

June 18, 1963

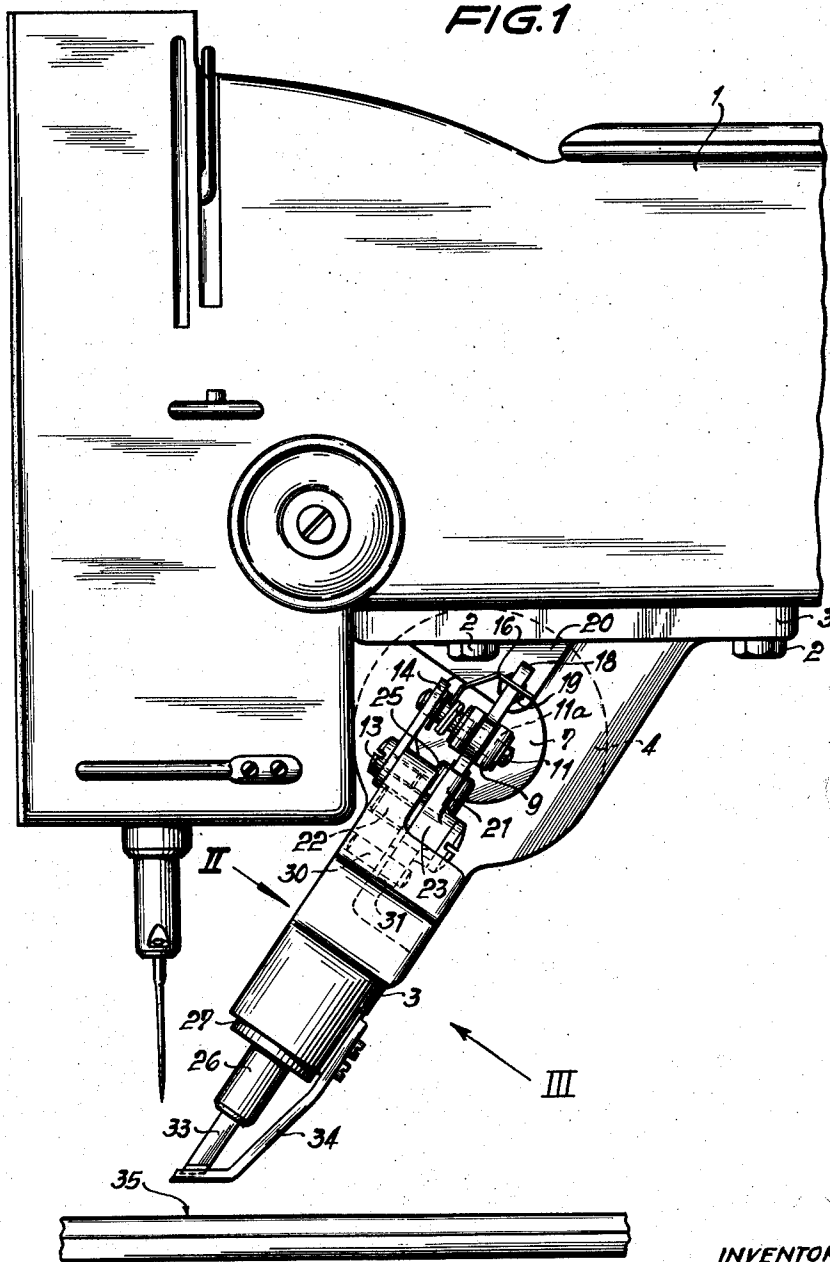
R. REEBER ET AL
ELECTROMAGNETIC CUTTING KNIFE AND THE
LIKE ACTUATING MECHANISM

3,094,031

Filed April 6, 1959

2 Sheets-Sheet 1

FIG. 1



INVENTORS

RUDOLF REEBER &
EMERICH SCHENKENDEL
BY

W. H. 1104
ATTORNEY

June 18, 1963

R. REEBER ET AL
ELECTROMAGNETIC CUTTING KNIFE AND THE
LIKE ACTUATING MECHANISM

3,094,031

Filed April 6, 1959

2 Sheets-Sheet 2

FIG. 2

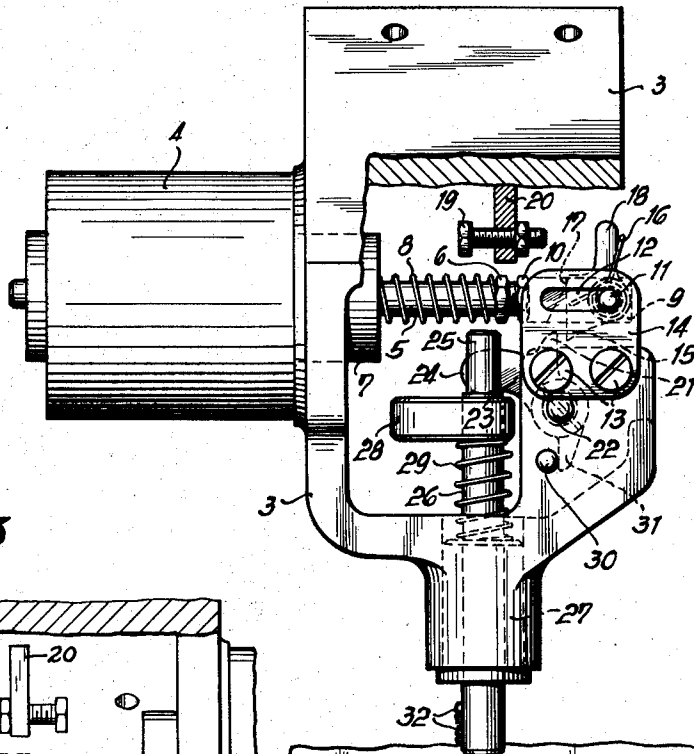
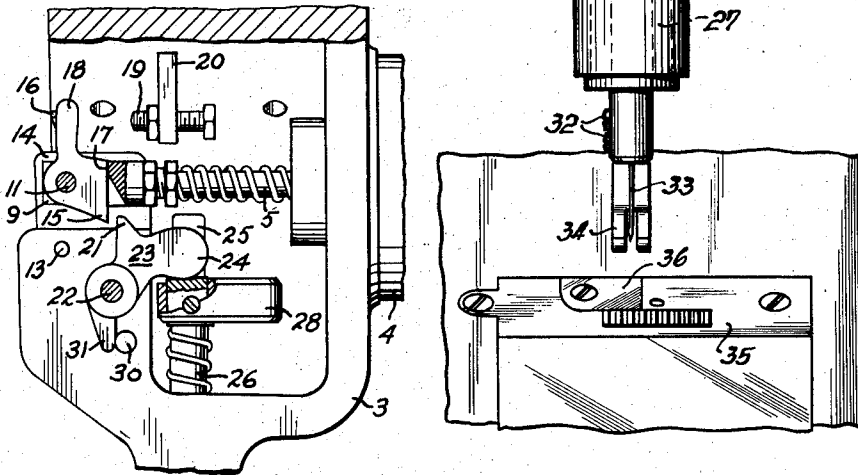


FIG. 3



INVENTORS

RUDOLF REEBER &

EMERICH SCHENKENGEL

BY

Wm. H. Wm.

ATTORNEY

1

3,094,031

ELECTROMAGNETIC CUTTING KNIFE AND THE LIKE ACTUATING MECHANISM

Rudolf Reeber and Emerich Schenkengel, Kaiserslautern, Pfalz, Germany, assignors to G.M. Pfaff AG, Kaiserslautern, Pfalz, Germany, a corporation of Germany

Filed Apr. 6, 1959, Ser. No. 804,270

Claims priority, application Germany Apr. 10, 1958

12 Claims. (Cl. 83—571)

The present invention relates to impact-operated devices, such as cutting knives or the like, more particularly to devices of this type being operated by an electromagnetic device or mechanism.

While the invention will be described in the following with specific reference to a sewing machine cutting knife mechanism serving to sever the thread and/or to cut or trim a work piece or garment upon the completion of a sewing operation, it will become evident that the improved actuating mechanism according to the invention will have other useful applications in the operation of a device actuated by quick-acting or impact force, especially where the time element or operating time plays an important part in improving the operating efficiency and economy of a machine or device.

In the use of cutting knife operating devices for sewing machines, it has been customary to provide an electromagnet or solenoid having a plunger or armature coupled with a thread cutting knife through a suitable connecting or actuating mechanism. Known devices of this type have the disadvantage, among others, when operated both manually as well as automatically in high speed sewing machines, that the operating time of the cutting knife is determined by or equal to the operating period or excitation time of the electromagnet, that is, an operating period substantially in excess of the actual time necessary to operate a cutting knife or the like impact-operated device from its inoperative to its operative position and to return it to the former position. This added operating time may result in a cumulative loss of time and substantially reduce the operating efficiency of the machine, especially in case of quantity production operations upon identical goods or garments.

