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PROVISIONAL SPECIFICATION.

Improvements in Calculating Machines.

A communication from abroad by HENRY GOLDMAN, Accountant and Manufacturer, of Chicago, in the State of Illinois, United States of America.

I, JAMES GRIEVE LORRAIN, M.I.E.E., M.I.Mech.E., of Norfolk House, Norfolk Street, London, W.C., in the County of Middlesex, Chartered Patent Agent, do hereby declare the nature of this invention (as communicated to me from abroad) to be as follows:—

This invention relates to improvements in calculating machines by means of which certain advantages are obtained.

In order that the invention may be readily understood I have appended hereto certain sheets of drawings, in which

Fig. 1 shows my calculating machine, as seen from above.

Fig. 2 shows the right hand side of the side-plate, the outer cover-plate being removed.

Fig. 3 shows the interior construction after the two side-pieces (Figs. 4 and 5) are removed to show the mechanism of a chamber or cell.

Fig. 4 shows the inner side-plate and Fig. 5 shows the cover-plate.

Fig. 6 shows two numeral-tablets and their end-connecting piece

Fig. 7 shows a top view of the internal mechanism of the machine.

Fig. 8 shows a septum or partition between successive cells.

Fig. 9 shows a transverse section of Fig. 1, taken at any point, as on the plane *x x* of Fig. 1.

Fig. 10 shows an enlarged plan of two registering-wheels, together with parts of the side-wall, *b c*, (Figs. 4 and 5) in section, a part of the registering-wheel shaft and the resetting-wheel with its stop-mechanism.

Fig. 11 shows a central section of one of the registering-wheels of Fig. 10, the shaft and the septum.

Fig. 12 shows a fragment of the side-plate *b.* shown in Fig. 4, with the stop-mechanism shown in Fig. 10, in side view.

Fig. 13 shows a fragment of the stop-pin, in elevation or perspective.

Fig. 14 shows, in front and in side elevation, a pawl which holds the registering-wheels from reversing motion.

Fig. 15 shows a side view of a registering-wheel as seen from the right hand end of the shaft together with a fragment of the actuating chain of it with the mechanism of its opposite side in broken outlines.

Fig. 16 shows the reverse side of the wheel shown in Fig. 15, with the mechanism of the opposite side in broken or dotted outlines.

Fig. 17 shows a fragment of the upper part of a septum and a registering-wheel on the further side of it, a part of said wheel covered by said septum, being shown in broken or dotted outlines. The pawl *q* is the actuating member to said wheel, and forms a part of the wheel on this, or near side of said septum,

[*Price 8d.*]

its spur q^1 reaches across the septum and as shown is just making contact with the tooth e^3. The wheel to which said pawl and its spring belong being removed in both Figs. 17 and 18 to fully indicate the operation.

Fig. 18 shows the said parts of Fig. 17 after the pawl q has completed its work and is released from the tooth e^3 by the action of the cam-edge o^5, the wheel e having now advanced the space of one tooth.

Said Figures 15, 16, 17 and 18 show the mechanism and its operation which performs the decimal notation of my machine.

Fig. 19 shows a collar on which the registering-wheels turn, and are carried in end view.

Figure 20 shows a reversing-cam in side view.

Fig. 21 shows a fragment of the upper end of the cover-plate showing the resetting-wheel and the stop mechanism on it.

Fig. 22 shows the resetting-wheel of Fig. 21 on its reverse side. Fig. 23 shows a fragment of the lower or front end of the bottom plate of the machine with its rollers.

Fig. 24 shows the right hand of a fragment of a registering-wheel, a chain-roller and chain, the ends of the levers which operate the chain in place and the free end of the long lever with a part of its length broken out and its normal position indicated in broken outlines while the extreme position of the opposite condition is shown in full lines.

Fig. 25 shows two links of the chain in side elevation.

Fig. 26 shows Fig. 25 as seen from below.

Fig. 27 shows both a front and an end elevation of a sliding shutter.

Fig. 28 shows, in front and end elevation, a separatrix or decimal pointer.

Fig. 29 shows an end for end reversed view of the registering-wheel shaft.

Fig. 30 shows a spring which works on the lever and chain within the respective cells, seen in elevation.

Fig. 31 shows the spring, shown in preceding figure, in plan.

Fig. 32 shows a chain-cover, or shield, or guard, for shielding any chain against the stylus point.

Fig. 33 is an adjustable stop for the stylus.

Like letters of reference denote like parts in all figures.

The purpose of my invention is to produce a machine, adapted to perform all arithmetical computations, of large capacity, though small in dimensions, light, low-priced, durable and accurate, with an operating surface like the ruling of an account-book, over which the machine may be moved, and serve as a guide to the figures operated upon, yet so simple in its mode of operation, that it may be used by anyone without practice or preparation.

My machine is placed in a metal case a which can be opened on the right hand side, because thus most convenient for replacing or removing its contained mechanism. Said opening is closed by a side-plate b, fitting within the walls of the case, and a cover-plate c fitting over the case.

The top of the case has an opening within which the chain-mechanism is operated. A raised chamber a^1, at the upper end of the case, contains the registering mechanism, consisting of a channeled shaft d on which rotate a series of notationally connected registering-wheels e having long figure-receiving tooth-faces e^2, and radial faces e^1.

Endless chains g moving under and tangentially to the wheels e on rollers h, h, turning on shafts i are so placed as to bring the spurs g^1 in contact with the tooth-faces e^1 and while the chain g moves tangentially to the wheel e it is, simultaneously, actuated towards and from said wheel to engage and release its spurs with the teeth of said wheel by means of connected levers j k, (see Fig. 24), the fulcrum of the lever j being on an off-set arm j^2, the lever j fulcrumed at j^1; the lever k being fulcrumed at k^1 near the shoulder made by said off-set arm; and at said shoulder is a spur j^3 which engages an offset-spur j^4 of the lever k.

In Fig. 24 the normal condition of the levers j k is shown in broken lines,

their upper edges forming a straight line, while their opposite condition is shown in full lines; the chain g depressed by the stylus l (Fig. 3) bringing the parts e^1 g^1 in full contact, the chain g moving on the upper edge of the levers j k. The stylus l is set on the chain at any point below the roller s and pressed down to the roller s^1 where every stroke made with it is ended.

A notch m^4 in the lever-leg j^5 through which passes a bar m^5, limits the motion of the levers j and k. The roller s^1 makes an easy passage under it of the depressed chain-spur g^1 and also helps said chain-spur to rise behind it and pass between it and the bar s^3 whose front edge arrests the chain-spur, and the roller s partially arrests the chain by allowing the chain-spur to pass between it and the bar s^2 when the chain rises with the lever j. The bar s^2 is rounded in front to allow the chain to move from it freely when it is started.

