PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Calculating Machines

I, ENDRE ZOLNAY, of 4, Vörösmarty tér, Budapest, V, Hungary, of Hungarian nationality, do hereby declare the nature of this invention 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 a calculating machine having figure wheels loosely mounted on a counter mechanism shaft, each figure wheel standing in driving connection with the said counter mechanism shaft by means of a friction coupling only, and further having a series of pawl mechanisms, each of which, by means of the friction coupling belonging thereto, hinders the rotation of one of the said figure wheels and is at the same time also constructed so as to constitute a figure-wheel changing-over member, a control mechanism being provided for said pawl mechanisms for temporary releasing and locking said figure wheels.

The object of the invention is to provide a calculating machine which owing to its extremely simple construction and to the relatively small number of its parts can be manufactured at a substantially lower cost than known types of calculating machines that are equivalent to it from the point of view of the operations that can be performed with its aid, and which at the same time, owing to its simplicity, also offers the additional advantage of increased reliability.

According to the invention the arrangement of the control mechanism is such that it is actuated by a control shaft parallel to and in driving connection with the said counter mechanism shaft, and that a complete revolution of the said control shaft in one or in the other direction is necessary for each pawl mechanism to release the figure wheel belonging to it along a length of travel corresponding to an angle of deflection proportionate to the value of the figure transmitted to the figure-wheel in question by the adjustable control gear.

The simplicity of construction of the calculating machine according to the invention results partly from the fact that it belongs to the known type of calculating machines wherein, by actuating the control shaft, by hand for example, it is possible to drive all of the figure wheels through a single transmission gear without having to bring the various figure wheels individually into driving connection with separate gear wheels for each figure wheel, and wherein the simple putting in gear or out of gear of pawl mechanisms is sufficient to decide whether the rotating effect of the driving members permanently acting on the figure wheels should be operative or not. The simplicity of construction and also of operation results, however, chiefly from the fact that with calculating machines of the known type above referred it is not an oscillating movement of the control shaft but one or more complete revolutions of said control shaft in one or in the other direction which effects the step by step rotating movement of said figure wheels, and performs, wholly or partly, the calculation just desired. From the fact that the said actuating of the control shaft has to be effected by one or more full revolutions in one or in the other direction and not as hitherto merely by oscillations follows the further advantage offered by the special coercive connection proposed according to the invention between the control shaft and the counter mechanism shaft, that it enables the figure wheels to be rotated from the control shaft step by step at will either in one direction of rotation or in the other and thereby to perform all the four fundamental arithmetical operations without the insertion of any further parts as has heretofore been necessary.

Further details and advantages of the invention will be explained with reference to the accompanying drawings, in which two embodiments of the calculating machine according to the invention are illustrated diagrammatically by way of example.

Fig. 1 is a side elevation, partly in section, of the calculating machine according to the invention, with the casing usually employed in calculating machines removed.

[*Price* 1/-]

Fig. 2 is the plan view belonging to Fig. 1.

Figs. 3 and 4 each show a side elevation corresponding to Fig 1, on which side elevations, however, the parts are represented in different operative positions.

Fig. 5 is a view from below of various figure wheels.

Figs. 6 and 7 are side elevations similar to Figs. 3 and 4, corresponding to further different operative positions of the parts.

Fig. 8 represents, in side elevation similar to Fig. 1, an embodiment, shown by way of example, of the calculating machine according to the invention, suitable for calculation with a non-uniform numerical system.

Fig. 9 is a plan view of Fig. 8.

In the drawing, I denotes the control shaft, whilst III is the counter mechanism shaft parallel to the control shaft. These two shafts are arranged in a rotatable manner on a frame u (Fig. 2) contained in a casing j, which latter, for the sake of greater clearness, is only diagrammatically indicated in the drawing, the arrangement being such as to enable the control shaft I to be rotated in either sense of rotation by means of a handle w. The two shafts I and III are in positive mutual driving connection, for instance by means of gear wheels t_1, t_2, indicated by dot-and-dash lines in Fig. 1.

The figure wheels, on the peripheral surfaces of which figures are provided in succession from 0 to 9, are mounted loosely alongside each other on the counter mechanism shaft III. Alongside each figure wheel r a friction disc s is provided. These friction discs, as shown in Fig. 3, are connected with the shaft III by means of an extension s_1 engaging with a longitudinal groove III_1 in the counter mechanism shaft III in such a manner as to ensure that the shaft III will continuously rotate the friction discs s if the shaft III is rotated from the control shaft I. The figure wheels r and the friction discs s are pressed against one another by a spring, not shown in the drawing in such a manner as to enable the friction discs to effect the rotation of the figure wheels mounted loosely on the counter mechanism shaft III. The transmission of the rotating movement from each friction disc s to the corresponding figure wheel r is prevented by a pawl mechanism engaging with the tooth system r_1 provided on the periphery of the figure wheel r, the said pawl mechanisms gripping the figure wheels r and being operated by the control gear driven by the control shaft I.

The control gear according to the invention comprises circular segments g mounted alongside one another on the control shaft I in such a manner that they can be displaced jointly in the axial direction but can be rotated independently of one another. The circular segments may be mounted on a flange tube h, mounted loosely on the control shaft I, so that by getting hold of this tube it is possible to displace the circular segments jointly in what is the upward direction in Fig. 2, in such a manner that one or more of the circular segments g will come into a position opposite to the figure wheels r provided on the shaft III.

One part g_4 of the periphery, coaxial with the control shaft I, of the circular segments g, is of smooth surface, its other part g_1 being fitted with a tooth system (Fig. 1) whereas on the extension g_3 of the circular segment the figures shown in Fig 2 are provided in succession from 0 to 9.

