Jan. 30, 1951 W. J. HIGGINS 2,539,906

FULL STROKE MECHANISM FOR CALCULATING MACHINES

Filed April 22, 1947 2 Sheets-Sheet 1

FIG. 1

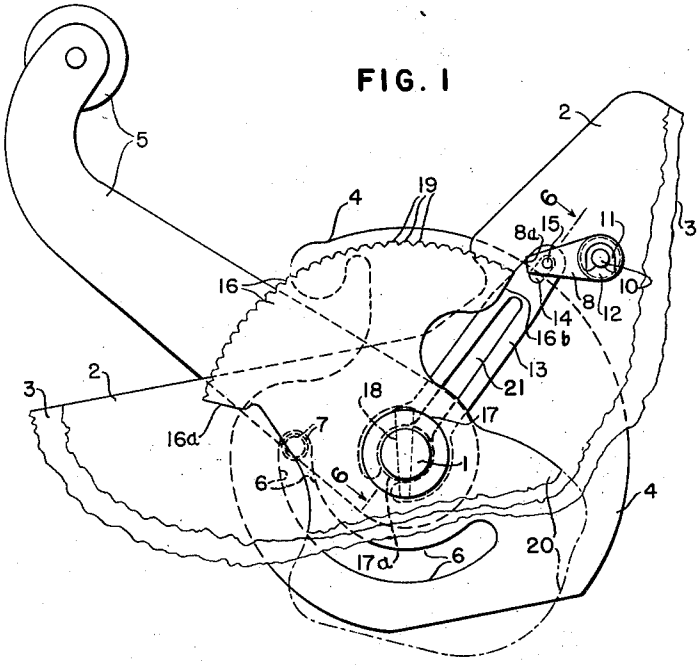


FIG. 2

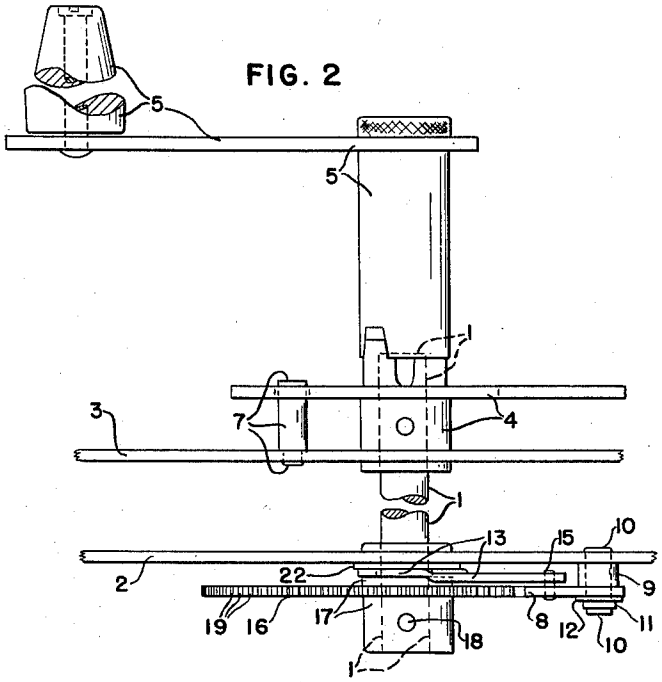


FIG. 3 FIG. 4

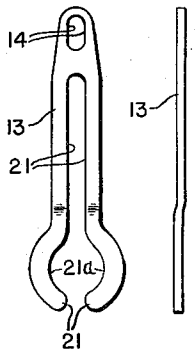


FIG. 5

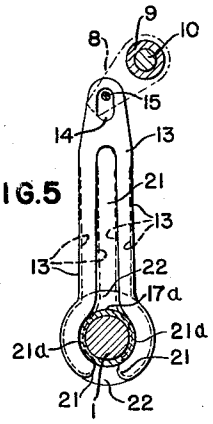
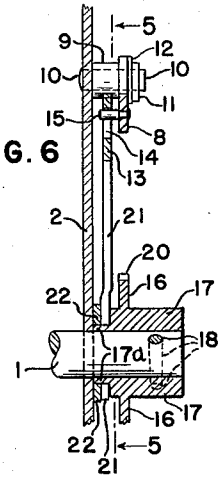


