April 23, 1935. B. E. GETCHELL 1,998,810

ELECTROMAGNETIC DEVICE

Original Filed Jan. 15, 1930 2 Sheets-Sheet 1

Fig. 1.

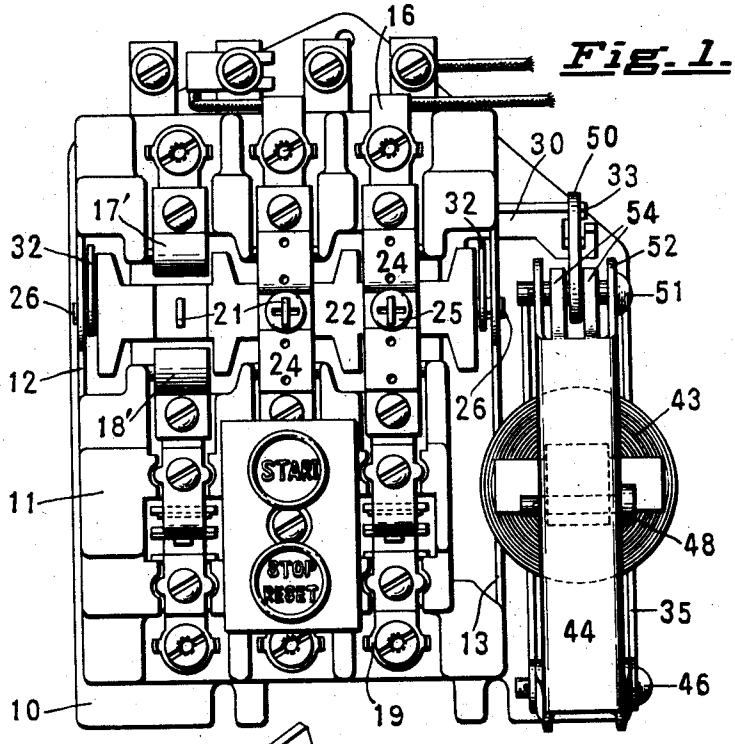
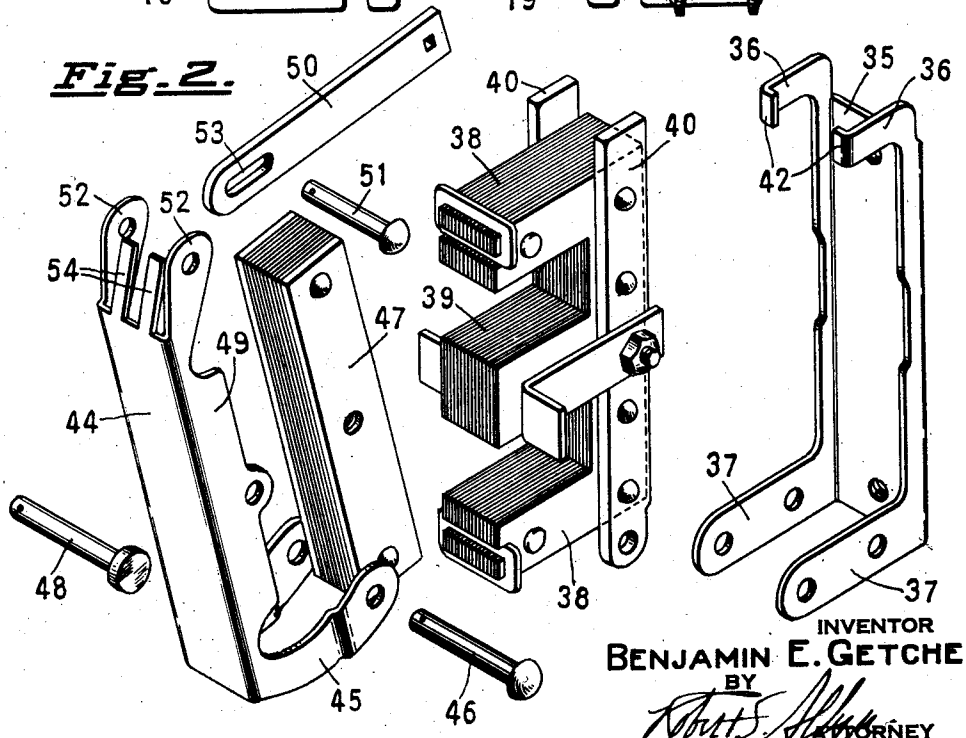


Fig. 2.



