United States Patent [19]

Pollmann et al.

[11] **3,766,503**

[45] **Oct. 16, 1973**

[54] **ELECTROMAGNETIC SWITCHING APPARATUS**

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[73] Assignee: **Siemens Aktiengesellschaft,** Munich, Germany

[22] Filed: **Aug. 14, 1972**

[21] Appl. No.: **280,430**

[30] **Foreign Application Priority Data**

Aug. 14, 1971 Germany ..... P 21 40 807.1

[52] **U.S. Cl.** **335/281,** 335/299

[51] **Int. Cl.** **H01f 7/08**

[58] **Field of Search** 335/220, 278, 281, 335/282, 298, 299

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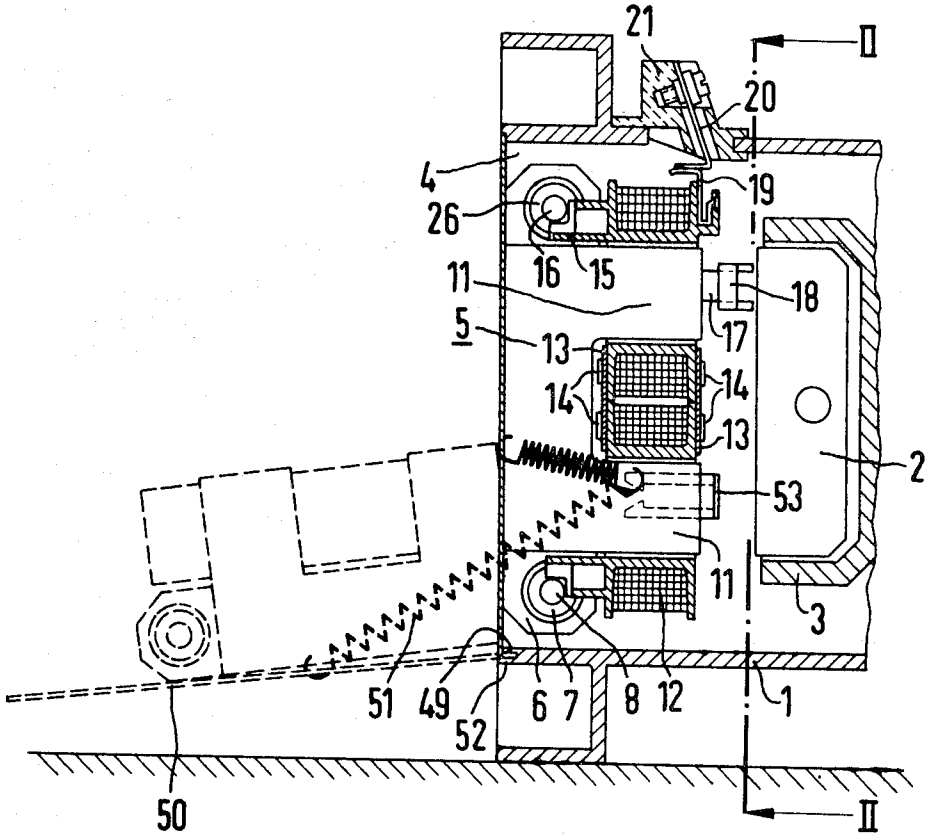
Primary Examiner—George Harris
Attorney—Hugh A. Chapin et al.

[57] **ABSTRACT**

An electromagnetic switching apparatus is disclosed which incorporates a housing and an excitation unit that includes a magnet part and an excitation coil. The unit is held in the housing so that it can be swung-out; this permits replacement of the coil without taking the entire apparatus apart. The housing is preferably provided with an opening that is covered with a spring-loaded lid.

