No. 842,694. PATENTED JAN. 29, 1907.

H. P. HAYES.

DIVIDING MACHINE.

APPLICATION FILED OCT. 16, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

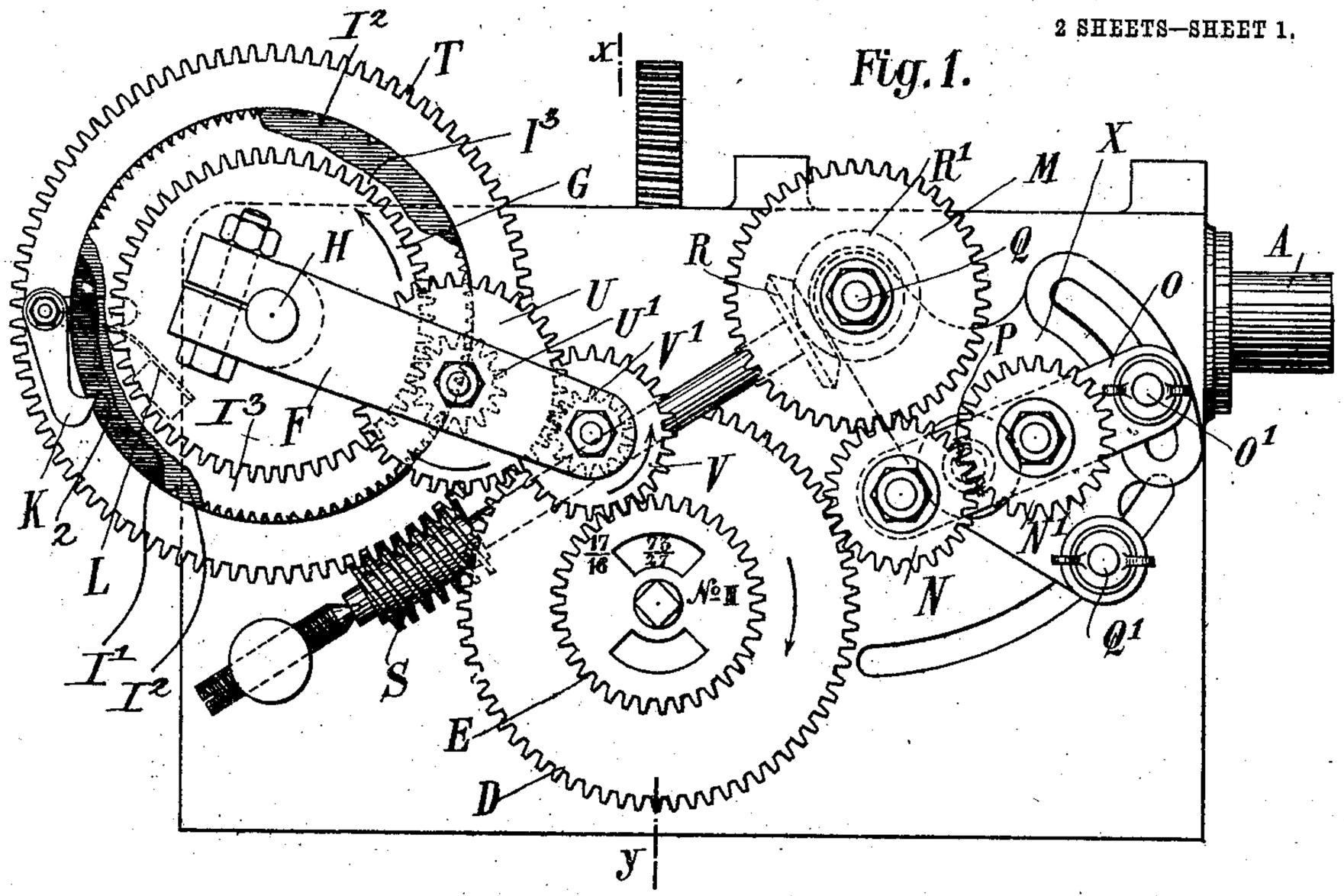
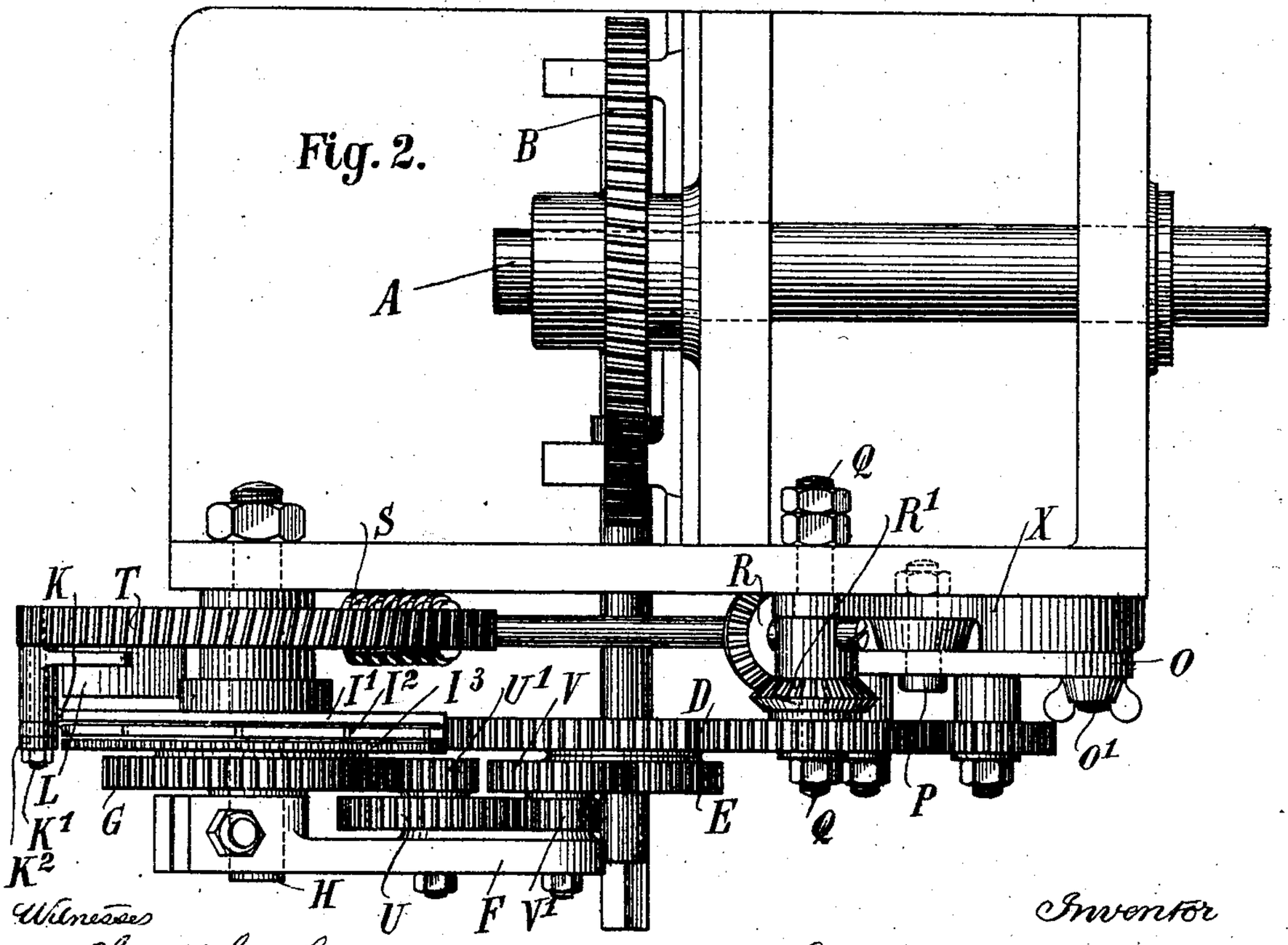