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Fig. 3.

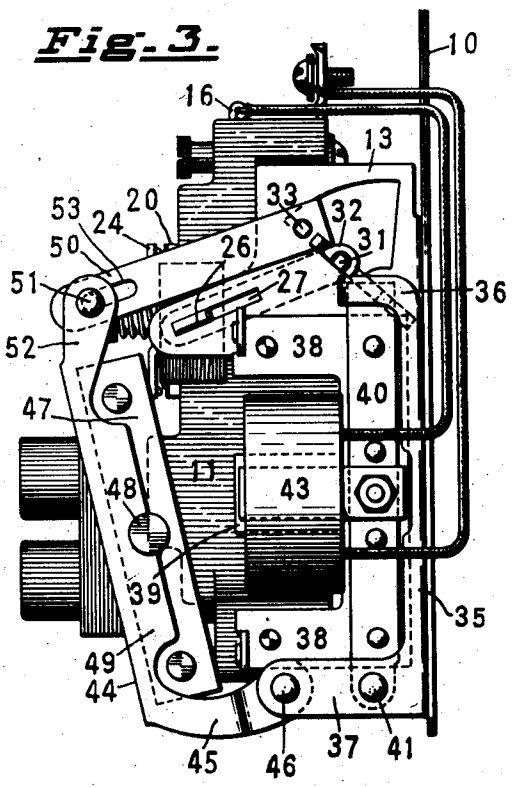


Fig. 4.

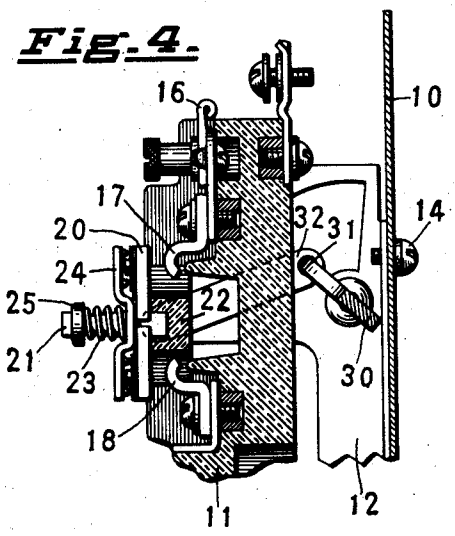


Fig. 5.

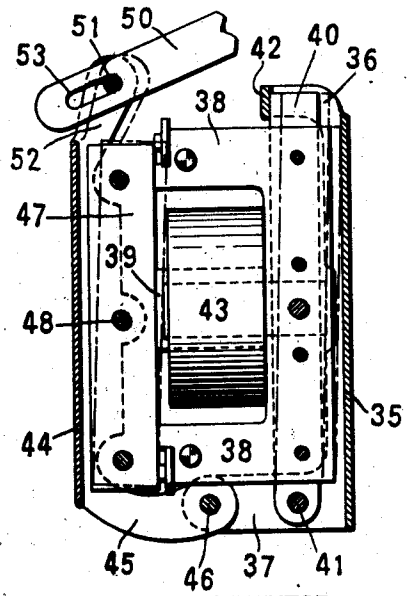
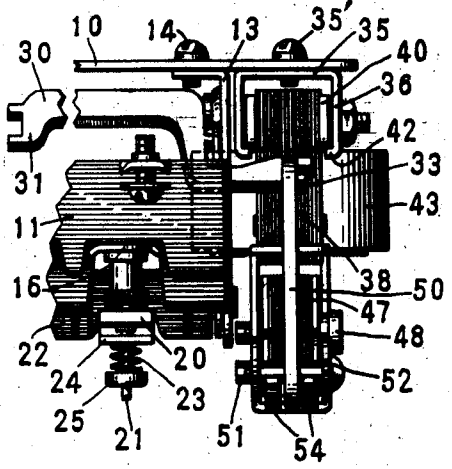


Fig. 6.



