April 25, 1944. E. F. WEISER 2,347,528

SWITCH

Filed May 16, 1942

Fig. 1.

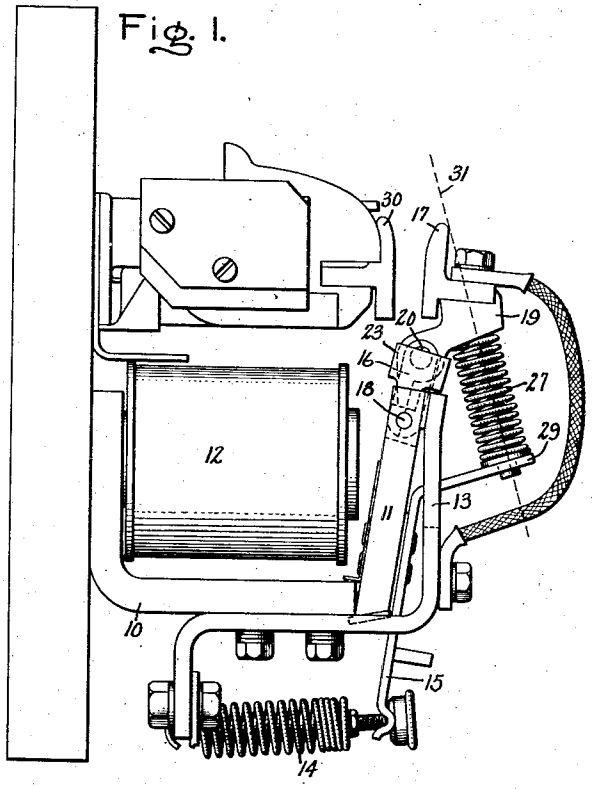


Fig. 2.

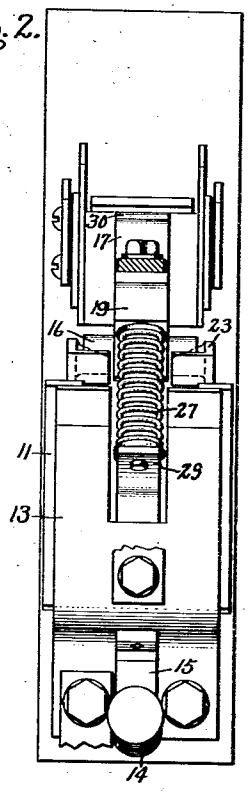


Fig. 3.

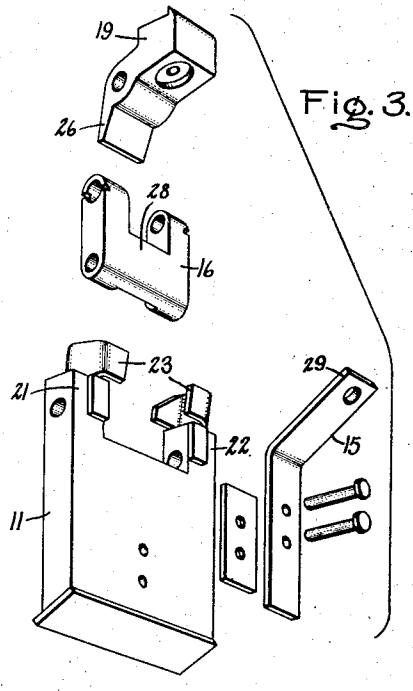
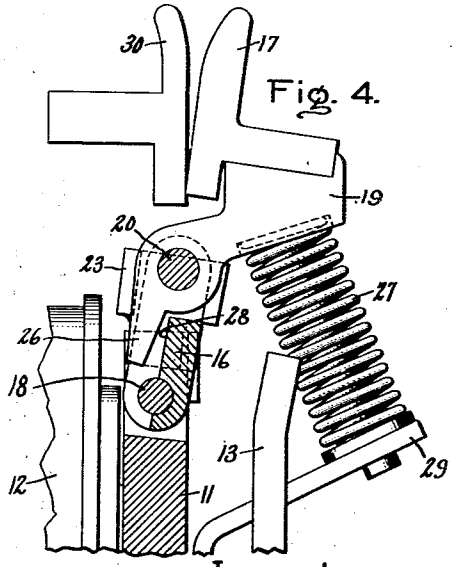


Fig. 4.



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UNITED STATES PATENT OFFICE

2,347,528

SWITCH

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Application May 16, 1942, Serial No. 443,183

9 Claims. (Cl. 200—165)

My invention relates to switches, more particularly to electromagnetically operated switches of the type having a movable contact mounted on the end of an arm, and has for its object the provision of simple, reliable and inexpensive means for preventing bouncing of the contacts on closing and consequent arcing between the contacts and welding of the contacts together.