Fig. 2.



Witnesses

Chas. H. Smith

A. D. Borrell

Inventor

Henri Perrenoud Hayes

per Harold Serrell

Atty

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2 SHEETS—SHEET 2.

Fig. 3.

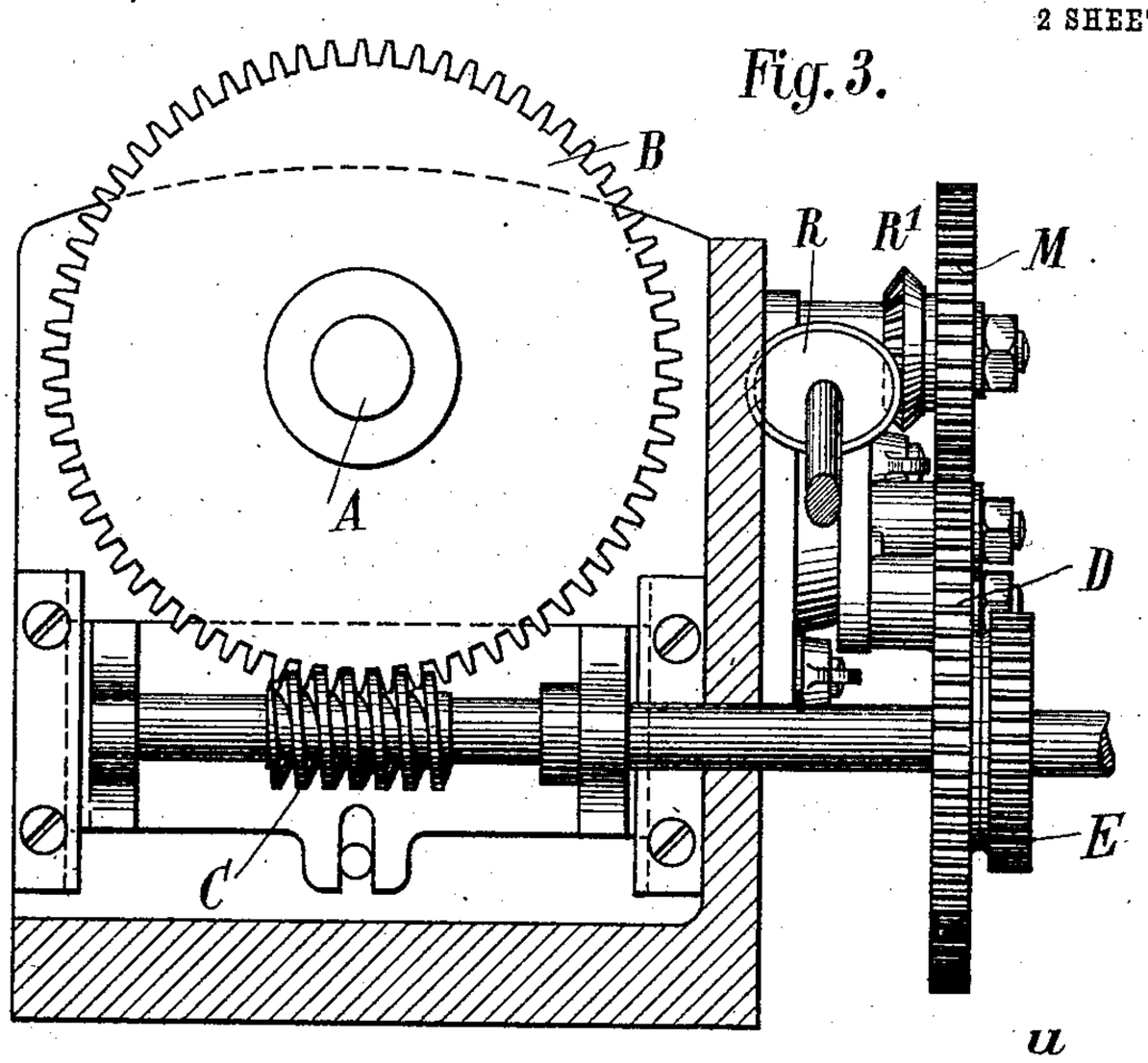


Fig. 4.