29 Claims, 13 Drawing Figures



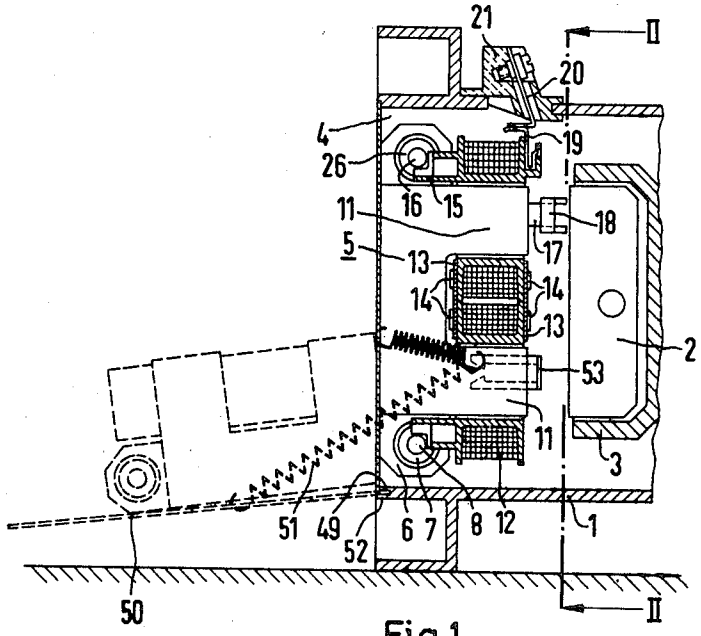

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Fig.1

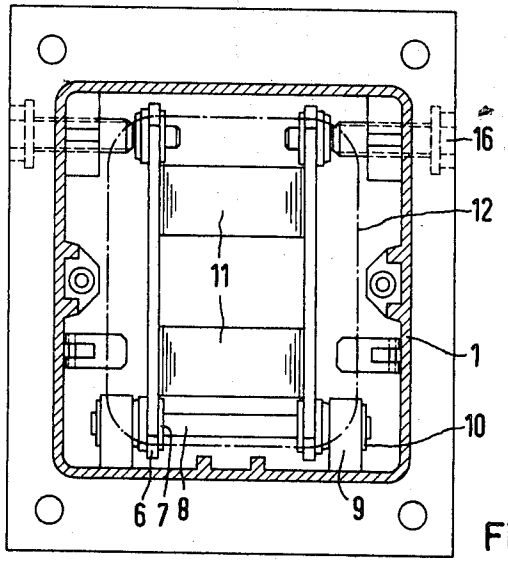
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Fig.2

