

Nov. 17, 1959

S. D. VIGREN ET AL

2,913,551

SWITCH GROUP

Original Filed June 21, 1951

2 Sheets-Sheet 1

Fig. 1

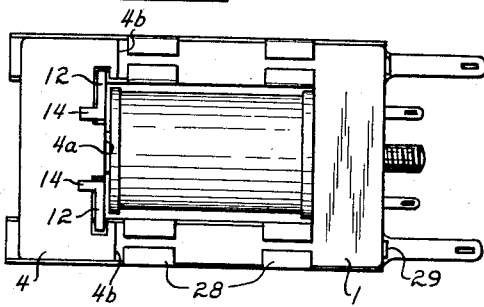


Fig. 4

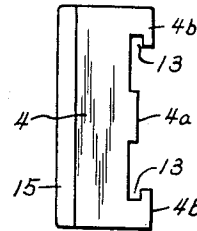


Fig. 2

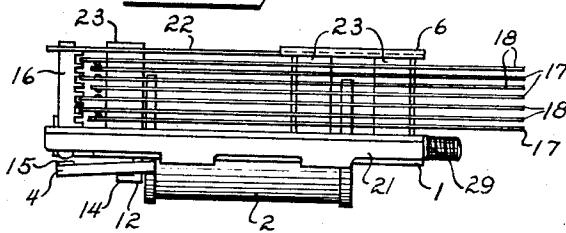


Fig. 5

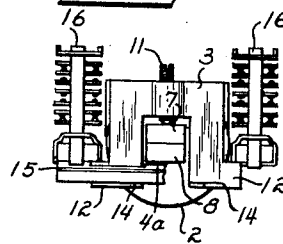


Fig. 3

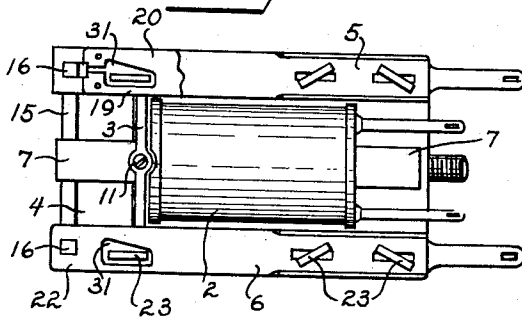
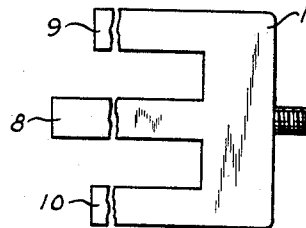


Fig. 6



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2 Sheets-Sheet 2

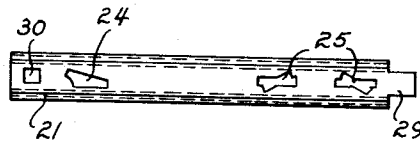
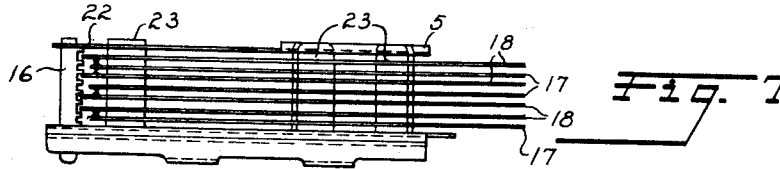


