June 7, 1949. J. CARLSEN 2,472,519

KEY-OPERATED DIFFERENTIAL ACTUATOR

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Fig. 1.

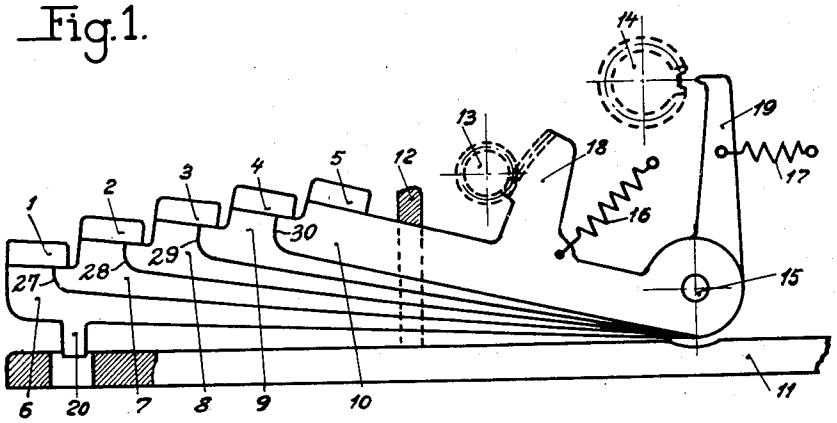


Fig. 2.

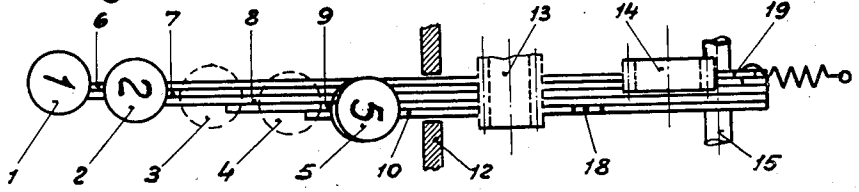
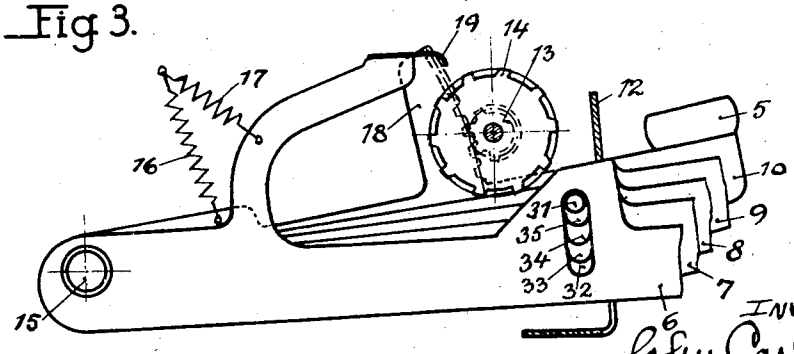


Fig. 3.



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KEY-OPERATED DIFFERENTIAL ACTUATOR

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5 Claims. (Cl. 235—82)

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The present invention relates to adding machines or calculators of the kind in which the adding or calculating operation is effected by depressing the amount keys, as distinguished from the type in which the amount keys merely serve to set stops, and the op ation of adding is accomplished by a prime mover such as a crank handle or lever, and more particularly the invention has to do with the construction and arrangement of key units, or in other words rows or banks of keys for use in connection with machines of the type set forth.

In the known calculators of this kind it is necessary to arrange the keys at a relatively high level above the bottom of the machine, because the keys are provided with stems that are slidably mounted in guides below the keys, and below the said guides, again, there is arranged a system of members for transmitting the motion of the keys to the calculating mechanism. Besides, this arrangement is rather complicated, and as the movements are transmitted by way of a number of small parts, the inexactitudes of which are added to one another, the said small parts must be produced with very narrow tolerances which renders them expensive.

The invention has for its purpose to eliminate these drawbacks and at the same time to devise a construction which is reliable, simple and cheap to manufacture.

With these and other purposes in view the main feature of the invention consists in the provision, in calculating machines of the kind set forth, of a key unit comprising a number of key arms each carrying a key and all of them combined so as to form a fan-like structure and coupled together in such a manner that each key, when operated in the prescribed manner, will cause the key arm representing the highest amount within the unit to be moved through an angle which is proportional to the amount represented by the depressed key.