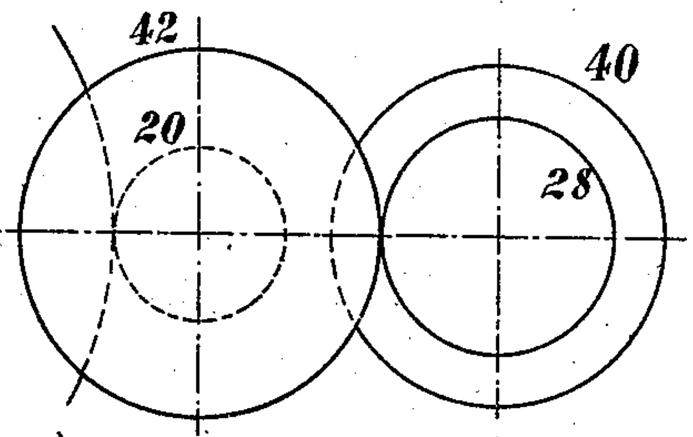


Fig. 5.

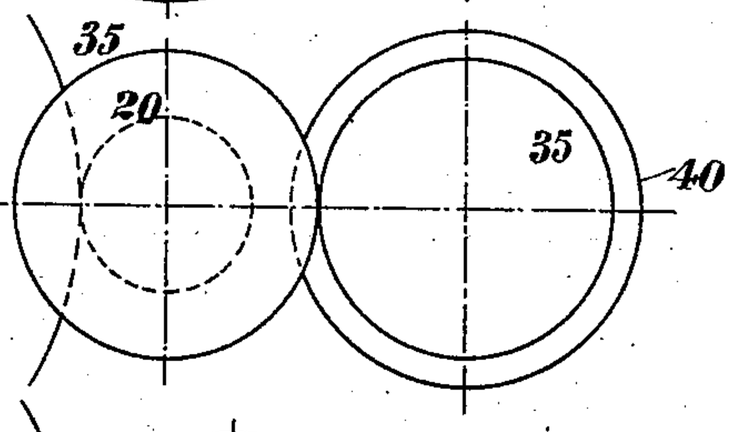


Fig. 6.

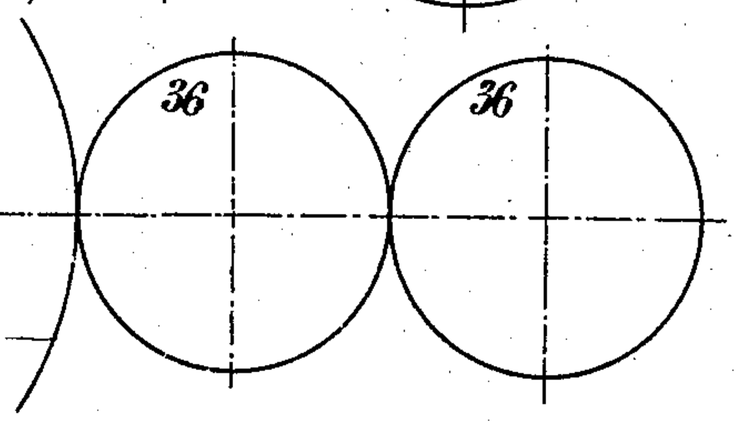


Fig. 7.

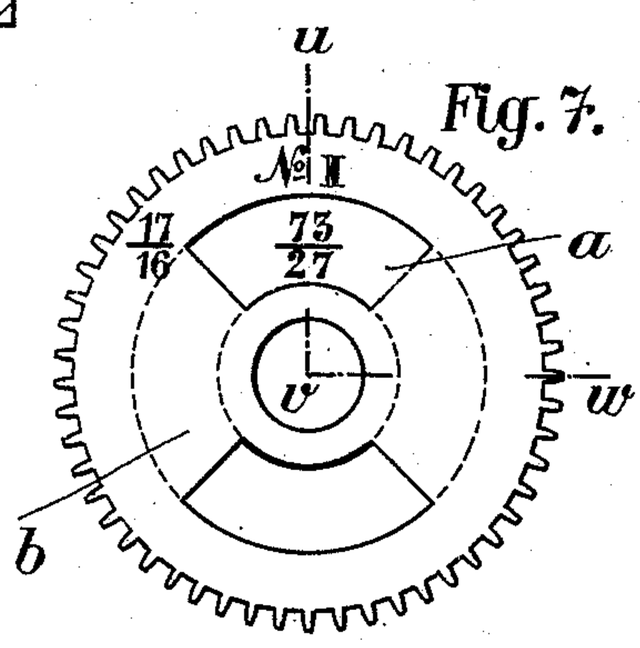
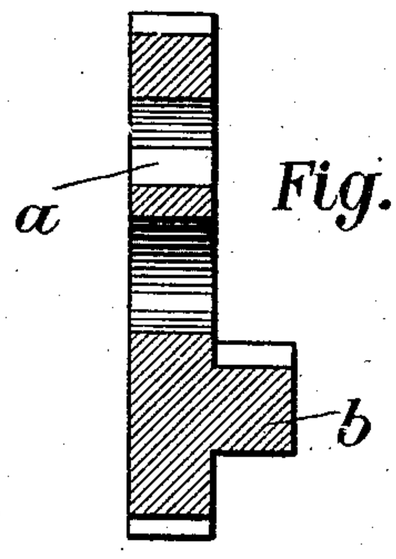


