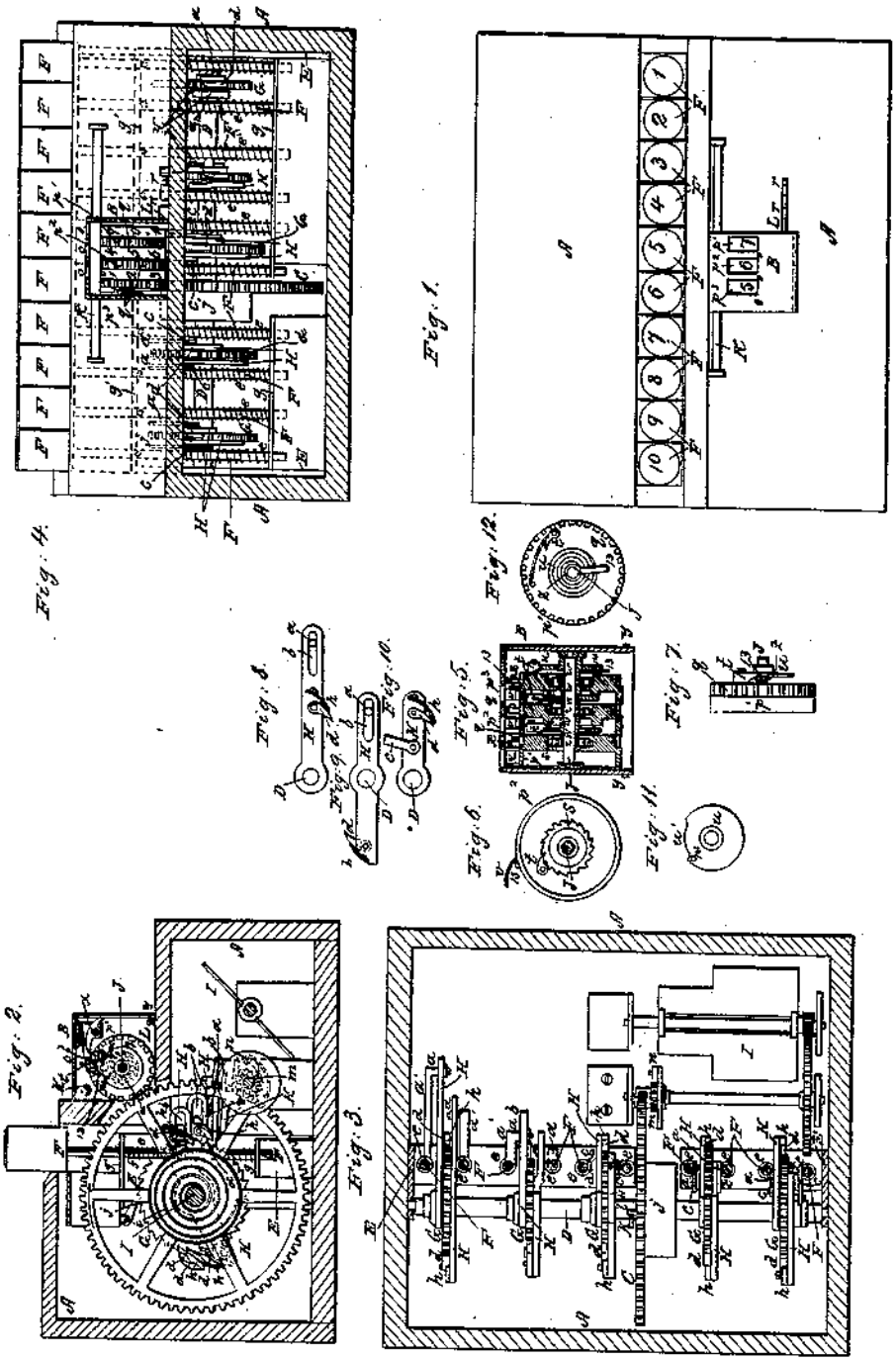
O. L. CASTLE.

Calculator.

No. 21,941.

Patented Nov. 2, 1858.



UNITED STATES PATENT OFFICE.

ORLANDO L. CASTLE, OF UPPER ALTON, ILLINOIS.

IMPROVED ARITHMOMETER FOR ADDITION.

Specification forming part of Letters Patent No. **21,941**, dated November 2, 1858.