Electromagnetically operated switches, particularly contactors, are provided with a movable contact which is pivotally mounted on an operating member such as on the end of a pivoted armature, the movable contact being spring biased to a predetermined angular position with respect to the operating member. When the operating member is moved to its closed circuit position, the movable contact engages the stationary contact before the operating member reaches its final position, and the continued movement of the operating member thereafter causes the movable contact to move on its pivot on the operating member and effect a rolling and wiping action on the stationary contact.

This final pivotal movement of the movable contact on its operating member, while of small angular extent, takes place at very high speed and, as a result, kinetic energy of rotation of appreciable magnitude is stored in the movable contact. This stored energy causes the movable contact to continue very slightly its pivotal movement on the operating member, and, since the operating member is now at rest, the movable contact moves slightly away from the stationary contact with consequent destructive arcing between the contacts and often welding of the contacts together.

In carrying out my invention, I provide for movement of the pivot support of the pivoted contact after the operating means has come to rest, which movement of the pivot support provides for a slight pivotal movement of the pivotal contact without separation of the contacts. In effect, during this final movement, the pivoted contact pivots slightly about its point of contact on the other contact. Thus, the kinetic energy stored in the pivoted contact is dissipated without separation of the contacts, and arcing and welding between the contacts is prevented.

More specifically, I provide in one form of my invention an intermediate member or link between the movable contact and its operating member with pivotal connections between these three parts and suitable spring biasing means whereby, after the operating member has moved to its closed circuit position, the link moves about its pivot on the operating member. Thus the final energy dissipating pivotal movement of the movable contact causes a pivotal movement of this link and takes place without separation of the contacts.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a side elevation view of a contactor embodying my invention; Fig. 2 is a front elevation view of the device shown in Fig. 1; Fig. 3 is a view of the armature with the parts disassembled; while Fig. 4 is an enlarged fragmentary view, partly in section, showing the connection between the armature and the movable contact.

Referring to the drawing, I have shown my invention in one form as applied to a contactor provided with a U-shaped magnet iron core 10, an armature 11 forming an operating member pivotally mounted at its lower end on one of the legs of the core, as shown the lower leg, and pivotally movable when the coil 12 is energized to an attracted position into engagement with the end of the other leg on which is mounted the coil 12, the end of the leg forming a stop against which the armature comes to rest in its attracted position. The armature is biased to its unattracted position against a stop arm 13 by means of a tension spring 14 which is applied to an arm 15 secured to the armature and extending below its pivot, as seen in the drawing.

In accordance with my invention, I provide an intermediate member in the form of a link 16 which forms a connection between the movable contact 17 and the upper end of the armature 11. As shown, the member 16 is connected to the upper end of the armature by means of a pivot pin 18 and connected to the support or contact arm 19 for the movable contact by means of a pivot pin 20. As shown clearly in Fig. 3, the upper end of the armature is provided with a central notch forming two projections 21 and 22 between which the link 16 is pivoted on the pin 18 extending through registering apertures in the two parts.

For the purpose of limiting the angular movement of the link 16 on its pivot 18 with relation to the armature to a predetermined small acute angle, a pair of inwardly extending stop projections 23 is provided on each of the extensions 21 and 22. These pairs of projections each embrace the link 16 on opposite sides of the link and the projections of each pair are spaced apart a distance somewhat greater than the width of the link 16 so as to provide freedom for this limited pivotal movement on the armature. In the construction shown, this pivotal movement amounts to only a few degrees. For convenience in construction, the pairs of stops 23 are formed on separate metal plates which are secured by welding to the ends of the extensions 21 and 22.

A stop 26 is provided on the pivoted supporting member 19, which stop is normally held by the spring 27 against a stop or wall 28 on the link 16. The biasing spring 27 is placed between an

extension 29 on the arm 15 secured to the armature and the outer end of the support 19, suitable seats for the spring being provided in these parts. The spring is of the compression type and applies a force tending to move the support 19 in a counterclockwise direction toward the stationary contact, as shown, about its pivot 20 and tending to move the link 16 in a counterclockwise direction about its pivot 18 to the limit of the small pivotal movement provided for the link. This normal position of the parts is shown in Fig. 1, the coil 12 being deenergized and the armature 11 being in its unattracted open circuit position. It will be observed that the contact engaging surface of the contact 17 is substantially in alignment with the pivots 18 and 20.