Fig. 8

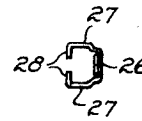


Fig. 9

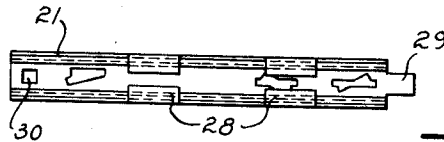


Fig. 10

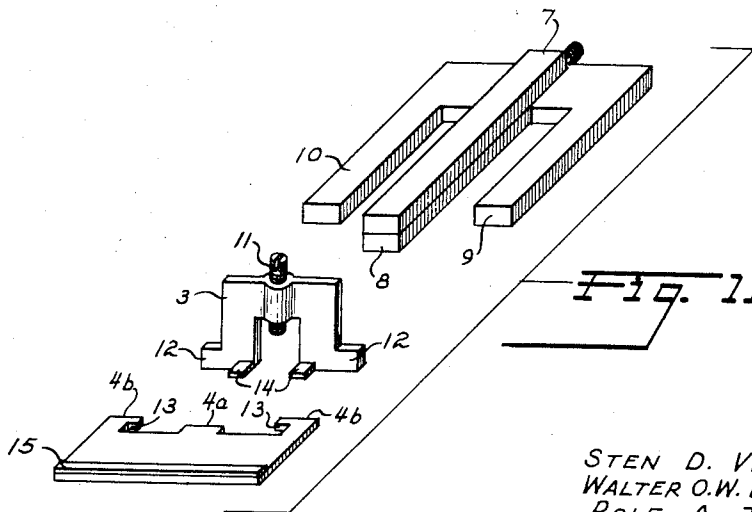


Fig. 11

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Original application June 21, 1951, Serial No. 232,722, now Patent No. 2,786,163, dated March 19, 1957. Divided and this application June 4, 1956, Serial No. 589,109

Claims priority, application Sweden June 22, 1950

18 Claims. (Cl. 200—104)

This invention relates to electromagnetic switching devices and particularly switch groups for use with electromagnetic devices of the type having a bar-like electromagnetic core and frame structure with an armature pivoted on the frame structure. This is a division of application Serial No. 232,722, filed June 21, 1951, and granted as United States Patent No. 2,786,163.

It has proved to be possible to produce electromagnets of this kind, which are extremely sensitive by making the armature length, measured in the longitudinal direction of the core, very short so that the distance between the attracting surface of the armature in non-operated condition and the pole face of the core increases from a very small amount near the pivotal axis of the armature to a comparably large amount at the outer edge of the armature or core respectively. An air gap of this shape may be obtained if the total length of the air space between the pole face of the core and the attracting surface of the armature measured in the longitudinal direction of the core is at least equal to, preferably materially greater than, the distance from the pivotal axis of the armature to the adjacent boundary line of the same. By way of example it may be mentioned, that an electromagnetic relay has been produced having in non-operated condition a "minimum air gap" of 0.25 mm. (in operated condition 0.04 mm.) and a "maximum air gap" of 0.95 mm., and in this relay the required number of ampere turns for operation was reduced by more than 50% as compared with corresponding relay structure of a conventional type. The amount of the said "minimum air gap" is critical and a rather small deviation from the optimum value will cause a substantial increase of the required number of ampere turns. As will be understood it is rather difficult to keep the structural clearances in the manufacture within the required small tolerances so as to obtain the optimum value of the said "minimum air gap."

The present invention is applicable to the improved type of relays described above. It is not restricted thereto, however, but may also be used in conventional flat-type relays.

According to the invention disclosed in the aforementioned parent application, adjusting means are provided for adjusting the position of the pivotal axis of the armature relative to the pole face of the core.

According to a preferred embodiment of the invention applied to a core forming part of an E-shaped member or supporting frame, the middle leg of which forms the core and the side legs of which support the armature so as to define its pivotal axis, one or several adjustable distance members are inserted between the side legs or each side leg respectively on one hand and the middle leg on the other hand so as to render the pivotal axis of the armature displaceable in a direction substantially perpendicular to the pole face of the core. The core and the side legs are made resilient, thereby enabling such a displacement by elastic deformation, so the reluctance

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of the iron path of the magnetic circuit may be kept at an unchanged minimum value regardless of the adjustment.

The main object of this invention is to provide an improved mounting structure of the contact spring assemblies of the switching device. In known devices of the contemplated type an electromagnetic armature acts directly or by the intermediary of selecting fingers or the like on one or more spring groups fixed to a base or supporting frame structure including a so-called bridge of magnetic material integral with or magnetically coupled to the core of the device having, in addition to its supporting function, the task of forming a return path of the magnetic flux.