It has already been proposed, in order to minimize the afore-mentioned drawbacks and disadvantages, to utilize control means designed to control the excitation of the electromagnet in dependence upon the position of a work piece relative to the position of the cutting knife, in an effort to reduce the effective operating time or period. As an example, there has been provided in known arrangements a photoelectric cell impinged by a light beam at the instant when the work piece or garment reaches a predetermined position. The output current of the photoelectric cell, upon adequate amplification, serves to energize the electromagnet operating the knife mechanism. According to another arrangement known, there is utilized a mechanical feeler scanning the garment or work piece and adapted to close an electric circuit at a predetermined position of the garment, to again result in the energization of the electromagnet and, in turn, in the operation of the thread or material cutting knife or mechanism.

In order to reduce the operating time or period of energization of the electromagnet, various attempts have been made to limit the operation to a minimum, in an effort to minimize the time during which the knife is projected into or interferes with the sewing operation, inasmuch as a subsequent sewing operation can be started only after the cutting knife has been returned or retracted safely from its projected or operative position to its retracted or inoperative position. In this regard, attempts have been made, such as by the use of specially constructed electrical switches, relays or the like electrical de-

2

vices, to minimize the exciting time of the electromagnet and, in turn, to decrease the operating time or period of the cutting knife mechanism.

All these prior attempts suffer, however, from the fact that they are both complex in design, expensive and more or less unreliable, primarily on account of the use of electrical devices such as relays, switches or the like auxiliary parts and circuit elements.

Furthermore, where in place of a photoelectric cell, mechanical scanning means are used to control the operation of the cutting knife manually by the operator upon completion of a sewing operation, it is found to be of special importance to reduce the operating time of the knife to an absolute minimum, inasmuch as in this case, the operator must operate or close a switch at the exact instant when the work piece or garment reaches or passes a definite position, to initiate the cutting operation by the electromagnet and control mechanism. As a result, the operating periods which may be realized in case of manual operation are still greater than in the case of automatic control, on account of the variations caused by the human element, aside from the general defects and drawbacks as mentioned hereinabove.

Accordingly, a principal object of the present invention is the provision of improved electromagnetic operating mechanism for the cutting knife of a sewing machine or the like impact-controlled device, whereby the operating time or period of the cutting mechanism is reduced to a minimum determined practically by the operating time proper of the knife or equivalent impact-controlled device.

Another object of the invention is the provision of actuating mechanism of the foregoing type, wherein the operating time or period of the cutting knife or the like is substantially independent of the duration of the energization of the electromagnet controlling the same.

Yet another object of the invention is the provision of cutting knife and the like actuating mechanism of the foregoing type, wherein the operating time or period proper of the cutting knife, being initiated by the energization of an electromagnet, is substantially independent of the duration of energization of said magnet.

Further objects of the invention are the provision of cutting knife or the like actuating mechanism of the above type which is both simple in construction, as well as reliable in operation, which is inexpensive to manufacture and which can be readily and structurally embodied in conventional sewing machines, without involving essential changes in the design or construction of the machines.

The invention, both as to its further objects as well as novel aspects, will be better understood from the following detailed description of a preferred practical embodiment, forming part of this specification and in which:

FIG. 1 is a side view of an electromagnetic thread cutting device mounted upon a conventional sewing machine and constructed in accordance with the principles of the invention;

FIG. 2 is a front view of the cutting mechanism of FIG. 1 as viewed in the direction of the arrow II; and

FIG. 3 is a rear view of the cutting mechanism as viewed in the direction of the arrow III of FIG. 1.

Like reference numerals denote like parts in both views of the drawings.

With the foregoing objects in view, the invention involves generally the provision of an electromagnet or solenoid having a plunger or armature operable within a predetermined operating stroke and serving to actuate an impact-controlled device, such as the cutting knife of a sewing or the like machine. For this purpose, there is provided by the invention improved actuating mechanism comprising essentially a first lever pivotally mount-

ed upon said armature, first stop means upon said armature and further means, such as a biasing spring, to normally resiliently urge said lever into engagement with said stop means, to thereby block rotation of said lever in a predetermined, say anticlockwise, direction. A second actuating lever having a stationary pivot is arranged to cam with said first lever, forming a cooperating pawl, in predetermined sequence to the starting of the operating stroke of said armature upon energization of said electromagnet by a control current or pulse, to initiate a cutting operation. There is furthermore provided suitable actuating means coupling said second lever with said knife or the like impact-controlled device, said actuating means including resilient return means, such as a return spring, to independently and substantially instantly retract said knife to its inoperative position upon completion of a cutting operation.

