No. 806,698. PATENTED DEC. 5, 1905.

F. MUGNIER.

CALCULATING MACHINE.

APPLICATION FILED MAY 27, 1904.

Fig.1

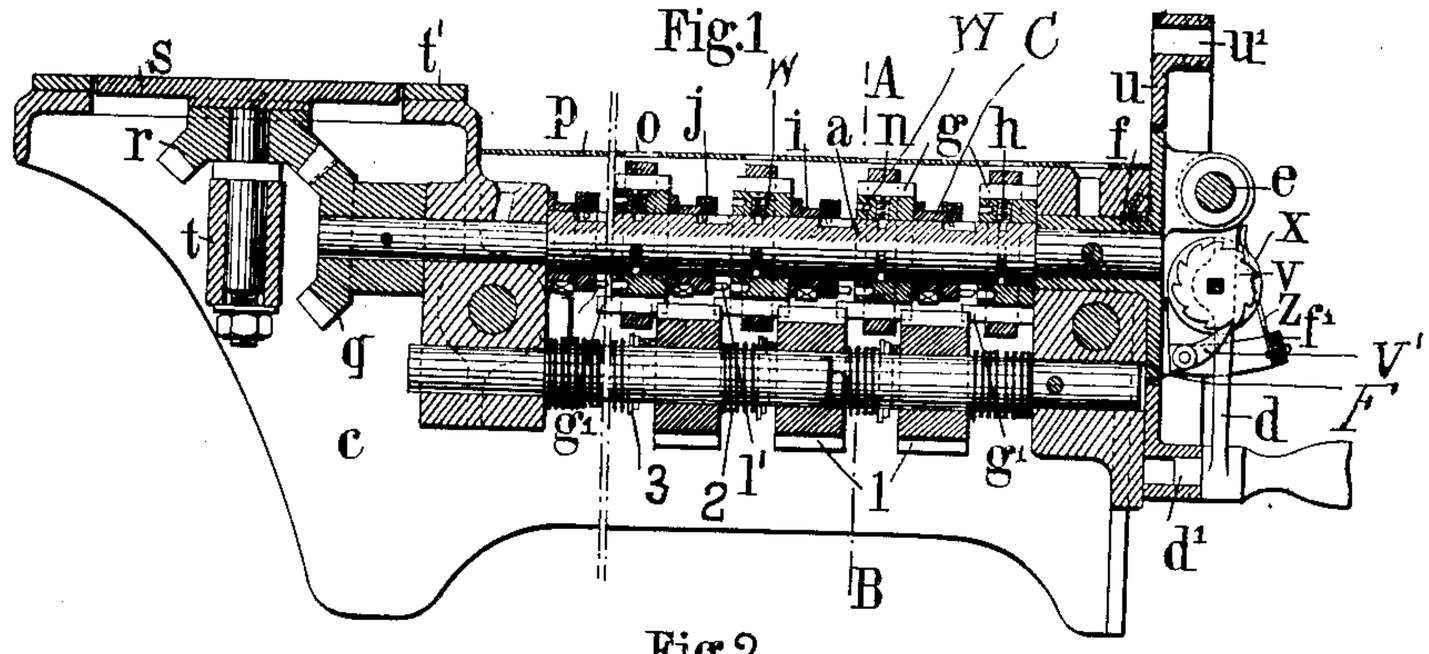


Fig.2

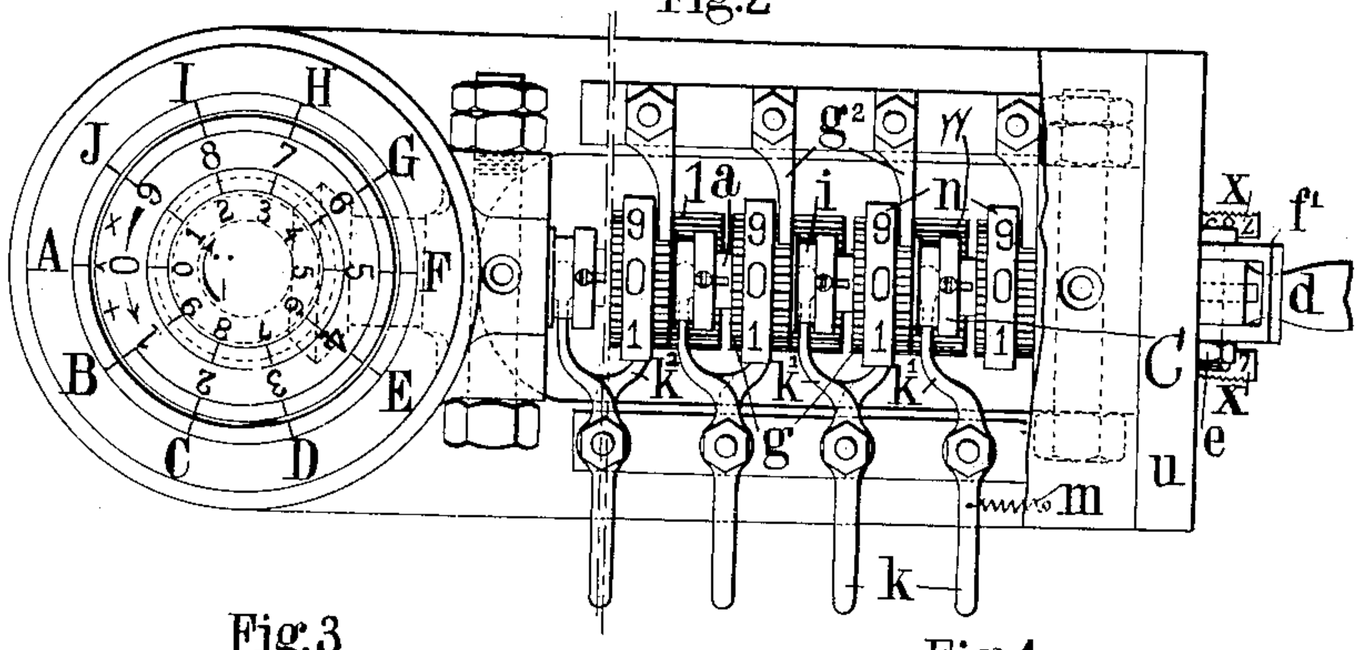


Fig.3

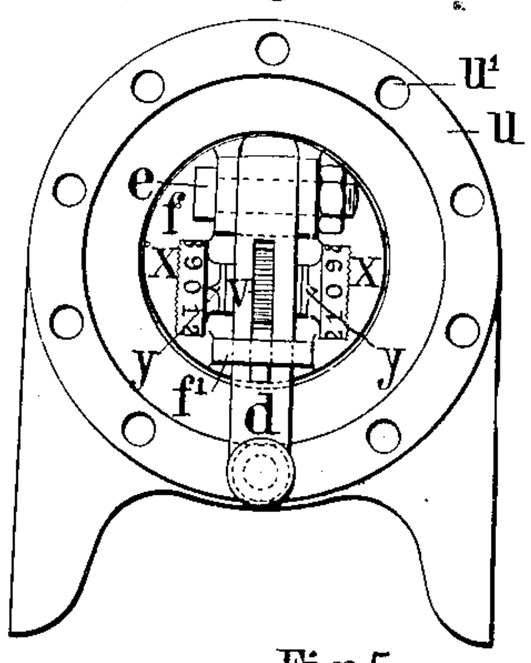


Fig.4

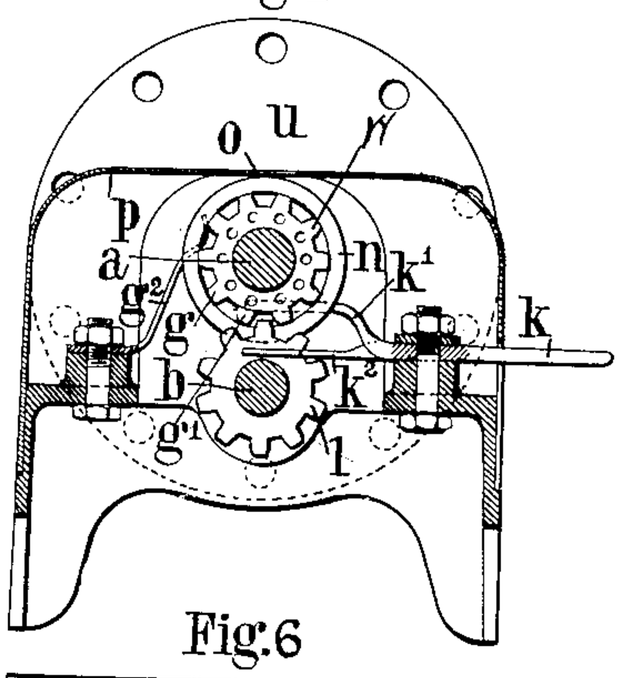


Fig.5

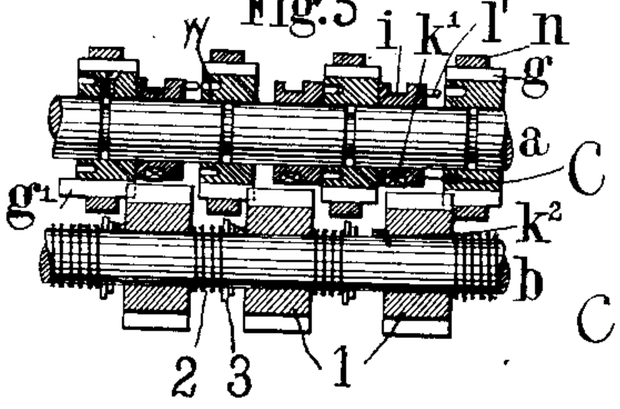
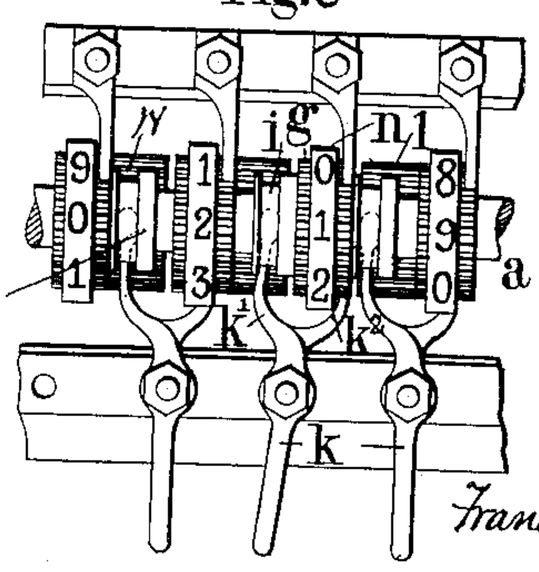


Fig.6



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FRANÇOIS MUGNIER, OF PARIS, FRANCE.

CALCULATING-MACHINE.

No. 806,698. Specification of Letters Patent. Patented Dec. 5, 1905.

Application filed May 27, 1904. Serial No. 210,095.

To all whom it may concern:

Be it known that I, FRANÇOIS MUGNIER, a citizen of the Republic of France, residing in Paris, France, (whose postal address is 49 Rue Sedaine, Paris, France,) have invented a Calculating-Machine, (for which I have obtained a French patent, dated May 30, 1903, No. 332,332,) of which the following is a specification.

This invention relates to calculating-machines, and has for its object to provide a cheap, simple, accurate, and readily-manipulated machine for carrying out an arithmetical operation; and it is particularly adapted for performing the four fundamental operations—namely, addition, subtraction, multiplication, and division.