In devices hitherto known it has been a practice to fix the contact spring groups by means of screws passing through threaded holes in the bridge or supporting frame. These holes, however, cause local constrictions of the flux conducting area of the bridge and supporting frame resulting in an increased reluctance and, sometimes, in unfavorable saturation conditions. This is particularly true in relays having U- or E-shaped bridge or supporting frame members, wherein the shanks are comparably narrow in a direction perpendicular to the axial direction of the screw holes. Another factor which should not be disregarded in this connection is that the magnetic properties of the supporting frame structure may be unfavorably effected by mechanical working of heat treatment subsequent to the normal annealing operation. From the foregoing it will be understood, that the fixation of the spring groups makes a problem which is far from being negligible.

By the invention, however, the above-mentioned drawbacks and difficulties have been entirely overcome. According to the main feature of the invention one or more contact spring groups form a separate unit being fixed to the said bridge or supporting structure by fixing means embracing edge portions of said bridge or supporting structure.

The invention will be better understood in connection with the annexed drawing, in which:

Figure 1 is a plan view from underneath, illustrating a relay according to the invention;

Figure 2 illustrates the same relay in side view;

Figure 3 illustrates the same relay in plan view as seen from above;

Figure 4 is a detail plan view of the relay armature;

Figure 5 illustrates the same relay in front view with the right half of the armature cut away;

Figure 6 is a detail plan view of the integral core and side legs;

Figure 7 is a detail side elevation view of a spring assembly unit of the relay;

Figure 8 illustrates the base piece of the spring assembly unit in a plan view as seen from above;

Figure 9 illustrates the same base piece in cross section;

Figure 10 illustrates the same base piece in plan view as seen from underneath; and

Figure 11 is a perspective exploded view of the supporting frame member, the yoke and the armature.

In the embodiment shown in the drawing the relay has a bridge, forming part of an E-shaped member 1 having a central core leg 8 and two side or bridge legs 9, 10. The distance between the core leg and the side legs is so chosen, that the magnetic stray flux will not be detrimental. The armature 4 (Figure 4) is E-shaped and the side arms are hooked or L-shaped to provide recesses 13, with which lugs 12 of a yoke member 3, made of non-magnetic material and transversely arranged in front of the winding coil 2, are in engagement, whereby the position of the armature in the longitudinal direction of core

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leg 8 is determined. The side arms of the armature abut against the lower surface of side legs 9 and 10 respectively, and the non-operated angular position of the armature is determined by the armature hooked arms embracing the rear face of the yoke and by the supporting lugs 14 extending from the yoke member 3 and engaging the under side of the armature. The central extension member of the E-shaped armature faces the pole face of the core leg 8, and the transverse edge line 4a of this extension is situated at such a distance from the transverse edge lines 4b of the side shanks of the armature as counted in the longitudinal direction of the core leg 8, that an extremely small air gap will exist between the edge line of the said extension and the pole face. In order that this air gap shall be adjustable and not require too high a degree of accuracy during manufacture, the yoke member 3 is interengaged with the side legs 9 and 10 and is provided with an adjusting screw 11 for applying a force to the core leg 8 via a bar or strip 7 of magnetic material. Bar or strip 7 is provided to increase the area of the core as clearly shown at the right hand side of Figure 5, the lugs 12 of the yoke member 3 abut against the underneath side of the side legs 9 and 10 whilst the adjusting screw 11 abuts against the upper side of strip 7, whereby the adjusting screw acts against the inherent resilience of the member 1, and the yoke 13 is kept in its position by the spring force of legs 8, 9 and 10. Preferably the core leg 8 is somewhat bent beforehand to form a small angle upwards against the common plane of the side legs 9 and 10. As will be understood the desired small air gap may be readily obtained by turning the screw 11 until the distance between the pole face of core leg 8 and the edge 4a of the central extension of the armature 4 is the desired value.

The armature 4, at its front edge is provided with a pole plate 15 of non-magnetic material determining the angular position of the armature in operated condition.