Further stationary stop means for said first lever serves to rotate the latter in a direction opposite to said predetermined direction, that is, in the clockwise direction according to the example mentioned, upon engagement of said first lever by said further stop means, in such a manner as to cause a disengagement of said second lever from said first lever or pawl accompanied by a quick-acting impact force or torque being imparted to said knife, to operate the same from its inoperative to its operative or cutting position against the action to said resilient means. The latter, which may be in the form of a coiled return spring, acts to retract the knife instantly to its normal or inoperative position, substantially independently of and prior to the return of the armature upon energization of the electromagnet.

In other words, the energization of the electromagnet merely serves to initiate the operation of the cutting knife or the like device by the application thereto of a quick-acting force or torque, while the resilient return means causes an immediate return or retraction of the knife to inoperative position, independently of the de-energization of the electromagnet or duration of the energizing current or pulse controlling the operation of the knife or equivalent impact-operated device. As a result, the actual operating time of the cutting knife is reduced to a practical minimum, whereby to result in a substantial saving of total operating time, as well as in increased operating safety and economy of the sewing or the like machine.

Another advantage of the invention is the fact that the armature of the electromagnet may be accelerated to its maximum speed independently of the load imposed by the knife actuating mechanism, by a proper choice of the time interval between the instant of the starting of the operating stroke of the armature or release pawl and its engagement with the lever or actuating mechanism of the cutting knife, as will be further described and understood from the following.

Referring to the drawings, there is shown the front part 1 of the upper arm of a conventional sewing machine having attached thereto by the aid of screws or bolts 2 a support 3 to the side of which is secured an electromagnet 4 having a magnet core 7 and a plunger or armature 5 movable in horizontal direction. Secured to the outer threaded end of the armature 5 is a nut 6 serving as an abutment for one end of a coiled return spring 8 encircling the armature 5 and having its opposite end arranged to engage the wall of the core 7. Further secured to the outer end of the armature 5 is a fork 9 being fixed against rotation by a securing nut 10. The front end of the fork 9 is provided with a bore 11a in which is mounted one end of a pin or axis 11 whose opposite end is arranged to move within the slot 12 of a guide plate 14 secured to the wall of the support 3 by means of screws 13.

Rotatively mounted upon the axis 11 within the fork 9 is a release pawl or lever 15 normally being urged against a stop 17 upon the central portion of the fork 9 by means of a spring 16, in such a manner as to cause the pawl 15 to project downwardly and to prevent rota-

tion thereof in a predetermined, that is anti-clockwise, direction in the example shown. Rigidly connected to or integral with the pawl or lever 15 is a lever arm 18 extending upwardly or substantially opposite to said pawl and being arranged to engage an adjustable stationary stop 19 upon energization of the magnet 4 and attraction of the armature 5 towards the left, in the example shown in the drawing. The instant of engagement of the stop 19 by the lever arm or extension 18 may be controlled by adjustment of the stop 19 shown for this purpose in the form of an adjusting screw mounted in a plate or bracket 20 secured to the support 3.

Arranged in the path of movement of the pawl 15 is an arm or extension 21 of an actuating lever 23 pivoted at 22 upon the support 3. The lever 23 has a further arm or extension 24 engaging the upper bifurcated end 25 of a knife actuating rod or carrier 26 slidably mounted in a sleeve or bearing 27 forming part of or being secured to the support 3. Secured to the rod 26 below the bifurcated end 25 is a weight 28 serving as an abutment for one end of a return spring 29 encircling the rod 26 and arranged with its opposite end engaging the wall of a bore in the extension 27. As a consequence, the downward movement of the rod 26 by the lever 23 is decelerated and arrested upon engagement of the weight 28 with the wall of the support 3. The upward movement or stroke of the rod 26 by the return spring 29 may be fixed in any suitable manner, such as by a further stationary stop 30 upon the support 3 cooperating with a further extension 31 of the actuating lever 23, or in an other suitable manner.

Secured to the lower end of the rod 26 by means of screws 32 is a cutting knife 33 arranged between the prongs 34 of a suitable stripping member, in a manner well known and understood.