FIG. 6



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Jan. 30, 1951 W. J. HIGGINS 2,539,906

FULL STROKE MECHANISM FOR CALCULATING MACHINES

Filed April 22, 1947 2 Sheets-Sheet 2

FIG. 7

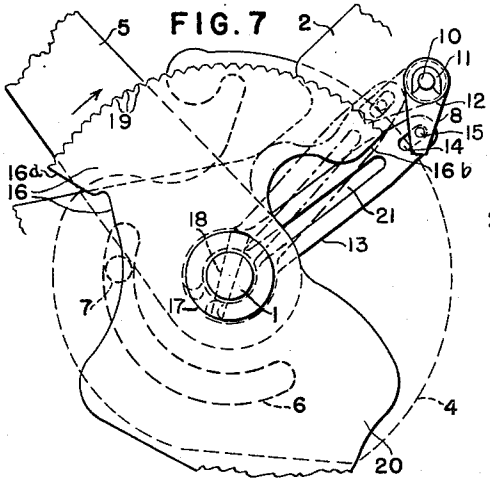


FIG. 8

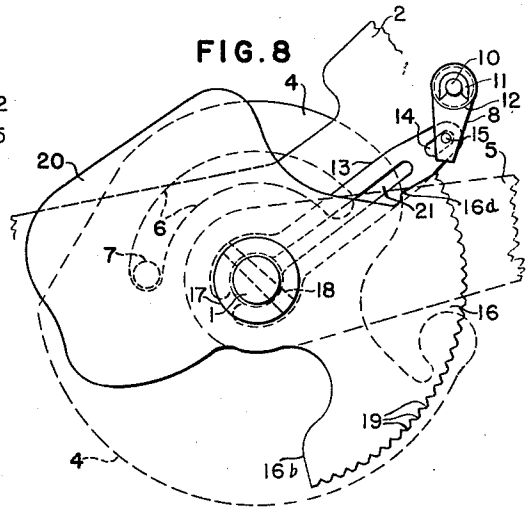


FIG. 9

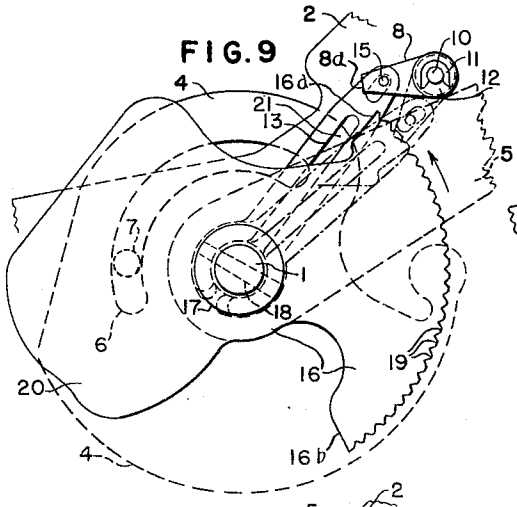


FIG. 10

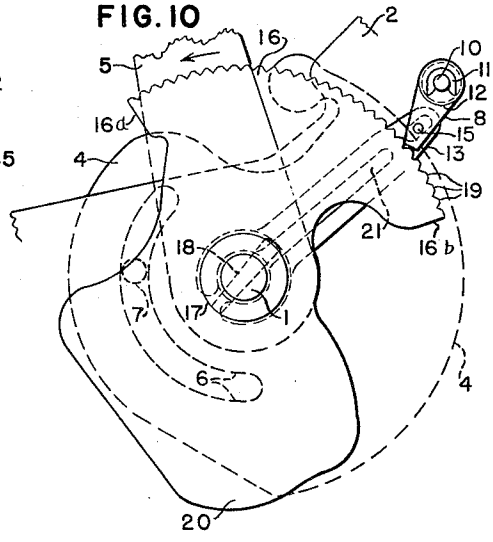
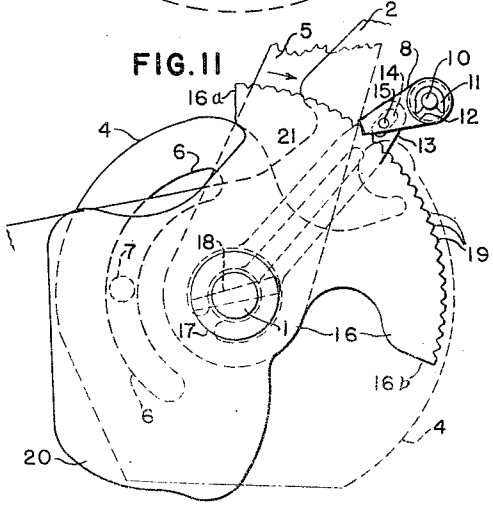