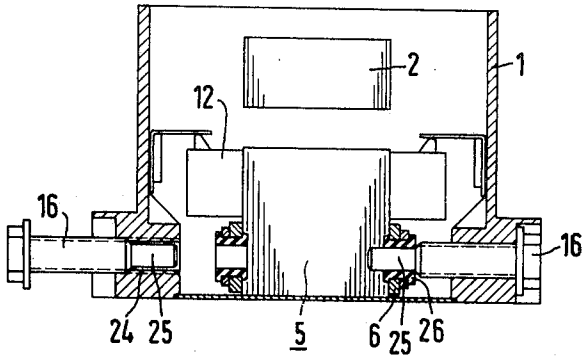

Fig.3

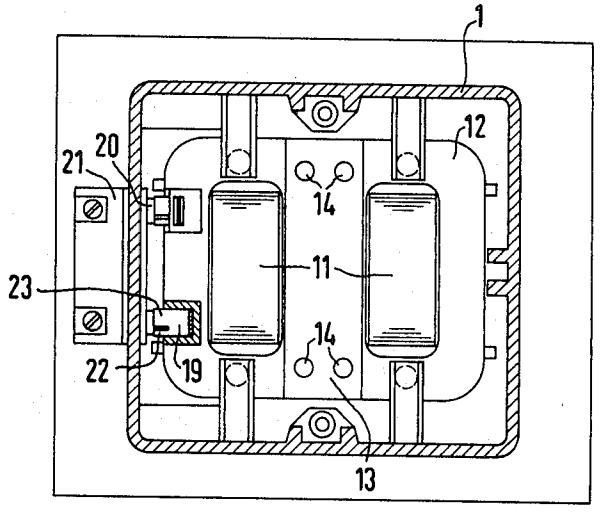

Fig.4

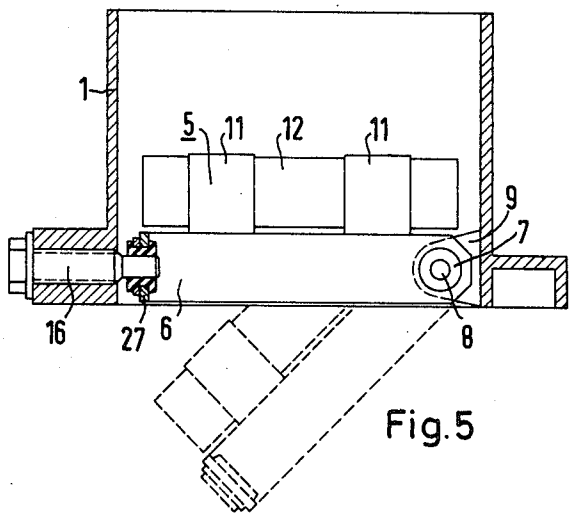

Fig.5

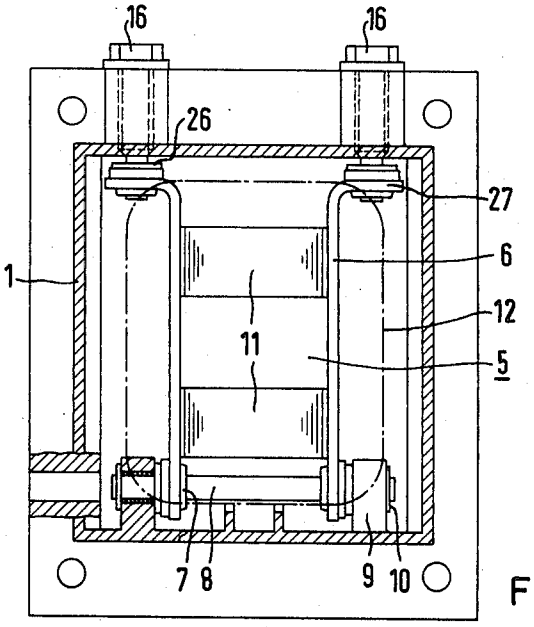

Fig.6

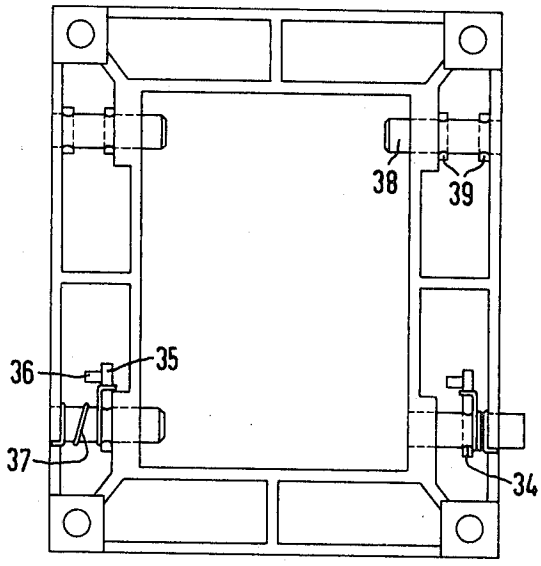

Fig.8

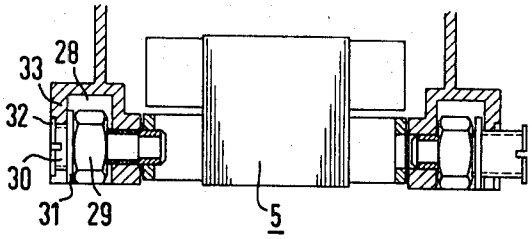

Fig.7

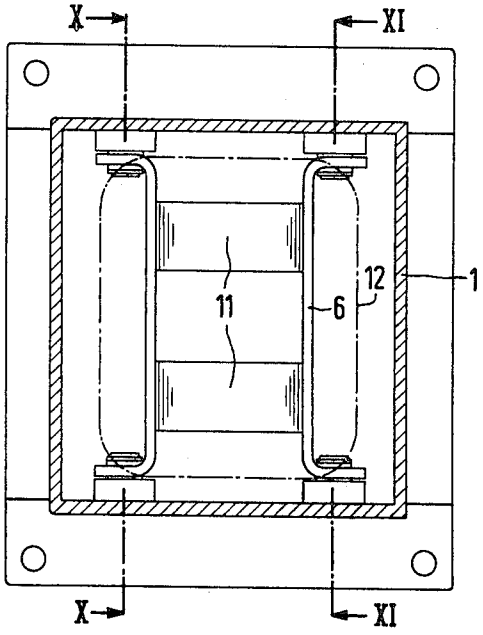

Fig.9

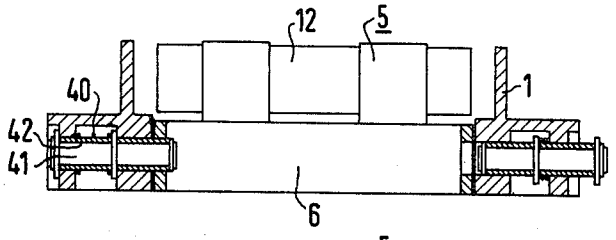

Fig.10

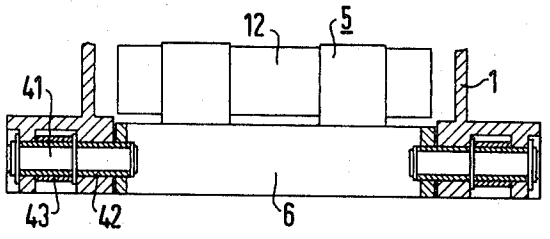

Fig.11

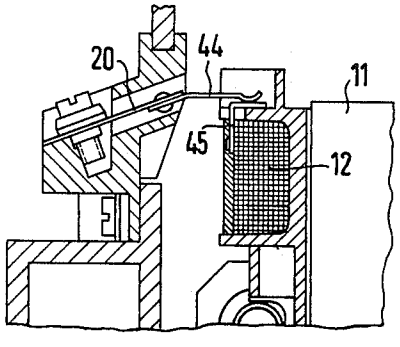

Fig.12

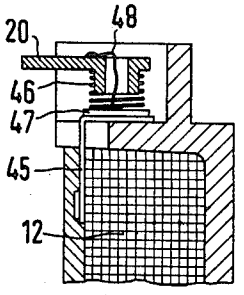

Fig.13

ELECTROMAGNETIC SWITCHING APPARATUS

BACKGROUND OF THE INVENTION

The invention relates to an electromagnetic switching apparatus having an excitation unit including a magnet part and an excitation coil which is held on the housing, or on a base-plate of the apparatus. The excitation unit can be swung-out from the housing to facilitate replacement of the coil.

German Offenlegungschrift 1,813,453 discloses an arrangement wherein a carrier is connected to the base-plate. Opposite to the carrier or opposite to the base-plate, the iron core is tensioned via fastening elements which grasp the coil body. These fastening elements can be, for example, arms configured as hook-like claws. After these fastening elements are loosened, the coil body and the iron core can be mutually separated. If in such a switching device the coils have to be replaced, then the fastening elements holding the coil elements are loosened, and, if necessary, the carrier also is removed from the base-plate, unless the upper part of the device is to be removed, or lateral openings are provided in the device.