The drum h (Fig. 24) may be notched into teeth h^1 to receive the end of the lever k to aid in promptly arresting the chain-motion. The roller k^2 reduces friction, but is not essential.

A spring m, pivotally supported on a rod at m^2 presses with both its ends against the lever j and raises and holds it to its normal position. The extended and supplemental member m^1 of said spring depresses the chain under it and yieldingly counteracts the lever k while the foot j^5 depresses the part of the chain under it which, thereby, tends to straighten the upper half of the chain and release it from its locked position between the parts s^1, s^2, said springs and levers always taking up all slack but never straining the chain. The spring-end m^3 lifts the free end of the lever j.

A pawl f on a shaft f^1 pressed by a spring f^2 against the wheel e both prevents reverse motion and also completes any insufficient motion of each wheel e by means of its beveled end-face f^3 which slides over the radial face e^1 until pawl and wheel-face e^2 touch, then the end-face of the pawl will be on the face e^1 and the wheel e in normal position.

The notation-wheel, and thereto connected mechanism, of a single cell, as above set forth, is complete, but is, serially, connected for carrying to any number of such cell-mechanism by recessing the notation-wheels e (see Figs. 15, 16, 17, and 18), on the right hand side with a series of peripheral in-pointing teeth e^3 and a plain peripheral circle e^5 on the opposite side. Said recessing is indicated by the broken lines e^4 e^4, shown in Fig. 11, and it extends to the wheel-hub e^0. In the left hand recess are pawls q and r hinged at q^3 and r^3, with short spurs q^2 and r^2 and springs q^4 r^4 to said spurs, one of said spurs pressing interiorly, the other exteriorly; the latter to throw the free end of the pawl outwardly, against the rim e^5 and the other to throw its free end inwardly onto the cam p, provided with a radial notch-face p^1. Said pawls have, each, a spur at their free ends q^1 r^1, projecting vertically from the wheel; the spur q^1 reaching across the septum o into the teeth e^3 of the next wheel and the spur r^1 across the cam p. The cam p is of the same thickness as the septum o, and in its plane and is held by the spur p^2 in the groove d^1 to rotate with its axis.

The incomplete circle o^2, in the septum o, holds the spur q^1, radially, inside the teeth e^3 until it reaches the edge o^4, at one end of said arc o^2, after which it slides on the face of the tooth e^3 and catches the radial face of its next tooth, which it takes along until the edge o^5, a tangent part of the arc o^2; pushes it inward until released from said tooth, (Fig. 18). The said spur is thus carried across the gap between the edges o^4 o^5, it having turned the wheel e the length of one registering-tooth, or distance between two radial faces e^1. Said gap is also shown as o^1 in Fig. 8.

The spur r^1 rides over the cam p, continuously, until the wheels e are to be reset to zero, when the axle d is turned toward said cam-face p^1 by the resetting-wheel a^2 so as to cause the outer face of the spur r^1 to push against the radial face whereby said spurs are assembled into line, set so as to bring all the zero-marked faces on e^2 to the registering-opening t at that same time the stop s^4 is thrown into the hole s^5 of the resetting wheel a^2 by the forked spring s^6 slipped

into the groove s^8 on the stop s^4, one revolution of said shaft always setting all said wheels to zero. The push-bottom s^x releases the wheel a^2.

The hubs e^0 of the wheels e turn on collars n slightly longer than the hubs e^0 and they hold the cams p in place and also prevent frictional contact of the wheels and septa.

To indicate certain notations the tops of the septa or partitions o are made of different form, or color, as shown at o^7. The chains may also be similarly distinguished for like purposes.

A shutter t^1, held by inturned ends t^2 in undercut grooves t^3 moves over the register-opening and covers such figures as the operating of the machine may require; and below said shutter moves a pointer u held by a stud u^1 in a slot u^2 for decimal or other notation.

On the sides c are tablets v each provided with a row of large figures v^1 and outside thereof a row of smaller figures, the one on the left v^2 beginning with zero and ending with nine. while the one on the right v^3 begins with one and ends with ten, the numeral, one, being written within the large cipher of the other row of numerals. Said sets of figures occupy opposite squares whose dividing line is in line with the transverse rows of chain-spurs g^1, which always stop on such lines. A transverse plate v^4 connects the side-tablets v into a single piece. A shutter, or chain-guard, w. Fig. 32, with spurs w^1 w^2 at its ends, sprung between and held by the rollers s s^1 covers an entire row of chain-links for the purpose of preventing their use, while the numbers on its face correspond with the larger side-tablet figures, to farther aid the eye in the same manner as do said larger figures. One of said shutters divides the machine into two independent machines whose results, within certain limits, depending on the number of chains on either side of the shutter, or shutters so used, give practical results.

Two or more such shutters may be used to divide the machine into two or more independent result-producing machines.

An adjustable transverse stop 12 having arms 13 parallel to the tablets v, under which they slide and hold said stop, slides on said tablets which may be adjusted over any row of chain-spurs to stop the motion of the stylus is particularly advantageous when the registration of the same figures in different columns is required as it admits of increased speed and convenience in operation. The stylus-point is claw-like in form so that its point may push the chain-spur fully under the roller which stops the stylus.

The front edge of the case has a scale 11 which corresponds to the ruling of an account-book and thus serves to guide the accountant as he runs over the page from the top downward. Rollers n^x projecting slightly from the bottom of the case a reduce the friction of the machine as it runs down the page of the account-book.

The operation of my computing machine, called the "arithmachine," is substantially as follows, namely:

To place a number on the arithmachine the large figures on each tablet, constituting the fundamental numeral scales, direct where the stylus point is to be inserted, and the septa aid in selecting the notational chain, where the stylus is to be depressed and moved to its stop. To indicate 70, for instance; the stylus point is inserted opposite the large 7 in the second column from the right, and moved forward with the chain to the stop. A number composed of two or more significant figures, is placed by registering the several figures successively. Ciphers are never registered because the place value of the significant figures is defined by the columnar arrangement of the chain-surface. To register the complement of a number the small figures on the left hand tablet govern, except units figures, which are registered according to the small figures of the right hand tablet. For instance, by placing 567, according to the small figures, 433 appears in the register-opening, which is the difference between 567 and 1000.

In addition the numbers or amounts are placed successively, according to the large numeral scale, preferably from the left to the right, as written, starting at the head of the page or column, keeping the figures at the front end of the machine, and making mental combinations whenever practicable. For example, 475 and 25 are registered as 500 by a single stylus stroke.