The operation of the device afore-described is as follows. Upon closing of the circuit of the electromagnet by the operation of a switch or relay (not shown), either manually by the operator or automatically, the armature or plunger 5 will be attracted into the magnet core 7 or towards the left against the action of the return spring 8. As a consequence, the lever or release pawl 15, rotation of which is prevented by the stop 17, engages the arm or nose 21 of the actuating lever 23 shortly after the starting of the operating stroke upon energization of the electromagnet. Engagement of the pawl 15 with the projection 21 causes the lever 23 to rotate anti-clockwise about the pivot 22, whereby, in turn, to cause the lever arm 24 engaging the bifurcated end 25 of the knife operating rod 26 to move in a downward direction. This rotation of the actuating lever 23 by the pawl 15 is continued until the lever arm or extension 18 of the pawl 15 engages the adjustable stationary stop 19, whereupon the pawl or lever 15 will be rotated clockwise about its axis 11 until its lower projecting end has been substantially withdrawn or retracted into the fork 9, or out of the path of the projection 21. As a consequence, the pawl 15 is now disengaged from the arm 21 of the actuating lever 23.

As a result of the rotation of the pawl 15 about its axis, an additional quick-acting force or torque is imparted to the arm 21 of the actuating lever 23 at the instant of engagement of the arm 18 with the stop 19, resulting in a downward acceleration of the knife carrier or rod 25 from the inoperative position shown to its operative or cutting position, until the weight 28 engages the wall of the support 3. Immediately thereafter, the rod 26 returns to its initial or inoperative position by the action of the return spring 29 causing, at the same time, a rotation of the lever 23 until its arm 31 engages the stop 30, whereby to arrest the upward movement of the rod 26. During the return movement of the latter and of the lever 23, the projection or arm 21 passes freely underneath the lower end of the pawl 15 formed with a suitably shaped contour, while the armature 5 of the electromagnet 4 further remains in its attracted position and the arm 18 engages the stationary stop 19. After de-energization of the electromagnet, the lever 18 and pawl 15 return to their

5

starting position by the action of the return spring 8, causing the armature 5 to move towards the right, whereby lever 18 and pawl 15 will be briefly deflected in anticlockwise direction while the pawl 15 engages projection 21 during the return movement.

From the foregoing, it is seen that the release lever or pawl 15 engages the knife actuating member or lever 23 during a relatively small fractional period only of the operating stroke of the electromagnet, that is, shortly after the starting of the operating stroke, in such a manner as to enable the knife carrier or rod 26 to return substantially instantly to its inoperative position by the action of the return spring 29, independently of the duration of the energization of the electromagnet or length of the current pulse controlling the same. As a consequence, the operator is enabled to start a subsequent sewing operation immediately upon the retraction of the cutting knife to its inoperative position, without regard or attention to the interruption of the energizing current of the electromagnet. Furthermore, in case of automatically operated sewing machines, the instantaneous and independent return of the cutting knife will enable a substantial increase in the operating speed of the machines, resulting in both greater operating efficiency and economy.

Another advantage of the invention is due to the fact that the armature 5 being disengaged from the load during the initial stage of the operating stroke is enabled to be accelerated rapidly to its full operating speed prior to the engagement between the release pawl 15 and the nose 21 of the actuating lever 23, whereby to result in a further decrease of the operating time and efficiency of the knife actuating mechanism.

Item 36 is a shock-absorbing or impact plate mounted flush with the cloth plate 35, to reduce wear and to prevent premature dulling of the cutting knife 33.

In the foregoing, the invention has been described with reference to a specific illustrated device. It will be evident, however, that variations and modifications, as well as the substitution of equivalent elements or parts for those shown herein for illustration, may be made without departing from the broader purview and spirit of the invention. The specification and drawings are accordingly to be regarded in an illustrative rather than in a restrictive sense.

We claim:

1. Electro-mechanical actuating mechanism for an impact-operated device comprising an electromagnet having an armature operable to and fro within a predetermined working stroke upon energization and de-energization, respectively, of said electromagnet, a double lever pivotally mounted upon said armature and having a first and a second arm, stop means upon said armature and means to resiliently urge said first arm into engagement with said stop means, to block said lever against rotation in a predetermined direction, an actuating lever having a stationary pivot and arranged to have an end engaging the end of said second arm of said double lever immediately upon starting of a working stroke by said armature, operating means connecting said actuating lever with said device including resilient return means, and stationary stop means therefor for said first arm, to rotate said double lever in a direction opposite to said predetermined direction, to thereby disengage said actuating lever from said second arm, said stationary stop means arranged in relation to the operating path of said armature to effect disengagement of said actuating lever from said second arm upon imparting a quick-acting force upon said device by said actuating lever through said operating means, to operate said device from its inoperative to its operative position, said resilient return means adapted to substantially instantly retract said device to its inoperative position substantially independently of the return of said armature upon disengagement of said actuating lever from said second arm.