A fixing rail f_5 on a transverse bar f_3 carried by levers f_1 is pivotable around the control shaft I. The fixing rail f_5 extends only to the region opposite to the figure wheels r, and, as shown more particularly on the left-hand side of Fig. 2, merges, in the region extending to the initial position, shown in Fig. 2, of the circular segments g, into a lower rail f_4.

Between the control shaft I and the fixing rail f_5 a transmission gear is inserted, which is of such a kind that upon a complete revolution of the control shaft I the fixing rail f_5 will perform an oscillation to and fro, corresponding only to an angular deflection of a limited extent, preferably of an extent less than 90°. This transmission gear is composed, in the case of the embodiment illustrated, of an eccentric disc a, fixed to the control shaft I, and a rod-and-lever mechanism which is articulated to the fixing rail f_5 and is reciprocated by means of the eccentric disc. This mechanism consists according to Fig. 1 of a lever c, pivotable around a pivot b, and an articulated bar e; and, further, of a lever f_2 (Fig. 1) connected with or integral with the levers f_1 carrying the fixing rail f_5. The eccentric disc a acts on a roller d provided on the lever c in such a manner that in the course of a complete revolution of the eccentric disc the lever c swings out downwards and subsequently upwards, and an oscillating motion corresponding thereto is also performed by the fixing rail f_5.

The tooth systems g_1 provided on the circular segments g are arranged in such a manner as to enable any of the tooth gaps to be brought into connection with

the fixing rail f_5 by displacing the circular segment g in what is the upward direction in Fig. 2.

The pawl mechanisms by which the figure wheels r are held fast or released are operated by the control surfaces g_4 of the circular segments g. To each figure wheel r there belongs a pawl mechanism, and each pawl mechanism contains a double-arm control lever k_1, k_2, a fixing pawl q and a control pawl m. Preferably all the control levers k_1, k_2 and all the fixing pawls q are mounted on the same pivot II; and on the lever arm k_1 of each control lever the control pawl m is journalled in a pivotable manner. A spring n, acting on the other arm k_2 of the control lever, keeps the control lever arms k_1 in the position shown in Fig. 1, in which the control arm k_2 is supported against a fixed stop o, whereas the roller l provided on the end of the control arm k_1 occupies its extreme left-hand position. A spring x is inserted between the fixing pawl q and the control pawl m. one end of the said spring being fixed to an extension q_1 on the fixing pawl q, whilst its other end is fixed to an extension m_2 on the control pawl m, the said spring tending to rotate both pawls simultaneously in the same sense. On the fixing pawl q a step q_4 (Figs. 6 and 7) is provided, with which a nose m_3 on the control pawl m is capable of engaging.

Along the peripheral surface of each figure wheel r a cam r_2 is provided. which, after one complete revolution of each figure wheel, effects the changing of figure wheels, and, in the case of the decimal figure system, effects the so-called decimal change, notably, in connection with the fixing pawl q, a nose q_2 on the latter, which is suitable for engagement with the tooth gaps r_1 of the figure wheels r, being of such a type (Fig. 5) as to project into the region of action of the cam r_2 provided on the adjacent figure wheel e.

The method of operation of the apparatus is as follows:—

In order to carry out any arithmetical operation, the first thing to be done is to adjust on the circular segments g the figure which forms the basis of the arithmetical operation to be performed. Adjustment may be effected, for instance, in such a manner that the figure in question is adjusted by rotating the circular segments g around the control shaft I in such a manner as to enable it to be read in the direction of the arrow IV through a window j_1 provided in a casing j. This adjustment can be effected by means of any desired known members, for instance by means of keys etc., in which case the tube h carrying the circular segments g, in a manner similar to the carriage of a typewriter for instance, may always jump by one gap along the shaft I against the action of a spring v, in such a manner that one circular segment g should become placed opposite to a numeral wheel e.

Owing to the deflection to a different extent, corresponding to the adjusted figure, of the various circular segments g, the control surface g_4 of each circular segment g will occupy a different position in relation to the fixing rail f_5, and when the adjusted circular segments g are displaced in what is the upward direction on Fig 2, into the region opposite to the figure wheels r, the tooth system g_1 of the circular segments g will engage with the fixing rail f_5, whereby the adjusted position of the various circular segments will become fixed. Each of the circular segments g displaced into the position opposite to the figure wheels r will become arranged opposite to a figure wheel r, and a roller l on the control arm k_1 will lie in the path of the control surface g_4 of each circular segment g. If the control shaft I is now rotated by means of the handle w, this will constrain the counter mechanism shaft III also to rotate. Together with this counter mechanism shaft the friction discs s also rotate, but the figure wheels r are compelled to remain stationary as long as the nose q_2 of the fixing pawl q belonging to each figure wheel, engaging with a tooth gap of the figure wheel in question, holds these figure wheels fixed. As soon as the eccentric disc a, in the course of rotation of the control shaft I, has swung out the circular segments g by means of the transmission gear composed of the rod-and-lever mechanism c, e, f_2, f_1, to a sufficient extent to ensure that the step g_5 in front of the control surface g_4 of the said circular segments will come into contact with the roller l provided on the lever k_1 (Fig 3) at first only the control lever k_1 will be displaced from its extreme position by the step g_5, but the fixing pawl q will still remain stationary and will for the present still continue to keep the figure wheel r belonging to it fixed. As soon as the roller l runs up from the step g_5 on to the control surface g_4, the control lever k_1 will deflect the fixing pawl q by impact in such a manner that the nose q_2 of the latter will rise out from the tooth gap r_1 of the figure wheel r pertaining to it, so that now the friction disc s will be capable of rotating the figure wheel r in question. The rotation of the figure

wheel r will continue as long as the control surface g_4 provided on the circular segment g placed opposite to it is in contact with the roller l in question. The length of time contact varies according to the figure to which the circular segment g in question has been adjusted, and it is upon this figure that the said length of time of contact depends. Thus, for instance, in the case of the circular segment being adjusted to the figure "2", the length of time of contact will be half as long as in the case of the circular segment being adjusted to the figure "4", and so on. Thus during a complete revolution of the counter mechanism shaft III, each mechanism k_1, m, q will release the figure wheel r belonging to it along a length of travel corresponding to an angle of rotation proportionate to the value of the figure to be transmitted by the adjustable circular segments g to the figure wheel r in question.