In the accompanying drawings, Figure 1 is a vertical sectional view on the longitudinal axis of the machine. Fig. 2 is a top plan with the cover partly broken away. Fig. 3 is an end elevation of the end provided with the operating-handle. Fig. 4 is a vertical cross-section on the line A B, Fig. 1. Fig. 5 is a detail in section of the wheels of Fig. 1, showing the "tens clutch" thrown in; and Fig. 6 is a plan of Fig. 5.

The machine has two parallel shafts *a b*, mounted in a suitable frame *c*. Shaft *a* carries at one end a bevel-wheel *q*, meshing with a similar bevel-wheel *r*, mounted on a shaft supported in bearings *t* in the frame *c* and carrying at its upper end a disk S, marked in concentric circles in reverse numerical positions with figures from "0" to "9." A ring *t'* encircles the disk S and is provided with a series of ten characters for guide data. (Shown as the first ten characters of the alphabet.) To the extreme other end of the shaft *a*, outside the frame *c*, a plate F is made fast to the shaft *a* by means of its bushing *f*. This plate F carries on a pivot *e* a lever-arm *d*, having a pin *d'* at its end. On the arm of the lever there is mounted a ratchet-wheel V, on the shaft of which are two wheels numbered on their peripheries from "0" to "9." A pawl V' on the plate F is adapted to engage the ratchet-wheel to turn it one tooth upon the insertion of the pin *d'* of the lever arm into one of ten holes *u'* near the edge of a plate *u*, surrounding the plate F, but permanently attached to the frame, while a spring Z, bearing on the lever *d*, tends to hold it in place in the recesses u^4.

Above the shaft *a* is a cover *p*, provided with a number of openings *o*, through which the result, as displayed by the computing-wheels W, will show. These wheels are mounted on the shaft so as to normally be independent of the motion of the shaft, but are prevented from longitudinal motion by a pin *h*, engaging a circular slot in the shaft. One face of each wheel is provided with ten depressions or holes, each corresponding to one of the numbers which are displayed on a ring *n*, mounted and secured around its gear-teeth *g*. One of the teeth *g'* is longer than the others for carrying over or transferring to the next higher wheel. To one side of each wheel and having a limited motion along the shaft, but mounted to turn with it, is a clutch C, fastened to the shaft by a pin *j*, engaging a short slot lengthwise of the rod. A pin *l'* of the clutch may engage any one of the ten holes in the adjacent face of the wheel W.

A number of pivoted forked levers K, comprising part of the lever mechanism, to be hereinafter more fully described, are each provided with an arm K', which serves to engage a groove *i* around the clutch for throwing it into operation, while a spring *m* tends always to detach the clutch from its wheel. A spring g^2, attached to the frame and having a bent end bearing on the teeth of each wheel W, as shown in Fig. 4, serves to prevent friction or jar from displacing a calculating-wheel W.

On the shaft *b* I place a number of loosely-mounted geared transfer-wheels 1 of ten teeth each, adapted to mesh with the gears of the wheel W to its left, but normally only with the extra-long tooth *g'* of the wheel W to its right. These wheels are prevented from motion to the left by stops 3, against which they are pressed by springs 2, the second arm k^2 of the forked lever K being adapted to move such wheel 1 out of the path of the teeth of that wheel which is at that time "clutched," such clutch and such wheel 1 being therefore operated together from one lever.

In the lever mechanism the lever K is not only forked, but one arm K' is above the plane of the other. (See Fig. 4.) As the handle end is moved to the left the upper arm, which engages the groove *i* of the clutch, forces the pin *l'* into engagement with the number-wheel. At the same time the lower arm K^2 forces the transfer-wheel adjacent thereto out of mesh with its corresponding number-wheel.

The disk S, comprising two dials, is marked with two arrows, one marked "+" and "×" to indicate the direction it should be turned

for addition and multiplication and one marked "—" and "÷" to indicate the direction of rotation for substraction and division. In addition, as now described, the handle is turned clockwise, which through the gears *q r* gives a contra-clockwise direction to the disk S.