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UNITED STATES PATENT OFFICE

1,998,810

ELECTROMAGNETIC DEVICE

Benjamin E. Getchell, Plainville, Conn., assignor to The Trumbull Electric Manufacturing Company, Plainville, Conn., a corporation of Connecticut

Original application January 15, 1930, Serial No. 420,929. Divided and this application November 19, 1932, Serial No. 643,317

6 Claims. (Cl. 175—336)

My invention relates to magnetically operated switches and particularly to an electro-magnet construction which is specially adapted for use in connection with switch constructions similar to the type disclosed in my Patent No. 1,714,085.

This application is a division of my application Serial No. 420,929, filed January 15, 1930, issued as Patent No. 1,893,827 on January 10, 1933.

Electro-magnetic switches of the type referred to are necessarily made up of a comparatively large number of parts including stationary and movable contacts, connectors, bolts, screws, etc., and the hammer-like blows of an ordinary electro-magnet in the circuit closing movement tends to loosen some of these parts to a serious extent especially when the magnet is rigidly connected to the movable switch contacts or is mounted directly on the switch base or on a part of the enclosing box.

The principal object of my invention is to provide an electro-magnet construction suitable for use in operating switches of the type referred to, or other similar devices, and which may be associated with such devices and operated with considerable force without transmitting any harmful shock to itself or to the device to be operated or to the enclosure in which the construction is housed.

Another object is to provide an electro-magnet unit having an armature and a magnet consisting of a coil and a core, the core having one or more armature engaging legs and in which construction, the parts are so mounted and co-related that the operating force or impact will be absorbed by the members of the unit without transmitting any harmful shock to the other associated parts or devices.

Another object is to provide an electro-magnet construction in which the armature and the magnet with its core are independently and pivotally mounted with their respective axial centers spaced so far apart that when the armature engages the core of the magnet or vice-versa, it will be with a pivotal motion and also with a sliding or surface wiping movement as soon as the parts have come into contact with each other.

Another object is to provide an electro-magnet construction in which, in the circuit closing movement, the armature and the core of the magnet will engage with a sliding surface action in such a manner that the operating shock or impact will be partly absorbed by the magnetic grip between the armature and the core of the magnet and a directly related object is to provide means to allow the normally stationary member of the magnet to recede to a limited extent to check the impact of the movable member in response to a greater impact than can be absorbed by the magnetic braking grip between the armature and the core of the magnet.

Another object is to provide an operable electro-magnet in which one of the movable members of the magnet may have a lost-motion connection with a movable switch member or a similarly operated device so that the movement of the part to be operated will not begin until the operating part of the magnet has already attained substantially full speed in its operating movement.

Another object is to provide an electro-magnetic operating mechanism which may be made, assembled and operably tested independently of the device which it is intended to operate and which may readily and operably be connected to or disconnected from the device.

Another object is to provide an electro-magnetically operated switch construction in which the switch, including all of its directly related parts, may be assembled as a unit and in which the electro-magnet, including all of its directly related parts, may be assembled as another independent unit and in which the switch unit and the magnet unit may be readily connected for service or use.