In subtraction the minuend is registered according to the large figures, while the subtrahend is placed according to the small figures. The difference then appears in the register-opening, from which, however, the figure one, in the highest place, must always be omitted.

Multiplication is best performed by simply registering the partial products of the multiplicand by the figures of the multiplyer, taking care that the results of the multiplication table are placed in the proper columns, which produces the answer in the register-opening.

In division the dividend is first registered, according to the large figures, then the divisor is registered, complementally, or according to the small figures, as often as contained in the first partial dividend, whereupon the first remainder appears in the register opening and the first quotient figure in the left hand place. The adjoining figure of the dividend is then annexed and the operation repeated until every figure of the dividend has been used. The sliding shutter and decimal pointer are, here, advantageously employed.

In computations with common fractions and denominate quantities, as pounds, shillings, pence, and so forth; the chain-guard is utilized to, practically, suspend the decimal operation of the wheels between the different denominations. For instance, English currency requires the use of two chain-guards, so placed as to preserve two places for pence and two places for shillings. The operations are then performed as with ordinary numbers and the partial results reduced to the proper denomination. Problems in interest, discount, average, and so forth, are easily solved and computations involving powers, riots, logarithms, and the like, are quickly solved on my arithmachine; in fact all known methods of mental or manual arithmetic can be readily worked on my machine.

Dated this 15th day of May 1899.

J. G. LORRAIN,
Communicatee.

COMPLETE SPECIFICATION.

Improvements in Calculating Machines.

A communication from abroad by HENRY GOLDMAN, Inventor, Accountant and Manufacturer, of Chicago, in the State of Illinois, United States of America.

I, JAMES GRIEVE LORRAIN, M.I.E.E., M.I.Mech.E., of Norfolk House, Norfolk Street, London, W.C., in the County of Middlesex, Chartered Patent Agent, do hereby declare the nature of this invention (as communicated to me from abroad) and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in calculating machines by means of which certain advantages are obtained.

In order that this invention may be readily understood I shall refer to the drawings left with my Provisional Specification, in which

Fig. 1 shows my calculating machine, as seen from above.

Fig. 2 shows the right hand side of the side-plate, the outer cover-plate being removed.

Fig. 3 shows the interior construction after the two side-pieces (Figs. 4 and 5) are removed to show the mechanism of a chamber or cell.

Fig. 4 shows the inner side-plate and Fig. 5 shows the cover-plate.

Fig. 6 shows two numeral-tablets and their end-connecting piece.

Fig. 7 shows a top view of the internal mechanism of the machine.

Fig. 8 shows a septum or partition between successive cells.

Fig. 9 shows a traverse section of Fig. 1, taken at any point, as on the plane *x x* of Fig. 1.

Fig. 10 shows an enlarged plan of two registering-wheels, together with parts of the side-wall, *b c*, (Fig. 4 and 5) in section, a part of the registering-wheel shaft and the resetting-wheel with its stop-mechanism.

Fig. 11 shows a central section of one of the registering-wheels of Fig. 10, the shaft and the septum.

Fig. 12 shows a fragment of the side-plate *b*. shown in Fig. 4, with the stop-mechanism shown in Fig. 10, in side view.

Fig. 13 shows a fragment of the stop-pin, in elevation or perspective.

Fig. 14 shows, in front and in side elevation, a pawl which holds the registering-wheels from reversing motion.

Fig. 15 shows a side view of a registering-wheel as seen from the right hand end of the shaft together with a fragment of the actuating chain of it with the mechanism of its opposite side in broken outlines.

Fig. 16 shows the reverse side of the wheel shown in Fig. 15, with the mechanism of the opposite side in broken or dotted outlines.

Fig. 17 shows a fragment of the upper part of a septum and a registering-wheel on the farther side of it, a part of said wheel covered by said septum, being shown in broken or dotted outlines. The pawl q is the actuating member to said wheel, and forms a part of the wheel on this, or near side of said septum, its spur q^1 reaches across the septum and as shown is just making contact with the tooth e^3. The wheel to which said pawl and its spring belong being removed in both Figs. 17 and 18 to fully indicate the operation of said pawl.

Fig. 18 shows the said parts of Fig. 17 after the pawl q has completed its work and is released from the tooth e^3 by the action of the cam-edge o^5, the wheel e having now advanced the space of one tooth.

Said Figures 15, 16, 17 and 18 show the mechanism and its operation which performs the decimal notation of my machine.

Fig. 19 shows a collar, on which the registering-wheels turn and are carried, in end view.

Fig. 20 shows a reversing cam in side view.

Fig. 21 shows a fragment of the upper end of the cover-plate showing the resetting-wheel and the stop mechanism on it.

Fig. 22 shows the resetting-wheel of Fig. 21 on its reverse side. Fig. 23 shows a fragment of the lower or front end of the bottom plate of the machine with its rollers.

Fig. 24 shows the right hand of a fragment of a registering-wheel, a chain-roller and chain, the ends of the levers which operate the chain in place and the free end of the long lever with a part of its length broken out and its normal position indicated in broken or dotted outlines while the extreme position of the opposite condition is shown in full lines.

Fig. 25 shows two links of the chain in side elevation.

Fig. 26 shows Fig. 25 as seen from below.

Fig. 27 shows both a front and an end elevation of a sliding shutter.

Fig. 28 shows, in front and end elevation, a separatrix or decimal pointer.

Fig. 29 shows an end for end reversed view of the registering-wheel shaft.

Fig. 30 shows a spring which works on the lever and chain within the respective cells, seen in elevation.

Fig. 31 shows the spring, shown in preceding figure, in plan.

Fig. 32 shows a chain-cover, or shield, or guard, for shielding any chain against the stylus point.

Fig. 33 is an adjustible stop for the stylus in its upward motion. It is shown applied at the top of the tablets in Fig. 1.

Like letters of reference denote like parts in all figures.

The purpose of my invention is to produce a machine adapted to perform all arithmetical computations, of large capacity, though small in dimensions, light, low-priced, durable and accurate, with an operating surface like the ruling of an account-book, over which the machine may be moved, and serve as a guide to the figures operated upon, yet so simple in its mode of operation that it may be used by anyone, without practice or preparation.

My machine is placed in a metal case *a* which can be opened on the right hand side, because thus most convenient, for placing or removing its contained mechanism. Said opening is closed by a side plate *b*, fitting within the walls of the case, and a cover-plate *o* fitting over the case.