If the figure wheel r has performed a full revolution, the part result thus obtained as a result of the calculation has in the case of the decimal numerical system, to be transmitted by means of so-called decimal change to the adjacent figure wheel r of higher value. At the moment of transmission this adjacent figure wheel r of higher value is either standing still, and is therefore, in accordance with the starting position visible in Fig. 1 held fast by the nose q_2 of the fixing pawl q, or is itself rotating also, that is, has become released, in accordance with the position shown in Fig. 4, from the action of the nose q_2 of the fixing pawl q. The manner in which changing-over, for instance decimal changing, is performed, differs according to these two possibilities.

In the first case, that is, when the central figure wheel r shown in Fig. 5 is held fast in accordance with Fig. 1 by the nose q_2 of the fixing pawl q, the cam r_2 belonging to the lowest figure wheel r shown in Fig. 5 lifts out the nose q_2 of the fixing pawl q belonging to the adjacent figure wheel, that is, to the central figure wheel r, as shown in Fig. 5, notably during a length of time corresponding to the length of the cam r_2, in accordance wherewith the central figure wheel r shown in Fig. 5 will become deflected to an extent corresponding to one figure, whereupon this central figure wheel r will again be fixed by the nose q_2 of the fixing pawl q belonging to it. On the other hand, if on the occasion of this change the adjacent figure wheel r of higher value is itself rotating, and if accordingly the pawl mechanism occupies relatively to this figure wheel r of higher value, for instance relatively to the central figure wheel shown in Fig. 5 the position shown in Fig. 4, the lowest figure wheel r shown in Fig. 5, after the performance of a complete revolution, will press the nose q_2 of the fixing pawl q belonging to the adjacent central figure wheel r in Fig. 5 by means of the projection r_2 away from the position shown in Fig. 4 into a still lower position, in consequence whereof it will become possible for the nose m_3 of the control pawl m to catch, under the action of the spring x behind the step g_4 of the fixing pawl q, as shown in Fig. 7. The control pawl m keeps the fixing pawl q disconnected until the roller l provided on the end of the control lever arm k_1 belonging to the figure wheel r, which is the central wheel in Fig. 5, has left the control surface g_4 of the circular segment g co-operating with it, and has returned into the position shown in Fig 1, as in the meantime the extension m_1 of the control pawl m runs up on a fixed stop p and thereby lifts out the nose m_3 of the control pawl m in a positive manner from the step g_4. In consequence hereof the fixing pawl q, under the action of the spring x, catches in the tooth gap r_1 of the figure wheel r belonging to it, and thereby fixes this figure wheel again relatively to the rotating effect of the friction disc s belonging to it.

The figure adjusted on the circular segments g has been transmitted by a single rotation of the control shaft I to the figure wheel r, and in case the figure wheels r have not been adjusted to zero, but some figure has already been so to speak stored on them as a result of a previous calculation, the figure adjusted on the circular segments g, by a single revolution of the control shaft I, has been added to this stored figure. If after a single rotation of the control shaft I the common supporting tube h of the segments g is not returned into the position shown in Fig. 2, but if the control shaft I is rotated for instance "n" times, the figure adjusted will have been multiplied by "n". By rotating the control shaft I in the opposite sense, the figure adjusted on the circular segment g is deducted from the figures stored on the figure wheels r, or by rotation in the opposite sense the figure stored on the figure wheel r can be divided by the figure adjusted on the segments g (quotient of division by "n").

It may be observed that only a small number, such as is necessary for understanding the invention, of circular segments g and figure wheels r, has been

shown in the drawings, but this has only been done in order to simplify the drawing, and it is a matter of course that the calculating machine according to the invention may be constructed with any desired number of circular segments *g* and of figure wheels *r*. Further the known details of construction usually employed in calculating machines, such for instance as the adjusting mechanism of the key type or of some other type, any possible writing mechanism and so forth, have for the sake of simplicity not been shown in the drawings.

After the performance of the arithmetical operation, springs, not shown in the drawings, may return the circular segments *g* into their initial positions determined by a stop g_2.

The embodiment shown in Figs. 8 and 9 differs from the preceding one only in that it enables calculation to be effected in a system with non-uniform denominations for instance in English currency.

In Figs. 8 and 9, those parts that are in conformity with the preceding figures are indicated by identical numerals so that these need not be described specially.

Such parts as have to be employed in addition to those employed in Figs. 1 to 7 are marked in Figs. 8 and 9 by capital letters; and it should be noted that parts corresponding to one another from the point of view of operation are indicated in Figs. 8 and 9 by the same capital and small letters.

As appears from Figs. 8 and 9, two eccentric discs *a* and A are provided in this case on the control shaft I. The disc *a* co-operates with the transmission gear or rod-and-lever mechanism *c*, *e*, f_2, f_1, whereas to the eccentric disc A there belongs the rod-and-lever mechanism C, E, F2, F1. Further, two fixing and control rails can be oscillated around one and the same control shaft I, namely the rails f_5 and F_5, the regions of action of which are contiguous to one another in a longitudinal direction, as appears from Fig. 9. Accordingly the tooth system g_1 of the circular segments *g* may be brought into connection with either of the fixing rails f_5 and F_5, which are arranged in transverse section in one and the same plane, as seen in Fig. 8. In the case of the calculation mentioned above by way of example, the fixing rail F_5 corresponds to the pennies, that is, to the figure system based on the figure "12", in accordance wherewith twelve teeth are provided on the periphery of the first figure wheel *r*. In other respects the construction and method of operation of the pawl system and of the figure wheels *r*, as well as of the friction discs *s*, corresponds to the first embodiment already described, and the method of operation of the whole apparatus is also identical with the one already described in connection with the first embodiment.

