side of its stop 161. The bars 143 and 145 are held down by the catches 157. Either projection 160 can be arranged to actuate the valve lever 154. When neither projection engages the lever, the said lever is raised and the valve moved for admitting air to the opposite side of the cylinder e by a spring. With the arrangement above

described either set of adding mechanism can be brought into engagement with the racks, for performing either adding or subtracting operations, or both can be brought into action together, the one for performing adding operations and the other for simultaneously performing subtracting operations.

As the travel of the slide valve already described is only equal to that required for a single cash column, it is necessary to return the valve to its original position when it is required to type and total items in another column alongside the first. For this purpose each lever 143 and 145 is formed with an extension 162 adapted to actuate a lever 163 by which motion can be imparted to a valve spindle 164 which admits air to a cylinder 165 (Figs. 15 and 16). A plunger 166 is thereupon pressed outward by the air and caused to move the valve if in a position adjacent to the cylinder to the opposite end of its travel. In order that the valve spindle 164 may be held in position for sufficient time to permit an adequate flow of air to the cylinder 165, a spring catch 167 is arranged to engage a collar on the valve spindle as shown in Fig. 27, when the spindle is pressed inward. A plunger 168 actuated by a piston in a cylinder 169 liberates the catch after a predetermined interval of time which is controlled by a screw 170 adapted to throttle the air passage to such cylinder. Supposing the lever 145 to be depressed the valve spindle 164 is pushed inward and air thereby admitted to the cylinder 165 for actuating its plunger and moving the slide valve to its proper position. When the slide valve reaches the opposite end of its travel, it is necessary to return it again in order that adding may be performed in the next column. To prevent the operative inadvertently passing to the second column without resetting the valve a pair of levers 171 and 172 is mounted on a common pivot adjacent to the bar 51 (Fig. 15) and connected by a spring 173 and stop pin 174. When the bar 51 moves from right to left it depresses the lever 171 and raises the upwardly projecting end of the lever 172 into position for arresting a bar 175 secured to the typewriter carriage when the latter has moved through a distance corresponding to the total width of a cash column. When the slide valve is reset the bar 51 is drawn back and the levers 171 and 172 are permitted to resume their original position. In order that the lever 172 may be put out of action when the operation of the adding mechanism is not required, the said lever is connected by a link 176, lever 177, rod 178 and lever 179 (Figs. 3, 15 and 16) to the lever 109. When the latter is in its upper position the head 180 of the link 176 abuts upon a shoulder 181 of the lever 172 and prevents it from rising when the lever 171 is depressed.

Instead of racks, pivoted sectors capable of receiving forward and backward and lateral motions may be adopted, and instead of a slide valve a rotary valve may be substituted. As alternatives to the valves illustrated, disk valves or pinch cocks acting on rubber tubes may be used. Further the machine may be readily adapted by appropriate alterations in the disks and their gear wheels for the addition or subtraction of simple numbers, or weights and measures, instead of cash items as described.

In the above description of the machine minor details of construction have been disregarded, also various springs have been omitted both from the drawings and the description. It will be understood that all return movements of the various parts where no special provision is made is effected by any conveniently arranged springs some of which have been mentioned.

To insure the wheels *b* being always in suitable positions for engagement by the racks the wheels are held after each operation by spring controlled plungers 182 adapted to be pressed between the teeth of the wheels.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In calculating machines, the combination with a plurality of indicating disks, of a plurality of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, and manually operated controlling mechanism for said pneumatically operated mechanism, substantially as described.

2. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage, racks mounted on the carriage and detachably engaging the wheels, power operated mechanism imparting motion to the carriage and racks and determining said motion, and manually operated mechanism controlling the power operated mechanism, substantially as described.

3. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage, racks mounted on the carriage and detachably engaging the wheels, pneumatically operated mechanism imparting motion to the carriage and racks and determining said motion, and manually operated mechanism controlling the pneumatically operated mechanism, substantially as described.

4. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage and power actuated operating mechanism therefor, racks mounted on the carriage and detachably engaging the wheels, power actuated mecha-

nism moving the racks independently into engagement with the wheels, power actuated stops for the carriage, power actuated devices controlling the carriage and rack operating mechanism, and manually operated devices controlling the power actuated parts of the machine, substantially as described.

5. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage and pneumatically actuated operating mechanism therefor, racks mounted on the carriage and detachably engaging the wheels, pneumatically actuated mechanism moving the racks independently into engagement with the wheels, pneumatically actuated stops for the carriage, pneumatically actuated valves controlling the air supply to the carriage and rack operating mechanism, and manually actuated valves controlling the air supply to the power actuated parts of the machine substantially as described.

6. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage, racks mounted on the carriage and detachably engaging the wheels, a power operated plunger arranged to impart motion in one direction to the carriage, a spring producing motion in the opposite direction, a power operated lever mechanism arranged in conjunction with each rack and moving the latter into engagement with a wheel of an indicating disk, a spring producing the disengaging movement of the rack, a carriage locking device released by any rack prior to movement of the carriage, and means for automatically returning the device to its original position after the return of the carriage, substantially as described.

7. In calculating machines, the combination with indicating disks and wheels, of a reciprocatory carriage, racks mounted on the carriage and detachably engaging the wheels, a pneumatic cylinder and piston and plunger imparting motion in one direction to the carriage, a spring producing motion in the opposite direction, a pneumatic cylinder and lever mechanism in conjunction with each rack and moving the latter into engagement with a wheel of an indicating disk, a spring producing the disengaging movement of the rack, a carriage locking device released by any rack prior to movement of the carriage, and means for automatically returning the device to its original position after the return of the carriage, substantially as described.

8. In calculating machines, the combination with indicating disks, of power actuated reciprocatory elements rotating the disks, stops situated in the path of motion of the said elements, and power operated mechanism actuating said stops individually, substantially as described.

9. In calculating machines, the combination with indicating disks, of pneumatically actuated reciprocatory elements rotating the disks, stops situated in the path of motion of the said elements, and pneumatic mechanism actuating said stops individually, substantially as described.

10. In calculating machines, the combination with indicating disks, of power actuated reciprocatory elements rotating the disks, a compound stop arranged in the path of motion of the said elements, and power actuated mechanism adapted to render said stop either effective or ineffective in arresting motion of the elements, substantially as described.

11. In calculating machines, the combination with indicating disks, of pneumatically actuated reciprocatory elements rotating the disks, a compound stop arranged in the path of motion of the said elements, and pneumatically actuated mechanism adapted to render said stop either effective or ineffective in arresting motion of the elements, substantially as described.

12. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, manually actuated levers, and valves arranged for operation by the said levers and adapted to control the admission and release of air to and from the said mechanism, substantially as described.

13. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for said elements, a number of manually operated levers, rods in conjunction with said levers, means actuated by the levers and controlling the application and release of power to and from the said power operated mechanism, and means engaging the rods and preventing operation of any rod after one has been depressed until the latter has been returned, substantially as described.

14. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, a number of manually operated levers, rods in conjunction with the levers, valves actuated by the levers and controlling the admission and release of air to and from the said pneumatically operated mechanism, and means engaging the rods and preventing operation of any rod after one has been depressed until the latter has been returned, substantially as described.

15. In calculating machines, the combination with indicating disks, of a reciprocatory carriage and elements rotating the disks, power actuated operating and controlling

mechanism for said carriage, a number of manually operated levers, rods in conjunction with the levers, means actuated by the levers and controlling the application and release of power to and from the said power actuated mechanism, catches engaging the rods, and means actuated from the carriage at the commencement of its movement for releasing the catches into engagement with all the rods excepting the one which has been depressed and withdrawing the catches after the carriage has returned, substantially as described.

16. In calculating machines, the combination with indicating disks, of a reciprocatory carriage and elements rotating the disks, pneumatically actuated operating and controlling mechanism for said carriage, a number of manually operated levers, rods in conjunction with the levers, valves actuated by the levers and admitting and releasing air to and from the pneumatically actuated mechanism, catches engaging the rods, and means actuated from the carriage at the commencement of its movement for releasing the catches into engagement with all the rods excepting the one which has been depressed and withdrawing the catches after the carriage has returned, substantially as described.