Fig. 8.



Witnesses

Chas. F. Smith

N. Barrell

Inventor

Henri Perrenoud Hayes

per Harold Barrell

Atty

UNITED STATES PATENT OFFICE.

HENRI PERRENOUD HAYES, OF LOCLE, SWITZERLAND.

DIVIDING-MACHINE.

No. 842,694. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed October 16, 1905. Serial No. 283,075.

To all whom it may concern:

Be it known that I, HENRI PERRENOUD HAYES, engineer, of Locle, Switzerland, have invented certain new and useful Improvements in and Relating to Dividing-Machines, of which the following is a specification.

My invention relates to an improved machine for dividing circles and with which it is possible to obtain practically any desired division of a circle by means of a comparatively small number of interchangeable gears. The circle which is to be divided may of course be drawn on the surface of an object of any shape whatsoever, but generally will be the periphery of a wheel or similar article.

The machine comprises a shaft carrying a drive-gear and upon which is fastened the object bearing the circle which it is desired to divide, a shaft with an endless screw which gears into the said drive-gear and by means of which the circle to be divided is caused to rotate, two gear-wheels mounted on the last aforesaid shaft, one of which causes the rotation of a notched disk by means of a suitable intermediate transmission and the other wheel causes, by means of a reversible transmission, the rotation of a wheel provided with a catch so arranged as to engage with the notched disk. This construction is such that each time the catch engages a notch in the disk the motion of the said parts is stopped and the working piece has been turned a distance equal to one of the divisions to be made on its periphery, and this division may be marked upon the circle to be divided by means of a fixed cutter or pointer, in front of which the work is turned.

In the drawings, Figure 1 is an elevation of the machine. Fig. 2 is a plan thereof. Fig. 3 is a section on line *x y* of Fig. 1 seen from left to right. Figs. 4, 5, and 6 show the different combinations of the interchangeable gears. Fig. 7 is a front view of an interchangeable gear. Fig. 8 is a section on the line *u v w* of Fig. 7.

A is a shaft which may be called a "work-shaft" and one end of which is adapted to receive the object bearing the circle to be divided and the other end of which carries a drive-gear B, into which an endless screw C meshes. Upon the outer end of the shaft of the latter, which may be called a "drive-shaft," there are fixed two toothed wheels D and E, which can be easily removed and replaced by other wheels having a different number of teeth, depending upon the number of divisions to be made on the work. The extremity of the drive-shaft is provided with a square portion, to which may be fastened a suitable crank or handle, (not shown,) by which latter the rotation of the shaft in the direction marked by an arrow in Fig. 1 may be effected.

A pivot H is fixed in a suitable position in the frame of the machine, and loosely mounted on this fixed pivot H is a gear-wheel G, and on its inner face the gear-wheel G carries three circular plates I′ I² I³, the peripheries of which are provided, respectively, with one, ten, and one hundred equally-spaced notches.

