March 7, 1950 J. CARLSEN 2,499,946

CARRYING MECHANISM FOR CALCULATING MACHINES

Filed Oct. 14, 1946

Fig. 1.

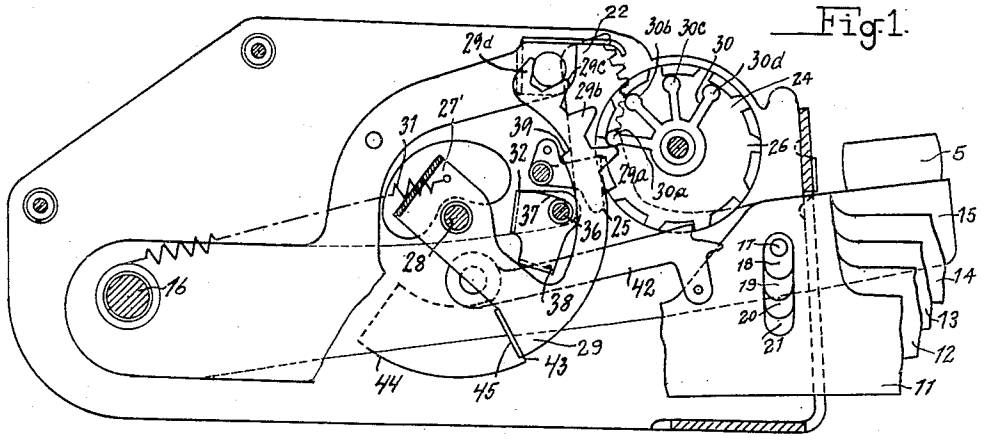


Fig. 2.

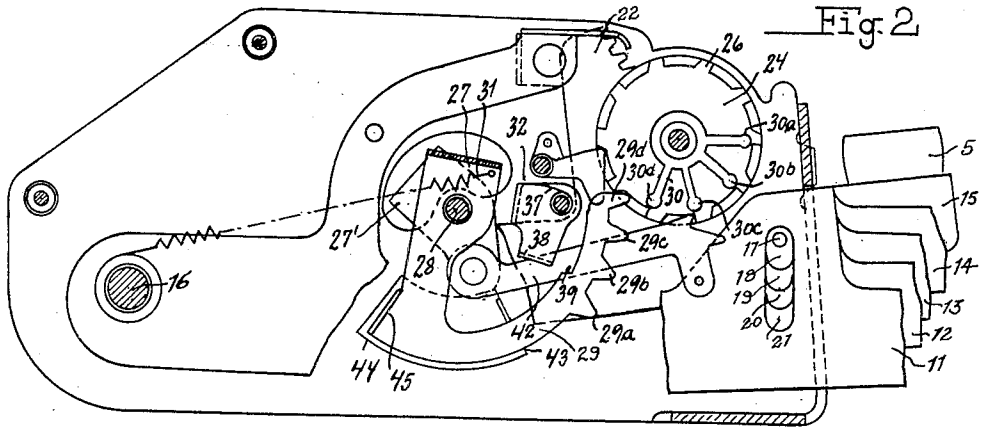
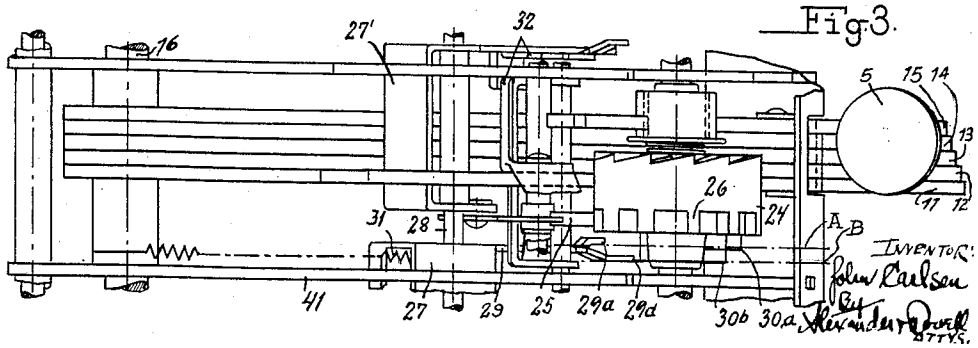


Fig. 3.