Another requirement of the spring 27 is that its line of force as applied to the support 19 must have a component as large as possible extending inward tending to hold the contacts together, but at the same time its line of force must extend, as seen in the drawing, above or outside of the initial point of contact between the movable contact 17 and its stationary contact 30. As shown in the drawing, the line of force of the spring 27 is along the dotted line 31 of Fig. 1 which, it will be observed, passes slightly to the right of the upper end of the movable contact 17, and, therefore, clearly is above or outside of any initial point of contact between the contacts. In other words, the line of force passes on the side opposite said link of the initial point of contact. The purpose of this mounting of the spring 27 is to reverse the bias of the spring on the link 16 after the initial engagement of the contacts, the spring 27 then biasing the link 16 in a clockwise direction about the pivot 18. This is because after the contact 17 engages the stationary contact 30, the spring 27 applies a force tending to turn the contact and the support 19 about this point of engagement as a pivot in a counterclockwise direction.

It should be noted that the device is workable if this line of force 31 extends below the initial point of contact between the contacts as long as it does not extend through or below the center line of the pin 20. However, when this line of force passes below the initial point of contact, the spring force and gradient necessary to supply tip pressure and to absorb the kinetic energy of the tip and support 19 make the spring impractical in size.

It will now be assumed that the coil 12 is energized and the armature is pulled to its attracted position by the coil. When the movable contact 17 engages the stationary contact, it starts pivoting on the stationary contact and in a clockwise direction about the pivot 20 as the movement of the armature continues toward its attracted position. This produces the conventional rolling and wiping action between the contacts.

Also, upon engagement of the contacts, the spring 27 applies a force tending to turn the movable contact about the point of engagement between the contacts in a counterclockwise direction, as seen in Figs. 1 and 4. This action reverses the bias of the spring 27 on the link 16 and moves the link about its pivot 18 in a clockwise direction away from the stationary contact to its other extreme position against the opposite sides of the stops 23. The upper end of the link 16 and the pivot pin 20 are under these conditions yieldably movable in a counterclockwise direction back to their first positions to dissipate the kinetic energy stored in the contact 17 and its support 19. This clockwise rotation of the contact 17 and support 19 about the pivot 20 during the rolling and wiping action, while angularly small, is carried out at a very high speed and therefore stores a substantial amount of kinetic energy of rotation in the contact 17 and the support 19. This stored energy is effective after the armature 11 comes to rest in its fully attracted position, as shown in Fig. 4, to cause a slight continued movement of the contact 17 and support 19 on the stationary contact and about the pivot 20 in a clockwise direction. But the pivot 20 is now yieldably movable about the pivot 18 toward the left hand and toward the stationary contact, as seen in Fig. 4, and the contact 17 and support 19 in attempting to move about the pivot 20 actually cause this movement of the pivot 20 toward the left hand. In effect, therefore, this final movement is a pivotal movement of the movable contact on the stationary contact, this pivotal movement being about the final closed circuit point of engagement between them. It takes place without separation of the contacts and, consequently, arcing and welding are prevented.

When this slight energy dissipating movement has been completed, the spring 27 moves the contact 17 and support 19 about the point of contact in a counterclockwise direction and the link 16 is moved clockwise about its pivot 18 to its other extreme position. The parts are then in the closed circuit positions shown in Fig. 4.

Another advantage of this anti-bounce and anti-weld construction is that the distance between the lower end of the movable contact and the pivot pin 20 can be decreased considerably as compared with conventional devices thereby obtaining a much larger angular wipe on the movable contact for the same rectilinear movement of the pin 20. This increased angular wipe has the advantage of giving greater wear allowance and thereby providing substantially longer life for the contacts. Without this anti-weld construction, the distance between the movable contact and the pivot 20 must be great enough to decrease the arcing and welding to some permissible value. In this discussion of conventional construction, it will be understood that the pivot 20 is mounted directly on the end of the pivoted armature, the link 16 not being provided.

As shown in Fig. 4, the movable contact has a final line contact at its lower end with the stationary contact.

It will be understood that the pin 18 may be mounted, if desired, on the end of a solenoid plunger or air cylinder piston rod so as to be given a rectilinear motion instead of an arcuate motion, as shown in the drawing. In such case, the link 16, support 19 and contact 17 will extend laterally, substantially at right angles, to the direction of movement of the pin 18 as in the form shown in the drawing.