The top of the case has an opening within which the chain-mechanism is operated. A raised chamber a^1, at the upper end of the case, contains the registering mechanism, consisting of a channeled shaft *d* on which rotate a series of notationally connected registering-wheels *e* having long figure-receiving tooth-faces e^2, and radial faces e^1.

Endless chains *g* moving under and tangentially to the wheels *e* on rollers *h h* turning on shafts *i* are so placed as to bring the spurs g^1 in contact with the tooth-faces e^1 and while the chain *g* moves tangentially to the wheel *e* it is, simultaneously, actuated towards and from said wheel to engage and release its spurs with the teeth of said wheel by means of connected levers *j k*, (see Fig. 24), the fulcrum of the lever *j* being on an off-set arm j^2, of the lever *j* fulcrumed at j^1; the lever *k* being fulcrumed at k^1 near the shoulder made by said off-set arm; and at said shoulder is a spur j^3 which engages an offset-spur j^4 of the lever *k*.

In Fig. 24 the normal condition of the levers *j k* is shown in broken lines, their upper edges forming a straight line, while their opposite condition is shown in full lines the chain *g* depressed by the stylus *l* (Fig. 3) bringing the parts e^1 g^1 in full contact, the chain *g* moving on the upper edge of the levers *j k*. The stylus *l* is set on the chain at any point below the roller *s* and drawn down to the roller s^1 where every stroke made with it is ended.

A notch m^4 in the lever-leg j^5 through which passes a bar m^5 limits the motion of the levers *j* and *k*. The roller s^1 makes an easy passage under it of the depressed chain-spur g^1 and also helps said chain-spur to rise behind it and pass between it and the bar s^3 whose front edge arrests the chain-spur and the roller *s* partially arrests the chain by allowing the chain-spur to pass between it and the bar s^2 when the chain rises with the lever *j*. The bar s^2 is rounded in front to allow the chain to move freely when it starts.

The drum *h* (Fig. 24) may be notched into teeth h^1 to receive the end of the lever *k* to aid in promptly arresting the chain-motion. The roller k^2 reduces friction, but is not essential.

A spring *m*, pivotally supported on a rod at m^2 presses with both its ends against the lever *j* and raises and holds it to its normal position. The extended and supplemental member m^1 of said spring depresses the chain under it and yieldingly counteracts the lever *k* while the foot j^5 depresses the part of the chain under it which thereby tends to straighten the upper half of the chain and release it from its locked position between the parts s^1 s^2, said springs and levers always taking up all slack but never straining the chain. The spring-end m^3 lifts the free end of the lever *j*.

A pawl *f* on a shaft f^1 pressed by a spring f^2 against the wheel *e* both prevents reverse motion and also completes any insufficient motion of each wheel *e* by means of its beveled end-face f^3 which slides over the radial face e^1 until pawl and wheel-face e^2 touch then the end-face of the pawl will be on the face e^1 and the wheel *e* in normal position.

The notation-wheel, and thereto connected mechanism of a single cell, as above set forth, is complete, but is serially connected for carrying to any number of such cell-mechanism by recessing the notation-wheels e (see Figs. 15, 16, 17 and 18) on the right hand side with a series of peripheral in-pointing teeth e^3 and a plain peripheral circle e^5 on the opposite side. Said recessing is indicated by the broken or dotted lines e^4 e^4 shown in Fig. 11, and it extends to the wheel-hub e^0. In the left hand recess are pawls q and r hinged at q^3 and r^3, with short spurs q^2 and r^2 and springs q^4 r^4 to said spurs, one of said spurs pressing interiorly the other exteriorly; the latter to throw the free end of the pawl outwardly, against the rim e^5 and the other to throw its free end inwardly onto the cam p provided with a radical notch-face p^1. Said pawls have each a spur at their free ends q^1 r^1 projecting vertically from the wheel; the spur q^1 reaching across the septum o into the teeth e^3 of the next wheel and the spur r^1 across the cam p. The cam p is of the same thickness as the septum o and in its plane, and is held by the spur p^2 in the groove d^1 to rotate with its axis.

The incomplete circle o^2 in the septum o, holds the spur q^1, radially, inside the teeth e^3 until it reaches the edge o^4, at one end of said arc o^2, after which it slides on the face of the tooth e^3 and catches the radial face of its next tooth, which it takes along until the edge o^5, a tangent part of the arc o^2, pushes it inward until released from said tooth (Fig. 18). The said spur is thus carried across the gap between the edges o^4 o^5, it having turned the wheel e the length of one registering tooth, or distance between two radial faces e^1. Said gap is also shown as o^1 in Fig. 8.

The spur r^1 rides over the cam p continuously, until the wheels e are to be reset to zero, when the axle d is turned toward said cam-face p^1 by the resetting wheel a^2 so as to cause the outer face to the spur r^1 to push against the radial face whereby said spurs are assembled into line, set so as to bring all the zero-marked faces on e^2 to the registering-opening t and at that same time the stop s^4 is thrown into the hole s^5 of the resetting-wheel a^2 by the forked spring s^6 slipped into the groove s^8 on the stop s^4 one revolution of said shaft always setting all said wheels to zero. The push-button s^x releases the wheel a^2.

The hubs e^0 of the wheels e turn on collars n slightly longer than the hubs e^0 and they hold the cams p in place and also prevent frictional contact of the wheels and septa.

To indicate certain notations the tops of the septa or partitions o are made of different form, or color, as shown at o^7. The chains may also be similarly distinguished for like purposes.

A shutter t^1 held by inturned ends t^2 in undercut grooves t^3 moves over the register-opening and covers such figures as the operating of the machine may require, and below said shutter moves a pointer u held by a stud u^1 in a slot u^2 for decimal or other notation.

On the sides c are tablets v each provided with a row of large figures v^1 and outside thereof a row of smaller figures, the one on the left v^2 beginning with zero, and ending with nine. while the one on the right v^3 begins with one and ends with ten, the numeral one being written within the large cipher of the other row of numerals. Said sets of figures occupy opposite squares, whose dividing line is in line with the transverse rows of chain spurs g^1, which always stop on such lines. A transverse plate v^4 connects the side tablets v into a single piece. A shutter, or chain-guard w. Fig. 32, with spurs w^1 w^2 at its ends, sprung between and held by the rollers s s^1 covers an entire row of chain-links for the purpose of preventing their use while the numbers on its face corresponds with the larger side-tablet figures, to further aid the eye in the same manner as do said larger figures. One of these shutters divides the machine into two independent machines whose results, within certain limits, depending on the number of chains on either side of the shutter or shutters so used give practical results.

Two or more such shutters may be used to divide the machine into two or more independent result-producing machines.