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CARRYING MECHANISM FOR CALCULATING MACHINES

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2 Claims. (Cl. 235—137)

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The present invention relates to the carrying mechanism of calculating machines of the type in which a carrying mechanism is associated with each row of keys, which carrying mechanism is adapted to be moved against a restoring force on the depression of the keys, and, in the case of a calculating operation requiring a carry transfer, to be released so as to be permitted to move back under the influence of the restoring force thereby influencing the calculating unit of the next higher order.

In machines of this kind, it has been proposed to arrange for the carrying mechanism to be strained or wound up by means of a spiral cam fixed to the number wheel, the spiral surface of which contacts an arm of the carrying mechanism under the influence of a spring. When the spiral cam is turned the arm is urged backwards against the spring force until the position is reached where the spiral cam has its discontinuity. At this position the arm is suddenly released and permitted to swing back under the influence of the spring, thereby effecting a carrying operation.

This known construction suffers from the drawback that during the straining of the carrying mechanism the frictional losses are relatively great as compared with the useful energy, with the result that a comparatively small increase of the coefficient of friction as a consequence of wear etc. in the course of time may lead to a point where the carrying mechanism fails, in which connection it is to be taken into account that every carrying mechanism, when released, should be capable of straining the carrying mechanism of the next higher order to the extent corresponding to a turning of the number wheel by one step. If a point is reached where the carrying mechanism fails, it will not be possible to make the mechanism operate again by increasing the spring force, since practically all the frictional resistances to be overcome are proportional to the spring force.

The present invention is based on the recognition that by arranging for the straining or winding-up action to take place by means of intermeshing teeth instead of a spiral cam, the construction may be made less sensitive to an increase of the coefficient of friction, because in this manner it will be possible to reduce the proportion of frictional losses to useful energy, so that a greater increase of the friction is permissible before a point is reached where the carrying mechanism fails. The invention accordingly provides for a carrying mechanism in which a toothed sector is associated with the number

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wheel and adapted, by meshing with teeth on a member of the carrying mechanism, to bring about the above mentioned movement of the latter.

The greater the number of teeth of the two intermeshing toothed sectors is selected, the smaller will be the friction, but on the other hand, the releasing point of the carrying mechanism will be less well-defined with an increasing number of teeth; but by compromising between these two points of view, it has been found that the most advantageous number of teeth is four, and that in any case the number of teeth should lie within the limit 3–6.

But in order that my invention may be better understood, reference will now be had to the accompanying drawings, in which the invention is illustrated as applied to a five key calculating machine, i. e. a machine of the type having keys only for the numerals 1–5 in each column, the addition of the higher numerals being effected by striking twice, e. g. 2×3 instead of 6, $3+4$ instead of 7 etc. In said drawings

Fig. 1 shows such of the parts of a calculating unit of one order as are necessary for understanding the invention, as viewed in cross-sectional elevation along the line I—I of Fig. 3,

Fig. 2 shows the same with the parts in a different position, and

Fig. 3 shows the same in plan view.

In the drawings, 11—15 are five key arms, each carrying a key representing the numerals 1–5 respectively. Of these keys only the key 5 representing the amount "5" is shown in the drawing. The key arms 11—15 are arranged in juxtaposition so as to form a fan-like structure, and all the key arms are pivotable on a common pivot 16. The key arm 15 is provided with a stud 17 engaged in elongated slots 18, 19, 20 and 21 of the key arms 11, 12, 13 and 14, so that on the depression of any of the keys fixed to the key arms 11—15, the key arm 15 will be swung downwards on the pivot 16. The angle through which each key arm 11—15 is depressed until striking the base of the machine as represented at 50 will be proportional to the number represented by the key in question, and since each of the key arms 11—14 on being depressed carries with it the key arm 15 through its entire stroke, the angle through which the key arm 15 is moved will always be proportional to the number represented by the depressed key. The detailed construction of the key system is the subject matter of my co-pending application Ser. No. 628,698, filed on Nov. 15, 1945, now Patent No. 2,472,519, and has no direct bearing on the pres-

ent invention, so that a further description is considered unnecessary for the purpose of the present specification.