17. In calculating machines, the combination with indicating disks of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for said elements, a number of manually actuated levers, rods in conjunction with the levers, means actuated from the levers and controlling the application and release of power to and from the said power operated mechanism, and means engaging the rods and retaining the same on being depressed, substantially as described.

18. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, a number of manually actuated levers, rods in conjunction with the levers, valves actuated by the levers and controlling the admission and release of air to and from the said pneumatically operated mechanism, and means engaging the rods and retaining the same on being depressed, substantially as described.

19. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for said elements, a number of manually actuated levers, rods in conjunction with the levers, means actuated from the levers and controlling the application and release of power to and from the said power actuated mechanism, catches engaging and retaining the rods on being depressed, a bracket and stops mounted in the path of motion of the said elements, and receiving movement from the elements, and means actuated with the movement of the said bracket for releasing the catches, substantially as described.

20. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, a number of manually operated levers, rods in conjunction with the levers, valves actuated by the levers for the admission and release of air to and from the said pneumatically operated mechanism, catches engaging and retaining the rods on being depressed, a bracket and stops mounted in the path of motion of the said elements and receiving movement from the elements, and means actuated with the movement of the said bracket for releasing the catches, substantially as described.

21. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for the elements, a number of manually operated levers, means actuated by said levers and controlling the application and release of power to and from said mechanism, a check device preventing simultaneous operation of two or more levers, and a support for the said device, substantially as described.

22. In calculating machines the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for the elements, a number of manually operated levers, valves actuated by the levers and controlling the admission and release of air to and from said mechanism, a check device preventing simultaneous operation of two or more levers, and a support for said device, substantially as described.

23. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, a number of manually operated levers, valves actuated by said levers for controlling the admission and release of air to and from said mechanism, a hinged support carrying the levers, and means moving said support and thereby raising or lowering the levers into or out of their operative position, substantially as described.

24. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for said elements, a number of manually operated levers, rods in conjunction with the levers, means operated by the levers and controlling the application and release of power to and from said power operated mecha-

nism, catches engaging and retaining the rods on being depressed, a check device preventing simultaneous operation of two or more levers, a hinged support for said device, and means for both withdrawing the check device and support into an inoperative position and preventing engagement of the catches with the rods, substantially as described.

25. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, a number of manually operated levers, rods in conjunction with the levers, valves operated by the levers and controlling the admission and release of air to and from the said pneumatically operated mechanism, catches engaging and releasing the rods on being depressed, a check device preventing simultaneous operation of two or more levers, a hinged support for said device, and means for both withdrawing the check device and support into an inoperative position and preventing engagement of the catches with the rods, substantially as describe ..

26. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating mechanism for said elements, means controlling the application and release of power to and from the said mechanism, a number of power operated devices mounted adjacent to said means, and levers whereby the latter can be actuated from any one of the said devices, substantially as described.

27. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating mechanism for said elements, a valve admitting and releasing air to and from the said mechanism, a number of pneumatic cylinders and pistons and plungers mounted adjacent to said valve, and levers whereby the valve can be actuated from any one of the cylinders, substantially as described.

28. In calculating machines, the combination with indicating disks and wheels, of corresponding reciprocating elements detachably engaging and rotating the wheels, pneumatically actuated mechanisms independently engaging the said elements with their wheels, a valve admitting and releasing air to and from any of the mechanisms, and actuating means for the valve, substantially as described.

29. In calculating machines arranged in conjunction with a typewriter, the combination with indicating disks and wheels, of corresponding reciprocatory elements detachably engaging and rotating the wheels, pneumatically actuated mechanisms independently engaging the said elements with their wheels, a slide valve and distributing plate controlling the admission and release of air to and from each of the pneumatic mechanisms and means detachably engaging the valve with the typewriter carriage and operating the valve synchronously with the movements of the carriage, substantially as described.