Figure 11 discloses, in perspective exploded view, the preferred construction of the E-shaped bridge or supporting frame member 1 with core leg 8 and side legs 9 and 10; the U-shaped yoke member 3 having depending legs with side lugs 12 and transverse lugs 14 on the lower edges of the legs; and the E-shaped armature 4 with hooked or L-shaped side arms having end surfaces 4b in a plane parallel to and offset from the plane of the central member end surface 4a.

To enable a clearer understanding of the relationship between the various components, reference is made to Figure 11, viewed in conjunction with Figures 1, 2 and 5 which will show that in assembly of the supporting frame member, coil, yoke and armature units, the yoke 3 is placed with its depending legs between the side arms and central member of armature 4. The armature 4 is moved down yoke 3 to rest on lugs 14 with armature recesses 13 loosely embracing a portion of yoke side lugs 12. With the yoke and armature in this relationship, the hooked ends of the armature's L-shaped side arms bear on rear surface of yoke lugs 12 and limit downward pivotal movement of the armature.

Bar 7 is placed on top of core leg 8 and coil 2 slipped over the core leg 8 and bar 7. Yoke 3 and armature 4 are placed into the open end of E-shaped supporting frame 1, with the depending legs of the yoke 3 between supporting frame side legs 9 and 10 and straddling center core leg 8 and bar 7, with the armature 4 and yoke side lugs 12 beneath the supporting frame legs, and with the rear face of the yoke abutting or closely adjacent the front face of coil 2. Adjusting screw 11 is tightened to bear against bar 7 and create a spring force between side legs 9 and 10 of the bridge and core leg 8 to hold the yoke in position.

With the unit so assembled, end surfaces 4b of the armature side arms abut the lower surfaces of bridge side legs 9 and 10 and determine, in cooperation with yoke

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lugs 14, the inclination of the armature in the inoperative condition.

Assuming screw 11 is so adjusted to place the lower surfaces of the three legs 8, 9 and 10 of the bridge in a common plane, the transverse edges of the armature side legs, bearing on the lower surfaces of the bridge side legs, will lie in that common plane and the armature central member, being shorter than the side legs will have its transverse edge 4a spaced a short distance from the lower face or pole face of core leg 8 to thus form the small desired air-gap hereinbefore mentioned.

In operative condition the armature will pivot about the transverse edges 4b toward the pole face of core leg 8. Pole plate 15 on the front edge of the top surface of armature 4 will abut the lower surface or pole face of core leg 8 and maintains a small clearance between the armature and the lower surface of the core leg.

The spring assemblies 5 and 6, which are identical with each other, are in the form of separate units, one of which is shown in Figure 7, provided with fixing means making it possible to secure the spring assemblies to the side legs 9 and 10 without the need of any holes through the side legs, which would increase the magnetic resistance and reduce the sensitivity of the relay.

The base piece of each spring assembly consists of a sheet-metal slide 21 having a cross section as shown in Figure 9. The two bent-down side portions 37 of slide 21 extend along the sides of the respective side leg and guide the slide in lateral direction, the slide is fixed in its position by bottom lugs 28 and end lug 29, the end lug 29 being bent down in assembly as in Figure 2. At its top the slide is provided with an elevated portion forming a space 26 (Figure 9) for receiving the fixing means of the contact springs as will be described below.

As will be seen from Figures 8 and 10, showing slide 21 from above and underneath respectively, there are apertures 24, 25 and 30 through the slide. All the contact springs, the stationary ones 17 as well as the movable ones 18, and also a pressing spring 22 at the top of the spring assembly are provided with apertures similar to 25. At the assemblage of the spring pile-up the springs and the slide are placed in the desired relative positions in a guiding tool or the like and flat pieces 23 of insulating material are put through the respective vertical rows of apertures 25 and turned around into a position as shown in Figure 3, the edges of the apertures 25 then cutting into the edges of the pieces 23 so as to fix the springs mutually and to the slide 21. The stationary springs 17 are provided with apertures similar to aperture 24 and have their contact ends fixed in relation to the slide 21 in a similar way by an additional insulating piece 23. The movable springs 18 and the pressing spring 22 are provided with apertures 31 (see Figure 3) that permit them to move freely.

The aperture 30 of the slide 21 receives the lower end of the actuating stud 16.