Further details of the invention will appear from the following description with reference to the accompanying drawing, in which

Fig. 1 shows an embodiment of a key unit according to the invention in side view,

Fig. 2 the same in top view, and

Fig. 3 another embodiment of a key unit according to the invention in side view.

The key unit shown in Figs. 1 and 2, belonging to one of the denominational adding or calculating units of the calculator, consists of keys 1, 2, 3, 4 and 5, that are fixed to key arms 6, 7, 8, 9 and 10 respectively, which are all pivoted on a

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common axis 15. The keys 1, 2, 3, 4 and 5 are supposed to correspond to the amounts represented by the reference numerals. Thus it will be understood that the calculator is of the kind, where two depressions are effected for all denominational amounts above "5."

The key arm 10, representing the amount "5," carries a rack 18, the teeth of which mesh with a gear 13 which, in a manner not shown, drives a number wheel associated with the denominational calculating unit to which the key unit belongs. A spring 16 tends to keep the key arm 10 pressed against an abutment formed by a wall 12 standing on a base plate 11. The key arm 6, representing the amount "1," carries a stop 19 which, when depressing the key 1, engages with a gear 14 coupled to the number wheel. A spring 17 keeps the key arm 6 in conact with the abutment formed by the wall 12. The abutment is formed by the upper edge of an aperture, the vertical edges of which combine with tubular distance members surrounding the pivot 15 to form a guide for the whole key unit. In the downward direction, the movements of the key arms are limited by the base plate 11, this acting as a stop either directly or through a silencing intermediate, preferably consisting of felt, rubber or the like.

In Fig. 2 the keys 3 and 4 are removed and represented by a dotted line only in order that the shape and the arrangement of the key arms should be seen more clearly. From this figure in connection with Fig. 1 it is seen, that each of the key arms 7, 8, 9 and 10 is provided with a nose 27, 28, 29 and 30 respectively, extending below the key of the next lower amount 1, 2, 3 and 4 respectively. Further, it is seen that each of the keys 2, 3, 4 and 5 overhangs the key arms of all lower amounts.

The function is as follows: If e. g. the key 4 is depressed, it will carry with it the key arm 10 by means of the nose 30, or, in other words, the key arm 10 is turned through an angle equal to the angle described by the key arm 9, when moving from its position of rest until striking the base plate. If, on the other hand, e. g. the key 3 is depressed, it carries with it the key arm 9 by means of the nose 29, and the latter key arm in turn carries with it the key arm 10 by means of the nose 30. Accordingly, also in this case the key arm 10 will be turned, and this time through an angle equal to the angle described by the key arm 3 from its top position to its bottom position. Now, the key arms are arranged to form a fan-like structure in such a manner, that each of

them, when moving from its top position to its bottom position, will move through an angle which is proportional to the amount represented by the key arm. This again means that, by any depression of a key, the key arm 10 is turned through an angle proportional to the amount represented by the depressed key, and the key arm 10 can, therefore, by means of the rack 18 transmit the depressed amount to the calculating mechanism in a correct manner.

When e. g. the key 4 is depressed, the key arm 9, after having performed ¾ of its movement, will carry with it the key arm 6 on the last fourth of the movement, whereby the stop 19 is caused to engage with the gear 14, the said movement of the key arm 6 being caused by the key 4 overhanging the key arm 8, the key 3 overhanging the key arm 7 etc. As the gear 14 is coupled to the number wheel and thereby to the gear 13, all the moving parts will be stopped, so that overrunning, resulting from the tendency of the inertia of the moving parts to turn the number wheel too far, is avoided.

Adjacent its outer end, the key arm 6 is provided with a projection 20 depending into a hole in the base plate 11. The projection 20 has for its purpose to prevent the longest key arm 6 from bending away from the other key arms, which would have the effect, that the noses of the various key arms might come out of engagement with the respective keys.

The embodiment shown in Fig. 3 differs from that of Figs. 1 and 2 mainly in the manner in which the key arms are coupled to one another. Similar parts are designated by the same reference numerals as in Fig. 1. As regards the mutual coupling of the key arms, the movement of the key arm 6 during the depression of any key is effected in the same manner as in Figs. 1 and 2, whereas the movement of the key arm 10 is effected by a pin 31 fixed to the key arm 10 and extending into long holes 32, 33, 34 and 35 of the other key arms. In the normal position, where no key arm is depressed, the pin 31 is situated at the upper end of all the long holes 32, 33, 34 and 35, so that the key arm 10 is moved immediately on depressing any of the other keys. The form of the long holes enables the key arm 10 to be fully depressed when operating the key 5.