Suppose six were to be added to nine, then twenty, and then twenty-nine. The operator would first operate the lever mechanism for throwing the units-wheel into clutching engagement with the shaft and then turn the handle to rotate the disk S contra-clockwise until "0" came opposite G, where "6" previously was, then "6" would appear at the opening *o* over the units-wheel W. "0" then being at G and "9" to be added, the disk would be again turned until "0" came opposite F, or where "9" was. The units-wheel would have been operated an equal angle and in its complete rotation have caused the long tooth *g'* to strike the transfer-wheel 1 to rotate the tens-wheel one tooth, causing "15" to appear over the tens and units wheels. "0" having been stopped at F, "9" will be at E, and to add another "9" (that of the "29") the disk S will again be turned until "0" comes opposite E, thereby rotating the units-wheel and again transferring by one complete revolution a movement of one more tooth of the tens-wheel, causing the appearance of "24" on the units and tens wheels. The operator then throws the lever *k* to throw the units-transfer wheel 1 out of mesh and to render it and the units-wheel inoperative, but at the same time clutching the tens-wheel to its shaft. The operator now proceeds to add "2" (of the "20") by operating the disk S, as before described, causing "2" to be added to the tens-wheel, which will then indicate with the now inactive units-wheel "44." Then the "2" of "29" will be added in like manner, and the result appear as "64." Thus six, nine, twenty, and twenty-nine will have been added, the units first and the tens afterward. In other words, for addition, the "0" is to be turned until it reaches the point formerly occupied by the number to be added.

In subtraction the disk S is turned in contrary direction from that of addition and use made of the inner row of figures of the disk adjacent to the signs "—" "÷." To subtract twenty-nine from sixty-four, one will first turn the units and tens wheels to "64," then clutch the units-wheel to its shaft and rotate the disk clockwise according to the inner dial until "0" thereon appears where "9" previously was opposite to the letter of the scale. This will have caused the units-wheel to have turned nine spaces back, during which the long tooth of the transfer-wheel will have moved the tens-wheel one tooth, thus causing "5" to appear at the tens-wheel and "5" at the units. The tens-wheel is then clutched to the shaft and the units-wheel rendered inoperative, as described hereinbefore. The disk S, according to the inner dial, is rotated two spaces, thereby subtracting the "2" of the "29," and the "5" will be replaced by a "3" at the tens-wheel and the result be read as "35." If desired, subtraction can be carried out by subtracting the tens first and the units thereafter, as set forth under the operation of division.

The operation for multiplication is carried on in a manner like unto addition. The operator first adds the unit of the multiplicand as many times as represented by the units of the multiplier. By "adds" in this description it will be understood to mean to move the disk S that distance equal to the amount to be added. Then the tens-wheel is clutched and the tens of the multiplicand repeated as many times as represented by the units of the multiplier, &c. Then the tens-wheel is clutched and the units of the multiplicand added as many times as indicated in the tens of the multiplier, then the hundreds-wheel clutched and the tens of the multiplicand repeated as many times as represented in the tens of the multiplier, &c.

For example, to multiply twenty-four by thirteen I first clutch the units-wheel and move the disk S three times a distance equal to four spaces, resulting in "12," which will appear on the wheels W. I then clutch the tens-wheel and move the disk three times a distance equal to two spaces on the disk S, thus adding "6" to the tens and resulting in "72." Again clutching the tens-wheel I move the disk S one time a distance equal to four spaces of the disk S, thus adding "4" to the tens and changing "72" to "112." I then clutch the hundreds-wheel and move the disk one time a distance equal to two spaces, thus adding to the hundreds "2" and changing the result to "312," which is the product of thirteen multiplied by twenty-four.

Division is the reciprocal of the operation and is carried on like progressive subtraction. One first subtracts the divisor from the first set of numbers of the dividend which will contain it, as in subtraction, throwing the clutches successively. This subtraction is repeated as many times as the divisor can be subtracted from said set of numbers. Then the remainder and the next figure of the dividend not before used will be used as a new dividend and the operation repeated the number of times which one can subtract the divisor from the new dividend. The quotient will be the result of these successive subtractions, while the figure left in the dividend will be the remainder.