According to a similar principle it is also possible to construct calculating machines calculating with more than two non-uniform denominations, for instance in the case of a calculating machine working with three such denominations it would be necessary to provide three eccentric discs and three fixing rails pivotable in both directions on the control shaft I.

The invention can also be carried into effect differently from the embodiments described by way of example. Thus, for instance, it is not absolutely necessary that the eccentric discs *a* and A should be mounted on the control shaft I as they may also be rotated from the said shaft by means of a transmsision gear, Further, the pivot of rotation *b* of the rod-and-lever mechanism may be constituted differently from the examples illustrated, for instance by the counter mechanism shaft III, or by the pivot II.

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. A calculating machine, having figure wheels (*r*), loosely mounted on the counter mechanism shaft, each figure wheel standing in driving connection with the said counter mechanism shaft by means of a friction coupling (*s*) only, and further having a series of pawl mechanisms (k_1, *q*, *m*), each of which, by means of the friction coupling belonging thereto, hinders the rotation of one of said figure wheels, and is, at the same time, also constructed so as to constitute a figure-wheel changing-over member, a control mechanism being provided for said pawl mechanisms for temporary releasing and locking said figure wheels, characterised in that the arrangement of the control mechanism is such that it is actuated by a control shaft (I) parallel to and in driving connection with the said counter mechanism shaft, and that a complete revolution of said control shaft in one or in the other direction is necessary for each pawl mechanism to release the figure wheel belonging to it along a length of travel corresponding to an angle of deflection proportionate to the value of the figure transmitted by the adjustable control mechanism to the figure wheel in question.

2. A calculating machine as claimed in claim 1, characterised by the feature that the control gear comprises circular segments (g) coaxial with the control shaft (I) and mounted alongside one another on the said control shaft (I), in such a manner that they can be displaced in the axial direction jointly, but can be rotated independently of one another, the said circular segments being on one part (g_4) of their periphery of smooth surfaces, whilst on another part (g_1) of their periphery they are fitted with teeth, and further comprises a fixing rail (f_5), mounted on the control shaft so as to be pivotable around the said shaft, and capable of being brought into connection, by the axial displacement of the circular segments, with any tooth of the tooth system of the said segments, the said fixing rail extending only to the length of the region opposite to the figure wheels (r), and further comprises a transmission gear inserted between the control shaft (I) and the fixing rail (f_5), the said transmision gear being such as to ensure that upon the complete revolution of the control shaft the fixing rail should perform an oscillating motion corresponding only to a limited amount of angular deflection, preferably to an angular deflection smaller than 90°.

3. A calculating machine as claimed in claim 2, characterised by the feature that the transmission gear referred to comprises an eccentric disc (a) rotated by the control shaft (I) and a rod-and-lever mechanism (c, e, f_2, f_1) articulated to the fixing rail (f_5), and being oscillated by means of the eccentric disc.

4. A calculating machine as claimed in claim 3, characterised by the feature that the eccentric disc is mounted on the control shaft itself.

5. A calculating machine as claimed in claim 3 or 4, characterised by the feature that the eccentric disc as regards both its directions of rotation, is of such a type of design as to ensure that in case of its rotation in either sense it would swing out the fixing rail (f_5) and thereby also the circular segments (g) by an identical angular deflection.

6. A calculating machine as claimed in any one of the preceding claims, characterised by the feature that each pawl mechanism releasing the figure wheels (r) from time to time under the action of the adjustable control gear comprises a fixing pawl (q), engaging in or supported on the figure wheels owing to spring or weight action or both, and a control lever arm (k_1) positively swung to and fro, against the effects of a spring or weight or both, by a circular segment (y), whilst at the same time a control pawl (m), journalled in a pivotable manner on the control lever arm, is inserted by way of a transmitting member between the fixing pawl and the control lever arm.

7. A calculating machine as claimed in claim 6, characterised by the feature that a spring (x), acting on the one hand upon the fixing pawl (q) and on the other hand upon the control pawl referred to, and tending to deflect these two pawls by rotation relatively to one another, is inserted by way of a further transmitting member between the fixing pawl (q) and the control lever (k_1).

8. A calculating machine as claimed in claim 6 or 7, characterised by the feature that both the control lever arm (k_1) and the control pawl (m) are constructed as double-arm levers co-operating with fixed stops (o and p).

9. A calculating machine as claimed in any one of the claims 6 to 9, characterised by the feature that the fixing pawls and control-lever arms of all the pawl mechanisms are mounted on a common pivot (II).

10. A calculating machine as claimed in any one of the claims 6 to 9, characterised by the feature that the fixing pawl of each pawl mechanism is so constructed as also to serve as a figure-wheel changing-over member projecting into the region of one of the figure wheels adjacent to it at any time and co-operating with the changing-over cam (r_2) provided on the said adjacent figure wheel.

11. A calculating machine as claimed in any one of the claims 2 to 10, suitable for calculation with a non-uniform numerical system, characterised by the feature that the adjustable control gear comprises such a number of fixing rails (f_5, F_5) mounted so as to be pivotable in both directions around a common control shaft (I), and, further, such a number of transmission gears (a, c, e and A, C, E) whereby the said rails, during a complete revolution of the control shaft referred to, are pivoted to and fro to the extent of a limited angular deflection, the fixing rails mentioned being of such arrangement and type of design as to ensure that their respective regions of action should be adjacent to each other in mutual succession, and that it should be possible to bring any tooth of the circular segments (g) mounted on the control shaft into connection with any fixing rail.