FIG. 11



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FULL STROKE MECHANISM FOR CALCULATING MACHINES

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Application April 22, 1947, Serial No. 743,120

2 Claims. (Cl. 74—17.5)

1

In machines, such as calculating machines, having an element, such as an operating handle, requiring alternate converse strokes thereof under control of an operative to two fixed stroke limits for correct actuation of said element to perform its intended function or functions, mechanisms known as full stroke mechanisms have been provided which permit stroking of the element back and forth alternately to its two stroke limits but prevent any substantial reverse movement of the element until a stroke thereof initiated at either of said stroke limits has been completed to the other stroke limit. Such mechanisms are applicable to elements of the kind set forth regardless of whether the element is stroked in both directions by manually applied force or is stroked in one direction by manually applied force and in the opposite direction by a spring or its equivalent designed to return the element to a normal stationary position at one of its stroke limits when the element is moved by the operative from said one limit and released.

The principal object of the present invention is to provide an improved full stroke mechanism for elements of the kind above set forth which is characterized by simplicity of construction, low cost of production, substantially noiseless operation, and ability to operate efficiently and with a minimum of wear.

Another important object of the invention is to provide a mechanism of the kind set forth having two engageable and disengageable parts (such preferably as a rack and a pawl or dog) which are controlled by the strokable element to remain out of contact so long as the element is stroked alternately to its stroke limits, to automatically so engage, upon any slight reverse movement of the element while a stroke thereof initiated at either of said stroke limits remains incomplete, as to block further such reverse movement of the handle, and to automatically disengage upon resumption of the uncompleted stroke of the element.

Other objects and advantages of the invention will be apparent to those skilled in the art from the following description in detail of the preferred embodiment of the invention illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a fragmentary side elevation of a known calculating machine equipped with a preferred form of full stroke mechanism embodying the invention, the machine being shown as viewed from the left hand side thereof and with its operating handle at one stroke limit, and only so much of the known machine being shown as is necessary for a full understanding of the improved full stroke mechanism;

2

Figure 2 is a fragmentary top plan view of the machine with its operating handle positioned as in Figure 1;

Figures 3 and 4 are face and edge views, respectively, of a pawl driving or pawl controlling arm forming part of the improved full stroke mechanism;

Figure 5 is a detail sectional view on line 5—5 of Figure 6;

Figure 6 is a detail sectional view on line 6—6 of Figure 1; and

Figures 7 to 11 are views similar to Figure 1 showing the mode of operation of the improved full stroke mechanism as more fully hereinafter described.

The known calculating machine in connection with which a preferred embodiment of the invention is shown in the drawings has a main operating shaft 1 which extends horizontally and transversely of the machine and is journaled adjacent opposite ends of the shaft in a left hand side plate 2 and a right hand side plate 3 which are parts of the main frame of the machine. A cam disk 4 and the main operating handle or hand crank 5 of the machine are fixedly held to shaft 1 at the outer side of the right hand side plate 3 for oscillation of shaft 1, disk 4 and handle 5 as a unit about the axis of the shaft. Disk 4 is provided with an arcuate slot 6 concentric with shaft 1, and a pin or stud 7 which is fixed to side plate 3 protrudes through said slot. Engagement of opposite end walls of slot 6 alternately with the fixed pin 7 determines the two fixed stroke limits of the operating handle 5.

For correct functioning of the machine, the handle must be moved through a two-stroke cycle all the way from one of said fixed stroke limits to the other and then all the way back to the first-mentioned stroke limit, that one of said stroke limits at which the handle is shown in Figures 1 and 2 being the one in which the handle normally stands and at which each such cycle of operation thereof starts and ends. In the known machine shown, the handle has a full throw through a fixed arc of 135 degrees.