For example, to divide four hundred and thirty-three by twelve I first throw the hundreds-clutch and move the disk one space in the direction indicated by the inner dial, then throw the tens-clutch and move it two spaces, this resulting in changing "43" to "31." I

again repeat this operation, making "31" "19," and again I repeat it, making "19" "7." Each time that I make a complete subtraction of the divisor I move the counter-wheel X. In this instance it would have been moved three times, so "3" will be my first figure of the quotient. My dividend will now read "73." I then clutch the tens-wheel and move one space, then the units and move two spaces. I count "1" on the wheel X. I then have "61" on the computing-wheel. I repeat this operation, change "61" to "49," and count two. Then I change "49" to "37" and count three, then "37" to "25" and count four, then "25" to "13" and count five, then "13" to "1" and count six. As one cannot be divided by twelve, it is the remainder, and my quotient will be "$36\frac{1}{12}$."

In multiplication, as well as in division, it is necessary to know how many times the handle *d* has been moved on its pivot in rotating the ratchet-wheel. Consequently I place the number-wheels X X on the shaft of the ratchet-wheel and attach stationary pointers *y* to the handle. One such wheel is sufficient; but I prefer two for ready reading from opposite sides of the machine.

I claim as my invention—

1. A calculating-machine having an operating-shaft, number-wheels thereon, and interposed transfer-wheels, and hand-actuated means adapted to secure a number-wheel to the shaft and means operative at the same time to prevent the preceding number-wheel from rotating through the interposed transfer-wheel, and a guide-disk having ten figures marked thereon adapted to be moved through the same angle as the operating-shaft.

2. A calculating-machine, having an operating-shaft, a number of toothed number-wheels loosely mounted thereon, an extra-length tooth to each of said wheels, a second shaft parallel with the first shaft, a number of transfer-wheels thereon, a clutch moving rotarily with the operating-shaft but independently movable lengthwise of said shaft for each number-wheel and adapted to engage its adjacent number-wheel when moved, and a means for manually operating said clutch.

3. A calculating-machine, having an operating-shaft, a number of toothed wheels loosely mounted thereon, a set of numbers carried by each of said wheels, an extra-length tooth to each of said wheels, a clutch moving rotarily with the operating-shaft but independently movable lengthwise of said shaft and adapted to engage its adjacent number-wheel when moved, and a lever for said clutch, in combination with a shaft carrying transfer-wheels, connections between the aforesaid lever and the transfer-wheel operating on the next lower number-wheel, adapted to prevent said lower wheel from rotating on its shaft at the same time that the number-wheel directly controlled by the clutch is gripped thereby.

4. A calculating-machine, having an operating-shaft, number and transfer wheels therefor, and lever mechanism adapted to secure a number-wheel to the shaft and to prevent the preceding number-wheel from rotating with the shaft, in combination with a plate carried by said operating-shaft, a pivoted handle on said plate, a pawl and ratchet between the plate and handle, and a number-wheel operated thereby.

5. A calculating-machine, having an operating-shaft, number and transfer wheels therefor, and lever mechanism adapted to secure a number-wheel to the shaft and to prevent the preceding number-wheel from rotating with the shaft, in combination with a disk S operated by said operating-shaft, a set of numbers upon the disk, and a fixed ring surrounding said disk and marked with guide data.

6. A calculating-machine, having an operating-shaft, number and transfer wheels therefor and lever mechanism adapted to secure a number-wheel to the shaft and to prevent the preceding number-wheel from rotating with the shaft in combination with a disk S having two concentric rows of ten figures marked thereon in reverse, said disk adapted to be moved through the same angle as the operating-shaft and operated by said operating-shaft, and a fixed ring surrounding said disk and marked with guide data.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANÇOIS MUGNIER.

Witnesses:
LÉON FRANCKEN,
HANSON C. COXE.