In Deutsche Auslegungschrift 1,277,440, a switching device is disclosed wherein the unit, composed of the switching and nonswitching magnet parts along with the coil, is guided laterally into the protective housing in the manner of a drawer. This construction of a switching device is usually used only for the smaller switching devices, because here there is no direct coupling between the switching magnet part and the contact bridge carrier. The more or less firm holding of the nonswitching magnet part required with the larger switching devices is not present in this construction of switching devices.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an electromagnetic switching apparatus wherein the excitation coil is easily removed and replaced with only a minimal number of manual movements. Subsidiary to this object, it is an object of the invention to provide such an apparatus wherein it is not necessary to remove the switching magnet part of the apparatus to effect a replacement of the coil.

It is another object of the invention to provide such an apparatus which is especially suitable for higher switching capacities.

According to the invention, the electromagnetic switching apparatus incorporates an excitation unit which includes a magnet part and an excitation coil. The unit is held on the housing or on the base-plate so that it can be swung-out of the housing. Articulation means are provided for swinging the unit through a range between a first position adjacent the base of the housing and a second position outside the housing. The swinging motion may hereby be combined with a pushing motion. In the instant invention, it is significant that with the switching apparatus of the invention, the switching magnet part does not participate in the swinging motion, and the coupling between the contact bridge carrier and the switching magnet part is not affected.