Also, if desired, an anti-bounce pivotal mounting embodying my invention may be applied to the stationary contact, the movable contact then being mounted rigidly on the armature or other operating member. In this case, it will be understood that the pivot support 18 and the spring support 29 are stationary while the contact corresponding to the contact 30 of Fig. 1 has its

support mounted on the operating member so that this contact constitues the movable contact.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A switch comprising a pair of cooperating switch contacts, a support for each of said contacts, operating means for moving one of said supports between closed and open circuit positions, a link pivotally connected at one end to one of said supports, means limiting the angular movement of said link on said one support to a predetermined acute angle between two positions, a pivotal connection between one of said contacts and the other end of said link, cooperating stop means on said link and said one contact, spring means biasing said link and said one contact about their pivots to predetermined first angular positions with respect to each other and with respect to said one support, the line of force of said spring passing outside of the point of contact between said contacts so that upon engagement of said contacts and continued movement of said operating means in a closing direction said spring applies a reversed bias to said link and moves said link on its support to the other of said positions, and when said operating means comes to rest, said link moves on its support toward said first angular position thereby to provide for a final energy dissipating pivotal movement between said one contact and said link without separation of said contacts.

2. A switch comprising an operating member, a stationary contact, a link pivotally connected at one end to said operating member, means limiting the angular movement of said link on said pivot to a predetermined acute angle between two positions, a movable contact pivotally mounted on the other end of said link, cooperating stop means on said link and said movable contact, a spring having its ends bearing on said operating member and said movable contact thereby to bias said link and said movable contact about their pivots to predetermined first angular positions with respect to each other and with respect to said operating member, the line of force of said spring passing outside of the point of contact between said contacts so that upon engagement of said contacts and continued movement of said operating member in a closing direction said spring applies a reversed bias to said link and moves said link on said operating member to the other of said positions and when said operating member comes to rest said link moves on said operating member toward said first position thereby to provide for a final energy dissipating pivotal movement between said movable contact and said link without separation of said contacts.

3. A switch comprising a contact arm, means pivotally supporting said contact arm for movement of one end between closed and open circuit positions, a stationary contact, a link pivotally connected at one end to said one end of said arm, means limiting the angular movement of said link on said pivot to a predetermined acute angle between two positions, a movable contact pivotally mounted on the other end of said link, cooperating stop means on said link and said movable contact, a compression spring having one end secured to said arm and its other end bearing on said movable contact thereby to bias said link and said movable contact about their pivots toward said stationary contact to predetermined first angular positions with respect to each other and with respect to said arm, the line of force of said spring passing outside of the initial point of contact between said contacts so that upon engagement of said contacts and continued movement of said arm toward said closed circuit position said spring tends to pivot said movable contact about its point of engagement with said stationary contact and thereby applies a reversed bias to said link and moves said link on said arm to the other of said positions after which said link and said arm move together in a predetermined relation with each other until said arm comes to rest in said closed circuit position when said link moves on said arm back to said first position thereby to provide for a final energy dissipating pivotal movement between said movable contact and said link without separation of said contacts.

4. A switch comprising a pair of cooperating switch contacts, a first support on which a first one of said contacts is mounted, an arm to one end of which the second of said contacts is secured, a second support, a pivot member, a yieldable connection between said pivot member and said second support, a pivotal connection between the other end of said arm and said pivot member, spring means biasing said pivot member on said second support away from said first contact and biasing said arm about said pivot member toward said first contact so that when one of said supports is moved to bring said contacts into engagement with each other said arm moves about said pivot to provide for wiping pivotal movement of said second contact on said first contact whereby kinetic energy is stored in said second contact and said arm, and said yieldable connection when said movable support has come to rest in its closed position providing movement of said pivot member toward said first contact and continued pivotal movement of said second contact on said first contact for the dissipation of said kinetic energy while maintaining engagement between said contacts during said energy dissipating pivotal movement.

5. A switch comprising a pair of cooperating switch contacts, a first support on which a first one of said contacts is mounted, an arm to one end of which the second of said contacts is secured, an intermediate member, a second support, a first connection between said intermediate member and said second support providing for movement of said intermediate member toward said first contact, a pivotal connection between said intermediate member and the other end of said arm, a first stop means for limiting the movement of said intermediate member on said second support in a direction away from said first contact, a second stop means for limiting the pivotal movement of said arm on said pivot in a direction toward said first contact, spring means for biasing said intermediate member relative to said second support against said first stop means and for biasing said arm on said pivot against said second stop means so that when one of said supports is moved to a closed circuit position said arm turns on said pivot against the force of said spring means upon engagement of said contacts to provide for a wiping pivotal movement of said second contact on said first contact until said

movable support is brought to rest, after which said spring means yields to provide for movement of said intermediate member on said second support toward said first contact to effect a continuance of the pivotal movement of said second contact on said first contact for dissipation of the kinetic energy stored in said second contact and said arm during said wiping movement while maintaining engagement between said contacts during said energy dissipating pivotal movement.