In the drawings, this known machine is shown equipped with an improved full stroke mechanism embodying the present invention, and the illustrated construction and arrangement of parts whereby the machine is thus improved will now be described.

A pawl or dog, having a body part 8 and a hub

9, has its hub journaled on a pivot stud 10. The stud 10 is fixed at its inner end to the left hand side plate 2 of the machine and protrudes outward or to the left from said plate and is parallel to shaft 1 of the machine. The hub 9 extends a short distance inward beyond the body part 8 of the pawl and is held in contact with the outer face of plate 2 by a fastener 11 which is engaged with the stud 10 and holds a washer 12 on the stud against the outer face of pawl 8—9. The pawl is thus journaled on the stud for movement in a fixed plane which is normal to shaft 1, and the body part 8 of the pawl is held spaced a short distance from plate 2.

The position of the pawl is controlled by the operating handle 5 of the machine through a pawl controller or pawl driving arm 13 with which the handle has, as more fully hereinafter described, a two-way friction-slip driving connection. The arm 13, as more fully hereinafter described, is mounted for swinging thereof about the axis of shaft 1 of the machine by the friction driving connection of said handle with said arm, and is formed adjacent its outer end with a short closed slot 14. The slot 14 extends longitudinally of the arm and normal to the axis of shaft 1. A pin 15 is fixed at its outer end to the body part 8 of the pawl between the pawl hub and the outer end of the pawl and projects inward toward side plate 2 through slot 14 in arm 13, said pin being parallel to shaft 1 and pivot stud 10.

The slot 14 of the pin-and-slot connection 14—15 between the pawl and its driving or control arm 13 is of such length that swinging movements of the connected pawl and arm will be positively arrested at two limits of such movement by abutment of the pin 15 against the outer end wall of slot 14 but that the connected pawl and arm may be freely swung from each to the other of said two limits. In so swinging from one of said limits to the other, the pin passes between the axes of the arm and pawl across a straight line connecting said axes, which line extends longitudinally of, and medially of, the width of both the arm and pawl when the axial line of the pin is located in said line, so that the arm makes equal angles with said line at both limits of swinging movement of the arm and that the pawl makes equal angles with said line at both limits of swinging movement of the pawl. The outer end of the pawl is thus swingable between the pawl axis and the common axes of the handle, shaft and driving or control arm to equal and limited angles with a straight line connecting said two axes and radial or normal to both thereof, and the extent of possible swinging movement of the pawl and of the arm is positively limited by the connected therebetween so that separate limit stops are not required. The above described limited maximum possible movement of the connected arm and pawl is of such small extent that it may be effected by a very small fraction of the maximum throw or stroke of the handle.

The pawl or dog 8—9 is coactive, as more particularly hereinafter described, with the teeth of a rack to block mal-operation of the handle 5, which rack is positively conversely driven by the handle. This rack, and the driving connections of the handle with the rack and with the pawl driving arm or controller, now will be described.

The rack has a flat and substantially segmental and externally toothed body portion 16 provided with a hub 17, said hub of the rack being fixed to the protruding left hand end of the main shaft 1 of the machine outside of the left hand side plate 2 to oscillate in unison with said shaft and with disk 4 and handle 5. Hub 17 extends inward from body 16 of the rack into abutting engagement with plate 2 and has a reduced cylindrical inner end portion 17^a, said hub being fixed to the shaft by suitable means, such as a tapered pin 18 driven through registering holes in the hub and shaft, to compel the rack to oscillate in unison with the shaft and prevent axial movement between the shaft and rack. The substantially segmental body portion of the rack 16—17 is externally toothed at its periphery from one end edge 16^a to the opposite end edge 16^b thereof to provide a series of teeth 19 all of which lie in an arc concentric with the axis of the rack, said teeth being separated by V-shaped tooth spaces equally divided by lines radial to the axis of the segment, the included angle of the sides of each tooth space preferably being 90 degrees. In the machine shown there is also formed on hub 17 of the segmental rack, or externally toothed segment, and in substantially diametrically opposed relation to the rack, a cam 20 which, however, forms no part of the present invention.