It is of course also possible to use screws for the fastening of the contact springs, and in this case the heads of the fastening screws may be received by the space 26 in slide 21, or the screws may be fixed to the slide 21 by welding or soldering.

Due to the small moment of inertia of the armature its movement will be very rapid, and due to this fact special steps are taken in order to avoid contact vibrations. Thus the movable springs forming part of the make contacts are arranged for so-called indirect operation, i.e. they are pre-tensioned so as to effect the contact closure by their own spring force, the actuating stud 16 holding them in non-operated position through the action of pressing spring 22. The actuating stud 16 is provided with evenly spaced teeth forming a pair of opposing abutting surfaces for each space between any two neighboring spring positions in the assembly. By this arrangement the make and break contacts and also contacts containing three springs, such as change-over contacts, may be positioned

arbitrarily within the spring assembly with the use of one and the same type of actuating stud.

Furthermore, the movable contact springs have their tongues 19 and 20 (Figure 3) for carrying the twin contacts of different stiffness, the tongue 19 being more flexible than tongue 20. Preferably tongue 19 is somewhat pre-bent in a direction towards the corresponding stationary contact spring, so that this tongue originally forms a small angle to the plane of tongue 20 but is straightened out when assembled by the abutment against the corresponding stationary contact spring or its abutting surface on the actuating stud 16 respectively.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An electro-magnetic relay comprising a supporting frame including resilient substantially parallel members, each member having one free end, one member being a core and having a horizontal pole face adjacent its free end; yoke means interengaging all of said resilient members and pivotally maintaining an armature in close proximity and with the pivot axis parallel to said pole face; a contact spring stack including a longitudinal beam member having a channel clear of obstructions formed in its under surface, said channel slidably receiving a second one of said resilient members; and means on said beam for embracing the under surface of said second resilient member.

2. An electromagnetic relay comprising: a supporting frame including substantially parallel bar-shaped members, each member having one free end, one member being a core and having a horizontal pole face adjacent its free end; an operating winding on said core; a pivotable armature; adjustable means interengaging all of said parallel members and operatively pivotally maintaining said armature in close proximity to and with its pivot axis parallel to said pole face whereby the space between said armature and said pole face may be adjustably varied; a contact spring stack including a longitudinal beam member; a channel clear of obstructions formed in the under surface of said beam member, said channel slidably receiving a second one of said bar-shaped members; means on said beam for embracing the undersurface of said second bar-shaped member; and spring stack operating means operatively disposed relative to said armature whereby operative movement of said armature will cause actuation of said spring stack.

3. A contact spring group for use in combination with an electromagnetic switching device having a base structure which forms part of the magnetic circuit of the device and serves as a support for the contact spring group comprising: a base piece adapted to be disposed on one side of the base structure, having portions adapted to extend across edges of said base structure and press against that side of the base structure which is opposite to said base piece of the contact spring group.

4. A contact spring group as defined in claim 3, in which said base piece is provided with lugs bent down and under so as to engage that side of said base structure which is opposite to the contact spring group.

5. A contact spring group as defined in claim 3, wherein said base piece is provided with bent lateral edges adapted to fit beside and across the lateral edges of the base structure to guide said base piece to be slidably movable along the said base structure for assemblage and de-assemblage of the device.

6. A contact spring group as defined in claim 3, wherein contact springs are fixed to said base piece by studs of insulation material passing through non-circular holes in the springs and the base piece, said studs being turned so edge portions in said springs and base piece, defining said holes, penetrate into edges of said studs.

7. A contact spring group as defined in claim 3, comprising: stationary and movable contact springs, said stationary contact springs having their contact ends fixed to said base piece by a stud of insulating material passing through non-circular holes in the stationary contact springs and the base piece, said stud being turned so edge portions of said stationary contact springs and base piece, defining said holes, penetrate into edges of said stud.