An adjustable transverse stop l^2 having arms l^3 parallel to the tablets v under which they slide and hold said stop, slides on said tablets which may be adjusted over any row of chain-spurs to stop the motion of the stylus is particularly advantageous when the registration of the same figures in different columns is required as it admits of increased speed and convenience in operation. The stylus-point is claw-like in form so that its point may push the chain-spur fully under the roller which stops the stylus.

The front edge of the case has a scale l l which corresponds to the ruling of an account-book and thus serves to guide the accountant as he runs over the pages from the top downward. Rollers a^1 projecting slightly from the bottom of the case a reduce the friction of the machine as it runs down the page of the account-book.

The operating of my computing machine, called the "Arithmachine" is substantially as follows, namely:

To place a number on the arithmachine the large figures on each tablet, constituting the fundamental numeral scales, direct where the stylus point is to be inserted, and the septa aid in selecting the notational chain, where the stylus is to be depressed and moved to its stop. To indicate 70, for instance, the stylus point is inserted opposite the large 7, in the second column from the right, and moved forward from the chain to the stop. A number composed of more significant figures is placed by registering the several figures successively. Ciphers are never registered because the place value of the significant figures is defined by the columnar arrangement of the chain-surface. To register the complement of a number the small figures on the left hand tablet govern, except units figures, which are registered according to the small figures of the right hand tablet. For instance, by placing 567, according to the small figures, 433 appears in the register-opening, which is the difference between 567 and 1000.

In addition the numbers or amounts are placed successively according to the large numeral scale, preferably from the left to the right, as written, starting at the head of the page or column, keeping the figures at the front end of the machine, and making mental combinations whenever practicable. For example 475 and 25 are registered as 500 by a by a single stylus stroke.

In subtraction the minuend is registered according to the large figures, while the subtrahend is placed according to the small figures. The difference then appears in the register-opening, from which, however, the figure one, in the highest place, must always be omitted.

Multiplication is best performed by simply registering the partial products of the multiplicand by the figures of the multiplier, taking care that the results of the multiplication table are placed in the proper columns, which produces the answer in the register-opening.

In division, the dividend is first registered, according to the large figures, then the divisor is registered, complementally, or according to the small figures, as often as contained in the first partial dividend, whereupon the first remainder appears in the register-opening, and the first quotient figure in the left hand place. The adjoining figure of the dividend is then annexed and the operation repeated until every figure of the dividend has been used. The sliding shutter and decimal pointer are here advantageously employed.

In computations with common fractions, and denominate quantities, as pounds, shillings, pence, and so forth, the chain-guard is utilized to practically suspend the decimal operation of the wheels between the different denominations, for instance, English currency requires the use of the two chain-guards, so placed as to preserve two places for pence and two places for shillings. The operations are then performed as with ordinary numbers and the partial results reduced to the proper denomination. Problems in interest, discount, average, and so

forth are easily solved and computations involving powers, roots, logarithms and the like, are quickly solved on my arithmachine; in fact all known methods of manual arithmetic can be readily worked on my machine.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The combination with a series of operatively connected and toothed, non-reversible, registering-wheels, of endless chains, on rollers, radially tangent to said wheels, substantially as set forth.

2. The combination with spurred endless, roller-mounted, chains and rotating, non-reversible, registering-wheels, tangent at a radial point to said chains, of opposed tablets, each provided with numerals, relatively complemental to nine on one tablet, and relatively complemental to ten on the other tablet, substantially as set forth.

3. The combination with spurred endless, roller-mounted, chains and regis tering-wheels tangent at a radial point to said chains, and a register-opening, of opposed tablets each provided with scale-numbers relatively complemental to nine on one tablet and relatively complemental to ten on the other tablet, and chain-covers and register opening with movable shutter and separatrix, or decimal pointer, substantially as set forth.

4. The combination with a series of revoluble non-reversible chain-spur actuated side-recessed numerating-wheels, the right hand-sided recesses provided with teeth and the opposite recesses with two spring-actuated pawls, one actuated centripetally and the other centrifugally, and each provided with a spur at its free end, vertical to its wheel, of a shaft for said wheels, a circular cam with a radial spur and a septum in the same plane between said wheels, an opening in said septum forming a cam to operate said centrifugally acting spur to engage and release said in-pointing teeth and operate said numerating-wheels, and a hand-wheel with releasable spring-stop to said shaft to reset said numerating-wheels to zero, substantially as set forth.

5. The combination with a series of numerating-wheels and endless and spurred chains on rollers, radially tangent, to actuate said wheels, of spring-actuated and connected levers to carry and laterally actuate said chain, and rollers and bars to catch and release said chain-spurs, and a stylus to operate said chain, substantially as set forth.

6. The combination with a series of numerating-wheels and endless, radially tangent and spurred, actuating-chains and septa between said chains, of a stylus with curved point to actuate said chains, substantially as set forth.

7. The combination with a series of endless and spurred chains and numerating-wheels, actuated by said chains, of septa and chains provided with distinguishing colors and marks, substantially as set forth.

8. The combination with a series of chains and numerating-wheels actuated by said chains, of means to shut out any of said chains and thereby, temporarily, separate the numerating-wheels and chains into independent result-producing machines, substantially as set forth.

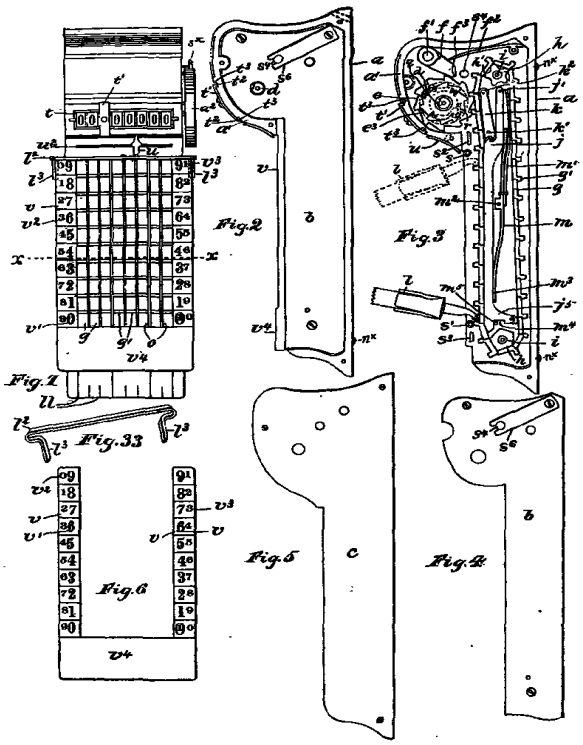
Dated this 15th day of February 1900.