In carrying out the invention in its preferred form I provide switch mechanism having stationary and movable contacts supported by an insulating body, the parts being constructed and assembled as a unit. I also provide an electro-magnetic actuating member which is constructed and assembled as an independent unit. Both of the units are supported by a common plate and are so related that, when installed for service, gravity tends to hold the parts of the switch and the parts of the electro-magnetic mechanism in the open circuit or Off position. The electro-magnetic device for actuating the switch proper includes a pivoted or hinged core member and an independently pivoted or hinged armature member. Both of these members are so mounted as to tilt forwardly at their upper ends away from the back plate and are limited in their swinging movements by suitable stops. They are so constructed that when the circuit is closed the armature member first moves rearwardly towards the core member which, by reason of its stop, remains stationary until the armature actually strikes it with all of its momentum less the magnetic braking force caused by the sliding or

wiping engagement of the armature and the core and which wiping engagement is due to the fact that the armature and the core are pivoted at spaced apart axial centers. When the magnet is de-energized, the core remains stationary by reason of its stop but the armature swings forwardly to the open circuit position and, by reason of its connections, simultaneously moves the switch contacts into the Off position.

Fig. 1 is a front view showing a switch with the electro-magnetic actuator.

Fig. 2 is an exploded perspective view of the parts of the electro-magnetic device.

Fig. 3 is a view of the right hand side of the switch with the electro-magnetic actuator in the open circuit position.

Fig. 4 is a vertical sectional view showing the switch contacts in the "Off" position.

Fig. 5 is a side view of the electro-magnetic device in the "On" position and showing in dot and dash lines the positions the parts of the magnet take when the armature strikes the magnet.

Fig. 6 is a plan view showing a fragment of the switch with the magnetic elements.

In the prefered form of construction the stationary and movable parts of the switch mechanism as well as the actuating mechanism are all supported directly or indirectly by a back plate **10** which is adapted to be suitably secured in a vertical position when in service and usually in an enclosing or protecting box or receptacle.

A body member **11** formed preferably of molded insulation is secured in any suitable manner to the side plates **12** and **13** which in turn are secured to the back plate, for instance, by screws such as **14**.

The switch illustrated is for a three-wire system but so far as the invention herein claimed is concerned the number of switching units embodied in the construction is immaterial. It will therefore be necessary to describe only the units necessary for controlling a single circuit. The line terminal **16** is connected to the stationary switch contact **17** and suitably anchored to the insulating body. The lower stationary switch contact **18** is connected in a suitable manner with the lower load terminal **19**. The front view of two stationary contacts **17'** and **18'** similar to contacts **17** and **18**, is shown at the left of Fig. 1. The movable contact member **20** is slidably supported on a stud **21** which is carried by the insulating cross bar **22** which is interposed between the upper and lower stationary contacts. Each movable switch member is provided with a resilient abutment spring **23** interposed between the reinforcing member **24** and the washer **25**. The insulating cross bar **22** is provided with projecting lugs **26** which are guided in inclined slots **27** formed in the side plates **12** and **13** respectively. When the parts are supported in their normal manner gravity tends to hold the cross bar **22** and all of the attached switch members in the open circuit position.

A crank shaft **30** is pivotally supported in the side plates **12** and **13** and has crank arms **31** hinged to the links **32** which in turn are connected to the lugs **26** which project from the opposite ends of the cross bar **22**. The crank shaft **30** also has an elongated arm **33** which extends laterally through an opening in the side plate **13** to facilitate connection with operating means. When the arm **33** is pressed rearwardly the crank shaft **30** turns on its axis and draws the two links **32** and the attached cross bar **22** rearwardly. In this movement the movable switch contacts **20** engage the stationary switch contacts **17** and **18**. As the rotation of the crank shaft is continued the cross bar **22** moves further rearwardly carrying with it the studs **21** which draw the washers **25** and the springs **23** to provide increased pressure on the movable switch members. When pressure on the crank shaft is released gravity tends to bring the movable switch members and the supporting cross bar outwardly to break the circuit. This movement is accelerated by the action of the springs **23** so as to ensure a prompt and effective breaking of the circuits through the respective switch units.