12. A calculating machine as claimed in claim 11, characterised in that the transmission gear comprises a number of eccentric discs (a, A) mounted in a fixed

manner on a common control shaft, the different eccentric discs effecting the oscillation, in both directions, of different fixing rails.

13. A calculating machine, substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 27th day of April, 1939.
MARKS & CLERK.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1940.

Fig. 1.

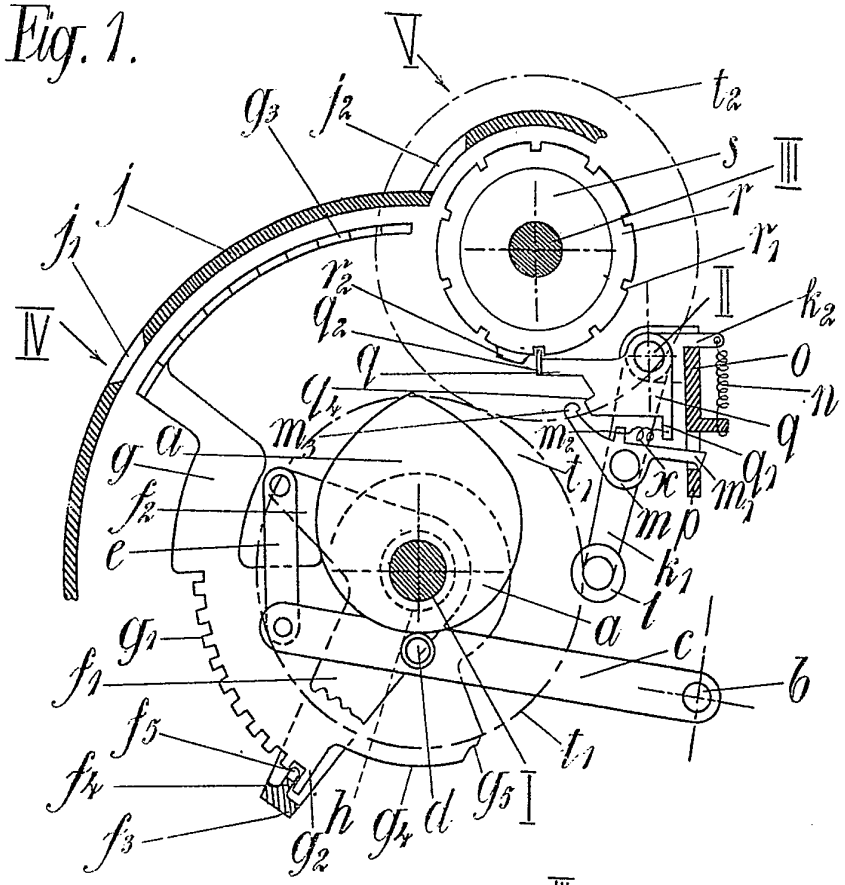

Fig. 2.

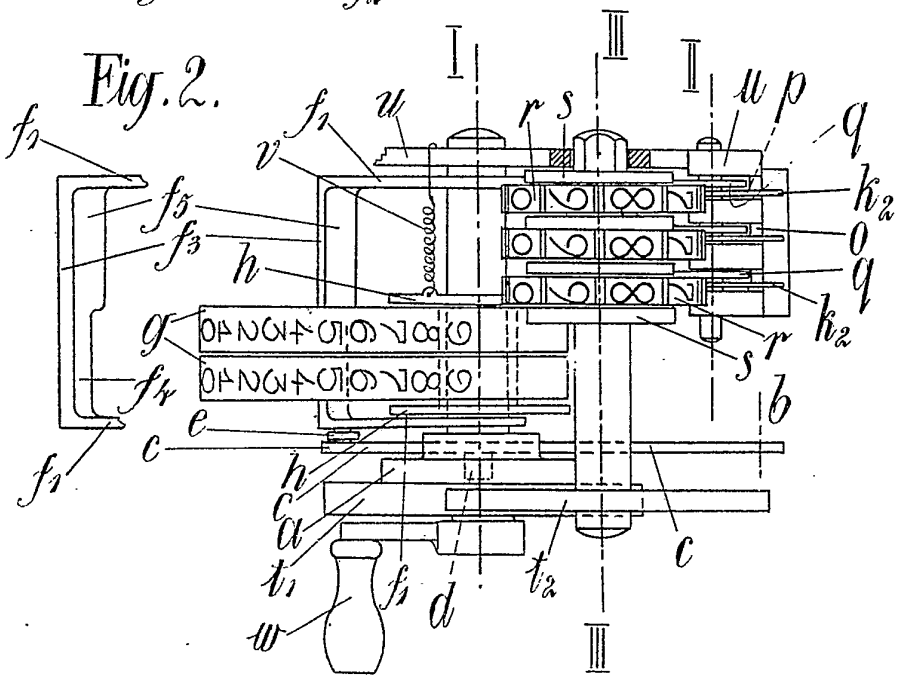

Fig. 3.