F is a bridge pivotally connected to the fixed pivot H and provided with arbors upon which the pinion U′, gear U, and the pinion V′ and gear V are respectively mounted. The gear V is adapted to mesh with the gear E, the pinion V′ with the gear U, and the pinion U′ with the gear G. Consequently the rotary motion of the gear E is transmitted to the gear G by the interchangeable set of gears in the bridge F. The gear T is also loosely mounted on the fixed pivot H, and secured in the gear T at a point adjacent to its periphery is a pin K′, pivotally mounted on which is a catch or click K, adapted to engage the notches 2 of either of the plates I′ I² I³ and to be maintained against the same by means of the spring L or otherwise, the position of the said click K being adjustable on the pin K′ by means of the washers K². (See Fig. 2.)

X is a rocker-bridge pivotally mounted on a pin Q, fixed in the frame of the machine, and the frame of the machine is provided with a segmental slot by means of which and a set-screw Q′ the said rocker-bridge X may be adjustably secured in position.

O is a rocker-arm pivotally mounted at P in the rocker-bridge X. Secured in the rocker-arm O are suitable pins upon which the intermeshing gears N N′ are mounted, and the rocker-bridge X is provided with a segmental slot, of which the pivot P is the center and by means of which, together with the set-screw O′, the position of the said rocker-arm O may be adjustably secured in its relation to the rocker-bridge X. The gear N meshes with the gear D, and it may also mesh with the gear M, mounted on the pin Q, or the

rocker-arm O may be so placed, as will be apparent, as to bring the gear N out of mesh with the gear M and at the same time throw the gear N′ into mesh with the gear M, whence it will be apparent that the gear M may be turned in either direction from the gear D by means of the intermediate and interchangeable set of gears N N′. A beveled gear R′ is also mounted on the pin Q and secured to the gear M. This beveled gear R′ meshes with a second beveled gear R on the end of the shaft provided with the endless screw S, which meshes with the gear-wheel T.

In the mechanism hereinbefore described the relationship of the numbers of teeth with which the wheels T, M, and B are provided is such that the product of the number of teeth in the wheels M and T is equal to one hundred times the number of teeth in the wheel B, and it will be apparent that the gear-wheel T may be driven in the same direction with the gear-wheel G and its index-plates or the gear-wheel T may be driven in the opposite direction to that in which the gear-wheel G is driven, and in either case the variable speeds depend upon the intermediate and interchangeable gearing employed.

All the interchangeable gears D and E are constructed in a similar manner. Each of them has two segmental slots *a*, (see Figs. 7 and 8,) and on one side they are flat, while on the other there are two projections *b*, which are adapted to enter the slots *a* of the adjacent wheel. The flat surface of each wheel bears a numeral indicating the number of divisions obtained whenever that wheel is employed, and immediately underneath this numeral there is inscribed the same numeral less one, as on the wheel E. Moreover, this wheel is provided with a numeral to indicate the set of intermediate gears F and the set of wheels N and N′ which are to be employed. Upon the projections *b* of each wheel D there is indicated the number of teeth on that wheel, and immediately underneath this indication there is inscribed a numeral, being the remainder of the number of teeth in the wheel from one hundred—for instance, as indicated in Fig. 7, the number of teeth is seventy-three and directly beneath it is shown the number "27." Whenever two such wheels have been adjusted adjacent to one another, any one is enabled to see at a glance the front side of the wheel E with the indications marked thereon and through the slots of the same the projections *b* of the wheels D with the indications marked on the same, thus enabling the selection and interchanging of the gears to be made easily and quickly.

In order that the working of the machine may be well understood, I will now describe how it is to be operated in solving successively several problems.

In the gear-wheels hereinbefore described let B′ = number of teeth in wheel B = 80, M′ = number of teeth in wheel M = 64, and T′ = number of teeth in wheel T = 125. Then

$$\frac{M'T'}{B'}=\frac{64\times125}{80}=\frac{8000}{80}=100,$$

or the desired relationship; but, of course, these numbers may vary, provided the necessary proportions are maintained.