J. G. LORRAIN, C.P.A.,
Communicatee.

Redhill: Printed for Her Majesty's Stationery Office, by Malcomson & Co., Ltd.—1900.

A.D. 1899. May 15. N° 10,237.
LORRAIN'S Provisional Specification.

SHEET 1



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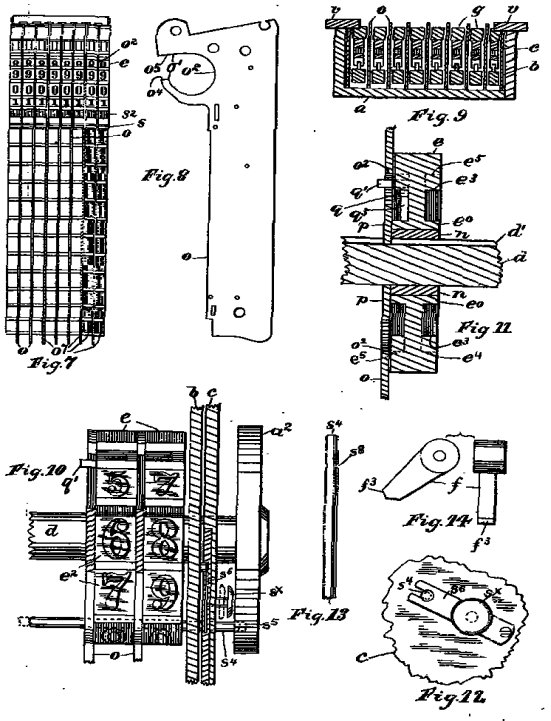

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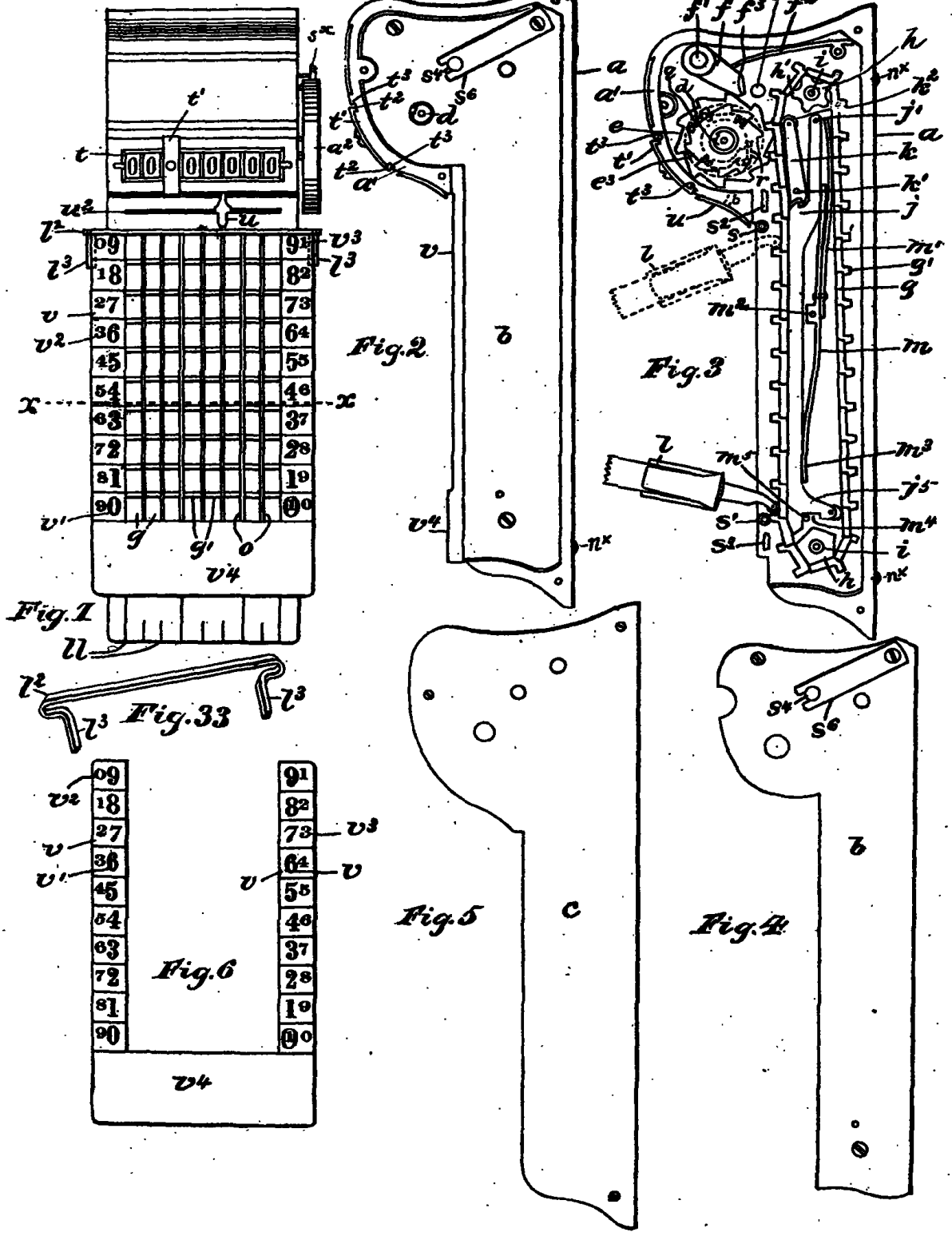
A.D. 1899. May 15. N:: 10,237.

LORRAIN'S Provisional Specification.