The key arm 15 carries a toothed sector 22, which by way of a gear wheel and a ratchet drive operates a number wheel 24 in such a manner that on the depression of any key the number wheel will be advanced through an angle corresponding to the number represented by the depressed key, such turning of the number wheel taking place simultaneously with the depression of the key.

At its circumference the number wheel 24 is provided with teeth 26 engaged by a pawl 25 serving to brake the number wheel and to fix it in its predetermined regular positions. The teeth 26 are also engaged by a pawl 42 coupled to a carrying member 27' which co-operates with the calculating unit of the next lower denomination. The carrying member 27' corresponds exactly to the carrying member 27 co-operating with the number wheel 24 and serving to carry transfer to the calculating unit of the next higher order each time the number wheel 24 is turned to or past the zero-position.

The carrying member 27 is pivoted at 28 and is loaded by a spring 31 tending to turn it in an anticlockwise direction. In the position shown in Fig. 1 it rests, under the influence of the force of the spring 31, with an abutment 45 on the edge 43 of a hole 44 in a partition 41 between the considered calculating unit and the calculating unit of the next higher order and is thereby fixed in the position shown. The carrying member 27 is provided with a toothed sector 29 adapted to co-operate with a number of projecting teeth 30 on the end of the number wheel 24. The lowermost tooth of the toothed sector 29 is bent out of the common plane of the toothed sector in a direction towards the number wheel 24, while the other teeth 29*b*, 29*c* and 29*d* of the toothed sector are bent out of said plane in the opposite direction. Similarly, the leading tooth 30*a* among the teeth 30 of the number wheel is lower, as measured in the axial direction, than the other teeth 30*b*, 30*c* and 30*d*. By this means it is obtained that the teeth 29*a* and 30*a* will intermesh in another plane A, Fig. 2, than the plane B in which the teeth 29*b*, 29*c* and 29*d* mesh with the teeth 30*b*, 30*c* and 30*d*.

Behind the toothed sector 29 there is arranged a barring member 32 pivoted at 36 and biased by a torsional spring 37. The construction and operation of the barring member 32 is described in detail in a co-pending application Serial No. 703,247. From such application it appears that as long as none of the keys of the numerical group in question is depressed, the barring member 32 is maintained free of the back edge of the toothed sector, while on the depression of any key the barring member is permitted to turn in such a direction that a detent 38 provided on the barring member 32 moves towards the back of the toothed sector and will be capable of snapping in behind a shoulder 39 of the toothed sector when the carrying member 27 has reached a certain position.

The position of the number wheel 24 shown in Fig. 1 corresponds to the "5" position. In this position the number wheel 24 begins to mesh with the toothed sector 29, and when the number wheel is turned in an anticlockwise direction by depressing one of the keys of the numerical group in question, the number wheel will, therefore, cause the carrying member 27 to be rotated in a clockwise direction against the action of the spring 31, which is thereby strained or wound up, the teeth 30 preventing the toothed sector 29 and thereby the carrying member 27 from returning to its neutral position under the influence of the spring 31.

Fig. 2 shows the number wheel in the zero-position immediately after the carrying member has been fully released for return movement. It will be understood that in the zero position the tooth 30*d* has just slipped off of the tooth 29*b*, so that the carrying member 27 may be rotated in an anticlockwise direction under the influence of its spring 31. However, this rotation of the carrying member may take place only after the key, the depression of which caused the number wheel to be rotated to the zero-position, has been restored to normal as shown, because as long as this is not the case the detent 38 will engage behind the shoulder 39 and detain the carrying member 27 in the position shown.