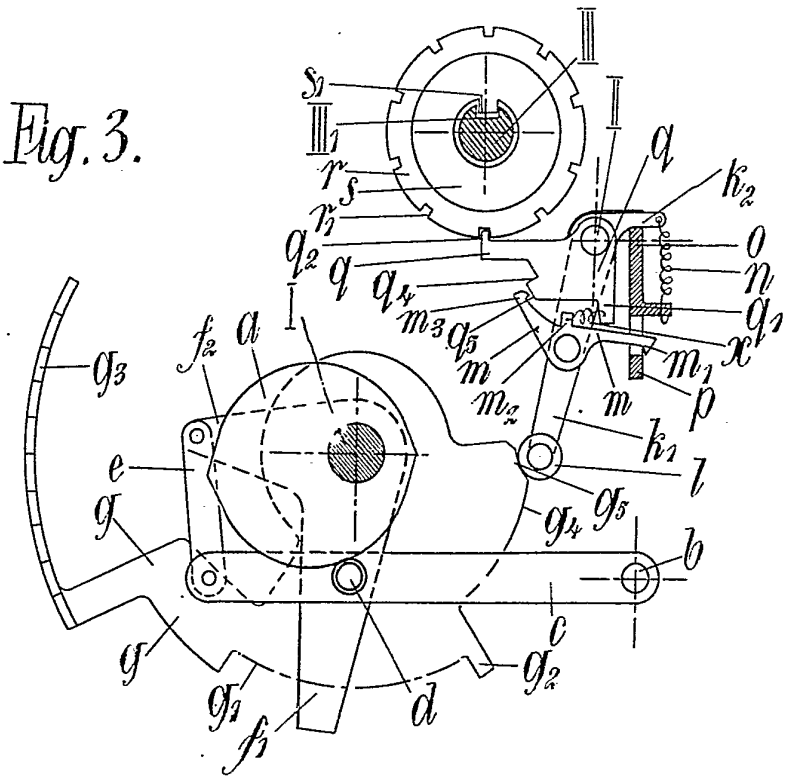

Fig. 5.

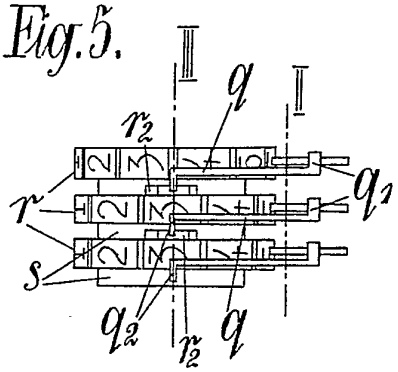

Fig. 4.

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4 SHEETS

SHEET 1

Fig. 1.

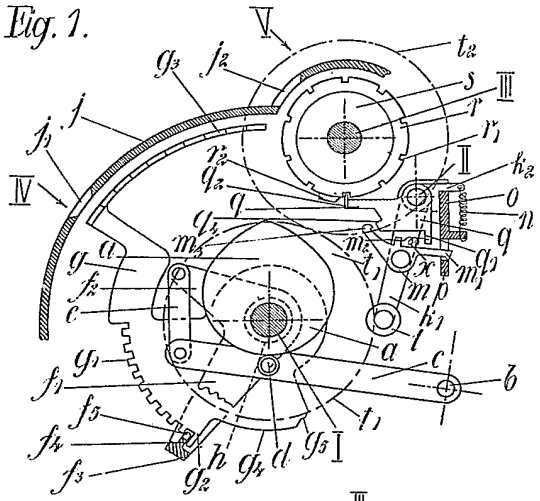
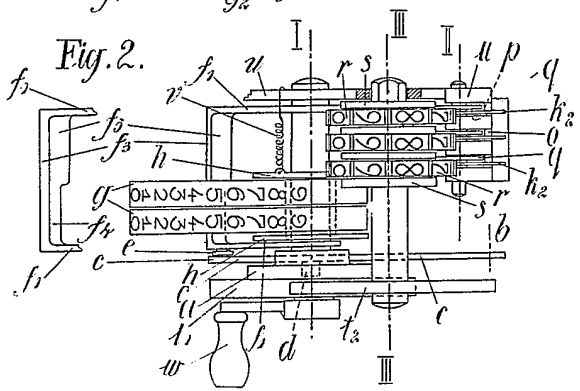


Fig. 2.



SHEET 2

Fig. 3.

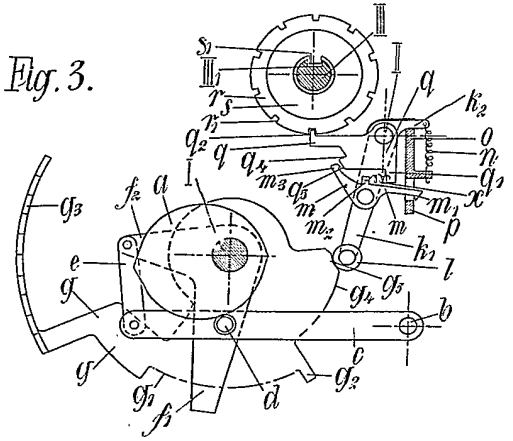


Fig. 5.

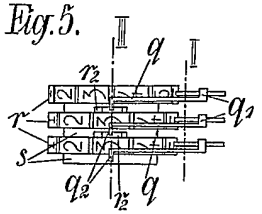


Fig. 4.

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Fig. 6.