The pawl controlling or driving arm 13 is formed of slightly resilient sheet steel or like material, and is medially divided from its inner end to a point adjacent the inner end of slot 14 by a longitudinal slot 21. Slot 21 is open at the inner end of arm 13 and is enlarged at opposite sides of said slot adjacent the open end of the slot to form a circular and diametrically split bearing aperture or pivot hole 21^a the normal diameter of which is slightly less than the major or external diameter of the reduced cylindrical inner end portion 17^a of the rack hub 17. The arm 13 is thus formed with two slightly springy leg portions which are oppositely curved adjacent their free ends to resiliently frictionally grip with their inner edges the periphery of part 17^a of hub 17 of the rack, which hub part is forced through the enlarged part 21^a of slot 21 and maintains said legs slightly sprung apart. Arm 13 thus will oscillate with the handle 5, shaft 1, and rack 16—17 until said arm is arrested, and the handle and shaft and rack also may oscillate as a unit relatively to arm 13 while said arm is held stationary, due to the two-way friction-slip driving connection between the handle and arm just described.

The arm is kept out of contact with plate 2 by a spacing washer 22 which is mounted on part 17^a of the rack hub and engages said plate and arm. The part 17^a of the rack hub terminates short of the plane of the inner face of the body part 16 of the rack to provide an annular shoulder which abuts the outer face of the arm 13 around the rack hub and maintains the arm out of contact with the rack outwardly beyond the perimeter of the rack hub.

It will be observed that the pawl or dog 8—9 is movable conversely in a fixed path and that it has a fixed maximum possible throw in said path from one to the other of two fixed maximum limits of movement in said path. The pawl or dog can, therefore, only move in a fixed and definitely limited zone relatively to the main frame of the machine and it also will be observed that only a small fractional part of a full stroke of the machine handle is required to frictionally drive the pawl or dog from one to the other of its maximum limits of movement.

The rack or toothed segment 16—17, which is

fixed to shaft 1 to oscillate as a unit therewith and with the handle 5 throughout all movements of said shaft and handle, is so fixedly related to the shaft and handle, and is so proportioned, that said rack is positively movable by the handle conversely in a fixed path to two fixed maximum limits of movement in said path, that the toothed edge of said rack moves in the direction of its length in the same plane in which the pawl or dog moves, that the rack teeth pass between the axes of pawl 8—9 and shaft 1 through only a medial portion of the zone of maximum movement of the outer or nose end of the dog or pawl, that the rack is conversely movable across a straight line connecting the axes of the shaft and pawl or dog on each full handle stroke to two fixed limits of possible rack movement at which the rack is located wholly out of the said maximum zone of movement of the pawl or dog, and that the point of closest approach of the pawl to the axis of the shaft and rack is closer to said axis than the bottoms of the tooth spaces of the rack.

Referring to the drawings, in Figures 1 and 8 the handle and shaft and rack are shown at different ones of the two maximum limits of converse movements of these fixedly united parts, and the dog is shown in said views at that one of its two maximum limits of motion in which it is located when the handle and shaft and rack are positioned as shown in the respective ones of said views. The parts are so related that in moving from the position of Figure 1 to that of Figure 8, the pawl or dog will, as shown in full lines in Figure 7, be frictionally driven through its full throw by movement of the fixedly connected handle and shaft and rack through only a small fractional part of their maximum movement. In passing from the position of Figure 1 to the position shown in full lines in Figure 7, the arm drives the dog in a path which would carry the dog below the path of the roots of the rack teeth or bottoms of the tooth spaces (as indicated in dotted lines in Figure 7), but the relative positions of the dog and rack in the Figure 1 position are such, and their relative rates of drive are such, that the dog travels from its position of Figure 1 to that shown in full lines in Figure 7 slightly in advance of the advancing end 16^b of the rack, so that on a full stroke of the handle and rack from the position of Figure 1 to that of Figure 8, the rack and dog make no contact with each other.

On a full stroke of the handle from its limit of movement shown in Figure 8 back to its starting limit shown in Figure 1, the pawl is correspondingly reversely driven to that fixed limit of movement thereof shown in Figure 1 and in full lines in Figure 9 in advance of the oncoming end edge 16^a of the rack by a small fractional part of said handle stroke, so that the pawl and rack make no contact with each other, the pawl and arm being shown in dotted lines in Figure 9 partly driven from one limit to the other.