It is advantageous for the magnet part to be fastened to the housing so that it is able to turn through the entire swinging range. Accordingly, the articulation means can include pivot means securely holding the excitation unit to the housing so as to be rotatable through the range from one of the positions to the other one of the positions. With this configuration, the magnet part can not be removed from the housing, so that no special means are needed to avoid interchanging the pole surfaces with respect to the switching magnet part. When the magnet part is swung-out, the excitation coil will not fall down from the magnet part if the pivot range is limited by a stop on the housing. For mounting on a framework, and for cases in which access to the excitation coil in the installed apparatus is required, it is advantageous for the swing-out opening to be provided in the bottom of the switching device. An entry of dirt or dust through the swing-out opening is avoided when the swing-out opening is closable by a lid spring-loaded in the closing direction thereof. Work on the opened switching device is facilitated if this lid can be latched in its opened position.

The pivotable mount can be made with practically no extra cost as to space when the pivot axis lies perpendicularly to the longitudinal direction of the magnet part. In this connection, it is also advantageous for the pivot axis to be situated outside the magnet part, because on the one hand, the pivot mounting arrangement will then not magnetically influence the magnet part, and on the other hand, the space already available for the excitation coil can be effectively used. A simple configuration of the pivotable mount is obtained by providing a pin to define the pivot axis. The pin can extend through the cover members projecting out from the magnet part and be held on the housing. This pin can be pushed through eye mounts formed on the housing or on the base-plate. As already mentioned, these mounts are formed in the space provided for the excitation coil. The separation of the elastic support from the more or less rigid support of the excitation coil can be obtained by holding the magnet part elastically on the pin and by providing the excitation coil with formations that abut on the pin. The excitation coil is thus decoupled from possible vibrations of the magnet part. For the purpose of pressing the excitation coil firmly against the pin, it is advantageous for the side opposite the pin to be held against the housing with intermediate elastic layers. In order to avoid damaging the connection from the excitation coil to the connector members fastened to the housing when the unit is swung-out from the apparatus housing, it is advantageous to equip the excitation coil with resilient connector members which are in electrically conductive connection with the connector members fastened to the housing when the excitation unit is in its swing-in position in the housing. This arrangement affords the advantage of rendering supplementary work in making these connections unnecessary. In order to avoid a situation wherein resilient connectors lift up from the connector members fastened to the housing at the occurrence of certain frequencies, it is advantageous for the resilient connectors to be slit asymmetrically so that each resilient connector has portions of respective widths; this assures that at least one of the resilient connector portions will always be in electrical contact. The asymmetry is advantageously selected to accommodate the frequencies that occur.

The excitation unit may be held in its swing-in position in the housing on the side thereof opposite the pivot axis by means of a plate threadably mounted on the base with an elastic mat interposed. However, it has

been found to be advantageous to hold the excitation unit in its swing-in position by at least one bolt that can be pushed in or rotated in. The bolt need be pulled out only a certain amount to release the excitation unit and it is therefore not necessary for the bolt to be removed from the housing. The bolts can be provided with a screw-thread; however, the bolts can be pushed in more rapidly if they can be locked in the pushed-in or pushed-out positions. It is possible to do without a threaded hole in the housing if the bolt engages nuts inserted in the housing.

It is possible to tightly arrest the bolts if the bolt-heads bear against the housing wall when they are rotated into the in position and when a lock-washer is clamped between the housing wall and the nut. In the case where the excitation unit is pivotable about a pin or bolt, the position of the unit relative to the housing transverse to the pivoting direction remains unchanged when swinging the unit out. After the introduction of the arresting bolts, the original position of the excitation unit can be restored with certainty without additional parts and without adjustment.

Making the elastic rings so that they can be snapped into place affords the advantage that they remain in the desired position when the arresting bolts are displaced. It is particularly advantageous if the rings have at their ends an annular collar interrupted at its periphery. The collar then constitutes a plurality of catching portions.

Although the invention is illustrated and described herein as an electromagnetic switching apparatus, it is nevertheless not intended to be limited to the details shown, since various modifications may be made therein within the scope and the range of the claims. The invention, however, together with additional objects and advantages will be best understood from the following description and in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation view, partially in section, illustrating an electromagnetic switching apparatus according to the invention. The switching apparatus is shown with its excitation unit pivotally mounted on a pivot pin.

FIG. **2** is a sectional plan view of the switching apparatus of FIG. **1** taken along line II — II of FIG. **1.**

FIG. **3** is a sectional view taken through the side of the switching apparatus lying opposite the pivot axis illustrating threadably engaging arresting bolts for holding the excitation unit in position in the housing.