2. Electro-mechanical actuating mechanism as claimed

6

in claim 1, including adjusting means to vary the position of said stationary stop means relative to said first arm.

3. Electro-mechanical actuating mechanism as claimed in claim 1, including further stationary stop means, to fix the inoperative position to said device.

4. Electro-mechanical actuating mechanism as claimed in claim 1, including further stationary stop means cooperating with said actuating lever, to fix the inoperative position to said device.

5. Electro-mechanical cutting knife operating mechanism for sewing and the like machines including a reciprocating knife carrier and an electromagnet having an armature operable from inoperative to operative position and vice versa upon energization and de-energization, respectively, of said electromagnet, said mechanism comprising a double lever pivotally mounted upon said armature and having first and second lever arms, stop means upon said armature and means to resiliently urge said first lever arm into engagement with said stop means, to block said lever against rotation in a predetermined direction, an actuating lever having a stationary pivot and arranged to have its end engage the end of said second lever arm of said double lever immediately upon starting of an operating stroke of said armature, operating mechanism connecting said actuating lever with said carrier including resilient return means therefor, and stationary stop means for said first lever arm, to cause rotation of said first lever in a direction opposite to said predetermined direction, to thereby disengage said actuating lever from said second lever arm, said stationary stop means arranged in relation to the operating path of said armature to effect disengagement of said actuating lever from said second lever arm upon imparting a quick-acting impact force upon said carrier, to operate said knife from inoperative to operative position, said resilient return means adapted to substantially instantly return said carrier to inoperative position upon disengagement of said actuating lever from said second lever arm substantially independently of the de-energization of said electromagnet.

6. Cutting knife operating mechanism as claimed in claim 5, including means to adjust the relative position of said stationary stop means and said first lever arm.

7. Cutting knife operating mechanism as claimed in claim 5, including further stationary stop means to fix the inoperative position of said carrier.

8. Cutting knife operating mechanism as claimed in claim 5, including further stationary stop means for said actuating lever, to fix the inoperative position of said carrier.

9. In combination with an electromagnet having an armature operable within a predetermined operating path by energization and de-energization, respectively, of said electromagnet and an impact-operated device to be actuated by said electromagnet, operating mechanism comprising a double lever pivotally mounted upon said armature and having a first and a second arm, stop means upon said armature and means to resiliently urge said first arm into engagement with said stop means, to block rotation of said lever in a predetermined direction, an actuating lever having a stationary pivot and an end engaging the end of said second arm immediately upon starting of an operating stroke by said armature, motion-transmitting mechanism operatively connecting said actuating lever with said device including resilient return means therefor, stationary stop means for said first arm to rotate said double lever in a direction opposite to said predetermined direction, to thereby effect disengagement of said actuating lever from said second arm, said stationary stop means arranged relative to said operating path, to cause disengagement of said actuating lever from said second arm upon operation of said device from inoperative to operative position by said actuating lever during an initial fractional portion of said operating stroke, whereby to return said device to inoperative position by said resilient means during the subsequent portion

of said operating stroke, substantially independently of the return stroke of said armature.

10. Operating mechanism as claimed in claim 9, including means to control the relative adjusting position of said first arm and said stationary stop means.

11. Operating mechanism as claimed in claim 9, including further stationary stop means for said actuating lever, to fix the inoperative position of said device.

12. Operating mechanism as claimed in claim 9, said levers being formed with mutually engaging surfaces, to allow both of actuation of said actuating lever by said double lever at a predetermined point of the operating stroke of said armature and to allow of ready return of said actuating lever to inoperative position by said resilient means independently of and prior to the return of said double lever to inoperative position upon de-energization of said electromagnet.

References Cited in the file of this patent

UNITED STATES PATENTS

971,713	Williams	Oct. 4, 1910
1,547,528	Sears	July 28, 1925
1,754,362	Johnson	Apr. 15, 1930
2,461,034	Castle	Feb. 8, 1949
2,475,394	Lester	July 5, 1949
2,768,560	Hirson	Oct. 30, 1956
2,798,548	Leirer	July 9, 1957
2,831,355	Zimmerman	Apr. 22, 1958
2,881,833	Hoffee	Apr. 14, 1959
2,937,554	Nathan	May 24, 1960
2,968,983	Cousino	Jan. 24, 1961