8. In an electromagnetic switching device, having a base structure which forms part of the magnetic circuit of the device and serves as a support for a contact spring group, a contact spring group comprising: contact springs; a base piece having portions extending across edges of said base structure and pressing against that side of the same which is opposite to the contact spring group; said base piece having an elevated portion, facing the contact springs of the contact spring group and apertured to provide non-circular holes; said contact springs being apertured to provide non-circular holes; studs of insulating material passing through said holes in the springs and the base piece; and said studs being turned so edge portions of said contact springs and base piece, defining said holes, penetrate into edges of said studs.

9. A contact spring stack comprising an elongate base piece; a longitudinal channel formed lengthwise in the under surface of said base piece; dependent, turned in components on each side of said longitudinal base piece; a contact spring assembly secured on said base piece; and actuating means for said contact spring assembly mounted in engagement with said base piece and at least a portion of the contact spring assembly.

10. A contact spring group as defined in claim 3 wherein said base piece is elongate with an upper portion and bent down turned under side portions; and a contact spring assembly and actuating means are mounted on said upper portion.

11. A contact spring group as defined in claim 10 wherein at least one end of said longitudinal base piece includes a tab portion adapted to be bent down.

12. A contact spring stack assembly having a contact spring stack, a base comprising an upper portion disposed adjacent to said stack and bent down, turned under side portions projected away from said contact spring stack, and means securing one end of said spring stack to said upper portion and maintaining said spring stack in assembled stacked relationship.

13. In an electromagnetic switching device having a base structure which forms part of the magnetic circuit of the device and serves as a support for a contact spring stack assembly, a contact spring stack assembly having: a contact spring stack and a base comprising a first portion rigidly fixed to said stack and positioned adjacent one side of said base structure and side portions integral with said first portion bent to embrace the opposite side of said base structure.

14. A contact spring group, for use in combination with an electromagnetic switching device having an elongate base structure with parallel lateral edges which forms part of the magnetic circuit of the device and serves as a support for the contact spring group, comprising: a longitudinal base piece adapted to be disposed on one side of the base structure having a longitudinal channel formed in its under surface and provided with bent lateral edges adapted to fit beside and across the lateral edges of the base structure and press against that side of the base structure which is opposite to said base piece of the contact spring group, to dispose said base to be slidably movable along the base structure for assemblage and de-assemblage of the device; a contact spring assembly; means

rigidly securing said contact spring assembly adjacent one end of said base piece; and actuating means for said contact spring assembly carried by said base piece adjacent its other end.

15. An electromagnetic relay comprising: a supporting frame providing a part of the magnetic circuit of the relay including substantially parallel elongate members with a transverse bridge portion joining one set of ends of said members, one of said members being a core and having a horizontal pole face adjacent its free end; an armature; means inter-engaging said supporting frame and pivotally maintaining said armature in close proximity and with its pivot axis parallel to said pole face; a contact spring stack including a longitudinal beam member and a contact spring assembly with an actuator means secured to one side of said beam member, said beam member including means on its other side enabling said beam member to be slidably disposed on one side of a second one of said parallel frame members, said last named means including embracing means engaging the under surface of said second parallel frame member.

16. An electro-magnetic relay as defined in claim 15, wherein said means enabling said beam member to be slidably disposed on one side of a second one of said parallel frame members comprises dependent lugs at least one of which projects transversely between said one core member and said second member and abuts said transverse bridge portion to determine the disposition of said contact spring stack with said actuator means being positioned adjacent, and adapted to be engaged and shifted by, said armature.

17. In an electromagnetic switching device, a base structure comprising: an E-shaped frame member which

forms part of the magnetic circuit of the device, the side legs of said E-shaped frame member being relatively narrow elongate bars each of which is adapted to support a contact spring group; at least one contact spring group comprising an elongate base piece disposed on one side of one of said side legs, having portions extending across edges of said one side leg and pressing against that side of said one side leg which is opposite to said elongate base piece.

18. In an electromagnetic switching device as defined in claim 17, at least one of said portions extending across edges of said one side leg being disposed between said side leg and the middle leg and abutting an inner edge of the bridge portion of said E-shaped frame member, and a further portion on the end of said base piece extending across and abutting an outer edge of the bridge portion of said E-shaped member.

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