Since the pawl and rack also are held out of engagement at each of the maximum limits of stroke movement of the handle, it will be noted that so long as no mal-operation of the handle is attempted, the pawl and rack at no time will engage each other and noise and wear which would result from such engagement are avoided, but the full stroke mechanism nevertheless is automatically reconditioned or set by a small and initial part of each stroke to function to prevent

or block mal-operation of the handle on that stroke.

In Figure 10, the pawl or dog is shown engaged with the rack to block return of the handle to the position of Figure 1 before completion of a handle stroke from that position to the position of Figure 8, and in Figure 11 the pawl or dog is shown engaged with the rack to block return of the handle to the position of Figure 8 before completion of a handle stroke from that position to the position of Figure 1.

It will be noted that the pawl or dog makes blocking engagement with the toothed edge of the rack while the dog is inclined to a straight line connecting the axis of shaft 1 and the pivotal axis of the dog. Preferably, as shown, the pawl or dog has a straight end edge 8^a making equal angles with the two longitudinal side edges of the pawl or dog, each of which angles is equal to the included angle of the sides of the tooth spaces of the rack, thus providing the nose of the pawl or dog with two corners each adapted to fit in any tooth space of the rack. One corner of the nose of the dog engages in the rack tooth spaces upon mal-operation of the handle in one direction, and the other corner so engages upon mal-operation of the handle in the opposite direction. A very slight improper reverse movement of the handle will throw the dog into engagement with the rack, and the dog will be disengaged from the rack immediately upon resumption of an improperly curtailed stroke of the handle.

Although I have thus described my invention in its preferred form, as required by the patent statutes, I desire to be limited only by the scope of the appended claims.

I claim:

1. In a full stroke mechanism, a pawl and a peripherally toothed segment mounted for oscillation contra to each other in a common plane and about separate axes into and out of toothed engagement, means positively arresting oscillation of said segment at two opposite limits at which its toothed periphery is located wholly to one side or the other of a straight line intersecting the axes of oscillation of the pawl and segment, a pin projecting from the pawl parallel to said axes, and a bar of slightly springy sheet metal having a closed longitudinal slot therein adjacent one end thereof in which said pin is engaged, said bar having a second longitudinal slot open at the opposite end of the bar and which is provided adjacent its open end and spaced from its other end with two opposed segmental edge portions, said segment having a hub provided with a cylindrical end portion resiliently frictionally gripped by said segmental edge portions of said second slot in the bar to frictionally drive said bar when the segment is oscillated and which journals the bar for positively limited oscillations of the connected bar and pawl contra to each other and to an extent sufficient to carry said pin across said straight line.

2. In a full stroke mechanism, the combination with a machine frame having an upstanding wall and a horizontal shaft which protrudes at one end thereof through said wall and is mounted in the frame to be oscillated about its axis to first one and then the other of two fixed limits, of a hub fixed on said protruding shaft end to oscillate with the shaft and having an annular shoulder facing said wall and also having a reduced cylindrical end portion which extends from said shoulder to said wall, a peripherally toothed

segment disposed in a plane normal to said shaft and formed on said hub to oscillate therewith and displaced farther from said wall than said shoulder, a pawl mounted on the frame wall to swing into and out of toothed engagement with the segment about a fixed axis parallel to the shaft axis, a pin projecting from said pawl toward said wall, a flat and slightly springy sheet metal bar journalled at one end on said reduced end portion of the hub with one face of said bar abutting the hub shoulder, and a spacing washer on said reduced end portion of the hub between said bar and said frame wall, said bar having a longitudinal slot which is open at the journalled end of the bar and extends beyond the hub and throughout the major part of the length of the bar and is provided adjacent said journalled bar end with two opposed segmental slot edge portions resiliently and frictionally embracing the periphery of the reduced end portion of the hub, said bar having a closed longitudinal slot therein adjacent its other end in whic hthe pin on the pawl is engaged for positively limited oscillations of the pawl and arm which carry the pin on the pawl equal distances to opposite sides of a straight line which is

crossed by the entire toothed periphery of the segment during each full oscillation of the segment and intersects the axes of oscillation of the pawl and segment.

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