To all whom it may concern:

Be it known that I, ORLANDO LANE CASTLE, of Upper Alton, in the county of Madison and State of Illinois, have invented a new and Improved Arithmometer for Adding Numbers; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view of the arithmometer. Fig. 2 is a transverse vertical section of the same. Fig. 3 exhibits a horizontal section of the case and a top view of the driving mechanism by which the register or adding apparatus is operated. Fig. 4 is a front elevation with the front parts of the case and register-box broken away to expose the interior mechanism. Fig. 5 is a longitudinal vertical section of the register. Figs. 6, 7, 8, 9, 10, 11, and 12 are views of some of the details of the register.

Similar letters and numerals of reference indicate corresponding parts in the several figures.

A is a case, which contains the driving mechanism to operate the register, and B is a small box outside of A containing the register.

C, Fig. 2, is the driving-wheel, consisting of a large spur-wheel which gears with one of the wheels of the register to drive the latter for the purpose of registering or adding the numbers, said wheel C being secured to a horizontal shaft D, which is inclosed within the case A, and which is fitted to work in bearings in the ends of a frame E, which extends from end to end of said case A.

In front of the shaft D are arranged the finger-keys F F, ten in number, consisting of upright pins, all arranged in a line parallel with the shaft D and having their heads, which project through an opening in the top of the case A, numbered, respectively, from 1 to 10 in regular order. The said keys are fitted to slide vertically in guides *g g'* in the frame E E and have springs *e e* applied to force them upward. The vertical movement of said keys is limited in a downward direction by their bottoms coming in contact with the bottom of box A and in an upward direction by stop-pins *f f*, which are secured to them and which stop against the upper guide *g'*. The driving-shaft D, besides the driving-wheel, has also secured to it five ratchet-wheels G G, one of which is arranged between the keys 1 2, another between those numbered 3 4, and so on throughout the whole series of keys and ratchet-wheels. The ratchet-wheels have all the same number of teeth and have the teeth all set in the same direction. Each key has attached to it a pin *a*, which either works in a slot *b* in or is connected by a link *c* with one of ten levers H H, which work freely upon the shaft D as their fulcrum, half the said levers being either of the second or third order, as shown in Figs. 8 and 10, which are side views of two of those levers detached from the machine, and the other half being all of the first order, as shown in Fig. 9, the even-numbered keys being connected with the levers of the first order and the odd-numbered ones with those of the second or third order, and each of the said levers carries a pawl *d*, which engages with one of the ratchet-wheels G G, two pawls engaging with each ratchet-wheel—viz., one belonging to an odd-numbered key engaging with it in front of the shaft and one belonging to an even-numbered one at an opposite point—by which arrangement and the arrangement of their two levers on opposite sides of the ratchet-wheel the two pawls are permitted to operate on the ratchet-wheel independently of and without interference with each other. The pawls are severally furnished with springs *h h* to keep them in gear with their respective ratchets.

The depression of the keys F F operates upon their respective levers H H in such a manner as to make their respective pawls *d d* operate on their respective ratchet-wheels and thus give rotary motion to the shaft D; but, as the keys are all permitted to have the same amount of vertical movement, and the pawls are all at the same distance from the fulcrum of the levers, it is necessary, in order that by the depression of any key its respective ratchet-wheel may be turned a distance corresponding with the number marked upon it, to connect the key at a point nearer to or farther from the fulcrum of the lever, according to its number, the key numbered 1 being connected at the greatest distance from the fulcrum, so that the action of its lever produced by the depression of said key, as far as permitted, will only cause its pawl to move far enough to move its respective ratchet-wheel

one tooth, the next key (marked 2) being connected with its lever at a sufficiently less distance to cause its pawl to be moved by a similar depression of the key far enough to move its ratchet-wheel two teeth, and so on throughout the whole series.

To provide for the connection of the pins *a* at suitable distances from the fulcrum of the levers H H, any number of the pins *a a* may be attached to their respective keys by rigid arms *a'* of suitable length, such length, when the connection of the pin with the lever is by a slot, requiring to be accurately proportioned to bring the pins to the proper distance from the fulcra of the levers; but when the connection is by a link *c* so exact a position of the pin *a* is not necessary.

To prevent the driving-wheel C acting too suddenly on the register, and thereby injuring the gearing in case of the gearing being suddenly and violently depressed, the said wheel is fitted loosely to the driving-shaft D, and is connected therewith by means of a coiled spring *i*, arranged within a box *j*, attached to the said wheel, the said spring being applied in a manner well known to mechanics, with suitable stops *k l* on the shaft and wheel, as shown in Fig. 1, to permit the shaft to move at first faster than the wheel, but to compel the wheel to continue moving after the shaft has stopped till it has moved as far as it would have done if attached rigidly to the shaft. A flier I is also geared with the wheel C to regulate its motion; but a ratchet-wheel *m* and pawl *n* are interposed between the said wheel and the flier to permit the flier to free itself from the wheel when the latter arrives at the proper position to stop.