The embodiment of Fig. 3 has the advantage as compared with that of Figs. 1 and 2, that the unidirectional coupling between each of the key arms 6, 7, 8 and 9 and the key arm 10 is a direct one, whereas in the embodiment of Figs. 1 and 2 the key arms representing the lower amounts are indirectly coupled to the key arm 10, viz. by way of one or more key arms representing intermediate amounts. In an indirect coupling of this kind, inevitable inaccuracies of the individual coupling elements will be summed up, which necessitates the adoption of narrower tolerances than in the case of a direct coupling, where no such summing up is encountered.

The invention is of course equally applicable to calculating machines, in which each row of keys comprises all the amounts from "1" to "9" or any other number of amounts.

The key arms may advantageously be stamped out of sheet material, e. g. Bakelite hard paper which is particularly suitable on account of the favourable relation between stiffness and weight. In the stamping operation the rack 18, the stop 19 and the projection 20 may conveniently be made integral with the key arms to which they belong.

The keys may advantageously be moulded directly on to pins extending from the key arms in a pressure moulding operation. For instance, the keys may be moulded from a thermoplastic material when the key arms consist of Bakelite hard paper, but, alternatively, it is of course also possible to employ metal alloys if the keys are made of metals. In this manner a very reliable fastening and a great exactitude of the position of the keys relatively to the keys are obtained, as the mould itself will form a jig in the fastening process.

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 calculating machines of the kind comprising keys adapted to impart a step-wise rotary motion to number wheels associated therewith directly on their depression, a key unit comprising a number of flat key arms independently pivoted on a common axis perpendicular to the overall planes of the key arms and having their flat sides situated in close relationship, keys individual to said key arms and carries by the latter at different distances from the said common axis and representing different amounts, means for keeping each key arm in a normal position and for restoring it to such position after depression, means for limiting the angular movement of each key arm when depressed to a value proportional to the amount represented by its associated key, a projecting member integral with each of said key arms other than that representing the lowest amount and engaging below the key representing the next lower amount, and means for operatively connecting the key arm representing the highest amount with the number wheel served by the unit.

2. In a calculating machine of the kind comprising keys adapted to impart a step-wise rotary motion to number wheels associated therewith directly on their depression, in combination, a plurality of number wheels, a key unit individual to each number wheel and comprising a number of flat key arms independently pivoted on a common axis perpendicular to the overall planes of the key arms and having their flat sides situated in close relationship, keys individual to said key arms and carried by the latter at different distances from the said common axis and representing different amounts, means for keeping each key arm in a normal position and for restoring it to such position after depression, means for limiting the angular movement of each key arm, when depressed, to a value proportional to the amount represented by its associated key, a one-way drive connection between each key arm representing a lower amount and the key arm representing the highest amount so as to cause the former, when depressed, to carry with it the latter, and means for operatively connecting the key arm representing the highest amount with the number wheel served by the unit.

3. A calculating machine as set forth in claim 2 and further comprising a lost motion drive connection between each key arm representing a higher amount and the key arm representing the lowest amount so as to cause the former, when depressed, to carry with it the latter during the last part of its downward movement, a nose on the key arm representing the lowest amount, and means associated with the number wheel served by the unit engagable by said nose on de-

pression of the key arm representing the lowest amount.

4. A calculating machine as set forth in claim 2 and in which said one-way drive connection is formed by means on each key arm representing a lower amount directly engaging with means on the key arm representing the highest amount.

5. In a calculating machine of the kind comprising keys adapted to impart a step-wise rotary motion to number wheels associated therewith on their depression, in combination, a plurality of number wheels, a key unit individual to each number wheel and comprising a number of flat key arms independently pivoted on a common axis perpendicular to the overall planes of the key arms and having their flat sides situated in close relationship, keys individual to said key arms and carried by the latter at different distances from the said common axis and representing different amounts, means for keeping each key arm in a normal position and for restoring it to such position after depression, means for limiting the angular movement of each key arm, when depressed, to a value proportional to the amount represented by its associated key, a coupling member projecting laterally from the key arm representing the highest amount and engaged in long holes in the other key arms so as to be situated at the top of such long holes in the normal position of the key arms, and means for operatively connecting the key arm representing the highest amount with the number wheel served by the unit.

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