Let *a* be a circle to be divided into a number of degrees less than one hundred. Let E′ be the number of teeth of the wheel E, F′ the ratio in which the wheels fixed to the bridge F are geared down, B′ the number of teeth on the drive-wheel B, and G′ the number of teeth on the gear-wheel G. Then for one revolution of the drive-wheel B—that is to say, of the circle to be divided—the wheel E is required to make B′ revolutions, and for one revolution of E, G will turn $\frac{E'F'}{G'}$ revolutions. Therefore during one revolution of B, G will make $\frac{B'E'F'}{G}$ revolutions. Now by construction B′ is equal to G′. G will then for one revolution of B make E′ F′ revolutions. If the click K has been placed in front of the plate I′, having one notch, the circle to be divided can be divided into E′ F′ degrees. In every apparatus there are a number of separate toothed wheels E with numbers of teeth thereon varying from fifty to one hundred, and there are also four separate bridges F with their gears U V, so arranged that the ratio F′ will be respectively 1/5, 1/3, 1/2, and 1/1, with which all the divisions from ten to one hundred may be effected. Let *n*, for instance, be the number of teeth in the wheel E to effect a given division. Then E′ F′ = *n*, and for F′ = 1/5 and E′ varying from fifty to one hundred *n* will vary from ten to twenty, and for F′ = 1/3 and E′ varying from fifty to one hundred *n* will vary from seventeen to thirty-three, and for F′ = 1/2 and E′ varying from fifty to one hundred *n* will vary from twenty-five to fifty, and for F′ = 1/1 and E′ varying from fifty to one hundred *n* will vary from fifty to one hundred. By adjusting the click K in front of the plate divided into ten or one hundred notches similar numbers may be obtained, ending, respectively, in one zero from one hundred to one thousand or ending in two zeros from one thousand to ten thousand.

Example.

a. To divide a circle into seventeen divisions, put into the machine an interchangeable gear-wheel E of fifty-one teeth and a set of wheels F, geared down one-third, Fig. 4. Then by placing the click in front of the plate I′, which has one notch, $\frac{n=51=17,}{3}$ and by placing the click in front of the plate with ten or one hundred notches *n* = 170 or *n* = 1700.

b. To divide a circle into any number of divisions from one hundred to ten thousand, in this case the number must be split into a sum of two parts, the first one consisting of a multiple of one hundred, the other one—the balance—less than one hundred. Let n here be the number of divisions to be obtained, then $n = p \times 100 + q$ where p and q are numbers less than one hundred. The first $p \times 100$ will be obtained in the manner as described above, the other by means of the wheel D. Now it will be assumed that the number of teeth on each wheel is indicated by the numeral of reference placed on the wheel. Whenever the wheel B—in other terms, the circle to be divided—makes one revolution, the wheel D makes B′ revolutions. The wheel M will therefore make $\frac{B' D'}{M'}$ revolutions, assuming B′ to be the number of teeth on the wheel B, D′ the number of teeth on wheel D, and M′ the number of teeth on wheel M. By construction the number of teeth on the gear-wheel N is the same as the number of teeth on the gear-wheel N′. Then these $\frac{B' D'}{M'}$ revolutions will be positive or negative—that is, will take place in one or the other direction, depending upon the position of the rocker-arm O. Then if the number of teeth on gear-wheel R is made equal to the number of teeth on the gear-wheel R′ the endless screw S will also make $\frac{+B' D'}{-M'}$ revolutions. Hence the gear T, with its click K, will turn $\frac{+B' D'}{-M' T'}$ revolutions. Now as by construction $\frac{M' T'}{B'} = 100$ and the click will in the meantime make $\frac{+D'}{-100}$ revolutions and as the click is in front of the plate I^3, having one hundred notches, one revolution represents the number "100," and the stroke of the click will be $\pm D'$. Therefore if we take such an intermediate wheel as to have $D' = q$, and, as described, the plate otherwise will be moved a distance $p \times 100$, the total motion will be represented by $p \times 100 \pm q$.

Example 1: To divide a circle into seventeen hundred and seventy-three parts, put into machine the same intermediate wheel E, the same set of wheels F, and the same position of the click as just described, (for the division into seventeen hundred parts,) and an intermediate wheel D of seventy-three teeth and place the rocker-arm O so as to move the click K a positive rotation. Then $n = 1700 + 73 = 1773$.