When the carrying member 27 is turned in an anticlockwise direction under the influence of its spring 31, it will effect a carry transfer to the numerical group of the next higher denomination by means of a pawl of exactly similar kind as the pawl 42 shown.

In order that the carrying member shall be able to operate in the desired manner, it is necessary that, after having been released, it is permitted to swing altogether back to the position shown in Fig. 1, because otherwise it will not transfer to the number wheel of the next higher denomination the full amount of motion necessary for the carrying operation. Accordingly, it is necessary to make certain that the teeth 30*a*—*d* cannot get in the path of the teeth 29*a*—*d* during the return movement of the carrying member 27. This necessitates special measures to be taken in two different respects.

First, it is necessary to make clear how far the number wheel may be turned beyond the zero-position in the same calculating operation that caused it to pass through the zero-position and thereby to initiate the carrying operation. The extreme position which the number wheel may reach will occur if, before the operation in question, it was in the "9" position and is now turned onwards by depressing the "5" key. This advances the number wheel to the "4" position, but at the same time a carry transfer may possibly have taken place from the calculating unit of the next lower order, particularly in the case of a multiplication, and if so, the number wheel will be advanced to the "5" position in the operation requiring a carry transfer. Accordingly, provision must be made, whereby the number wheel, when in its "5" position, does not prevent the carrying member from moving fully back to its normal position, and this again means that the teeth 29*a* and 30*a* must begin to intermesh only in the "5" position of the number wheel, or at any rate in the immediate neighbourhood of same.

Secondly, it must be taken into consideration that in the starting position thus fixed for the winding-up action of the carry transfer mechanism, while there is no objection to the tooth 30*a* lying in the path of the tooth 29*a*, the tooth 30*a* must not prevent the teeth 29*c*, 29*d* and 29*b* that arrive first during the return movement of the carrying member from passing by. That is the reason why, according to the invention, it is proposed to displace the teeth 29*a* and 30*a* out of the plane in which the other teeth mesh with each other. If this measure were not taken, it would not be possible to arrange for the tooth 30*a* to commence meshing with the tooth 29*a*

immediately in the "5" position, but it would have to be kept a little back so that the winding-up or straining of the carrying member would be distributed over a smaller interval.

The employment of a toothed winding-up mechanism leads to the particular advantage that very small frictional losses are encountered. These losses will be the smaller, the greater the number of teeth, but, on the other hand, the release of the carrying member will then be less positive, and by compromising between these two points of view, it has been found that the most favourable number of teeth will be four, and that in any case the number of teeth should lie within the limit 3–6.

The transfer lock controlled by the keys of the lower order in a single transfer mechanism is claimed in my copending application Serial No. 703,247 and the 5–0 transfer drive is claimed in my copending application Serial No. 703,248, now abandoned, both of which applications were filed concurrently herewith.

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

1. In five-key calculating machines, a number wheel of lower order, a set of driving teeth associated with said number wheel of lower order for rotation therewith, said set being distributed over part of the circumference of said number wheel and comprising a first driving tooth effective in a first plane and further driving teeth effective in a second plane, a spring biased transfer member having a first driven tooth effective in said first plane for engagement with said first driving tooth and having further driven teeth effective in said second plane for engagement with said further driving teeth and located entirely axially outside the path of movement of said first driving tooth, said interengaging teeth forming a tooth drive for moving said transfer member against the action of said biasing spring during part of a revolution of said number wheel of lower order and for thereafter releasing said transfer member to perform a return stroke, a number wheel of higher order, and means associated with said transfer member for imparting transfer motion to said number wheel of higher order from said transfer member during the return stroke thereof.

2. A five-key calculating machine as set forth in claim 1, said first driving tooth being located entirely outside the path of movement of said first driven tooth in all positions of said number wheel between the 0 and 5 positions thereof.

JOHN CARLSEN.

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