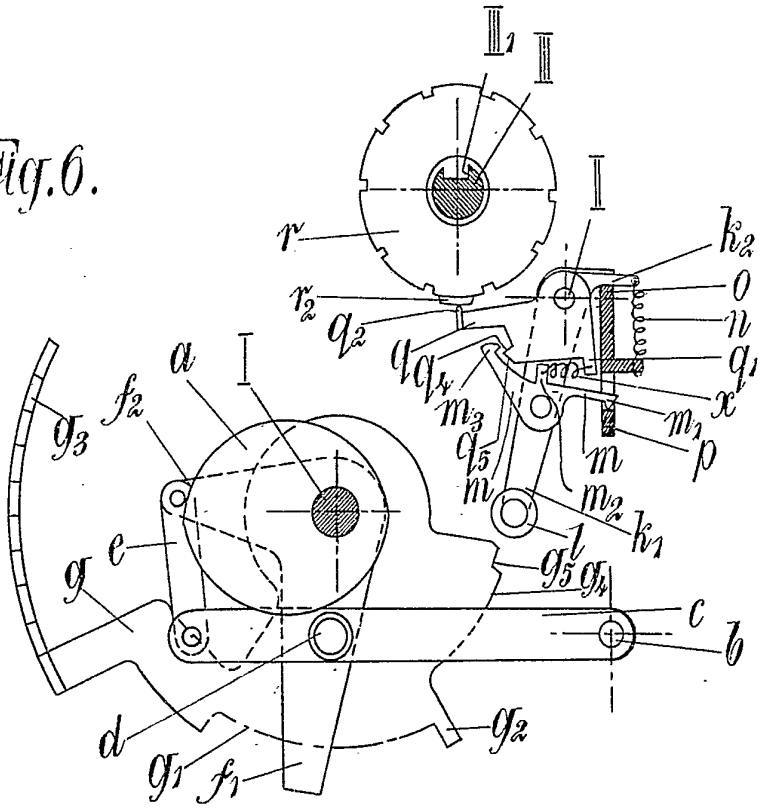


Fig. 7.

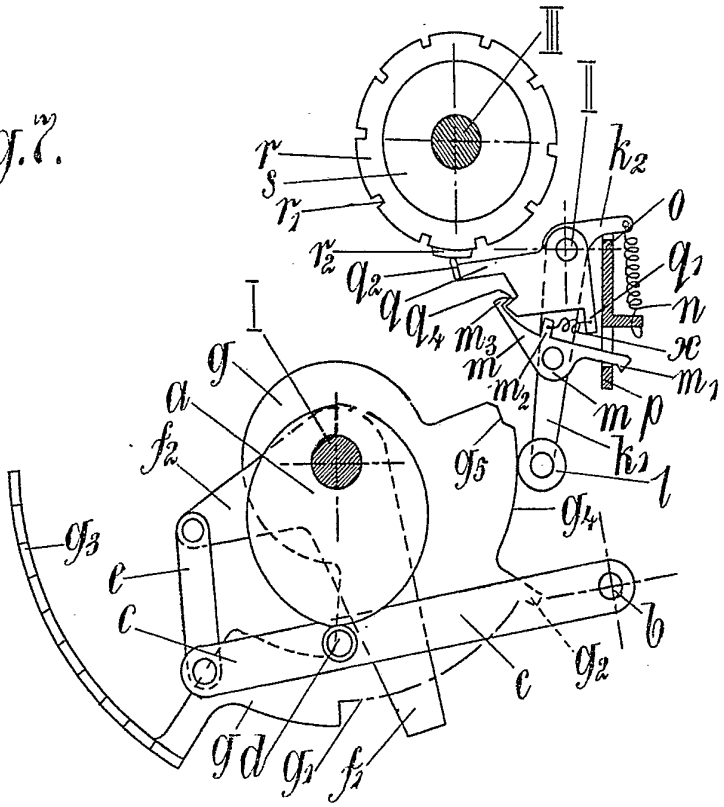


Fig. 8

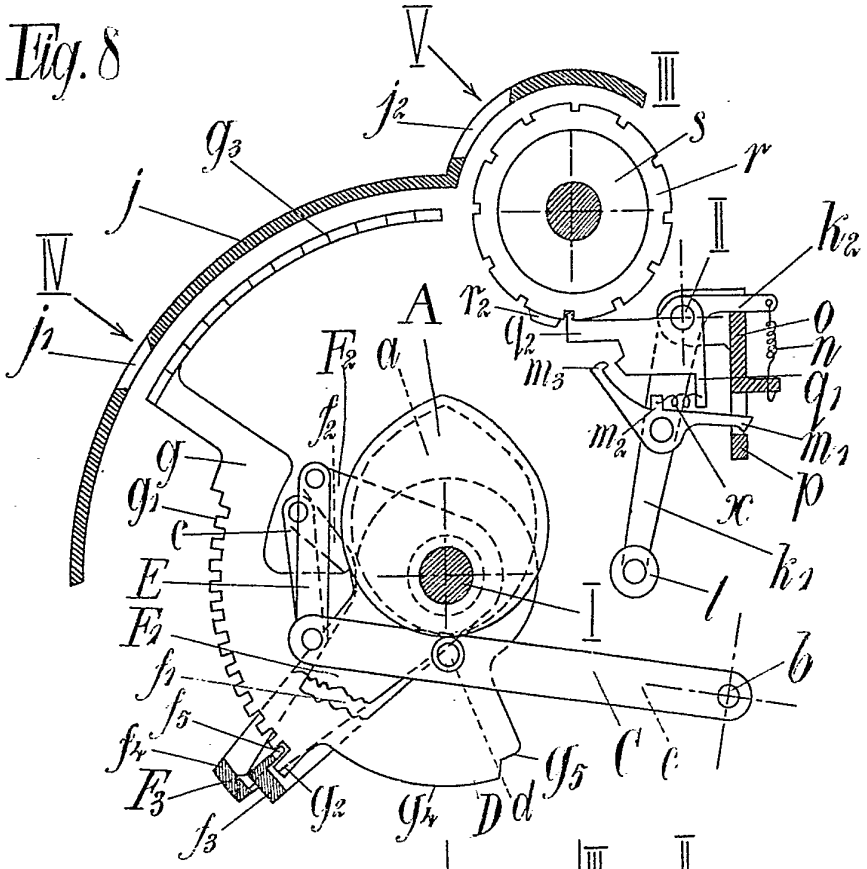
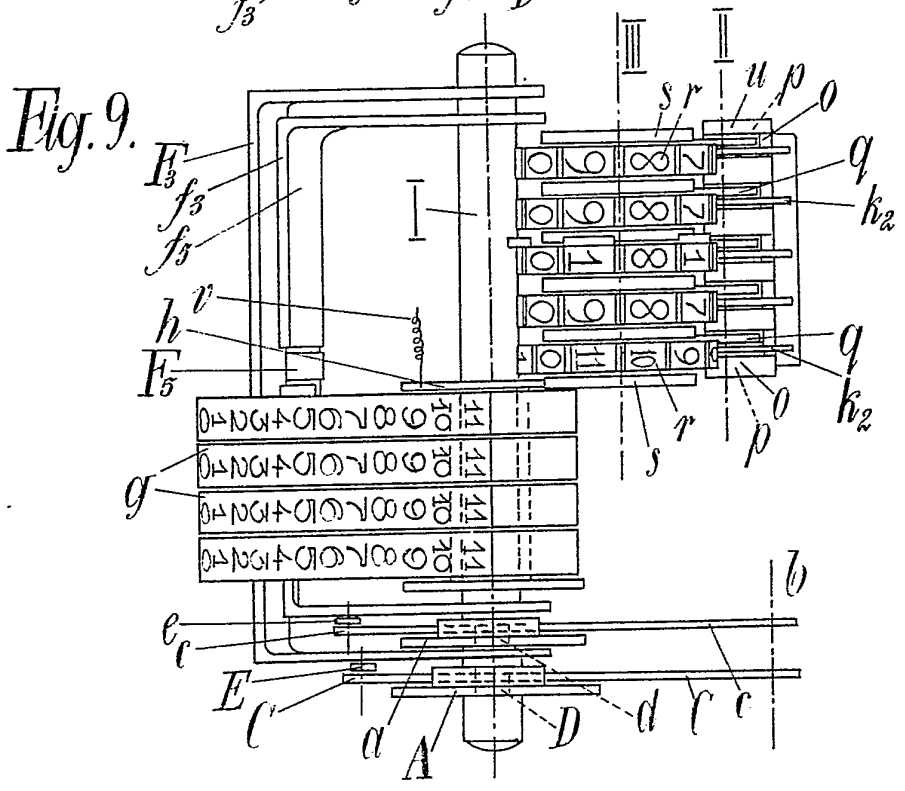