FIG. **4** is a sectional view of the connectors for the excitation coil of the excitation unit.

FIGS. **5** and **6** illustrate respective views of a switching apparatus wherein the thread engaging direction of the arresting bolts is in the same direction as the longitudinal axis of the magnet part of the excitation unit.

FIG. **7** illustrates an embodiment wherein the arresting bolts engage and are arrested by threaded nuts disposed in respective recesses of the housing.

FIG. **8** illustrates the housing of the switching apparatus provided with arresting bolts equipped with spring-loaded pivot levers.

FIG. **9** illustrates an embodiment wherein the arresting bolts are spring-loaded and in which the pivot axis lies parallel to the longitudinal axis of the magnet part of the excitation unit.

FIG. **10** is a sectional view taken along the line X—X of FIG. **9.**

FIG. **11** is a sectional view of the switching apparatus taken along line XI—XI of FIG. **9.**

FIGS. **12** and **13** illustrate respective embodiments of the excitation coil equipped with disconnectable coil connection means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1,** the housing **1** of the switching apparatus contains armature means comprising a movable magnet part **2** which is guided over the contact bridge carrier **3** so as to be displaceable. The housing **1** has an opening **4** at its base. The excitation unit comprises the excitation coil **12** and magnet part **5** and can include ancillary means to which the magnet part **5** is connected. The ancillary means includes cover members **6** made of sheet metal to which the magnet part **5** is connected. The ancillary means also includes elastic means in the form of snap-in elastic rings **7** which are held in the cover members to elastically hold the magnet part. The elastic rings accommodate articulation means comprising pivot means in the form of a pin **8** that defines the pivot axis. The magnet part is thus elastically held on the pivot pin. The pin **8** is in turn held in eye mounts **9** of the housing **1.** The pin **8** is secured against shifting by retaining rings **10.** The articulation means enables the excitation unit to be swung through a range between a first position adjacent the base of the housing and a second position (shown in phantom outline) outside the housing. This makes the coil easily accessible for replacement.

The two-part excitation coil **12** is placed onto the legs **11** of the magnet part **5** and joined into a unit by a plate **13.** A positive union is advantageously obtained by thermoplastic bonding patches **14.** The excitation coil **12** is provided with shaped parts **15** which bear respectively against the pivot pin **8** and the bolts **16.** At its side facing away from the pin, the excitation coil **12** is equipped with elastic intermediate layers **17** which bear against support means in the form of shaped elements **18** of the housing **1.** The excitation coil **12** is thus decoupled with respect to vibrations from the magnet part **5.**

For connecting the excitation coil **12,** excitation coil connection means are provided and can comprise resilient connectors **19** connected to the coil body of the excitation coil **12.** The connectors **19** rest against fixed connection parts **20** when the unit is swung into the housing to its operating position. These fixed connection parts **20** are held in form-locking fashion in a part **21** made of insulating material which in turn is held in the housing **1.** Referring to FIG. **4,** the resilient connectors **19** are slit asymmetrically to form portions **22** and **23** having respective widths such that always one of the two parts still bears against the connector part **20** when disturbing frequencies occur.

However, if disconnecting the coil can be tolerated when the same is replaced, then it is advantageous for the coil connections to be also swung-out when the magnet system is swung-out so that the coil can be removed from the housing with its connectors which are preferably in the form of screw-type connectors. For the embodiment of FIG. **1,** this would mean that the connector part **20** and the part **21** of insulating material would be fixedly attached to the coil body of the excita-

tion coil 12, and the cut-outs in the housing for the part 21 would be made such that the part 21 could be swung into the interior of the housing.

As discussed above, the pivot action of the unit comprising the magnet part 5 and the excitation coil 12 is shown in phantom outline in FIG. 1. FIG. 1 with FIG. 2 also shows holding means for engaging and holding the excitation unit in its first position. The holding means can be in the form of at least one bolt mounted in the housing so as to be movable between in and out positions for engaging and disengaging the above mentioned ancillary means. FIG. 2 illustrates arresting bolts 16 which can be provided separately for each side and are in the form of threaded bolts which threadably engage a tapped bore 24 (FIG. 3) in the housing 1. The bolts 16 further have an extension 25 which rotates into elastic rings 26 held in the cover members 6.