30. In calculating machines arranged in conjunction with a typewriter, the combination with indicating disks and wheels, of corresponding reciprocatory elements detachably engaging and rotating the wheels, pneumatically actuated mechanisms independently engaging the said elements with their wheels, a slide valve and distributing plate controlling the admission and release of air to and from each of the pneumatic mechanisms, and means detachably engaging the valve with the typewriter carriage, operating the valve synchronously with the movements of the carriage, and pneumatically actuated mechanism controlled by the operator and arranged to return the valve to its original position independently of the typewriter carriage, substantially as described.

31. In calculating machines, the combination with indicating disks and wheels, of corresponding reciprocatory elements detachably engaging and rotating the wheels, pneumatically actuated mechanisms independently engaging the said elements with their wheels, a slide valve and distributing plate admitting and releasing air to and from the pneumatic mechanisms, means for actuating the valve, and a pneumatic device pressing the valve upon the distributing plate and correctly positioning the valve after each movement, substantially as described.

32. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically actuated operating mechanism for said elements, a slide valve and distributing plate controlling admission and release of air to and from said mechanism, a main air supply valve, and pneumatic mechanism controlled by the slide valve and adapted to close the said main valve when the slide valve is in either limit of its movement, substantially as described.

33. In calculating machines, the combination comprising two sets of indicating disks, reciprocatory elements rotating said disks, power actuated operating and controlling mechanism for said elements, a movable support for each set of disks, and means separately or jointly engaging the two sets of disks with the operating elements, substantially as described.

34. In calculating machines, the combination comprising two sets of indicating disks, reciprocatory elements rotating said disks, pneumatically actuated operating and controlling mechanism for said elements, a movable support for each set of disks, and means separately or jointly engaging the two sets of disks with the operating elements, substantially as described.

35. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for said elements, ratchet wheels and cams in operative connection with the disks, pawls engaging the ratchets and power operated devices controlled by the cams and imparting motion to the pawls, substantially as described.

36. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, ratchet wheels and cams in operative connection with the disks, pawls engaging the ratchets and pneumatically operated devices controlled by the cams and imparting motion to the pawls, substantially as described.

37. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for said elements, cams and ratchet wheels in operative connection with the disks, a number of air valves and rods actuated by cams, cylinders and pistons, and pawls transmitting motion from the pistons to the ratchet wheels, substantially as described.

38. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for the elements, cams and ratchets in operative connection with the disks, a number of air inlet valves and rods actuated by cams, catches engaging the rods, an air release valve, cylinders and pistons, pawls transmitting motion from the pistons to the ratchet wheels, and pneumatically operated mechanism actuating the release valve and catches, substantially as described.

39. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, power operated actuating and controlling mechanism for the elements, ratchet wheels and cams in operative connection with the disks, pawls engaging the ratchet wheels and imparting motion in either a backward or forward direction to the disks, power operated devices controlled by the cams and imparting movements to the disks through the pawls, and manually actuated mechanism arranged to reverse the action of the pawls of the reciprocatory elements operating the disks, substantially as described.

40. In calculating machines, the combination with indicating disks, of reciprocatory elements rotating the disks, pneumatically operated actuating and controlling mechanism for the elements, ratchet wheels and cams in operative connection with the disks, pawls engaging the ratchet wheels and imparting motion in either a backward or forward direction to the disks, pneumatically operated devices controlled by the cams and imparting movements to the disks through the pawls, and manually actuated mechanism arranged to reverse the action of the pawls of the reciprocatory elements operating the disks, substantially as described.

41. In calculating machines, the combination with indicating disks and wheels, of reciprocatory elements rotating the disks and wheels, a slotted spindle having wheels mounted thereon and connected with the disks, a notched bar in said spindle, a pivoted handle adapted to rotate the spindle and slide the bar therein, keys engaging or disengaging the wheels to or from the spindle with the movements of the bar, and springs pressing the keys against the spindle, substantially as described.

In testimony whereof, I affix my signature in presence of two witnesses.

ARTHUR WILLIAM HARRIS.

Witnesses:
JOHN MORGAN,
HARRY DAVIS.