Fig. 9.



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4 SHEETS

SHEET 3

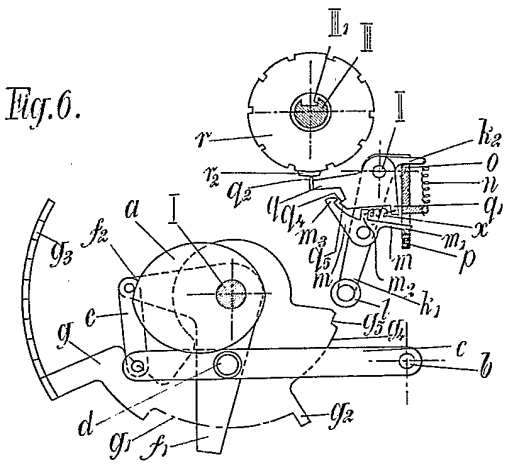

Fig. 6.

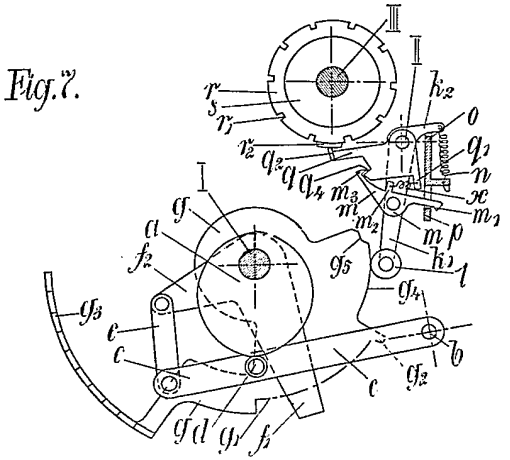

Fig. 7.

SHEET 4

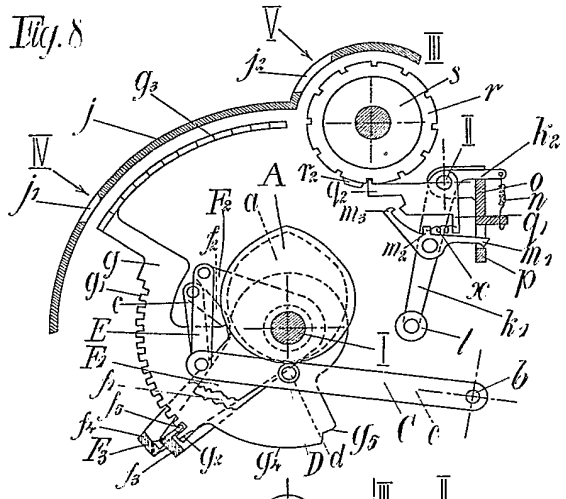

Fig. 8.

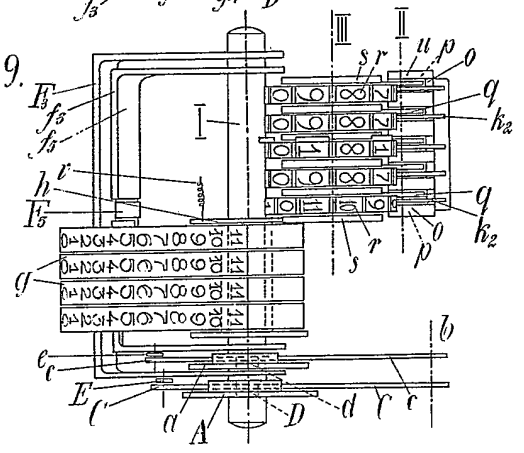

Fig. 9.

[This Drawing is a reproduction of the Original on a reduced scale.]

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