6. A switch comprising an operating member mounted for movement between open and closed circuit positions, a stop against which said operating member comes to rest in said closed circuit position, a stationary contact, a movable contact, an arm to one end of which said movable contact is secured, a link, a first pivotal connection between one end of said link and said operating member, a second pivotal connection between the other end of said link and the other end of said arm, a first stop means for limiting the movement of said link on said first pivot in a direction away from said stationary contact, a second stop means for limiting the movement of said arm on said link in a direction toward said contact, spring means for biasing said link relative to said operating member against said first stop means and for biasing said arm relative to said link against said second stop means so that when said operating member is moved to said closed circuit position said arm turns on said second pivot against the force of said spring means to provide for a wiping pivotal movement of said movable contact on said stationary contact until said operating member is brought to rest, after which said spring means yields to provide for pivotal movement of said link on said first pivot toward said stationary contact to effect a continuance of the pivotal movement of said movable contact on said stationary contact for dissipation of the kinetic energy stored in said movable contact and said arm during said wiping movement while maintaining engagement between said contacts during said energy dissipating pivotal movement.

7. A switch comprising an operating member, a stationary contact, a movable contact, an arm to one end of which said movable contact is secured, a link, a first pivotal connection between one end of said link and said operating member, a second pivotal connection between the other end of said link and the other end of said arm, stop means for limiting the movement of said link about said first pivot to an acute angle between two positions, stop means for limiting the movement of said arm about said second pivot toward said stationary contact to a position in which said arm is in substantial alignment with said link, and spring means normally biasing said arm and said link about their respective pivots toward said stationary contact to positions against said stop means but said spring means upon engagement of said movable contact with said stationary contact reversing its bias on said link thereby to move said link about said first pivot to its other position and provide, after said operating member has come to rest in its closed position, for movement of said second pivot about said first pivot in a circuit closing direction for energy dissipating pivotal movement of said movable contact on said stationary contact.

8. A switch comprising a pair of cooperating switch contacts, a first support on which a first one of said contacts is mounted, an arm to one end of which the second of said contacts is secured, a second support, a link, a first pivotal connection between one end of said link and said second support, a second pivotal connection between the other end of said link and the other end of said arm, cooperating stop means between said link and said second support for limiting the movement of said link about said first pivot to an acute angle between two positions, stop means between said link and said arm limiting the movement of said arm about said second pivot toward said first contact to a position of substantial alignment with said link, a compression spring between said second support and said arm for biasing said arm and said link about said pivots toward said first contact so that when one of said supports is moved to bring said contacts into engagement said spring first yields to provide for movement of said link about said first pivot to its other position and thereafter upon further movement of the movable support said arm moves about said second pivot to provide for a wiping action between said contacts until said movable support is brought to rest whereupon the kinetic energy stored in said second contact and said arm causes movement of said link about said first pivot toward its other extreme position for dissipation of said kinetic energy while maintaining engagement between said contacts.

9. A switch comprising an operating arm having one end mounted on a stationary pivot, a stationary contact, a movable contact, a contact arm to one end of which said movable contact is secured, a link, first and second pivotal connections between the ends of said link and the other ends of said operating arm and contact arm respectively, stop means for limiting the movement of said link about said first pivot to a predetermined acute angle between two positions and for maintaining said link in substantial alignment with said operating arm, stop means for limiting the movement of said contact arm about said second pivot toward said movable contact to a predetermined position in which the contact engaging surface of said movable contact is in substantial alignment with said two pivots, means providing bearing seats on said operating arm and said contact arm, a compression spring between said bearing seats for biasing said contact arm and said link about their pivots toward said stationary contact, a stop against which said operating arm is brought to rest in a closed circuit position, and means for moving said operating arm at high speed to said closed circuit position, said stationary contact being positioned to be engaged by said movable contact substantially before said operating arm comes to rest against said stop so that upon engagement of said contacts said spring is first compressed to provide for continued movement of said operating member until said link moves to its other position and thereafter said contact arm moves on said second pivot to effect a wiping action between said contacts until said operating arm comes to rest against said stop, after which said link is movable about said first pivot to its other extreme position for dissipation of the kinetic energy stored in said contact arm during said wiping action.

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