p' p^2 p^3 are the registering or adding-up wheels, of which there are only three represented, as that number is sufficient to illustrate my invention; but any greater number may be used, the first wheel p' at the right registering units, the second p^2 tens, the third p^3 hundreds, and so on. These wheels are arranged side by side and are fitted to turn independently of each other on a fixed shaft J, Fig. 5, secured in the register-box B, and severally having their peripheries divided circumferentially into ten equal spaces, marked with numerals from 0 to 9. One of the numerals of each wheel is visible through one of a series of openings *o o o* in the top of the register-box B, said openings being arranged in line with each other, so that the numerals presented opposite to them by the several wheels may be in line with each other and the sum represented by the combination of said numerals may be read off.

Each of the registering-wheels has firmly secured to it a spur-wheel *q*, and in order that either of the said spur-wheels may be brought into gear with the driving-wheel C the register-box is made movable longitudinally upon a fixed bar K, which attaches it to the case A. The register-box is open both at its back and bottom, which fit to the step-like portion of the front of the case, and the driving-wheel C is thus permitted to enter it. The wheels *q q q* and C must be so proportioned in size that the depression of the key numbered 1 will produce one-tenth of a revolution of that wheel *q* which is in gear with C, the depression of the key numbered 2 two-tenths, and so on.

The register-box is secured in place when either of the wheels *q* is in gear with the driving-wheel by one side of it being received within one of a number of notches *r r r*, corresponding with the number of wheels *q q q* in a projecting plate L, secured to the exterior of the case A. To change the gearing of the wheel C from one wheel *q* to another, the register-box B merely requires to be lifted in front to release it from the plate L, and then moved longitudinally along the bar K till the proper wheel *q* comes opposite C, and then the box may be allowed to fall into the notch *r*. Each of the register-wheels, except the units-wheel p', has secured to it a small ratchet-wheel *s*, which is inclosed within a cavity in the side of the register-wheel, and each register-wheel has attached to it a spring-pawl *t*, which (except in the case of that one attached to the wheel of highest denomination) is intended to engage with the ratchet-wheel on the register-wheel of the next denomination above; but said pawls are severally only permitted to engage with their respective ratchet-wheels during one-tenth part of every revolution of the wheels to which said pawls are respectively attached, their engagement during nine-tenths of the revolution being prevented by means of stationary plates *u u*, secured firmly to the shaft J in the cavities of the register-wheels, said plates being of the form shown in Fig. 11, which is a side view of one of them—viz., circular—but with a recess *u'*, the bottom of which is equal in width to one-tenth the circumference of the circle of which it forms part and the sides of which are slightly inclined. During nine-tenths of the revolution of either register-wheel its attached pawl, resting on the edge of one of its respective plates *u*, is held out of gear with its respective ratchet-wheel, but during the remaining tenth is allowed to come in gear therewith by falling into the notch *u'*, and during such remaining tenth it carries the register-wheel of higher denomination to which the ratchet-wheel is attached along with it. The plates *u u* are so arranged upon the shaft J that the pawl of each register-wheel acts on the ratchet of the one of higher denomination during that tenth part of the revolution of the former in which its "9" moves away from the opening *o* and its "0" is presented. The several register-wheels are prevented being rotated together by the friction that may be produced between any of them by friction-springs *v v v*, applied to each, and by the friction of spring-pawls *x x x*, which are applied to the wheels *q q q* to prevent the register-wheels moving backward.