The actuation of the crank shaft **30** and the movable switch members is affected in this construction by electro-magnetically actuated means preferably constructed as a unit adapted to be secured to the supporting back plate **10** independently of the switch per se. This actuating mechanism includes a stationary frame member of channel-like form having a back plate **35** and upper and lower end flanges or posts **36** and **37** respectively. The back plate **35** is secured to the back plate **10** by screws such as **35'**. The magnet core is of suitable construction and in the preferred form has the three legs **38** and **38** and **39**. In the form shown the core is laminated and provided with side bars **40** all riveted or otherwise suitably secured together. The lower ends of these side bars are hinged to a pin **41** which is supported in the post members **37**. The swinging movement of the magnet core is limited at the upper end in the forward direction by the lugs **42** which act as abutments for the outer ends of the side bars **40**. The back plate **35** serves as an abutment to limit the rearward movement of the magnet core. The location of the parts is such that the weight of the core together with the weight of the coil **43** tends to swing and to hold the magnet core forwardly. The coil is suitably connected in circuit to be controlled manually or automatically in any suitable manner.

The armature member also includes a channel-like carrier **44** having arms **45** hinged to a pin **46** carried by the outer ends of the posts **37** independently of the hinging of the core member. The armature bar **47** is loosely carried by a hinge pin **48** between the flanges **49** of the carrier so that the armature is free to adjust itself to the faces of the core. A link **50** has its rear end detachably hinged to the arm **33** of the crank shaft **30** and has its front end provided with a lost motion means of connection with the upper end of the armature member.

This connection is affected by a pin **51** carried by the lugs **52** and slidable in the slot **53**. The outer end of the link **50** is loosely positioned between fingers **54** at the upper end of the armature carrier. The parts of the armature are so disposed as to bring its entire weight forward of the hinge pin **46** so that gravity tends to swing the armature and to hold it in the open circuit or Off position in the same way that gravity tends to hold the magnetic core member forwardly.

When the magnet is energized either by local or remote control of its circuit the armature is of course drawn toward the core member. During the first part of its movement the magnet has to move only the armature member but as soon as the pin **51** strikes the rear end of the slot **53** in the switch connecting link **50**, the magnet tends to rock the crank shaft **30** and move the switch members to the closed circuit position. The first resistance met (other than the resistance

of gravity) is the resistance of the springs **23**. The armature continues its movement until it strikes against the outer ends of the legs **38**, **38** and **39** of the magnet core at which time, under ordinary circumstances, the magnetic force will tend to grip the armature and the legs of the core so securely with a frictional braking action that the magnet frame will not be forced to any great extent away from its position with its side bars **40**, **40** at rest against the stop lugs **42**, **42**.

Because of the fact that the armature frame and the magnet frame are pivoted at spaced apart axial centers, it is obvious that after the armature and the magnet core have been brought together, any further rotary movement of the parts in the circuit closing direction will cause a wiping or sliding engagement between the face of the armature and the contacting surface of the legs of the magnet core. It is also obvious that the strength of the magnet will constantly increase from the moment the armature begins to move until, just before the armature actually makes contact with the core of the magnet, it will be at substantially its full strength and ready to brake or prevent any sliding movement of the engaging portions of the magnet numbers after they have been moved into actual contact; under some conditions however, the impact of the armature may be great enough to overcome the braking force of the magnet and may force the frame of the magnet backwardly away from its stop lugs **42**, **42** and, I have provided means for this to occur without transmitting any appreciable shock to the switch or other device which is being operated.

The side bars **40**, **40**, which carry the magnet with its core are pivoted at their lower ends to the post members **37**, **37** and the upper ends of the bars **40**, **40** are free to swing between the stop lugs **42**, **42** and the back plate **35**. Normally the upper ends of the side bars **40**, **40** rest against the stop lugs **42**, **42** but in case of an excessive impact of the armature in striking against the core of the magnet the magnet part of the unit is free to swing back towards the base plate and thus absorb the excessive momentum of the armature.