The lid 50 is connected with the housing 1 of the switching apparatus by means of hinge-like connection 52 and is spring-loaded by a resilient member in the form of spring 51. The hinge-like connection 52 is made as a groove into which the lid slips in its opened position. When the lid is closed, it slides out of this groove. The groove is a form of latching means because it effects a latching of the lid in its open position. The movable magnet part 5 rests against a stop 49 of the housing 1 in the open position so that the lid 50 is not loaded by the magnet part 5. The stop 49 can be viewed as being a subsidiary feature of the articulation means and serves to limit the swing-out movement of the excitation unit thereby defining its second position. The spring 51 is hooked on the one hand to the lid 50, and on the other hand to the spring clamps 53, which take the place of the elastic intermediate layers 17 and/or the shaped elements 18 of the housing 1.

In the embodiments of FIGS. 5 and 6, the cover members 6 are provided with bent-out parts 27, so that the direction of rotation for the arresting screws 16 lies in the longitudinal direction of the magnet part 5. To obviate the need for threaded holes in the housing 1, nuts 29 are installed in recesses 28 as shown in FIG. 7. Then threaded bolts 30 are screwed into the nuts after placement of a lock-washer 31. The left side of FIG. 7 shows the tightened position of the arresting bolt 30 which bears by its head portion 32 against the wall portion 33 of the housing 1 and thus presses the lock-washer 31 between the wall part 33 and the nut 29. The right-hand side of FIG. 7 shows the arresting bolt 30 in the untightened position.

In FIG. 8 the bolt is provided with a bore 34 into which engages a spring-loaded pivoting lever 35. The lever 35 has an appendage 36 with which it can be brought into engagement with the housing in both its inserted and also in its withdrawn position. The pivotable lever 35 is spring-loaded by a spring 37. The different arresting positions are once more shown at the left and right sides, respectively of FIG. 8. FIG. 8 is a configuration alternate to that of the continuous pivot pin. Here two short bolts 38 are provided and are held by pins 39 in their inserted position.

FIG. 9 illustrates a further embodiment of the switching device of the invention wherein the arresting bolts are spring-loaded and in which the pivot shaft is disposed parallel to the longitudinal axis of the magnet part of the excitation unit.

FIGS. 10 and 11 show still further embodiments which incorporate different configurations for the arresting bolts. More specifically, FIG. 10 shows a configuration wherein the one spring 40 bears directly against an elastic jacket 42 of the arresting bolt 41. This form of construction has the advantage that both the stationary and also the displaceable bolts can be made similar. In FIG. 11 the stationary bolts are held in their position by a sleeve 43 which is used instead of the spring 40.

FIG. 12 shows a coil connection which incorporates a resilient tongue 44 connected to connection part 20. The resilient tongue 44 is in contact with the fixed contact part 45. This fixed contact part 45 is held by the coil band of the coil and can, in addition, be made resilient at its free end.

In FIG. 13 a spiral spring 46 co-acts with the fixed connection part 20 and the electrical connection between the connection part 20 and the stationary contact part 45 at the excitation coil constitutes a small plate-like portion 47 and a current lead 48.

As is shown by the different embodiments, it is possible to arrest the pivotable unit in various ways. It is advantageous for the direction of introducing the arresting means to be adapted to the desired requirements.

It is furthermore advantageous in the embodiments of the invention, if the mounting holes of the switching device are provided so that the excitation unit can also be swung-out when, for example, the apparatus is fastened to some apparatus, or to a framework, or upon a mount-plate having a rear cut-out. In such an instance, it is also possible to replace the coil even when the switching apparatus is built-in.

What is claimed is:

1. An electromagnetic switching apparatus comprising a housing having a surface portion defining a mounting plane for the switching apparatus, armature means mounted so as to be movable with respect to the housing, an excitation unit comprising a magnet part and an excitation coil mounted thereon for generating an electromagnetic force to actuate said armature means, the force acting along a line of action transverse to said plane, and articulation means for swinging said unit through a range between a first position adjacent the base of said housing and a second position outside of said housing.

2. The switching apparatus of claim 1 wherein said housing has a base plate and said unit is adjacent said base plate in said first position.