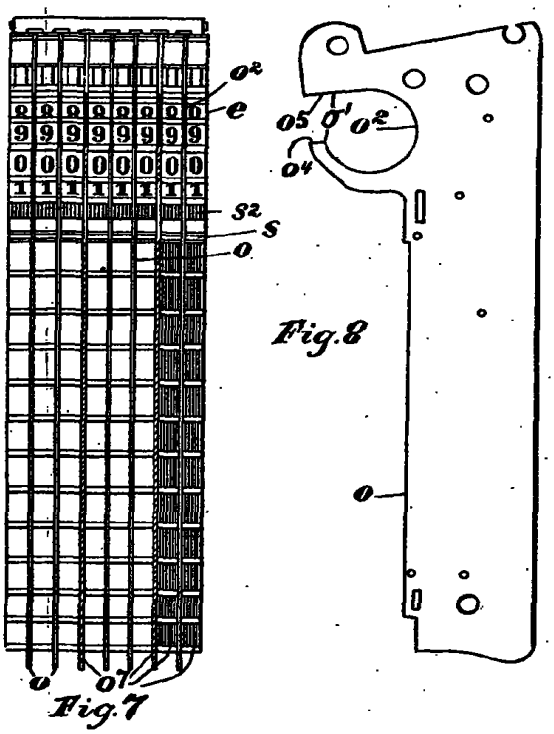


Fig. 7

Fig. 8

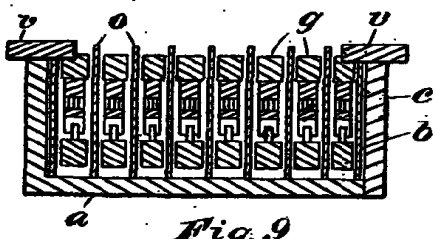
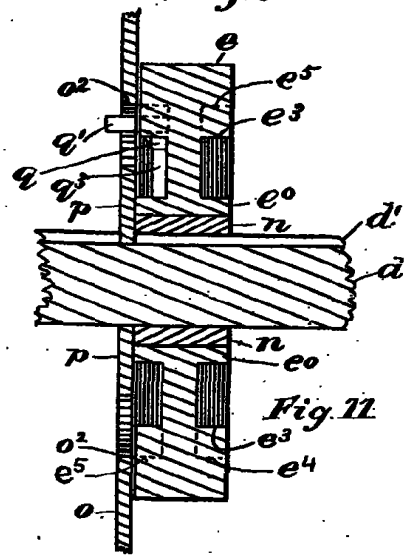


Fig. 9



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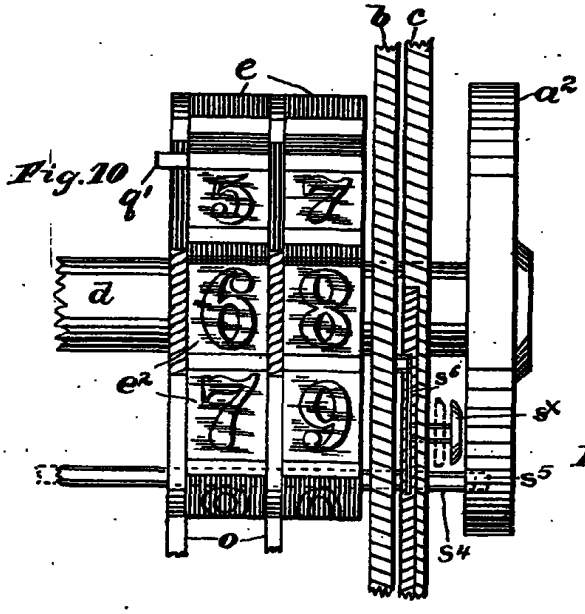
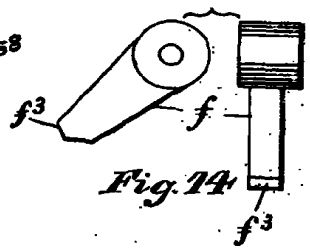


Fig. 10

Fig. 13



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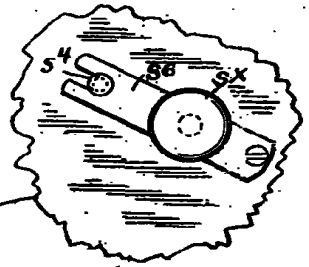

Fig. 12

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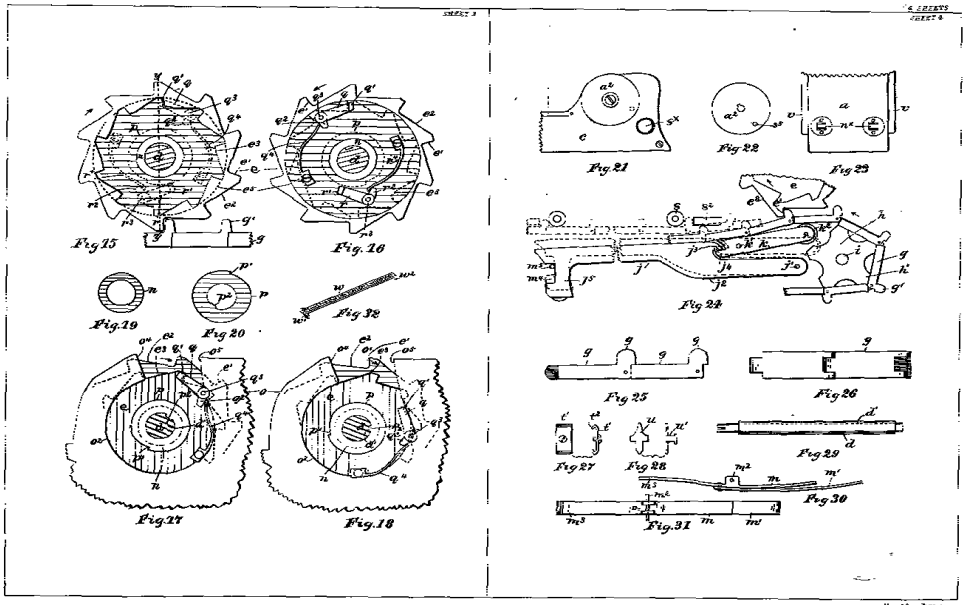

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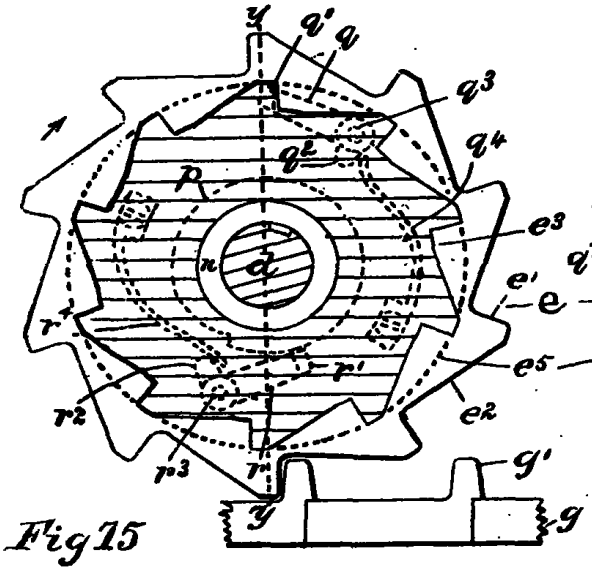
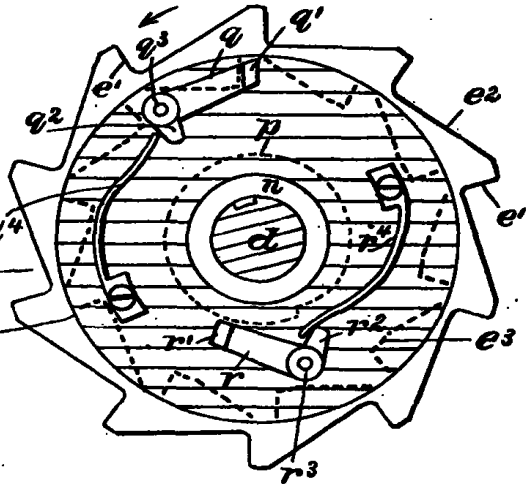