In some cases the core of the magnet may remain in this receded position due to the frictional resistance in which event the spring **23** will exert more pressure against the movable contacts to hold them more rigidly in the On position but, while this is desirable, it is not necessary since the construction is designed so that while normally, the core portion of the magnet may recede slightly in response to the impact of the armature, it will return to its position with the upper ends of the side bars **40**, **40** resting against the stop lugs **42**, **42**.

When the electro-magnetic circuit is deenergized either intentially or automatically, the armature is of course released and swings or falls away from the core by gravity and its weight tends to pull the links **50** and attached members outwardly. The lost motion connection of the pin **51** in the slots **53** allows the armature to have a certain freedom of movement so that when it is released and starts to move it is substantially free of the link **50** and attached parts and thus is able to obtain considerable momentum without the resistance of the other parts and before it has started to move the contacts to the open circuit or Off position.

By this construction a hammer-like blow is given to the cross bar **22** in the opening movement of the switch which prevents the contacts or other parts from sticking. The loose pivoting of the armature **47** in its carrier frame permits it to adjust itself to the core of the magnet and thus overcome any difficulty due to irregularities in mechanical construction and at the same time ensures the maximum strength of the magnetic field. Also, by means of the lost-motion connection between the armature and the connecting link **50**, the armature does not start the movement of the switch contacts until pin **51** reaches the other end of the slot **53** in the link **50** and by this time the armature has attained sufficient speed of movement to cause a very quick-make action of the movable switch contacts.

I claim:

1. An electro-magnetic switch actuator including a supporting frame, an electro-magnetic core hinged at its lower end to said frame and having its weight so disposed as to swing outwardly at its upper end away from said frame, an armature hinged at its lower end to said frame and movable independently of the core, means for limiting the forward tilting movement of the core and means for limiting the forward tilting movement of the armature, said core being tiltable toward the rear with the armature so as by its inertia at least partially to absorb momentum of the armature toward the core, the pivotal centers of said magnetic core and of said armature being spaced apart for the purpose specified.

2. An electro-magnetic switch actuator including a channel-like supporting frame, an electro-magnetic core hinged at its lower end inside of said frame and having its weight so disposed as to hang outwardly at its upper end away from said frame, an armature hinged at its lower end to said frame and movable independently of and also with the core, means for limiting the forward tilting movement of the core and means for limiting the forward tilting movement of the armature, said core being tiltable toward the rear with the armature, the armature and the magnet core being movable together rearwardly when the magnet is energized and the armature strikes the core.

3. An electro-magnet including a supporting frame, a magnet comprising a coil and a core therefor, an armature for said magnet, a stop for limiting the movement of said magnet towards said armature, the armature being free to move towards the core of the magnet, the said magnet and the said armature being pivotally mounted on said supporting frame at spaced-apart axial centers so that the core of the magnet will yieldingly check the operating impact of said armature and the magnetic grip of said armature and said magnet will check further axial movement of said armature.

4. An electro-magnet including a magnet core and coil, an armature pivotally supported at its lower end and adapted to coact with said core, a stop for limiting the movement of the core toward the armature, the armature being free to move toward the core, a pivotal support for the magnet core spaced apart from the pivotal axis of the armature so that the core of the magnet will check the momentum of the armature and the magnetic force between the magnet and the armature produces friction sufficient to retard the action of the armature with respect to the core.

5. A switch actuating electro-magnet construction comprising a core having an energizing coil and pivoted at its lower end near the rear so that

it tends to move forwardly by gravity, an armature hinged on a separate axis arranged in front of the axis of the core and having its weight disposed so that it tends to fall by gravity away from the magnet core, said core having one pole piece near the axis of the armature and another pole piece arranged above the first mentioned pole piece whereby the armature and the core move rearwardly when the magnet is energized.

6. A switch actuating electro-magnet including a core and a coil hinged at its lower end with its center of gravity disposed in front of the hinged center, a stop normally limiting the forward swinging movement of the core and coil, an armature coacting with the core and hinged on an axis spaced apart from the hinged axis of the core and means to be actuated by the movement of the armature and having a lost motion connection therewith.

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