Example 2. To divide a circle into sixteen hundred and twenty-seven parts, if there are only available intermediate wheels D of from fifty to one hundred teeth, and as q is less than fifty, it will be necessary to make use of the negative rotation of the click, and the number to be obtained is split in the following manner: $n = 1700 - 73 = 1627$. The wheel E, set of gears F, and the click are then to be placed as heretofore, and the wheel D will again be the one having seventy-three teeth; but the rocker-arm O, carrying the wheels N and N′, will require such a position as to impart a negative motion to the click K. In this case there will be seen, as in the former one, upon the surface of the wheels D and E, the following indications, as shown in Fig. 7: $\frac{17}{16}$ on wheel E and $\frac{13}{27}$ on wheel D. Thus it will be known, and without any computing, that by means of these two intermediate wheels and set of gears F, No. III, one may obtain seventeen hundred and seventy-three divisions upon the circle to be divided by moving the click in the positive direction, and sixteen hundred and twenty-seven divisions when causing the rotation of the click in the opposite or negative direction.

When it is desired to obtain fractions of numbers, which might be of use in some cases, the click must be placed in front of the plates having ten notches or one notch, respectively, to obtain $n = 177.3$ or $n = 17.73$. Thus it is possible to obtain with but two series of intermediate gear-wheels E and D of from fifty to one hundred teeth and four sets of gears F any whole number or fraction not exceeding four places and two decimals from ten to ten thousand.

I claim as my invention—

1. In a dividing-machine, the combination with a frame, a drive-shaft and a work-shaft driven thereby, of interchangeable gears on the said drive-shaft, a pivot fixed in the said frame, a gear loosely mounted on the pivot, index-plates with different numbers of notches thereon secured to the said loosely-mounted gear, a second gear also loosely-mounted on the said pivot, a catch carried by the said second gear, means whereby the catch may be positioned to engage the notch or notches of any index-plate to obtain a desired division, interchangeable means for driving the said loosely-mounted gear and its index-plates by one of the said interchangeable gears, a rocker-bridge pivotally connected to the said frame, a rocker-arm pivotally connected to the said rocker-bridge, intermeshing gears mounted on the said rocker-arm, one of which meshes with the other interchangeable gear, and means intermediate of the said gears mounted on the said rocker-arm and the said second gear-wheel loosely mounted on the pivot, whereby the said second gear-wheel may be driven in either direction by the other intermediate gear.

2. In a dividing-machine, the combination with a frame, a drive-shaft and a work-shaft driven thereby, of interchangeable gears on

the said drive-shaft, each of said interchangeable gears being provided with a segmental recess and a lug or projection, the lug on one gear being adapted to enter a recess in the other gear with which it is employed, a pivot fixed in the said frame, a gear loosely mounted on the pivot, index-plates with different numbers of notches thereon secured to the said loosely-mounted gear, a second gear also loosely mounted on the said pivot, a catch carried by the said second gear, means whereby the catch may be positioned to engage the notch or notches of any index-plate to obtain a desired division, interchangeable means for driving the said loosely-mounted gear and its index-plates by one of the said interchangeable gears and means for driving the said second loosely-mounted gear by the other of said interchangeable gears.

3. In a dividing-machine, the combination with a frame, a drive-shaft and a work-shaft driven thereby, of interchangeable gears on the said drive-shaft, each of said interchangeable gears being provided with a segmental recess and a lug or projection, the lug on one gear being adapted to enter a recess in the other gear with which it is employed and one face of each gear being provided with two numerals, one above the other, the upper indicating the number of divisions obtainable when the gear is employed and the lower being one less than the upper, and the face of the lug on each gear being provided with two numerals, the one above the other, the upper indicating the number of teeth in the gear-wheel and the lower being the difference between one hundred and the upper number, a pivot fixed in the said frame, a gear loosely mounted on the pivot, index-plates with a different number of notches thereon secured to the said loosely-mounted gear, a second gear also loosely mounted on the said pivot, a catch carried by the said second gear, means whereby the catch may be positioned to engage the notch or notches of any index-plate to obtain a desired division, interchangeable means for driving the said loosely-mounted gear and its index-plates by one of the said interchangeable gears and means for driving the said second loosely-mounted gear by the other of said interchangeable gears.

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

HENRI PERRENOUD HAYES.

Witnesses:

ARMAND PERRELET,

PHILIPPE BÉGUIN.