3. The switching apparatus of claim 1, said articulation means comprising pivot means for securely holding said unit to said housing so as to be rotatable through said range from one of said positions to the other one of said positions.

4. The switching apparatus of claim 3, said articulation means comprising a stop on said housing for limiting the swing-out movement of said unit thereby defining said second position.

5. The switching apparatus of claim 4, said housing having an opening formed in said base thereof for accommodating the passage of said unit from and into said housing as said unit is swung between said positions.

6. The switching apparatus of claim 5, said housing comprising a lid for covering said opening, and a resilient member connected to said lid for imparting a force thereto in a direction for opening the same.

7. The switching apparatus of claim 6, said housing comprising latching means for latching said lid in its open position.

8. The switching apparatus of claim 3, said magnet part of said excitation unit having a longitudinal axis, and said pivot means defining a pivot axis perpendicular to said axis.

9. The switching apparatus of claim 8, said excitation unit comprising ancillary means joined to said magnet part for engaging said pivot means at a location beyond the region of said magnet part.

10. The switching apparatus of claim 9, said pivot means being a pivot pin, and said ancillary means comprising cover members made of sheet metal joined to and extending beyond said magnet part, said pivot pin extending through said cover members and being held in said housing.

11. The switching apparatus of claim 10, said ancillary means comprising elastic means for elastically holding said magnet part on said pivot pin, and said excitation unit comprising shaped parts for supporting said excitation coil on said pivot bolt.

12. The switching apparatus of claim 11, said elastic means comprising snap-in elastic rings held in said cover members respectively for accommodating said pivot pin.

13. The switching apparatus of claim 11 wherein said housing comprises support means on the wall thereof, and said excitation coil has a side facing away from said pivot pin, said apparatus comprising elastic intermediate layers disposed between said side of said excitation coil and said support means.

14. The switching apparatus of claim 13 comprising excitation coil connection means for establishing an electrical connection from said excitation coil to a location on said housing when said excitation unit is in said first position, said connection means including an insulating part mounted in said housing, first connectors mounted in said insulating part, and second connectors connected to said excitation coil and arranged thereon so as to be in contact with corresponding ones of said first connectors.

15. The switching apparatus of claim 14, said first connectors being fixed connector members and said second connectors being resilient connector members.

16. The switching apparatus of claim 14, said first connectors being resilient connector members and said second connectors being fixed connectors members.

17. The switching apparatus of claim 15, each of said resilient connector members being asymmetrically cut.

18. The switching apparatus of claim 17, each of said resilient connector members being cut so as to form respective portions thereof having respective widths such that always one of said portions bears against the corresponding one of said fixed connector members when disturbing frequencies occur.

19. The switching apparatus of claim 14, said excitation coil defining a peripheral contour, said second connectors being configured so as to be within said contour.

20. The switching apparatus of claim 19, said excitation coil including a band at said contour, said second connectors being at least partially banded tight by said band.

21. The switching apparatus of claim 1 comprising holding means for engaging and holding said excitation unit in said first position.

22. The switching apparatus of claim 21, said holding means comprising bolt means movable between in and out positions for engaging and disengaging said excitation unit, and means for locking said bolt means in each of said in and out positions.

23. The switching apparatus of claim 9 comprising holding means for engaging and holding said excitation unit in said first position, said holding means comprising at least one bolt mounted in said housing and movable between in and out positions for engaging the disengaging said ancillary means for holding said excitation unit in said first position.

24. The switching apparatus of claim 23, said bolt being insertable into said ancillary means.

25. The switching apparatus of claim 23, said bolt rotatably engaging said ancillary means.

26. The switching apparatus of claim 23, said holding means comprising means for locking said bolt in said in and out position.

27. The switching apparatus of claim 23, said ancillary means comprising cover members made of sheet metal joined to said magnet part, said cover members having respective bent-out parts, and said holding means comprising a number of said bolts mounted in said housing and engaging corresponding ones of said bent-out parts.

28. The switching apparatus of claim 23 wherein said housing has a wall portion defining recess means therein, and wherein said holding means comprises a nut disposed in said recess means for threadably engaging said bolt.

29. The switching apparatus of claim 28 wherein said bolt has a head portion which lies against another wall portion of said housing when said bolt is in said in position, and said holding means comprising a lock washer tensioned between said nut and said wall portion of said housing defining said recess means.

* * * * *