Fig 15



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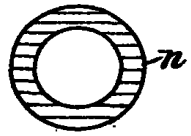

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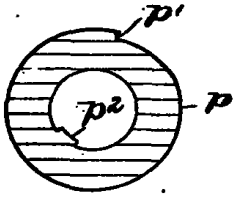
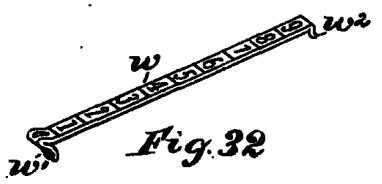


Fig.20



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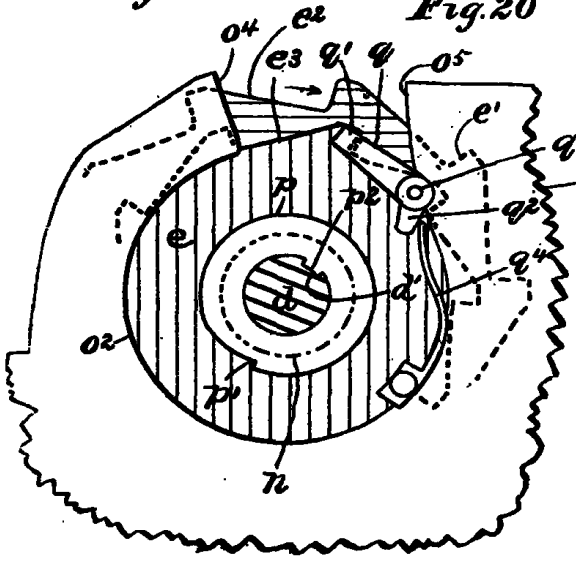

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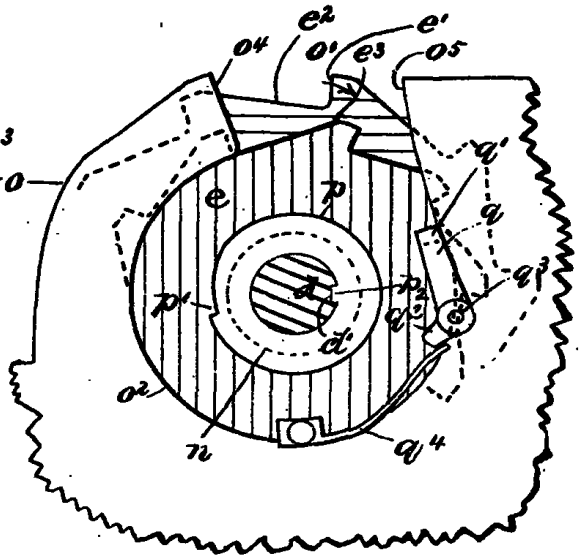

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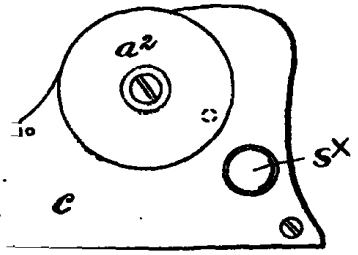

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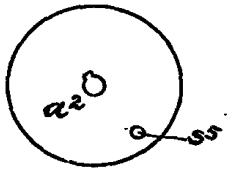

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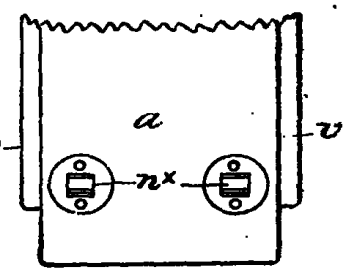

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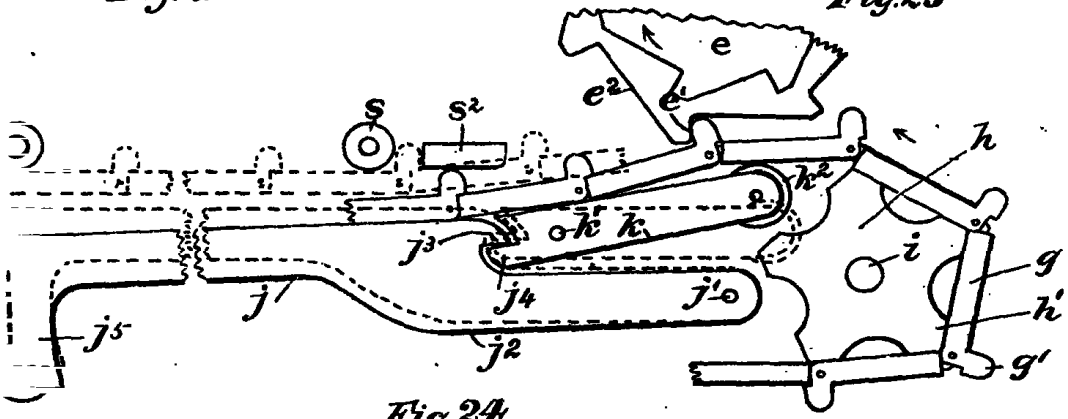

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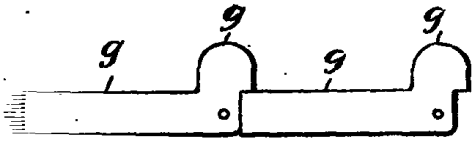
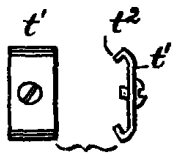


Fig.25

Fig.26



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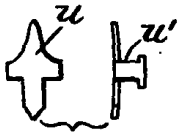

Fig.28

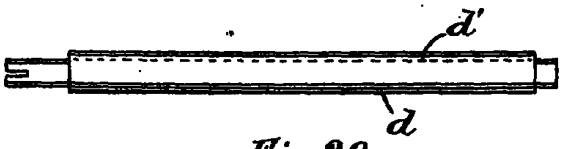

Fig.29

Fig.30

Fig.31

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