w w w in Figs. 5 and 12 (the latter of which figures is a side view of one of the registering-wheels and its appendages) are springs coiled up within cavities on the opposite sides of the register-wheels to their respective ratchet-wheels for the purpose, when the addition of a sum has been completed and it is desired to commence adding another, of causing the "0 0 0" of all the register-wheels to present themselves opposite the openings *o o o* of the box B. To permit such action it is necessary to release the wheels *q q q* from the pawls *x x x*, and for this purpose the bottom edge of the front of the box B is hinged or pivoted, as shown at *y y* in Figs. 1 and 5, and the upper part of said front made capable of being pressed back by the thumb of the operator against the heels of said pawls *x x x*, which are so arranged that by the said pressure against their heels their toes are thrown out of gear with the wheels *q q q*. The said springs *w w w* are secured each at one end to its respective register-wheel and at the other to a collar *z*, fitting loosely to the shaft J. The collars *z z z* have attached to them elastic arms 13 13 13, made of thin flat steel, which project up between the register-wheels and the plates *u u u*, which govern their respective pawls. I will here remark that the register-wheel of the highest denomination carries a spring-pawl *t* like all the others, and that a similar plate *u* is arranged to operate upon said pawl; but this pawl and plate are for a different purpose to that hereinbefore described, which purpose is also served by the other pawls *t t* and plates *u u*, and which I will presently describe. Each spring-arm 13 presses against the adjacent plate *u*, and the plates *u u u* have on the faces next the arms 13 13 13 very slight projections 14 14 14, which serve as stops to said arms 13 13 13 as their respective register-wheels rotate and cause said springs to be wound up by the rotation of the wheels. Consequently as soon as the pawls *x x x* are thrown out of gear the register-wheels are turned backward by the springs *w w w*; but the register-wheels are prevented going back farther than is necessary to bring their "0 0 0" in view by small projections 15 15 15 on their peripheries coming in contact with the ends of the friction-springs *v v v*. The springs *w w w*, it is obvious, however, cannot go on being wound up during repeated revolutions of the register-wheels, and hence they are liberated and allowed to uncoil every time their respective register-wheels respectively arrive with the "0" in view. The way in which this is done is by the projection 14 driving the elastic arm 13 between the pawl *t* and the wheel to which it is attached in the manner shown in the top view, Fig. 7, which, by reason of the beveled form of the side of the pawl next the wheel, forces the arm out of the way of the projection 14. This action is prevented taking place till the proper time by reason of the pawl only arriving in contact with the elastic arm as it drops into the recess *u'* in its respective plate *u*, the projection 14 on each plate always being close to the recess *u'*.

Having described the construction and operation of the several parts of my arithmometer, I will proceed to describe the mode in which addition is performed by it. Before commencing, the register should be set free of the driving-wheel C by raising up the register-box and moving it longitudinally to such a position that neither of its wheels *q q q* is opposite the driving-wheel and, then letting its bottom rest upon plate L between the notches *r r r*, which keeps all the wheels of the register clear of the driving-wheel, and then by pressing back the front plate of the box B to liberate the wheels *q q q* from the pawls *x x x* the register-wheels $p' p^2 p^3$ are all caused to present their "0 0 0" in view at the top of the box. The register-box is then moved longitudinally to bring the wheel *q* belonging to the units register-wheel *p'* opposite the driving-wheel C, and the box is then allowed to drop into the proper notch *r*, which brings the above-mentioned wheel *q* into gear with C. The addition is then commenced by depressing the keys F one after the other in the same numerical order as the figures occur in the column of units or lowest denomination to be added, and at every depression the units register-wheel p' is caused to make as many tenths of a revolution as the number on the key, and every time the revolution of the wheel *p'* is completed and its "0" arrives in view at the top of the register the pawl *i* attached to it acts upon the ratchet-wheel *s* attached to the tens register-wheel p^2, and gives that wheel a tenth part of a revolution, and if the sum of the column of units be sufficient the wheel p^2 will be caused in this way to complete its revolution, and the pawl *t* attached to it be caused to operate on the ratchet-wheel *s*, attached to the hundreds-wheel p^3, to give that wheel a tenth part of a revolution. When the column of units has been added in this way, the register-box B is moved to bring the wheel *q* that is attached to the tens register-wheel p^2 into gear with the driving-wheel C, and the column of tens proceeded with in the same manner as the addition of the units, as above described. In adding the column of tens every time the wheel p^2 completes a revolution it imparts through its pawl and the ratchet-wheel on the hundreds register-wheel a tenth part of a revolution to the latter wheel. In this way any number of columns of figures can be added, provided there is a sufficient number of register-wheels, by shifting the register-box after the addition of each column to bring the wheel *q* that is attached to the register-wheel of the next highest denomination into gear with the wheel C, and whenever in the operation any register-wheel (excepting, of course, that of the highest denomination) completes a revolution the

pawl attached acts on the ratchet-wheel attached to that of the next highest denomination to give it a tenth part of a revolution.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. Combining the shaft D of the driving-wheel C, which serves to give motion to the register, with the keys F F by means of a series of ratchet-wheels on the said shaft and a series of levers of different lengths which work on said shaft as a fulcrum and are connected with the keys, when the whole are arranged as set forth.

2. Combining the register-wheels of lower denomination with those of higher denomination by means of the pawls *t t*, ratchet-wheels *s s*, and stationary plates *u*, the whole applied, arranged, and operating substantially as described, for the purpose set forth.

3. The springs *w w w*, with their elastic arms 13, applied to the register-wheels, in combination with the stationary plates *u u u* and their projections 14 14 14, to operate substantially as and for the purpose set forth.

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Witnesses:

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CHARLES KIRK.